THE EFFECT OF MATHEMATICS ONLINE REVIEW SESSIONS THROUGH A WEBCAST SYSTEM ON FIFTH-GRADE STUDENTS' MATHEMATICS ACHIEVEMENT

AYSUN SÜLÜN TAŞ

BOĞAZİÇİ UNIVERSITY

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Aysun Sülün Taş

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The Effect of Mathematics Online Review Sessions Through a Webcast System on Fifth-Grade Students' Mathematics Achievement

The thesis of Aysun Sülün Taş
has been approved by:

Assoc. Prof. Dr. Serkan Özel _____
(Thesis advisor)

Prof. Dr. Emine Erktin _____

Assist. Prof. Dr. Fatma Aslan Tutak _____

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Thesis Abstract

Aysun Sülün Taş, "The Effect of Mathematics Online Review Sessions Through a Webcast System on Fifth-Grade Students' Mathematics Achievement"

The present study investigated the effect of mathematics review webcasts on students' mathematics performance depending on the type of webcast access and use (no access, access but not use, access with moderate use, and access with extensive use) controlling for differences in the mathematics background. Moreover, (a) the relationship between students' webcast use and their mathematics attitudes, (b) students' perceptions of webcasts for their learning, and (c) students' habits for using webcast system were examined. A purposive sample of 110 fifth-grade students was recruited from two middle schools which were using interactive white boards (IWB) in mathematics classes. This quasi-experimental research design employed seven instruments. Results indicated the following four major findings. First, planned comparisons ANCOVA results showed that there is a statistically significant difference between no access and access groups on their mathematics performance ($p < .005$). Next, there was a statistically significant positive correlation between webcast use and mathematics attitude, (r (56) = .326, p = .014). Third, students with webcast access reported that they found mathematics webcast system beneficial, engaging, and easy to use and they generally used mathematics webcasts for review, exam preparation, studying homework, and making up missing lessons. Last, students generally used watched more webcasts after mathematics classes, before mathematics exams and after motivational tools.

Tez Özeti

Aysun Sülün Taş, "İnternet Yayın Sistemi Üzerinden Gerçekleştirilen Çevrimiçi Tekrar Seanslarının Beşinci Sınıf Öğrencilerinin Matematik Başarısına Etkisi"

Mevcut çalışma internet yayını (webcast) tekrar derslerinin matematik yayını erişimi ve kullanımı seviyelerine bağlı olarak (erişimi olmayan, erişimi olup kullanmayan, erişimi olup orta seviyede kullanan, erişimi olup yoğun kullanan) öğrencilerin matematik başarılarına etkilerini araştırmıştır. Ayrıca, (a) öğrencilerin internet yayınlarını kullanımları ve matematiğe karşı tutumları, (b) internet yayınlarının öğrencilerin öğrenmeleri üzerindeki etkisi ile ilgili algıları ve (c) öğrencilerin internet yayın sistemini kullanma alışkanlıkları incelenmiştir. Amaçlı örnekleme yöntemi ile elde edilen 110 beşinci sınıf öğrencisi akıllı tahta kullanan iki farklı okuldan sağlanmıştır. Bu yarı deneysel araştırma çalışmasında yedi ölçme aracı kullanılmıştır. Araştırma sonucunda elde edilen dört temel bulgu şunlardır: (1) Planlı karşılaştırmalı ANCOVA sonuçlarına göre erişimi olmayan grubun ve erişimi olan grubun matematik performansları arasında istatistiksel olarak anlamlı bir fark vardır ($p < .005$). (3) İnternet yayın kullanımı ile matematiğe karşı tutum arasında istatistiksel olarak anlamlı pozitif korelasyon bulunmuştur (r (56) = .326, p = .014). (4) İnternet yayınlarına ulaşımı olan öğrencilerin çoğu matematik internet yayın sistemini faydalı, ilgi çekici ve kullanımı kolay olarak nitelendirmişlerdir. Öğrenciler internet yayın sistemini genel olarak tekrar yaparken, sınavlara hazırlanırken, ödev yaparken ve kaçırılan dersleri telafi ederken kullandıklarını belirtmişlerdir. (5) Öğrenciler internet yayınlarını genellikle, matematik derslerinden sonra, sınavlardan önce ve öğretmen tarafından övgü ve sisteme matematiksel oyunların yüklenmesi gibi motivasyon araçlarından sonra daha çok izlemişlerdir.

Dedicated to the memory of

my beloved father

and

my devoted mother

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ABBREVIATIONS

ISCED	International Standard Classification of Education
IWB	Interactive White Board
MAS	Mathematics Attitude Scale
MI	Multiple Imputation
SES	Socio Economic Status

CHAPTER 1

INTRODUCTION

The word "podcast" was created by combining the words iPod and broadcast (Anderson, 2011). A podcast is defined as media files that are distributed over the internet and are replayed on portable media players and personal computers (Copley, 2007). Podcasting initially started for playing audio materials on iTunes, then addition of pictures and video properties to portable devices enabled personal broadcasters to create video podcasts, too (Vajoezki, Watt, Marquis, Holshausen, 2010). Providing online storage for created podcasts was one of the most important issues of iTunes (Lazzari, 2009). As the interest for podcast was growing, other broadcasting mediums like Kaltura and Blackboard were founded. Then the word "webcasting" aroused interest. Webcasting and podcasting are nearly the same multimedia objects with a slight difference that podcasts are stored on devices they are played after fist play but webcasts require internet connection for every play. On the literature they are used for interchangeably (Traphagan, Kucsera, & Kishi, 2010).

Today, teachers and students are interacting with technology every day. As a natural extension of that, they want their teaching and learning information on demand, in anywhere, at any time, and at any device format as well. Nowadays, many universities have started to broadcast their lectures on their webpages like MIT, Harvard, Berkeley, and Yale. Many primary schools also started webcasting for their students.

Throughout the literature several use of webcasts were reported by teachers like delivering class lectures for review (Gosper, McNeill, Woo, Phillips, Preston, & Green, 2007; Lightbody, McCullagh, Hughes, &, Hutchison, 2007; Maag, 2006) and providing supplementary materials (Bell, Cockburn, Wingkvist, & Green, 2007). Students also reported a range of reasons for using webcasts including gathering missing information, studying complex material, working through material at one's own pace, and listening or watching a lecture that was missed (Boulos, Maramba, & Wheeler, 2006; Copley, 2007).

Webcasts' gains enabled for both teachers and students cannot go underestimated. Webcasts provide opportunity for students to make up their missing lectures (Donnelly & Berge, 2006). They also support autonomous learning in students by allowing students to study at their own pace and schedule (Baird & Fisher, 2006; Heilesen, 2010). Webcasts are also viewed valuable and effective resources for revision (Copley, 2007; Evans, 2008). There is an agreement amongst students that webcasts can be used as a resource to support learning and teaching (Salmon & Edirisingha, 2008).

Researchers regarding the assumptions of the cognitive theory of multimedia learning hypothesized that webcasts should enhance teaching and learning (Traphagan et al., 2010). Since webcasts as educational tools are relatively new, few studies correlated the webcast access and exam grades (Anderson, 2011). Putman and Kingsley (2009) and McKinney, Dyck, and Luber (2009) found positive correlation between webcast access and exam grades. On the other hand, some researchers could not found any statistically significant relationship between webcast access and exam grades (Badowski, 2009; Brotherton & Abowd, 2004; Harley et al., 2003; Traphagan et al., 2010). Although mixed results about the effect of webcast access on students' performance were found,

students who used webcasts generally reported these technologies had positive effect on their learning (Acharya, 2003; Evans, 2008).

This study focused on the effect of webcast use on achievement while also looking answers for the relationship between mathematics webcast use and mathematics attitude, students' perceptions for webcasts, and students use of webcast system. Reviewing related literature showed that previous research generally used students' feedbacks and cumulative information while tracking webcast use. Present study designed to record each student's personal information about webcast use.

Statement of the Problem

Most important current technologies are portable media, where users can download information and take it with them to use it anytime and anywhere. Two of the latest ways of sharing portable information using the Internet are webcasting and podcasting (Schnackenberg, 2008). However, literature on webcast and podcast usage in primary school is lacking. To the best knowledge of the researcher, there is not any study about the use of webcasts for mathematics education in primary years. Because almost all studies related to webcasts and podcasts targets high school and college students, there is a gap in the literature on the use of webcasts and podcasts in primary school students. Like high school and college students, primary school students sometimes become distracted or could not understand topics during lessons at school. Webcasts, as asynchronous learning tools, provide students an unconventional learning medium that they can study anytime at their own pace. Therefore the use of webcasts in primary school students should be researched.

Purpose of the Study

The primary purpose of this study is to analyze the effect of mathematics webcasts as a review tool on mathematics achievement of 5^{th} grade students. To achieve this goal, students who have access to mathematics webcasts and who do not were compared in terms of their mathematics achievement.

Students' mathematics attitudes play an important role in mathematics education (Zan, Brown, Evans, & Hannula, 2006). Positive attitudes towards mathematics may result in effective use of mathematics webcast system. Thus, the second purpose of the study is to find out the relationship between mathematics attitude and mathematics webcast use.

The study is also trying to find out how 5th grade students use an online webcast system and how they perceive mathematics webcasts for their mathematics learning.

Research Questions

This study aims to seek answers for the first and second research questions. Third and fourth research questions were investigated to support and increase the quality the findings of the first and second research questions.

i. Is there a significant difference in students' mathematics performance depending on the type of webcast access and use (no access, access but not use, access with moderate use, and access with extensive use) controlling for differences in the mathematics background?
ii. Is there a relationship between students' webcast use and their mathematics attitudes?
iii. How do students perceive webcasts for their learning?
iv. How do students use webcast system?

Hypotheses

All other variables being similar, the type of webcast access and use affect students' mathematics performance. There is a positive relationship between mathematics webcast use and mathematics attitudes. The null hypotheses are stated below.

Research Question 1

H_o: There is no significant difference in students' mathematics performance for those who have different types of webcast access and use controlling for the differences in the mathematics background.

Research Question 2

H_o: There is no relationship between students' mathematics webcast use and their mathematics attitudes.

Variables and Operational Definitions

Following definitions refers to operationalization of mathematics performance, webcast access, webcast use, and mathematics attitude.

Mathematics performance: Mathematics performance is defined as the mathematics knowledge and skills based on the curriculum. Mathematics performance was measured as the total score of 15% of in-class quiz-1, 15% of in-class quiz-2, 15% of in-class quiz-3, 15% of in-class quiz-4, and 40% of final test.

Access to webcasts: Access to webcast is defined as being able to watch mathematics webcasts through online webcast system. That is, students in the study group have access to webcasts created by the researcher whereas students in the control group do not have access to webcasts.

Webcast use: Webcast use can be defined as the amount of webcast watched. The amount of webcast use are categorized into three levels in this study: (a) no use, (b) moderate use, and (c) extensive use. Students in the study group who do not watch any webcast are categorized under "no use," who watch up to 40% in total are categorized under "moderate use," and who watch from 41% to 100% in total are categorized under "extensive use".

Mathematics attitude: Mathematics attitude can be defined as the score on the Mathematics Attitude Scale (MAS).

Independent variables are access to webcasts, webcast use, and mathematics attitude, while mathematics achievement will serve as the dependent variable. Access to webcasts independent variable will have two levels, those who have access to the webcast, known as the experimental groups, and those who do not have access to webcasts, known as the control group.

CHAPTER 2

LITERATURE REVIEW

This literature review is designed to provide a review of existing research pertaining to this study. In this chapter historical background of technology in education, latest trends in education, educational use of webcasting and podcasting, theoretical frameworks, student learning and webcasting/podcasting, and attitudes towards mathematics will be provided.

Historical Background of Technology in Education

In 1900s, silent films were introduced for educational purposes (Wisher & Curnow, 2003). Although governments and entertainment industry promoted the use of films in education, films could not reach the level of influence in schools (Kent & McNergney, 1999). Teachers rarely used films because of some reasons like teacher`s lack of technological skills, the cost of films and equipment, inaccessibility of equipment when it was needed and the time involved in finding the right film (Tyack & Cuban, 1995).

Radio and the television were the next technologies that gained attention in 1920s and 1950s respectively ("ICT in Education", 2007). After radio and television has occupied people's daily life as an entertainment tool, it has also been largely used for educational purposes (Dede, 2004). Radio was cost-effective and had an effect on big

groups (Tripp & Roby, 1996). However limited interaction, unavailability for feedback, and fixed pace for all students were the limitations that educational radio users faced with (Jamison & McAnany, 1978). Also after television become widespread, it overshadowed the radio (Couch, 1997). Television was more attractive than the radio because the way it transfers the educational material was different from traditional methods. It provided learners visual and audio information together and made learners motivated (Saglik & Ozturk, 2001). Television was used as a presenter of entire instructional program because of the teacher shortage in some areas, as a supplementary tool and dominantly as a teacher aid. Like previous educational technologies, television is also supported by governments; however, schools couldn't meet the substantial costs for program development and the purchase of equipment, and some teachers preferred to rest television on the shelves (Cuban, 1985).

Soon after computers become popular and widespread, they started to take place of television in 1990s. Before the appearance of microcomputers, some earliest efforts on instructional applications of computers took place but these efforts had little effect on education (Williams, Mehlinger, Powers, & Baldwin, 2002). Educators showed enthusiasm for use of computers in education after the appearance of microcomputers. As an educational technology, computers have more powerful effect in education. While films, radio, and television were mostly used as support for teachers, computers were also promoted as support for school curriculum (Williams et al., 2002). Learning about computers accepted by educators and is found necessary by public (Anglin, 1995). With the power of the internet to connect people to the endless information, computers became more charming (Stahl, Koschmann, & Suthers, 2006). Computers are being used

for various reasons today. Many nations use personal computers also for educational purposes in a high percentage of their use. Even education is the main reason for some nations to buy personal computers like Canadians (Patrick, 1998).

Power of computers in education is continuously increasing. Schools are increasing the number of computers in schools with the decline in computer costs. Governments have been supporting and funding technology in schools. To better understand the advantages of technology, current trends in educational technologies will be reviewed.

Latest Trends in Education: Webcasts and Podcasts

It is the age that information surrounds every aspect of our lives. Teachers are continuously seeking alternative ways to connect with their students instead of traditional ways. Infusing educational technology into the curriculum is one of the ways to make this connection. Every moment children use technology. Personal computers, cellular phones, iPods, laptop computers, Personal Data Assistants (PDAs), and wireless devices, to name a few, are the devices by which students communicate. Due to the high usage of these devices, podcasting and webcasting have become significant ways in which students can gain access to information (Badowski, 2009).

Definitions: Webcasts and Podcasts

Webcasts and podcasts are used in educational and training settings in order to deliver personalized content to learners in a specific course during a given semester (Copley, 2007). They are reusable, interesting and stimulating for today`s technology-savvy students (Van Zanten, Somogyi, & Curro 2012).

A webcast is defined as an audio or a video broadcast delivered over the web using streaming media technology. To be able to play a webcast, the internet connection is needed throughout the broadcast (Traphagan et al., 2010). Podcasts seem very similar to webcasts and are described as media files that are distributed over the internet and are replayed on personal computers (PCs) and portable media players (Copley, 2007). The only difference between webcasts and podcasts is whether they are stored on media devices or not. While webcasts are not stored on media devices they are played, podcasts are stored. An internet connection is required while watching webcasts because webcasts stream videos over the internet. Podcasts are downloaded and saved to media devices for offline use rather than broadcasted over the internet. An internet connection is required only for new podcasts (Traphagan et al., 2010).

Many times webcasting and podcasting are used interchangeably because they are used in similar ways in educational contexts (Traphagan et al., 2010). For the current study the name “webcast” were used for both “webcast” and “podcast” beyond this point.

Webcast Types

Recently webcasting has become a favored medium for accessing and assimilating information by users (Copley, 2007). There are three types of webcasts being produced and used: audio-webcasts, enhanced webcasts, and video webcasts or vodcasts (Liu & McCombs, 2008). Webcasts including only audio file are called audio-webcasts, and they take relatively small storage space. Enhanced webcasts are a combination of audio files and digital images. Video webcasts or vodcasts include audio and video so take larger storage space (Bolliger, Supanakorn, & Boggs, 2010; Liu & McCombs, 2008).

Educational Uses of Webcasting

Using recording materials is not new in education; however, growing attention has been given to webcasting in the last decade with technological changes. These rapid changes in technology make producing and accessing lecture recordings easier in each day. Webcasts have been integrated into the curriculum in different ways to meet a range of learning objectives. Although many universities have been using webcasts with the purpose of delivering supplementary lecture materials to campus-based students for improving learning performance using e-learning, webcasts also serve several opportunities for distance learning (Concannon, Flynn, & Campbell, 2005). One of the most commonly reported use of webcasts is recording of face-to-face lectures (Gosper et al., 2007; Lightbody et al., 2007; Maag, 2006). Tynan and Colbran (2006) reported that

webcasts had been used to record tutorials, and some other researchers found they had been used to deliver short recordings or "episodes" of important information (Clark, Taylor, & Westcott, 2007; Laing & Wootton, 2007) or supplementary materials (Bell et al., 2007). Webcasts can also provide glossaries of key terms (Lightbody et al., 2007), and they can be used as a feedback mechanism for lecturers (Maag, 2006).

Students reported a range of reasons for using webcasts including gathering missing information, studying complex material, working through material at one's own pace, and listening or watching a lecture that was missed (Boulos et al., 2006; Copley, 2007). According to the findings of researchers, students mostly use webcasts for examination revision (Copley, 2007; Gosper et al., 2007; Laing & Wootton, 2007). Additionally Copley (2007) reported that students with dyslexia found webcasts very beneficial on his survey. Several studies have shown differential uses of webcasts by students for educational purposes.

In 2006, Apple launched iTunes U that provided opportunity to present audio and visual materials easier in mostly United States. Also schools became able to present webcasted materials to their students in a way in which their students were familiar (Laing, Wootton, & Irons, 2006). This also provided an opportunity to listen or watch webcasts on their computers, mobile phones, iPads, or even other tablet computers. Even though the opportunity of iTunes U was for United States students at the beginning, as people became familiar with iTunes U and webcasts the diffusion of that innovation in other countries gained speed. Now, schools from many countries can broadcast their webcasts trough iTunes U.

Advantages of Webcasting in Education

Webcasts allow educators and learners to time-shift instructional or learning content. A learning content can be listened or watched at a later time via webcasts. Badowski (2009) reported that webcasting establishes a way for instructors to connect with their students who are in the classroom and who are not in the classroom. When learners are absent from classes they can easily listen or watch the webcast of the lesson whenever they want at their pace (Donnelly & Berge, 2006).

Researchers noted that technology has been praised for supporting autonomous learning in students, and webcasts are one of the best examples for such autonomous systems (Baird & Fisher, 2006; Heilesen, 2010). According to Covill and Gill (2008), webcasts that are recorded during the lesson provide flexibility and autonomy for students. Students can easily access to webcasted lesson in the presence of internet connection in anywhere and at any time. Individuals have their own control on watching webcasts as well as on the time they watch (Boulos et al., 2006; Donnelly and Berge 2006). Learners can find out areas they have problems and choose webcasts related to these areas then listen or watch the related webcast (Donnelly & Berge, 2006). That means they can define their learning spaces and establishing their own learning pace (Vygotsky, 1978).

Webcasts allow learners to listen or watch the portable recordings while engaging in other tasks (Donnelly & Berge, 2006). For example learner can listen to a webcast while exercising or walking.

Donnelly and Berge (2006) stated that webcasting provide the advantage of voice communication. They include the voice of the developer and this feature makes information more personal. Voice is personal and much more relieving than a text (Smith, 2005). When the tone is added to voice, the information becomes more personal. Students reported that being able to hear the lecture again and again with the voice of the instructor was much more useful than just having the PowerPoint presentations (Scutter, Stupans, Sawyer, & King, 2010).

There is an agreement amongst students that webcasts can be used as a resource to support learning and teaching (Salmon & Edirisingha, 2008). Webcasts are viewed valuable and effective resources for revision (Copley, 2007; Evans, 2008). Studies of Copley (2007) and Evans (2008) showed that most of the students found webcasts very beneficial, engaging and effective in traditional courses. Students generally used webcasts for exam preparation, note-taking, and review of missed lectures. Visual images in webcasts help students to remember, understand what they have missing, and help to recall information during assessments (Clark & Paivio, 1991). They also render revision easier, motivating, engaging and interesting (Hill, Nelson, France, & Woodland 2012).

Although it seems to record each lecture is time consuming for instructors, in the long run it is a time saving approach because they can be reused (Covill & Gill, 2008). The webcasting technology is getting more popular, easier to produce and use, and cheaper. These features make these technologies an attractive option for providing additional flexible learning resources for students (Scutter et al, 2010).

Possible Difficulties of Webcasting in Education

Beside many beneficial aspects of webcasts, there are some difficulties with these technologies as well. Although the video webcast are much more beneficial than audio webcasts, they are not as common as audio webcasts (Fill & Ottewill, 2006). The reason why video webcasts are rare is the production of them is not seen as an easy process. Copley (2007) stated that there are many software packages that make this process easier by combining PowerPoint slides, lecture audio and video; however, there are still several handicaps for instructors who want to video lectures. First a video camera and a microphone are needed to record the lecturers and their voice. Second in some occasions recording formats are not played on portable players. The other handicap is that the size of recorded lecture can be large and uploading them to the Internet may be troublesome. In that situation lecture videos can be distributed on CD or DVD but this is also a time consuming and difficult process. Moreover, if the sound quality and resolution of webcasts are not good, students may complain about recordings Copley (2007). This situation may result in negative thoughts toward webcasts. Instructors should be trained about both recording webcasts and properties of effective webcasts in order to help learners understand the content well (Skiba, 2006).

Fernandez (2007) stated one of the dangerous outcomes of webcasting is that students may leave classes and watch or listen to them at a later time. However, lecturer may edit the webcast before uploading to the system. Because it is suggested that rather than webcasting complete lectures, it is more effective to webcast to explain key points, lecturer may cut out discussion parts or questions from students (Scutter et al., 2010).

Consequently, students who choose to watch or listen to only webcasts and do not attend to live lectures may miss some information and may not able to ask questions to lecturer. Even though many researchers were worried about the absence rates will increase, Covill and Gill (2008) reported that students found crucial to ask questions during the lecture so webcasts could not take place of live lectures.

Palmer and Devitt (2007) reported that audio webcasting has also been argued to lead to passive learning in consequence of students focus on the audio facility rather than actively engaging with the content. Scutter (2010) argued that perceptions of disadvantages may stem from the constructivist educational thinking which is based on active learning. Listening to webcasts perceived as a passive skill; however, recent work on the value of webcasting in learning language depicts listening as an active process which enables to select and interpret information from auditory clues (Kavakiauskiene, 2008 as cited in Scutter et al., 2010).

Moreover, most of the students have access to digital media devices such as cell phones, iPods, and iPads; they may use them for entertainment purposes rather than educational activities. Many students use their desktops and laptops for educational purposes; however, it may take time to view other digital media devices as an educational learning tool (Walls et al., 2009).

Although there are some difficulties of generating and using webcasts properly, knowing the benefits can encourage both learners and lecturers.

Theories Behind Webcasting

Cognitive theory of multimedia learning serves as a catalyst for the use of webcasting in education (Baddeley, 1998). Mayer and Moreno (2003) based their cognitive theory of multimedia learning on three assumptions about how human mind works in multimedia learning: dual channel, limited capacity and active processing.

Dual-coding theory is the one that lends to understand the learning style of the digital generation (Paivio, 1986). Dual-coding theory states that information is processed by using two channels; with this respect, learning is obtained by integrating information between these channels (Mayer & Chandler, 2001). The first of these channels is the auditory-verbal channel which processes any auditory stimuli. The next channel is the visual-pictorial channel which processes pictures and visual information (Mayer & Moreno, 1998). When one is presented with a multimedia display, words are transmitted verbally and visually, and pictures are seen. Once the learning content is viewed or heard, the information is stored in the working memory in which sounds and images are processed and organized into verbal and pictorial images. They finally are stored in long-term memory. If a student can take both the words and images that s/he has seen, process them, and send them to long-term memory, the learning process is bound to generate much better results (Mayer & Moreno, 2003).

Paivio's (1986) research suggested that students learn better when they are presented with two different stimuli simultaneously. Similarly in their research Mayer and Moreno (1999) proved that when a person was presented with a visual and audio stimuli simultaneously, s/he performed better on assessments than those only presented with either audio or video stimuli. Webcasts are learning resources that can present

visual and audio information simultaneously. In this regard, video webcasts and enhanced webcasts should help students to learn better in comparison to textbooks and class notes (Traphagan et al., 2010).

Even though utilizing both auditory and visual channels are suggested, limited capacity theory suggests that humans have a limited ability for processing information as presented through both channels (Baddeley, 1998). In other words, the use of both channels increases scores on assessments; however, these channels can also be overloaded if one is receiving too much information (Sweller, Ayres, & Kalyuga, 2011). Mayer and Chandler (2001) suggested that while presenting a complex problem, the problem can be segmented into smaller groups to reduce the amount of information to be absorbed at once. Similarly segmented, targeted webcasts are suggested to be better to maximize learning gains (Anderson, 2011).

The final assumption of cognitive theory of multimedia learning, active processing, refers to active engagement in cognitive processing to construct meaningful representations (Mayer, 2001). Mayer and Moreno (2003) defined active processing as substantial cognitive processing in the verbal and visual channels. Mayer (2001) stated that building connection between word-based representations and visual-based representations are the most important step in multimedia learning. Webcasts as multimedia tools should be designed considering the connection between verbal and pictorial representations to make learners the most of them.

Student Learning and Webcasts

Researchers regarding the assumptions of the cognitive theory of multimedia learning hypothesized that webcasts should enhance learning (Traphagan et al., 2010). Researchers found webcasts as effective learning tools for student motivation (Dlott, 2007; Halderson, 2006). Oliver (2005) reported that webcasting may enhance student learning through increased motivation.

Since webcasts as educational tools are relatively new, few studies correlated the webcast access and exam grades (Anderson, 2011). Putman and Kingsley (2009) and McKinney et al., (2009) found positive correlation between webcast access and exam grades. On the other hand, some researchers could not found any statistically significant relationship between webcast access and exam grades (Badowski, 2009; Brotherton & Abowd, 2004; Harley et al., 2003; Traphagan et al., 2010). Harley et al. (2003) found that students who prefer to watch lecture webcasts instead of attending to the class lectures showed lower performance.

Although mixed results about the effect of webcast access on students' performance were found, students who used webcasts generally reported these technologies had positive effect on their learning (Acharya, 2003; Evans, 2008). Students also reported that webcasts help them to study their notes more effectively than textbooks (Brotherton & Abowd, 2004; Evans, 2008).

Neale (1969) defined attitude toward math as "aggregated measure of liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (p.623) (as cited in Ma & Kishor, 1997). Students' mathematics attitudes play an important role in mathematics education (Zan et al., 2006). Research has demonstrated that learning outcomes of students are closely related to their beliefs and mathematics attitudes (Schoenfeld, 1992). Researchers reported that attitude is positively, but slightly, related to achievement (Aiken, 1970; Haladyna, Shaughnessy, & Shaughnessy, 1983). In the review of related literature, no study was found analyzing the relation between mathematics attitude and watching webcasts of mathematics lectures in middle schools. However, there is a positive relationship between technology use in classroom and students' attitudes towards lessons (Eyyam & Yaratan, 2014). Thus positive relationship between technology use and attitude may result in positive relationship between watching webcast lectures and attitude.

With development and support of educational technology, webcast use has grown continuously since 2005 (Anderson, 2011). Although educational technology has an important place on the literature, webcasting is relatively new to the literature. Research on webcasts is limited. Although researchers found mixed results about the effect of webcasts on achievement, most of the researchers reported that students' perceptions were very positive about the use of webcasts on education. Previous research generally used students' feedbacks and cumulative information while tracing webcast use. Present

study designed to record each student's personal information about webcast use. That opportunity provided to uncover some unanswered questions on the literature.

CHAPTER 3

METHOD

Participants and Sampling

The process of sample selection, description of experiment and control groups, demographic information, and mathematics achievement background about experiment and control groups are explained below.

Choosing the Sample

A sample of 110 fifth grade students was recruited from two middle schools within the same school district in Istanbul. One of the schools had 58 students, and the other school had 52 students. The inclusion criterion was using interactive white boards (IWB) in mathematics classes.

Choosing the research sample took a long procedure. District for national education directorates in Istanbul were called and asked for the schools which had IWBs. Unfortunately this data was not available on most of district for national education directorates' records. Based on their statements, some schools did not have

IWBs while some had broken ones. Furthermore, the ones who had IWBs had used them in a very simple manner like a black/white board. In some schools 5th grade mathematics teachers were using them as a projector and to show some free online courses. In a very limited number of schools, some 5th grade mathematics teaches were using IWBs with an IWB software program that is necessary to use IWBs for more than a projector. The researcher purposefully selected those teachers who used IWBs with a software program. However, most rejected to be part of the study, some of them were worried about catching up the curriculum, some were expecting inspectors to visit their classrooms and did not want any other burden on them. There was very little number of fifth-grade teachers who were volunteered to be involved in the current study.

To assure that control group and experimental groups had similar academic achievement level and socio-economic status, with the help of district of national education directorates, two schools within a neighborhood in Beşiktaş district were chosen.

Experiment Group

Experimental group students of this study were chosen from a middle school located in Beşiktaş, Istanbul. The school had 22 teachers and 410 students. There were two 5th grade classes in the school. One of these classes had 35 students and the other had 28 students. Throughout the study five students dropped out. Two of them changed their

schools and three of them did not attend more than two assessments because of absence. Out of remaining 58 students in total, the number of girls was 27 and the number of boys was 31 (see Table 1). The mathematics teacher of these two classes was the same. In each class there were an interactive white board (IWB) and a computer that were key elements for the study.

Control Group

Control group students of the study are chosen from another middle school in Beşiktaş, İstanbul. The school has 35 teachers and 615 students. There were five 5th grade classes in the school. There were three mathematics teachers assigned to 5th graders. One of them volunteered to be the part of the study. Thus, his two classes were chosen as the control group. One of these classes has 30 students, and the other has 31 students. Throughout the study nine students dropped out. One of them changed his school, and eight of them did not attend more than two assessments because of absence. Out of remaining 52 students in total, the number of girls is 24 and the number of boys is 28 in the control group (see Table 1).

Table 1. Distribution of Sample According to Gender Before and After Drop Outs

	Gender	Before	Drop outs	After
Experiment Group (N=58)	Girls	28	1	27
	Boys	35	4	31
Control Group (N=52)	Girls	25	1	24
	Boys	35	7	28

Demographic Information about the Sample

A demographic information survey (see Appendix B) is administered at the beginning of the study. Fifty parents (86.21%) filled the demographic information survey out of 58 in the experiment group. In the control group, 44 parents (84.62%) filled the survey out of 52.

Although the information about the similarity of socioeconomic status (SES) of experiment and control groups is asked from the district for national education directorate, the similarity of SES is confirmed with SES analysis. Parental education was assessed as a predictor of socioeconomic status. As Sirin (2005) found in his study, education level is the most determinant aspect for SES. Parents' education levels are classified according to International Standard Classification of Education (ISCED) as follows: (a) low level (b) medium level, (c) high level. Further information about the categorization can be found in Ozel and Ozel (2013). The percentages for low, medium, and high parental education of experiment and control groups are similar as shown on the Table 2. In addition to parent education levels, total family incomes were analyzed. The average total income for a family in the experiment group is 2469 TL (*min* = 800, *max* = 6500, and *SD* = 1024) and in the control group is 2441 TL (*min* = 800, *max* = 5000, and *SD* = 1186).

Table 2. Parental Education Percentages for Experiment and Control Groups

Group name	Low parental education	Medium parental education	High parental education
Experiment group	34.00%	42.00%	24.00%
Control group	34.88%	44.19%	20.93%

While all experiment group students' parents are alive, only one student's father is not alive in control group. The parents of four students in the experiment group (8%) and three in the control group (6.82%) were divorced.

Average number of computers at students' homes is 1.55 for the experiment group and 1.41 for the control group. In experiment group all students have at least one computer and internet connection at their homes. In control group, three students (6.82%) do not have any computers in their homes and 4 students (9.1%) do not have internet connection at their homes as shown on the Table 3.

Table 3. Information about Computer and Internet Connection at Students' Homes

	Experiment Group	Control Group
Average number of computers	1.55	1.41
Percentage of students who do not have any computers in their homes	0%	6.82%
Percentage of students who do not have internet connection in their homes	0%	9.10%

One student's parents stated they do not let their child to use computer for studying in experiment group (2%). This student's parents informed about the study in detail and they let their child use computer for the study. In control group, 2 students' (4.55%) parents do not let their children to use computer for study purposes. Because no computer application was required for the control group, no intervention with parents was utilized.

Mathematics Achievement Background of the Sample

The experiment and control group students were not only similar in demographics but also similar in mathematics background. A mathematics background assessment applied to see if there was a statistically significant difference between the experiment group and control group students' mathematics achievements at the beginning of the study. The experiment and control group students were compared regarding their mathematics background assessment scores. Group statistics for mathematics background assessment are shown on the Table 4 and boxplots in Figure 1.

Table 4. Group Statistics for Mathematics Background Assessment

Group name	N	Mean	Std. Deviation
Experiment group	58	43.37	22.66
Control group	52	45.54	17.21

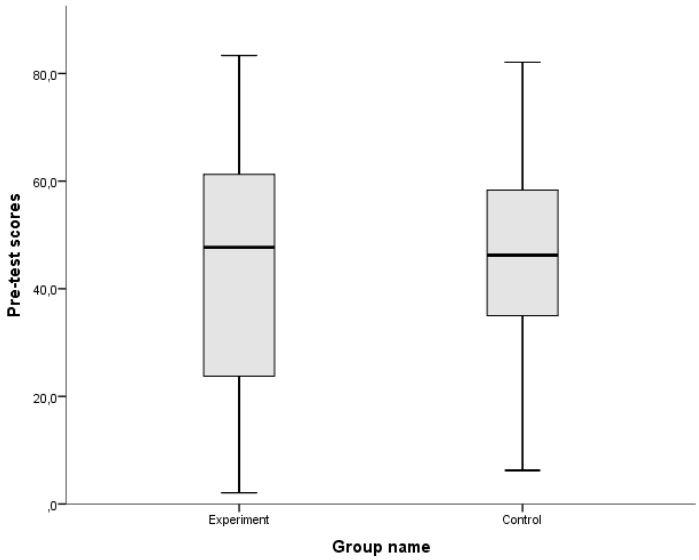


Fig. 1 Boxplot showing mean mathematics background assessment achievement of experiment and control group.

There were no outliers in the data, as assessed by inspection of a boxplot. Mathematics background assessment scores did not violate normality assumption for the experiment and control groups. Skewness and kurtosis values are shown on the Table 5.

Table 5. Skewness and Kurtosis Values for Mathematics Background Assessment Scores

Group name	Skewness	Kurtosis
Experiment group	-0.273	-0.996
Control group	-0.155	-0.190

Levene`s test for equality of variance was run before interpreting the results of *t* testing. Because the significance value was smaller than .05 in Levene`s test, equal variances were not assumed. Mean experiment group mathematics background assessment score was lower than mean control group mathematics background assessment score. An independent samples *t*-test showed that there was no a statistically significant difference in mean mathematics background assessment score between the experiment group and control group and Cohen's *d* effect size was small (see Table 6).

Table 6. T-test Analysis for Mathematics Background Assessment Scores

t	df	Sig.	*d*
-0.569	105.246	0.571	0.108

Instruments

Demographic Information Survey

Demographic information survey contained questions about education levels of parents, family income, information about computer possession, internet connection at students' homes and information about students' computer use. The survey was applied to both experiment and control groups at the beginning of the study (see Appendix B).

Mathematics Background Assessment

Mathematics background achievement levels of students in both schools were determined by a mathematics background assessment developed by the researcher and reviewed by the mathematics teachers of experiment and control group. The assessment was administered in two forty-minute sessions. 5th grade math objectives, topics and number of objectives related to each topic and time percentage for each topic were considered while developing the test (see Table 7). This assessment covered first four units of 5th grade mathematics curriculum. Learning domains of first unit were data and geometry, and the reserved time for the unit was 19 lessons. Second unit`s learning domains were data, numbers and measuring, and the reserved time was 24 lessons. Third

unit`s learning domains were data, numbers and measuring, and the reserved time was 33 lessons. Learning domains of the fourth unit were numbers, measuring and geometry, the reserved time was 19 lessons. Allocated time for the first four units which are covered in schools was 95 lessons. Approximately one fourth of each unit`s reserved number of lessons was determined the question number to be asked in each unit. Therefore, 5 questions for the first unit, 6 questions for the second unit, 8 questions for the third unit, and 5 questions for the fourth unit were asked in the assessment. The assessment was containing 24 questions (see Appendix C). Questions in each unit cover all the objectives related to the unit.

Table 7. Distribution of Questions According to Learning Domains on Mathematics Background Assessment

Units	Learning Domains	Allocated Time	Number of Question on Background Assessment
1st Unit	data and geometry	19 lessons	5
2nd Unit	data, numbers and measuring	24 lessons	6
3rd Unit	data, numbers and measuring	33 lessons	8
4th Unit	numbers, measuring and geometry	19 lessons	5
Total		95 lessons	24

In-Class Quizzes

In-class quizzes were administered for both experimental and control groups. Four in-class quizzes were developed by the researcher and reviewed by the experiment and control groups' mathematics teachers. In-class quizzes consists of 5, 6, 4, 6 questions

respectively and administered in 30-minute sessions (see Table 8). The numbers of questions to represent the objectives of the content related to in-class quizzes were determined by the time allocated in the curriculum by the Ministry of National Education. Appendix E shows in-class quizzes.

Table 8. Distribution of Questions and Topics in In-class Quizzes

Quizzes	Topics	Number of questions	Time (min.)
In-Class Quiz-1	Numbers, patterns	5	30
In-Class Quiz-2	Numbers, addition	6	30
In-Class Quiz-3	Arithmetic mean	4	30
In-Class Quiz-4	Addition, subtraction, multiplication	6	30

Online Quizzes

Online quizzes were available on the webcast system for each topic. Online quizzes were prepared by the researcher and reviewed by the mathematics teacher of the experiment group. There were six online quizzes on the webcast webpage. Each quiz had five questions except second and sixth quizzes which had four questions. Each quiz was containing multiple choice questions and had a time limit (see Table 9). Possible minimum and maximum scores for each quiz were 0 and 100. The highest 100 points were evenly distributed to each question in quizzes. Students were able to take quizzes before or after watching the webcast lectures on voluntary base.

Table 9. Distribution of Questions and Topics in Online Quizzes

	Topics	Number of questions	Time (min.)
Online Quiz-1	Numbers	5	8
Online Quiz-2	Patterns	4	9
Online Quiz-3	Arithmetic mean	5	12
Online Quiz-4	Addition	5	10
Online Quiz-5	Subtraction	5	20
Online Quiz-6	Four operations	4	15

Time limits for quizzes were varying. The remaining time was shown on the screen while students were taking quizzes. After completing the quiz students saw which questions were responded correct and which were responded wrong and their success percentage. For each wrong response there was a feedback available under the question (see Figure 2). Students were only able to take quizzes for one time. This restriction was announced to students at the beginning of the study and displayed on the screen before starting to each quiz. However, students could always access the quizzes to review their answers as they wish.

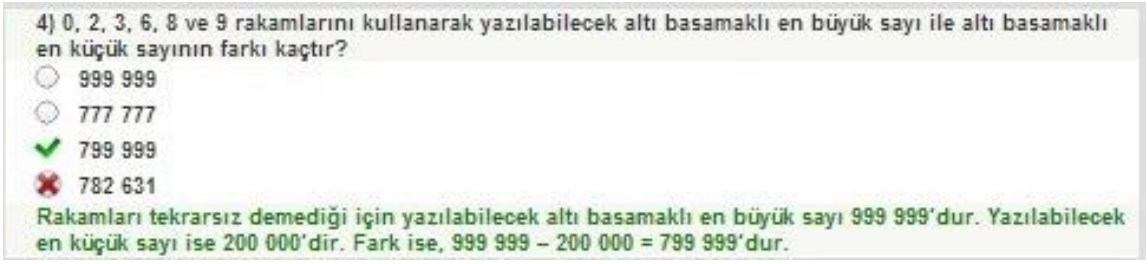


Fig. 2 Feedback for a wrong response.

Students' scores on online quizzes were correlated with in-class quizzes to understand if voluntary online assessments can be used instead of in-class assessment.

Mathematics Final Test

Mathematics achievement levels of students after study in both schools were determined by a final test developed by the researcher and reviewed by the mathematics teachers of experiment and control group. The test was administered in sixty minutes. One question was asked on the test for each objective covered during the study. The test was containing 20 questions (see Appendix F).

Mathematics Attitude Scale

Mathematics Attitude Scale developed by Erol (1989) and shortened for primary school students by Nazlicicek and Erktin (2003). The scale contains three subscales: (a) perceived success at mathematics, (b) perceived usefulness of mathematics, and (c) interest in mathematics. The scale is from 20 five-point rating scale ranging from 0 (never) to 4 (always) (see Appendix D). The numbers of questions including positive and negative items are presented in Table 10.

Table 10. Questions for Each Subscales of Mathematics Attitude Scale

Subscales	Items	
	Positive	Negative
Perceived success at mathematics	3, 7, 13, 14, 19	6
Perceived usefulness of mathematics	10, 16, 18	11, 15
Interest in mathematics	1, 4, 8, 20	2, 5, 9, 12, 17

Cronbach's alpha for the original test was calculated as 0.84 (Erol, 1989). 56 students in experiment group (n = 58) replied the scale. Similarly the scale has high level of internal consistency for the current study, as determined by a Cronbach's alpha of 0.84. Calculated reliability results for the subscales are shown in the Table 11.

Table 11. Calculated Cronbach's Alpha Values for Subscales of Mathematics Attitude Scale

Subscales of MAS	Cronbach's alpha (α)
Perceived success at mathematics	.79
Perceived usefulness of mathematics	.50
Interest in mathematics	.70

Reflections Questionnaire

To understand the experiment group students' ideas about the webcast system a short questionnaire was administered to experiment group students after completing the study. Students were asked to reply following questions:

"Do you like the mathematics webcast system?"

"Do you find the mathematics webcast system beneficial for your mathematics learning?"

"What are the reasons for you to find the mathematics webcast system beneficial or not for your mathematics learning?"

Design and Procedure

Research Design

This quasi-experimental study carries design and development research perspective. Richey and Klein (2007) defined design and development research as the systematic study of design, development and evaluation process with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new enhanced models that govern their development. The current study tests for the effectiveness of after-class review sessions on students' achievement and attitudes. Conjointly, the research developed an online-system to present after-class review sessions and collect user information.

Quantitative data of mathematics achievement was collected via test scores of each student. There were four types of achievement test administered in this quasi-experimental study: (a) mathematics background assessment, (b) in-class quizzes, (c) online quizzes and the last one is (d) final test. Because the groups were not randomly assigned, a mathematics background assessment was applied for both groups to compare their achievement levels prior to the study. In-class quizzes for both groups and online quizzes for only the experimental group were topic based achievement tests. Online tests were available on the webcast system after each topic. At the beginning of the study, mathematics attitude questionnaire and general attitude towards computers questionnaire was administered only to the experiment group.

Webcast System Design

Recorded lessons were first uploaded to an online video sharing website. In this current study, YouTube is used as free online video-sharing website. Each lesson record was divided into smaller clips according to the subtopics of the lesson by writing the time period of each part into the webcast system database. Each video and video clip had an explanation about the its content. YouTube videos were shown embedded in the webcast system. YouTube links were deactivated in order to prevent students leaving the Webcast system and watch the videos in YouTube. Thus, webcasts were only available through the system. This restriction was important for data security. Otherwise, the system would not collect student information on the webcast use.

Each student in the experiment group was provided with a username and password to login to the webcast system. Students' control over the video was restrained to pause/play the webcasts and to watch them in full screen. The webcasts would not be fast forwarded or rewound because watch percent of webcasts were wanted to be traced. The webcasts were in short video clip format, ranging from 1.07 to 13.55 (mean = 3.17) minute long. Thus, this restriction was not counted as an important limitation for the current study.

In order to organize webcasts, lectures were grouped under weeks. Beside, each week had a title to make students find webcasts easier (see Figure 3). For each week, there were lectures, and each lecture had a title (see Figure 4).

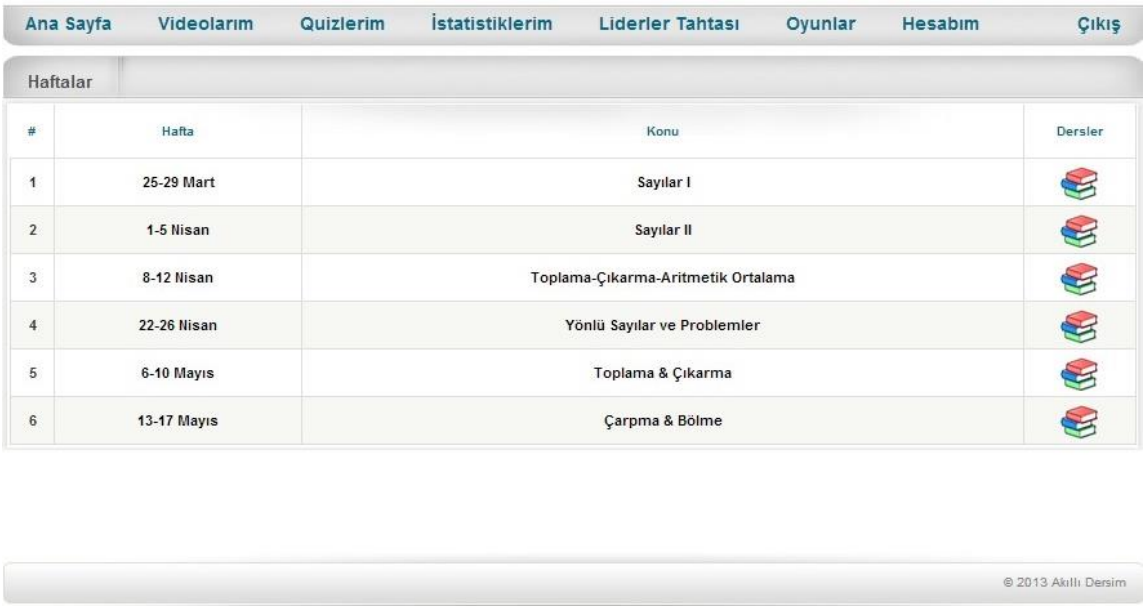


Fig. 3 Webcasts were organized under weeks.

Fig. 4 There were lecture webcasts under each week.

For each lecture there were parts and each part had a title and description (see Figure 5). In order not to increase the accessibility of webcast for students and keep them focused on specific topic, webcasts were divided into subtopics that were shorter than 15 minutes.

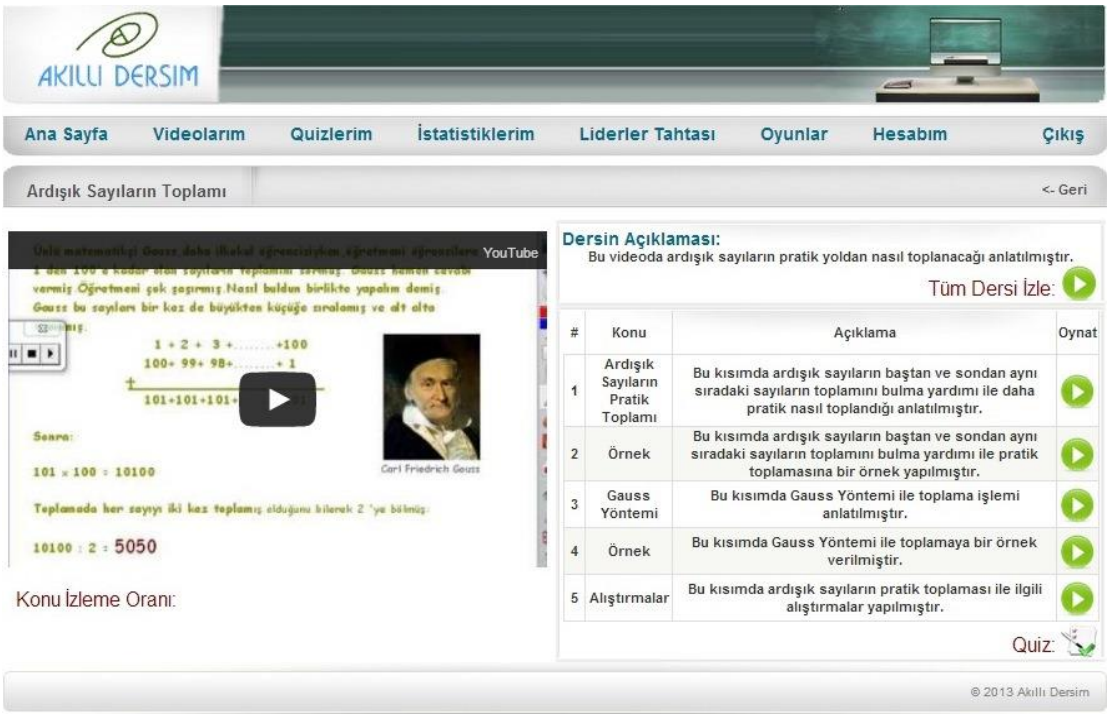


Fig. 5 Each lecture webcast was divided into subtopics.

Students were able watch webcasts as many times as they wish. However, they could solve topic-based quizzes only once, of which they were aware (Figure 6). When they revisited a quiz that they had solved, they could only have reviewed their answers and feedbacks.

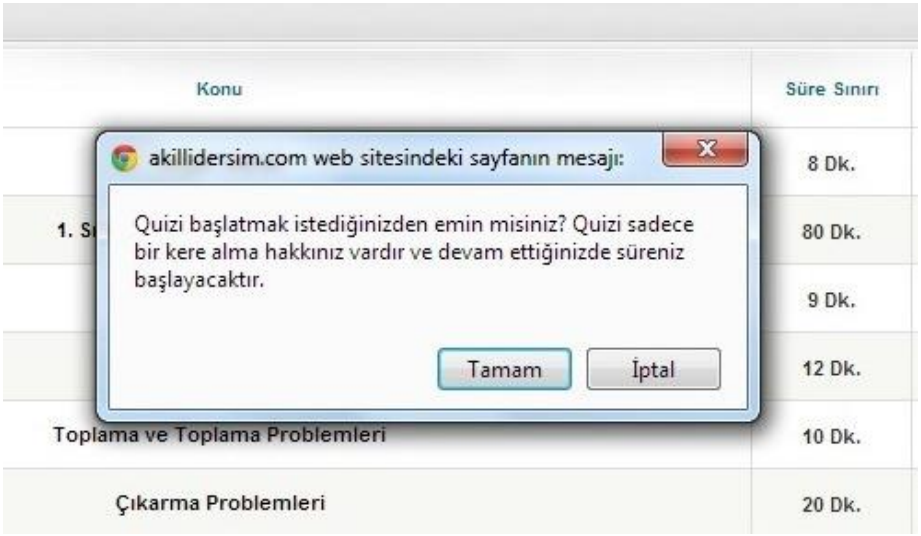


Fig. 6 Warning message showing online quizzes could be taken only once.

The number of questions in a quiz varied in each quiz, and students had time limit for each quiz (Figure 7). Each quiz had different time limit according to the number of question and difficulty level. Quizzes were composed of four-item multiple choice questions, which could include text and image. At the end of each quiz or within the time limit, students could submit their answers and review them. Students could also view the success percentage on the quiz. For each wrong question they got a feedback next to the question (Figure 8).

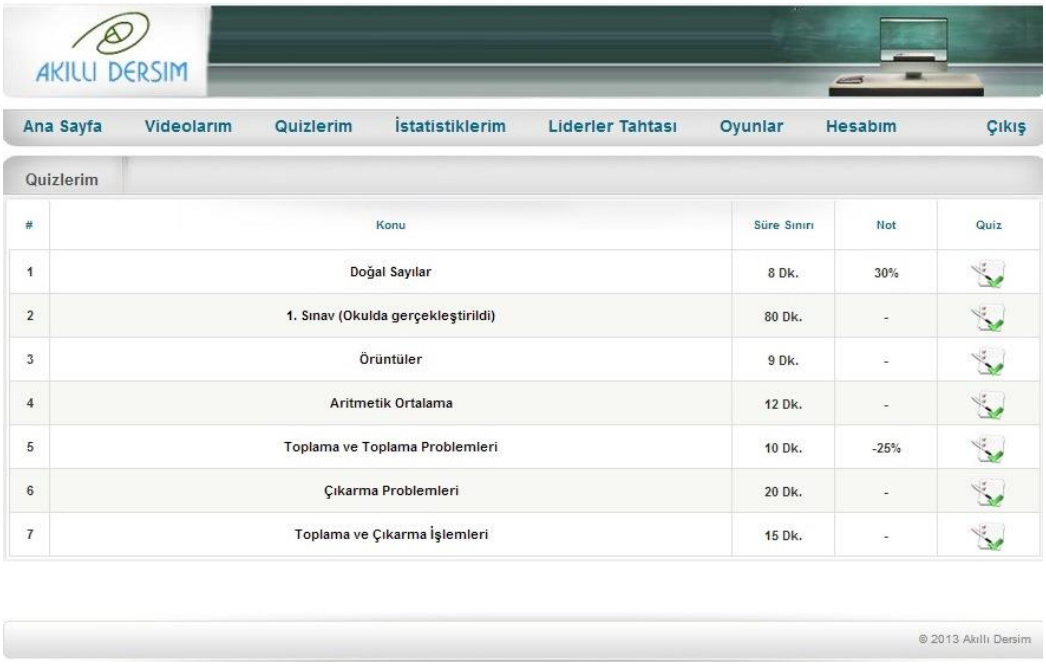


Fig. 7 Quiz page.

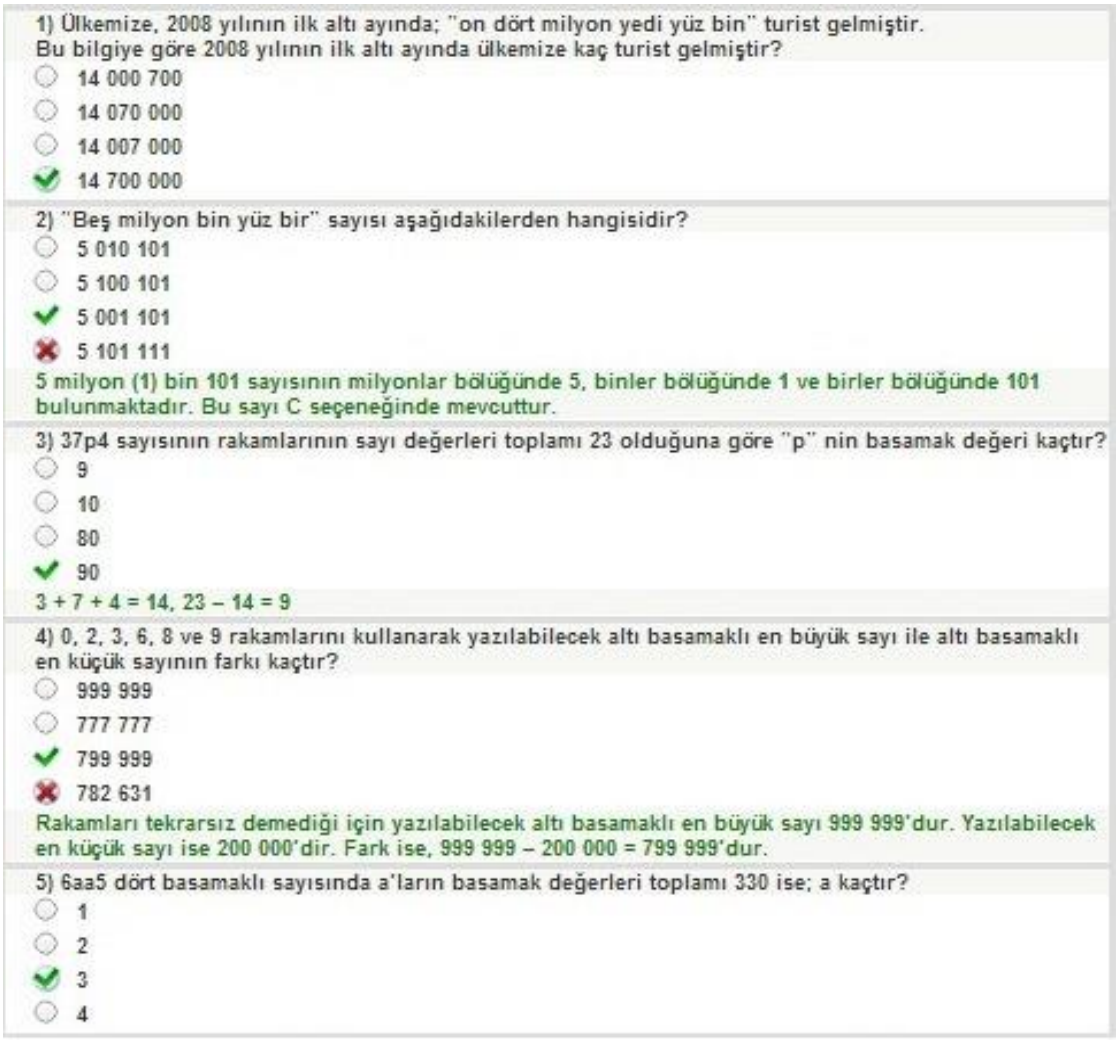


Fig. 8 A quiz example.

Students could trace their own webcast use trough the webcast system. To increase the personal traceability, students were shown whether they watched a webcast on each subtopic and, if so, how much they watched for that specific subtopic (see Figure 9).

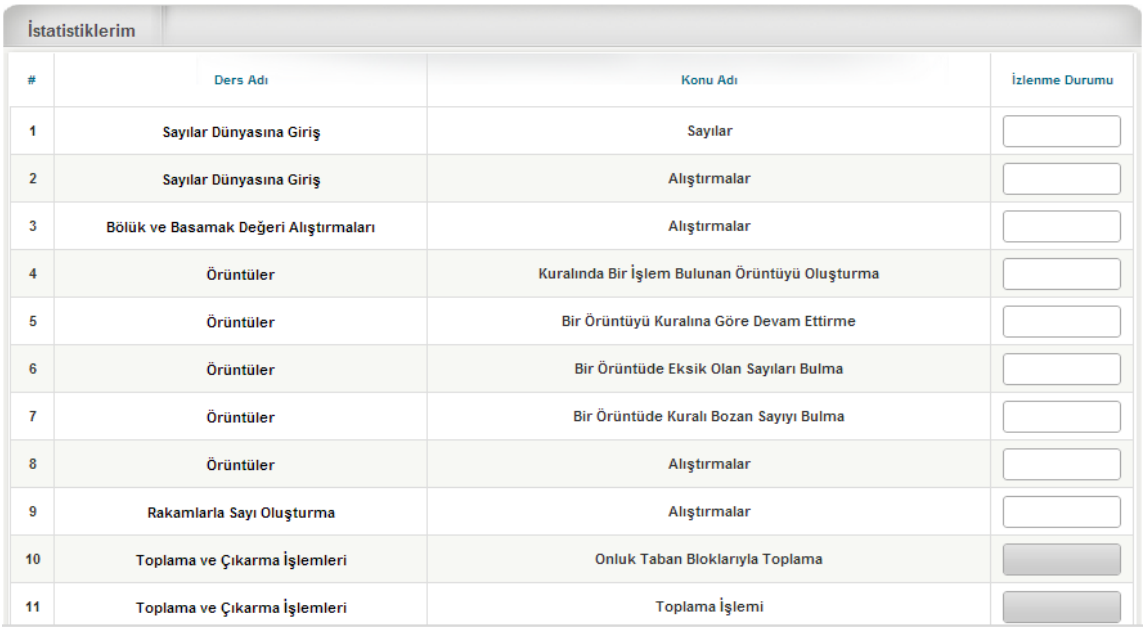


Fig. 9 Students' personal statistics page.

The webcast system was designed to keep user record such as personal information, login record, watch record, quiz result record, and quiz answer record. Table 12 presents the specific information kept under each category.

Table 12. Information Recorded by the Webcast System

User	Login Record	Watch Record	Quiz Result	Quiz Answer
IP Address	User	User	User	User
User Name	Login Time	Video Part	Quiz	Question
Gender	Logout Time	Start Time	Score	Answer
		End Time	Correct Answer	
		Watch Percentage	Wrong Answer	
			Not Answered	

Procedure

The current study was started with choosing two similar schools that satisfied the purpose of the study. One 5th grade mathematics teacher was selected from each school, and they were informed about the study. The teacher of the experimental group was taught how to record the whole lesson using the feature of interactive whiteboard (IWB) because recorded lesson webcasts would be available for only the experiment group students.

After informing 5th grade mathematics teachers, students were also informed about the study. Students in the experimental group were also informed additionally about the webcast system that they can watch recorded lessons and solve quizzes. In order to prevent identification confusion, students were registered by the researcher to the system. Each student in experimental group was provided a user name and password to collect specific data about his/her use of webcasts. User names and passwords were delivered to the students. If they want to change their passwords, they were able to change them on the web page any time after their first login to the system. When they forgot their username and password they contacted to their teachers.

The parents whose children were in the experiment group were also informed about the study with a parent letter and asked to sign a permit form. The contact information of the researcher was given for further information if they needed. Some parents called or e-mailed to understand the study in detail.

After informing students and parents a demographic information questionnaire and a mathematics background assessment applied for both experiment and control groups to understand each group's demographics and achievement levels. Beside the mathematics background assessment and questionnaire, mathematics attitude scale applied for experiment group to understand the relationship between students` mathematics attitude and their webcast use.

As soon as completing the mathematics background assessment, questionnaire and mathematics attitude scale experiment and control group teachers started to use same IWB lessons prepared by the researcher. IWB lessons were prepared on the light of 5th grade mathematics teacher's guidance book using ActivInspire IWB software program. IWB lessons were prepared in detail to diminish the teacher effect and shared with teachers weekly via Dropbox and e-mail or uploaded to teachers` computers by the researcher. The researcher visited both teachers at least once a week and reviewed the next week's lessons with teachers. The lessons, which were taught on IWB, were the same for both the control group and experiment group. Lessons are recorded by experiment group teacher only because only experiment group students had access to webcasts.

The teacher of the experiment group recorded their 5th grade mathematics lessons using the recording feature of IWB. Starting and finishing the recordings were done with only one click on the ActivInspire IWB software program and starting and finishing the recordings took less than a minute for each lesson. After each lesson, the experiment group teacher shared recordings with the researcher via Dropbox. The researcher cut out no-teaching parts such as unrelated talks to mathematics lesson including parts with no

sound at all. Then, the researcher divided the whole lesson webcasts into smaller, meaningful clips before uploading them to the webcast system.

The recording and webcasting process took 9 weeks. During this time period 4 in-class quizzes and a final test were administered for both experiment and control groups to understand the effect of after-class reviews of lessons through the webcast system on mathematics achievement. Reflections questionnaire was also administered for experiment group at the end of the study. Study procedure is also shown on the Table 13.

Table 13. Procedure Applied in the Study

Procedure	Experiment Group	Control Group
Students were registered to the webcast system.	Applied	Not applied
Parents were informed about the study with a parent letter and asked to sign a permit form.	Applied	Not applied
A demographic information questionnaire and a pretest applied.	Applied	Applied
Mathematics attitude scale were applied.	Applied	Not applied
IWB lessons were recorded.	Applied	Not applied
Four in-class quizzes and a final test were administered.	Applied	Applied
Reflections questionnaire was administered.	Applied	Not applied

Data Analysis

A discussion of each analysis for each research question is presented below.

Research question 1: Is there a significant difference in students' mathematics performance depending on the type of webcast access and use (no access, access but not use, access with moderate use, and access with extensive use) controlling for differences in the mathematics background? A planned comparison analyses of covariance

(ANCOVA) was conducted. Assumptions were checked before application of ANCOVA. There was a linear relationship between mathematics background assessment and mathematics performance, as assessed by visual inspection of a scatterplot. There was homogeneity of regression slopes as the interaction term was not statistically significant, $F(1, 106) = 2.05$, $p = .90$. Standardized residuals for the interventions and for the overall model were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$). There was a homoscedasticity and homogeneity of variances, as assessed by visual inspection of a scatterplot and Levene's test of homogeneity of variance ($p = .09$), respectively. There were no outliers in the data, as assessed by no cases with standardized residuals greater than ± 3 standard deviations.

Research question 2: Is there a relationship between students' webcast use and their mathematics attitudes? The experiment group students' mathematics webcast watch percentages and their scores on mathematics attitude scale were correlated by Pearson's correlation coefficient.

Research question 3: How do students perceive webcasts for their learning? Reflections questionnaires that the experiment group students write their reflections about mathematics webcasts were divided into small phrases and coded. Meaningful themes were created.

Research question 4: How do students use webcast system? Students' actions on webcast system were logged by the system. Students' login date/time information, webcast watch date/time information, webcast watched in minutes, students' achievements on online quizzes were analyzed.

CHAPTER 4

RESULTS

The data collection procedure took nine weeks. The data collection procedure was twofold: (a) through webcast system and (b) in-class applications. Data for the experimental group were collected through two channels while data for the control group were collected through only in-class applications. During the procedure, five students from experiment group and eight students from control group were dropped out. Some students could not attend some of mathematics achievement assessments. 6.35% of data was missing. Missing data percentages for mathematics background assessment, in-class quizzes, and final test for the experiment and control groups are shown separately on the Table 14.

Table 14. Missing Data Percentages for Each Achievement Test

Group name	Background assessment	In-class quiz 1	In-class quiz 2	In-class quiz 3	In-class quiz 4	Final test
Experiment	6.90%	0.00%	0.00%	10.34%	10.34%	12.07%
Control	21.15%	1.92%	0.00%	1.92%	1.92%	9.62%

Because each four in-class quizzes and post-test were contributing to mathematics achievement score, when students did not attend to any of these five assessments their mathematics achievement score could not be calculated. Multiple imputation (MI) was used to handle missing data. “Multiple imputation is a technique for analyzing incomplete data sets” (Buuren, 2012). MI software NORM (Schafer, 1999) was used.

Imputation gives best results when data missing less than 10% (Manly & Wells, 2012). The present research had a random missing data percentage of 6.35 so the data was appropriate for multiple imputation.

Six variables used for imputation: mathematics background assessment, in-class quiz 1, in-class quiz 2, in-class quiz 3, in-class quiz 4, and final test. Standard deviations of variables and correlation between variables were kept close. Listwise deletion was also applied for missing mathematics achievement data for comparison. MI and listwise deletion gave similar results. Imputed data with MI was used throughout the study and analysis results were shown on tables.

Research Question One

Planned comparison analyses of covariance (ANCOVA) was employed to assess whether students' mathematics review webcast access and webcast use level affect their mathematics performance with mathematics background performance as the covariate. Students are categorized under two groups according to their webcast access as (1) no access and (2) access groups. Access group categorized under three groups according to webcast use levels (a) no use, (b) moderate use, and (c) extensive use. Group statistics for each group are shown on the Table 15.

Table 15. Group Statistics for (1) No Access, (2) No Use, (3) Moderate Use, (4) Extensive Use Groups

Groups	N	Mean	Std. Deviation
No access	52	51.33	17.99
No use	19	43.39	21.73
Moderate use	25	57.52	22.96
Extensive use	14	72.33	11.16
Total	110	54.04	20.72

The difference between following groups were analyzed by planned comparisons ANCOVA:

(1) No access versus access

(2) No access and no use versus moderate use and extensive use

(3) Moderate use versus extensive use

(4) No use versus moderate use

(5) No use versus extensive use

The covariate, mathematics background assessment, was significantly related to mathematics performance, $F(1, 105) = 277.35$, $p < .005$, partial $\eta^2 = .73$. There was also a significant effect of mathematics webcast access or use on mathematics performance, $F(3, 105) = 5.16$, $p < .005$, partial $\eta^2 = .13$. Planned comparisons ANCOVA results showed that there is a statistically significant difference between no access and access groups while no statistically significant difference found on other contrasts. *P*-values are presented on the Table 16.

Table 16. *P*-values for Comparison Groups

Comparison groups	*P*-values
No access versus access	.001
No access and no use versus moderate use and extensive use	.052
Moderate use versus extensive use	.247
No use versus moderate use	.219
No use versus extensive use	.947

Research Question Two

The second research question that was asked in this study was, "Is there a relationship between students' webcast use and their mathematics attitudes?" To answer this question student's overall webcast use percentage and their score on mathematics attitude scale is compared.

Pearson correlation was run to assess the relationship between webcast use and mathematics attitude. Because two students in experiment group did not attend to MAS questionnaire, they were excluded from the data for this analysis. There was a statistically significant positive correlation between webcast use and mathematics attitude, r (56) = .326, p = .014. Squaring the correlation coefficient, 10.6% of the variance in the percent of experiment group 5th grade students` mathematics achievement was explained by webcast use.

Pearson correlation coefficient was also run to assess the relationship between webcast use and each three subscales of MAS questionnaire. There were positive correlations for each. Correlation coefficients are presented in the Table 17.

Table 17. Pearson Correlation Coefficients for Relationship Between Subscales of Mathematics Attitude Scale (MAS) and Webcast Use

Subscales of MAS	*r*	r^2	*p*
Perceived success at mathematics	.291	.085	.029
Perceived usefulness of mathematics	.195	.038	.150
Interest in mathematics	.309	.095	.021

Research Question Three

In order to investigate students' perspective on the webcast system, students in the experimental group (n = 58) were asked some reflection questions about the system and webcasts. Five students did not attend to the questionnaire. The keywords were extracted from the students' answers to reflection questions. Keywords, then, were coded into meaningful pieces. Using codes two overarching themes were created: (a) perceptions about the system and (b) use cases for the system.

Based on the experiment group students' answers on the reflections questionnaire fifty-one students liked the webcast system. One student stated he did not used system and one stated she did not like the system too much. Students, in general, found mathematics webcast system beneficial, engaging, and easy to use (see Figure 10). Fifty-one students stated mathematics webcasts were beneficial for their mathematics learning. Twenty-one students stated that they also engaged webcast while learning. One of the students found it engaging to hear her voice in some parts of the webcasts. Additionally seven students thought it was easier to watch webcast instead of studying

from the textbook. In general, students stated they found webcasts helpful when they studied mathematics. Example quotations of students' perceptions are stated below:

"The webcast system is very beneficial for studying because it is easier and I understand mathematics better than before."

"I have more fun while learning with webcast system."

"I more like studying mathematics with webcasts than studying with textbook. It is easier."

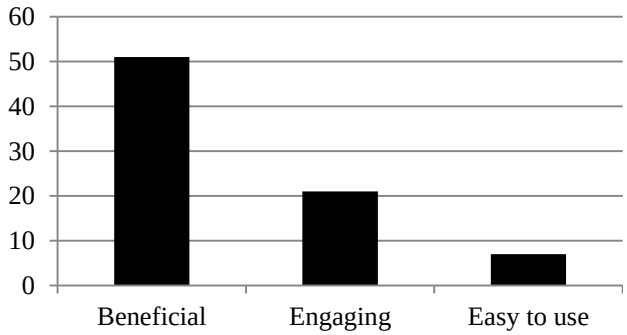


Fig. 10 Students' perceptions about the webcast system.

The second theme shed light on the reasons of webcast use. Students stated that they generally used mathematics webcasts for review, exam preparation, studying homework, and making up missing lessons (see Figure 11). Twenty-seven students stated the webcast system was beneficial for review. According to students' expressions, when they did not understand the topic well in class, they watched webcasts related to that topic. Also 12 students expressed that webcasts were beneficial for studying before mathematics exams and 10 students found webcast system useful when they had difficulty with their homework. Even though students attended classes regularly, six students think that webcast would be useful for the students who could not attend the class. Because webcasts were quickly available after the class on the webcast system,

students could watch the lesson before the next mathematics lesson. There was one student who complained about the interaction on the system and stated “We cannot ask question if we want to ask.”

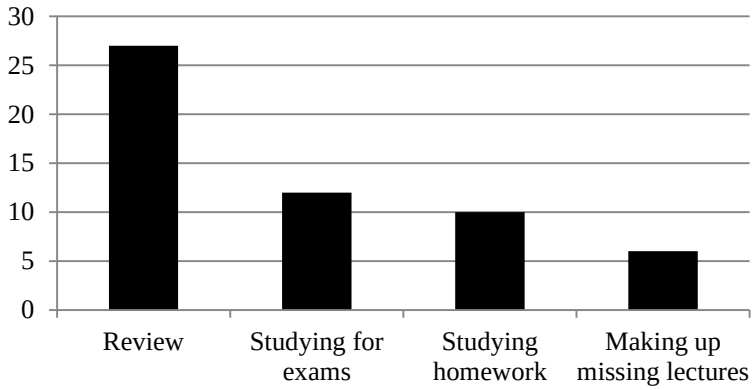


Fig. 11 Use cases for the system according to students.

Research Question Four

The final question that the study looks for answers was “How do students use webcast system?” The answer of this question was important because teachers can regulate the webcast system according to students’ use. The information about students’ behavior on the webcast system is retrieved from the webcast system software. The information of each student’s login time and date to the system and webcast watch time, date, and webcast watch duration (in minutes) for each webcast were recorded by the system. Total number of login and total webcast watch time according to seven days of the week and according to times of the day were calculated to understand busier days of a week and busier times during a day in general. Then total webcast watch time in minutes for

each day of the study were shown on a graph and peak points were explained on the light of obtained data.

The experiment group students had mathematics classes on Mondays, Wednesdays, and Thursdays. Students' activity on the webcast system was parallel to their mathematics class days. The webcast system had high login rates on these days. Also students watched more webcasts on these days and less on Friday. It was also significant that students used the webcast system excessively on Sundays too. Students' login and webcast watch information according to days is presented on the Figure 12.

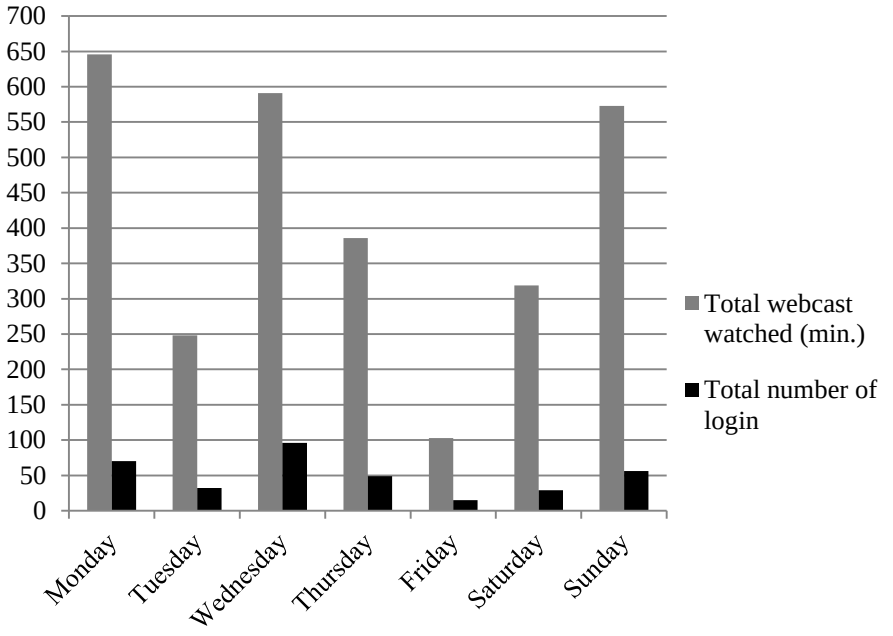


Fig. 12 Login and webcast watch information by days throughout the study.

Another pattern ensued by examining the data from webcast system was about login frequency during a day and amount of time students watched webcasts. The data showed that students used webcast system more on weekdays. Students mostly used webcast system and watched webcasts between 1 p.m. and 2 p.m. at weekdays and

between 11 a.m. and 1 p.m. at weekends. They had classes between 06:40 a.m. and 12:20 p.m. from Monday to Friday at school. The information showed that they generally logged-in to the webcast system and watched webcasts a short time after they arrive at their homes from the school. In general, students mostly preferred afternoons and evenings to watch webcasts. Even though there a few exceptions, students did not prefer watching webcasts after 10 pm and in the evenings. Detailed information about students' login and watching webcast information is presented in Figures 13 and 14.

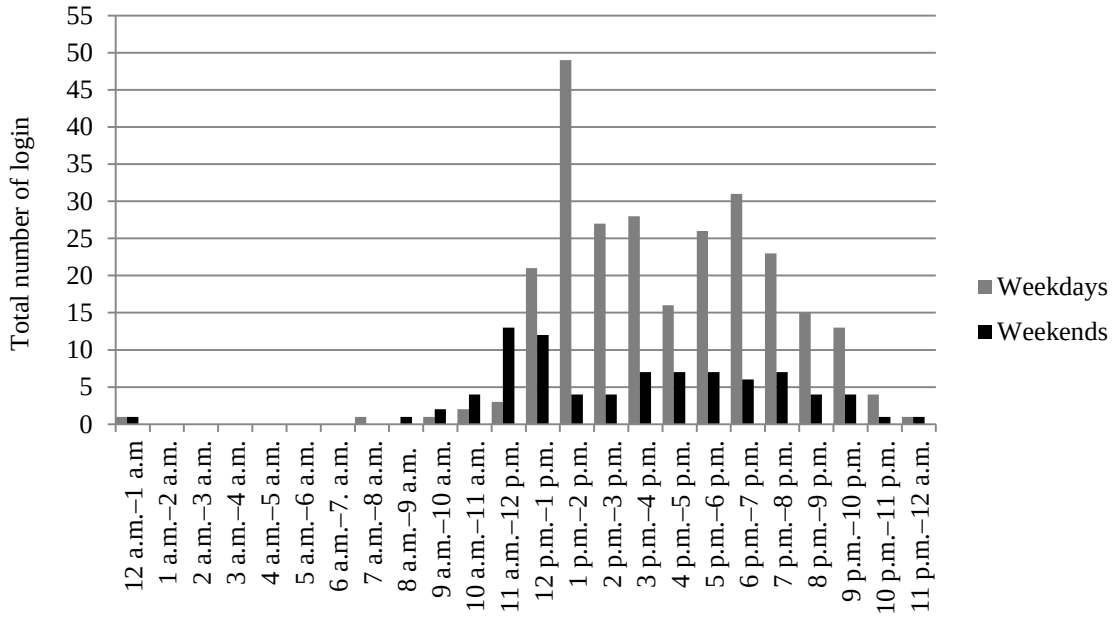


Fig. 13 Total number of login according to time for weekdays and weekends throughout the study.

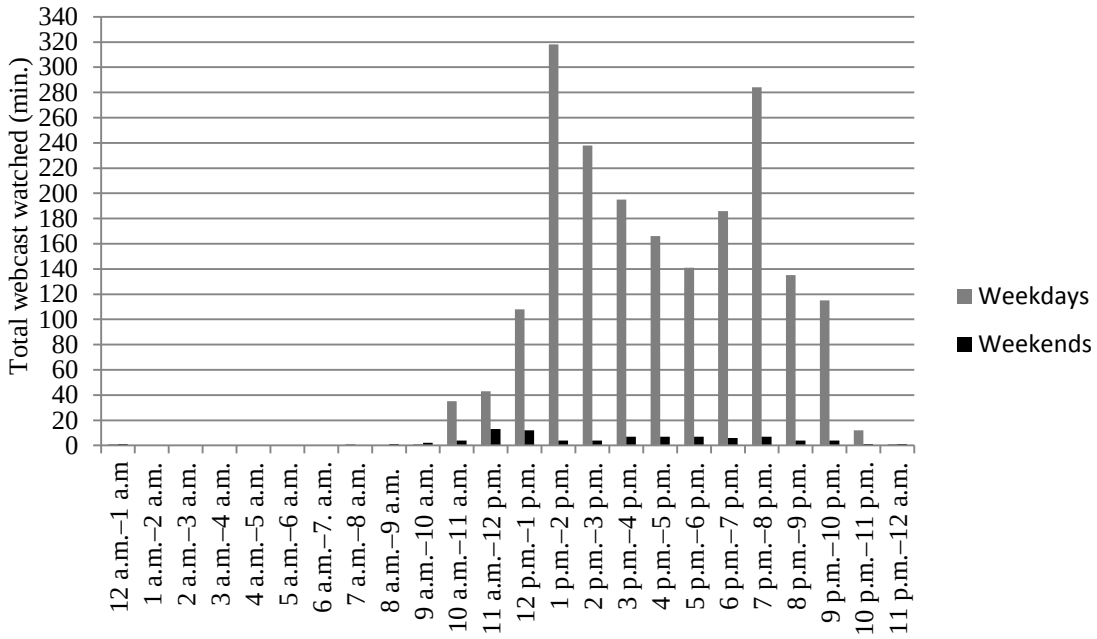


Fig. 14 Total webcast watched (min.) according to time for weekdays and weekends throughout the study.

Total webcast watch time for each day of the study is gathered trough webcast system as well. The mean total webcast watch time for 64 days of the study was 45 minutes. Students' webcast watch statistics was recorded continuously and shared with the experiment group teacher weekly. At the first day of the study students watched 104 minutes webcasts in total. For the next 10 consecutive days students did not show much attention for webcasts. After sharing the 10-day data with the teacher, the next day (April 8) he praised the students who watched webcasts regularly. It was clearly seen that students watched more webcasts next few days (see Figure 15).

Students had two school mathematics exams during the study. They watched webcasts more before exams as they stated on their reflection questionnaire. Total webcast watch time was higher on previous two days before exams (see Figure 15).

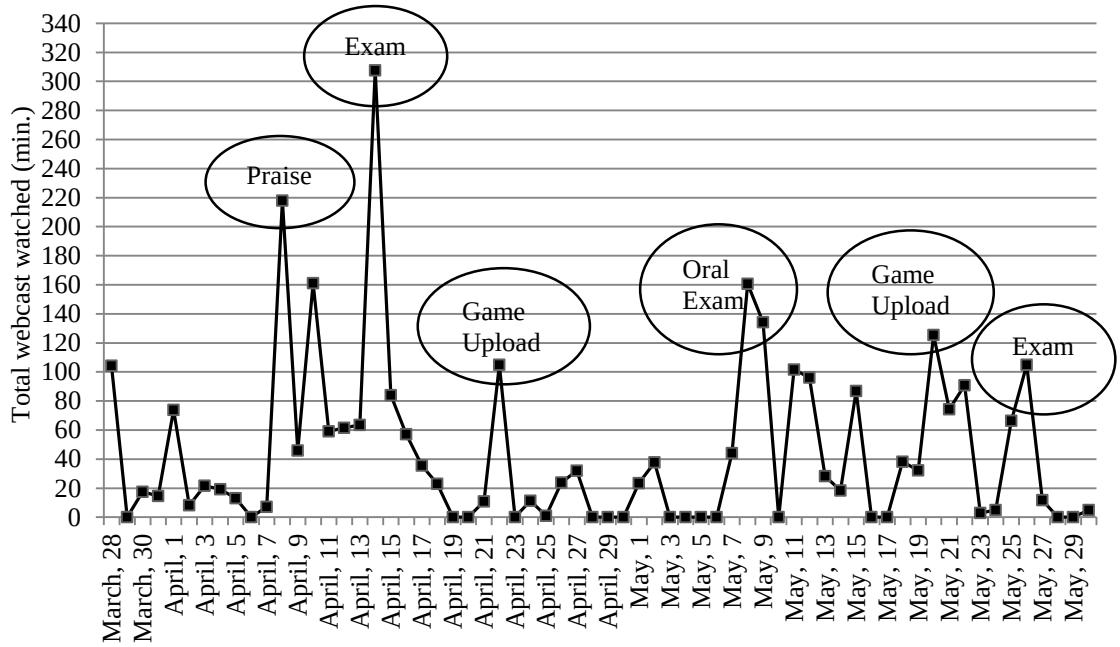


Fig. 15 Total webcast watch time (min.) for each day of the study.

On the webcast system there was not only webcasts but also mathematics games. Four games uploaded to the system. Games were about origami, addition of integers, subtraction of integers and patterns. Instructions were written next to each game. The first game was uploaded to the system at the beginning of the fourth week of the study. Other three games were uploaded on the seventh week. On the main page of the webcast system it is announced that games were uploaded to the system. The mathematics teacher also informed students verbally during the class. On the days games were uploaded students also watched more webcasts (see Figure 15).

For students who might forget their passwords or ask any questions, a communication form link was available on the main page of the webcast system. Students did not use that form. Only 3 students used the communication form. Two of them asked for new password and the other student suggested an idea for the webcast system. The student wrote that when he went to his personal statistics page, he saw his watch percentages for each webcasts; however, he could not reach his unwatched webcasts directly by clicking on the name of webcast. Because the suggestion by the student was meaningful and reasonable, hyperlinks were put to the names of webcasts as soon as possible. For the students who forgot their passwords, new passwords were created and the next day their new passwords were told to the mathematics teacher and the teacher forwarded new passwords to students. New passwords could not send them immediately because students did not have e-mail accounts in general. However students were explained to feel free to call on phone when they had a problem about webcast system.

CHAPTER 5

DISCUSSION

The main purpose of this quasi-experimental design was to analyze the effect of mathematics webcasts as a review tool on 5th grade students' mathematics achievement. Beside the main purpose, relationship between webcast use and mathematics attitude, students' perceptions about effectiveness of webcasts and students' actions on webcast system were also explored. In this chapter, findings of current research are discussed in the light of literature for better understanding of the study and its findings. This chapter will also include teaching implications, limitations of the study and recommendations for further research.

Webcast Access/Use and Performance

The main research question of the study was exploring the effect of mathematics webcasts on 5th grade students' mathematics performance. Planned comparison ANCOVA results showed that there was a statistically significant difference between students who have access to mathematics review webcasts and who do not. However no significant difference in other contrasts were found. The current research was proposing the webcast system as a review tool. However, the researcher did not know whether

students who did not watched webcasts or watched moderately used any other review mechanisms. This was an important extraneous factor that might had effect on the results. Moreover, there might be students who did not review via any medium but understood the content in class. Although detailed information about students and their use of webcast system was traced, no information about reasons for students watching webcasts was traced. When the data worked through, some students who had high mathematics performance scores stated on their reflections questionnaire that they found the system very beneficial but they did not use the system much because they understood the topic well in class. Such comments may provide a plausible explanation for being the groups statistically similar to each other.

In a similar research, Putman and Kingsley's study (2009) with fifth-grade on vocabulary development and McKinney et al.'s study (2009) with college psychology students found statistically significant differences between achievement scores and webcast access. Contrary to finding of the study, Brotherton and Abowd (2004) found no significant difference between groups who had access to webcasts and those who had not. When Cohen's *d* was calculated for Brotherton and Abowd's (2004) study, 0.087 and 0.118 were found in favor of access groups at Georgia Tech University and Kennsaw State University, respectively. Another study at UC Berkeley also found no significant difference between achievement scores of access group and non-access group (Harley et al., 2003). Calculated Cohen's *d* value was 0.059 in favor of non-access group indicating access and non-access groups were scored very close. The study of Traphagan et al. (2010) with college students on geology course and the study of Badowski (2009)

with college students on accounting course also found no significance difference between achievement scores and webcast access.

Most researchers who study webcast compared groups who have access to webcasts and who do not. This current study is moved one more step further and collected data about webcast use from students who have access to webcasts. This current study found that students who have access mathematics review webcasts significantly and practically have higher performance scores. The result of the current study is important from two perspectives as compared to aforementioned studies. First, the study not only found statistically significant results but also practical significance (d = .25). The results were practically greater than other studies conducted. Second, this current study is one of the leading studies using webcasts in primary schools. When considering the effect found and the sample selected, the results are in great importance. This study showed a simple touch in classrooms might have an important effect on students' performances. Thus, it is suggested that providing access to webcasts makes difference on students' mathematics performance.

Webcast Use and Attitude

For the second research question, the relationship between mathematics attitude and mathematics webcast use were explored. Experiment group students' mathematics attitude score and their webcast watch percentage were correlated. Pearson correlation coefficient was calculated. A positive statistically significant correlation was found between mathematics attitude and webcast use. No previous research could be found

investigating the relationship between attitude and webcast use. Associatively, there is a positive relationship between technology use in classroom and students' attitudes towards lessons (Eyyam & Yaratan, 2014). From this point of view, a positive and strong relationship was expected between webcast use and mathematics attitude.

Students' Perception About the Webcast System

The third research question provided deeper and more quality information on making sense out of quantitative results. Students' perception of webcasts on their learning was investigated. Students' writings to open ended questions were coded and two overarching themes were arisen. Students generally stated that they found mathematics webcasts beneficial, engaging, and easy to use. Previous research highly supports these findings. Copley (2007), Evans (2008), and Hill et al. (2012) also reported that students found webcasts motivating, and supportive in addition to being beneficial, engaging, effective, and easy to use. The second theme arisen was about uses of webcasts. Students stated that they generally used mathematics webcasts for review, exam preparation, studying homework, and making up missing lessons. Findings were parallel to the findings of previous research. Researchers reported that students mostly use webcasts for examination revision (Copley, 2007; Gosper et al., 2007; 2007; Janossy, 2007; Laing & Wootton, 2007; Williams & Fardon, 2007). Copley (2007) also stated that students use webcast for catching up on missed lectures. Many researchers got together on students' use of webcast for review of previous lectures (Laing et al., 2006; McGarr, 2009; Scutter et al., 2010; Zanten, Samogi & Curro, 2012). Consequently, students'

reflections about the system looked promising for the effort of supporting webcasts as review tools. Such a webcast system can help teachers to motivate their students or present them effective review tools without laying too much burden on teachers. Results of the current study and previous research provided evidence for raising the quality of education.

One of the students reported that webcasts are not like live lectures and students cannot ask questions to the teacher. Copley (2007) reported that students prefer to attend "live" classes and use webcasts as repetitive material. Present study also used webcast as repetitive review materials. Students could always ask questions to the teacher during lectures. Suggested webcast system was intended to provide supportive materials for the course while still prioritizing the role of the teacher. Online feedback from the teacher was possible but the aim of current study was to provide an effective review tool by using minimum time and effort.

How Students Used Webcast System?

The final research question scrutinized the data to explore how students used the webcast system. This explorative question was intended to provide insightful information about students' study habits and to provide plausible solutions to students. The data was collected in the background as students were studying on the webcast system. Students generally watched webcast longer on Sundays and the days that they have mathematics class (Monday, Wednesday, and Thursday). They watched webcasts shorter on Fridays. Sundays are seen as the preparation day for the week while Fridays

are generally considered as an off day after an exhaustive week. Thus, it is reasonable to capture students watching webcast the most on Sundays and the least on Fridays at weekend. Harley et al., (2003) also reported that students used webcast heavily on Sundays and Mondays, and little on Fridays and Saturdays. According to students' reflections, studying homework or review of the morning class after school were the most probable reasons for high webcast watch rates on the mathematics class days.

Students generally used webcast system between 1 p.m. and 2 p.m. Login rates and total webcast watched peaks between 1 p.m. and 2 p.m. The analysis of login and webcast watch by time shows that students mostly prefer to watch webcast right after school and probably after having lunch. That showed that it is really important to upload webcast to the system right after classes. When webcasts are not uploaded to the system as soon as possible or are uploaded irregularly students, students' watch rate may decrease.

At certain times students watched webcasts more. After 10 days of the webcast system started to be used by students, the teacher praised students who watch regularly. The day the teacher praised regular webcast watchers, students watched webcast more than previous days. Praise was a motivation source for some students. Many researchers found that praise increased children's desire to engage in the related task (Anderson, Manoogian and Reznick., 1976; Harackiewicz, 1979; Swann & Pittman, 1977). Webcast watch rate increased in general most probably because other students also wanted to be praised by their teacher next time. The system enabled the teacher to observe his students' study habits easily; consequently, the teacher communicated with his students more effective. The webcast watch rate was also higher before school exams. Students

used webcast for studying school exams as they stated. Similarly Brotherton and Abowd's study (2004), Harley et al.'s study (2003), and Traphagan et al.'s study were showing clear evidence that students' use of webcast system and webcasts peaks just before exams.

Adding mathematical games to the webcast system affected students' webcast watch rate positively. When the games uploaded to the system students watched more webcasts. The situation shows that students logged in to the system for games but they also watched webcast before logging out. Such an inference was done; however, students' interaction with games was not traced. Games are inherently motivating. Uploading educational games related to the course can invite students to the system.

The main purpose of creating communication link was keeping in touch with students in case they forgot their passwords or they had trouble while using the system. Although some students forgot their passwords very often, they did not use communication link instead they wait for asking to their teacher next day or some of students' parents called to learn their passwords. Only a few students used the link for forgotten passwords and offering suggestions for the system. The situation may be due to the characteristic of students' age. The mean of students' ages was 11. They use technology intensively however they were not yet accustomed to use communication links or e-mails.

Students also did not prefer taking online quizzes on the webcast system. Students' online quiz taking percentage for a quiz was between 57% at most and 10% at least. In general, students who took online quizzes were the ones who watched webcasts regularly. One of the purposes of the study was comparing the achievement on online

quizzes and achievement on in-class quizzes. This aim could not be achieved because the level of missing data for online quizzed was high. Students were not accustomed to online assessments so they might not paid attention for the online quizzes. Students also were not motivated for using online quizzes. Educational methods to increase students' motivation for taking online quizzes could be used.

Teaching Implications for the Study

There are some practical implications that can be made from the findings of the current study for teachers who use webcast as revision materials for their students. Webcasts are powerful tools that incorporate multimedia learning. Cognitive theory of multimedia learning should be a guide for presentation of the lessons on IWBs and creating the webcasts.

Students need to repeat what they learned in class after school. Sometimes their own notes may not be a good guide or they may have troubles while studying their textbooks. Textbooks can be weak for relating students' previous knowledge and the new knowledge (Arslan & Ozpinar, 2009). It may positively affect students' understanding of the topic to review what they learned in class as the way they learned in class. This study showed that student who study lecture webcasts were more successful than students who had the opportunity to reach webcasts but did not study lecture webcasts beside traditional study methods. Results show that using a webcast system as a review tool can be beneficial for students.

Such systems require having technical equipment and some technical knowledge for operation. Teachers may also need technical support while dealing with the technology at school. Studies showed that when teachers could not reach the technical support, they get away from the technology (Sadi et al., 2008). The current study offers a user friendly system for teachers. As a part of FATIH project, schools have being equipped with IWBs in Turkey. The current study proposes creating webcasts by using one of the most basic features of the IWBs, recording feature, being already provided by FATIH project. Broadcasting created webcasts on a video sharing website is very quick and an easy process.

Motivating students is one of the most crucial parts of teaching. Webcast motivates students for studying at home. The current study found that students use webcasts more, immediate after mathematics classes. Webcasts should upload to the webcast system by teachers immediately after classes so students are able to watch. Webcast are helpful tools for review. However they should be used as revision or supplementary materials, should not take place of "live" lectures because students found interaction with teachers crucial.

In certain time periods students watch webcast more. When 5^{th} grade students were appreciated for their regular webcast watch, total webcast watch time increased. It may be more motivating for students to know that their teachers know they are watching webcasts. Also adding attractive materials to the webcasting system like mathematical games influenced students total webcast watch time positively. Teachers can add attractive games, puzzles, or something interesting for students. However these

additional materials should not direct students to any website. Students should stay in webcast system as done for current study.

Limitations of the Study and Recommendations for Further Research

The study has several limitations and suggestions for future research. First, the research sample was not chosen randomly. The current study had some requirement like using IWBs in mathematics classes and sharing similar mathematics achievement and SES levels together for experiment and control groups. The most suitable sample was chosen in Istanbul base on the purpose of the study. Therefore, generalizability of results is limited.

Second, during the experiment the researcher always kept in touch with experiment and control group teachers mostly for eliminating the teacher effect. All lectures were prepared by the researcher and they were reviewed with both teachers every week regularly. Although many precautions were taken in order to disable teacher effect, there may be still a teacher effect on this study.

Third, when students were absent on assessment days, they could not joined to the assessment. For making up the missing assessment students and teachers could stay after school on the next day however both teachers and students did not preferred this way. If students did not take any assessments, they could not take them again. Making up the missing data should be taken more serious for further research. Assessment dates could be announced to parents by communicating with school administration.

Moreover, although experiment group students use many technological tools they generally were not using e-mail accounts. It was a hard to communicate with students immediately. Because their age was very young, they often forgot their passwords for the webcast system. They had chance to ask their password trough communication form however, because they were not using e-mails their passwords could not be sent them immediately. The next school day, their passwords were announced via their teacher. Most of the research on webcasting in school was done with college students, however; younger students' behavior in similar content may be different. Further studies should be done with young students.

Results showed that 5th grade students did not use online assessments. No motivation strategy was followed in the present study. Further research should apply motivating techniques. More research should be done in order to see if students use online assessments or not.

Finally, further research should investigate the reasons behind students' webcast watch and not watch reasons. With the help of this data, the effect of webcast use on achievement can be explained better.

APPENDIX A

PARENT LETTER

Sayın Veli, 04.04.2012

Ben Aysun Sülün Taş. Boğaziçi Üniversitesi yüksek lisans öğrencisiyim. Şair Behçet Kemal Orta Okulu 5. sınıflar seviyesinde uygulayacağım tez çalışmamın detaylarını aşağıda sizinle paylaşıp çocuğunuzun çalışmama katılmasına izin vermenizi rica ederim.

Matematik dersleri, ders öğretmeni tarafından akıllı tahtanın ekran kayıt özelliği kullanılarak video olarak kaydedilecektir.

- Tüm derslerin videoları **www.akillidersim.com** internet sitesine yüklenecektir.
- Çocuğunuza verilen kullanıcı adı ve şifre ile çocuğunuz siteye giriş yapıp bu dersleri tekrar etme fırsatı yakalayacaktır.
- Ayrıca bu siteye konu sonlarında eklenecek mini testlerle öğrenciler kendisini sınayabilecektir.

Bu sistemin, etkin bir şekilde kullanıldığında, çocuğunuzun matematik dersindeki başarısını olumlu yönde etkilemesi beklenmektedir. Çocuğunuzu bu sistemi kullanmak için teşvik etmek bu bakımdan önemlidir. Eğer siz de siteyi incelemek isterseniz çocuğunuz ile birlikte inceleyebilirsiniz veya kullanıcı adı ve şifre talep edebilirsiniz. Çocuğunuzum bilgileri ile siteye giriş yapmamanızı önemle rica ederim.

Öneri ve sorularınız için irtibat:

e-posta: akillidersim@gmail.com Tel: 0531 818 73 83

aysunsulun@gmail.com

ÖNEMLİ: Bu siteye **Google Chrome** ile giriş yaparsanız daha yüksek verim almanızı sağlayacaktır. Internet Explorer (e) ile girerseniz video yüklenmesinde sıkıntı yaşayabilirsiniz.

Bilgisayarınıza **Google Chrome** indirmek için: **www.google.com/chrome** sayfasına giriniz ve ücretsiz indiriniz.

Not: Aşağıdaki izin belgesini işaretli yerden kesip gerekli yerleri doldurup imzaladıktan sonra lütfen ders öğretmeni Hakan Karataş'a teslim ediniz.

Şair Behçet Kemal Orta Okulu, 5- ..... sınıfı ..... no'lu .....'ın

yukarıda detayları belirtilen çalışmaya katılmasına izin veriyorum.

Tarih: Veli Adı, Soyadı:

İmza:

APPENDIX B

DEMOGRAPHIC INFORMATION SURVEY

Öğrencinin Adı, Soyadı: Tarih:
Okulu:
Sınıfı:

Bu bilgiler veli tarafından doldurulup, izin kağıdı ile birlikte kapalı zarfta matematik ders öğretmeni Hakan Karataş'a teslim edilecektir. Vereceğiniz bilgiler kesinlikle 3. şahıslarla paylaşılmayacaktır. Katılımınız için teşekkürler.

ANNE	BABA
Sağ ☐ Ölü ☐	Sağ ☐ Ölü ☐
Yaş:	Yaş: .....
Eğitim Durumu:	Eğitim Durumu: .....
Meslek:	Meslek: .....
Çalışıyor mu?	Çalışıyor mu? .....

Anne-Baba ayrı mı? .....

Ailenin aylık toplam geliri: ..... TL

Çocuk sayısı: .....

Evinizde bilgisayar var mı? Varsa kaç tane? .....

Evinizde internet erişimi var mı? .....

Çocuğunuz ödevleri için bilgisayar kullanabilir mi? .....

Çocuğunuzun bilgisayar kullanımını sınırlandırıyor musunuz? .....

Çocuğunuzu **akillidersim.com** sitesine girmesi için teşvik eder misiniz? .....

Yorumlarınız-Eklemek istedikleriniz:

.....

.....

APPENDIX C

MATHEMATICS BACKGROUND ASSESSMENT

ADI, SOYADI: CİNSİYET: Kız / Erkek

OKUL : SÜRE: 40'

---

1. a) Aşağıda verilen üçgenleri kenar uzunluklarına göre sınıflandırınız.

- Kenar uzunlukları 7 cm, 5 cm ve 11 cm olan üçgen

  .....

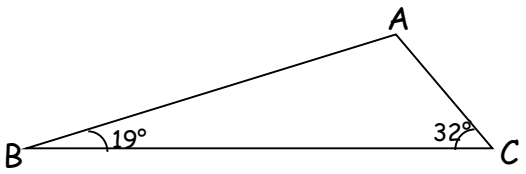
- Kenar uzunlukları 9 m, 9 cm ve 9 cm olan üçgen

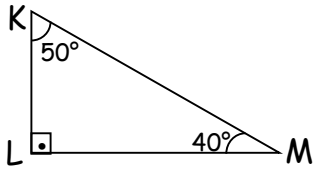
  .....

- Kenar uzunlukları 6 cm, 8 cm ve 6 cm olan üçgen

  .....

b) Aşağıda verilen üçgenleri açı ölçülerine göre sınıflandırınız.





....

2. Aşağıda dörtgen isimleri ve bunların kenar özellikleri verilmiştir. Dörtgen isimlerini, kenar özellikleri ile eşleştiriniz. (Harfleri birden fazla kullanabilirsiniz.)

..... Paralelkenar

..... Eşkenar Dörtgen

..... Yamuk

a) Bütün kenarlarının uzunlukları eşittir.

b) Dört kenarlıdır.

c) Karşılıklı kenarlarının uzunlukları eşittir.

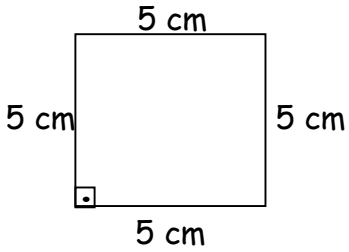
d) Karşılıklı kenar çiftlerinden en az biri

---

3. a) Aşağıdaki ifadelerde eksik bilgileri doldurunuz.

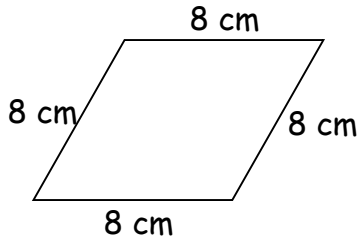
- Kenarları ve açıları eş olan çokgenlere ..... çokgen denir.
- Dörtgenlerin iç açıları toplamı ..... derecedir.
- Çokgenlerde komşu olmayan köşeleri birleştiren doğru parçasına ..... denir.
- ..... ve ..... bütün kenar uzunlukları birbirine eşit olan dörtgenlerdir.

b) Aşağıdaki dörtgenlerin isimlerini yazınız ve köşegenlerinin eşit olup olmadığını belirtiniz.



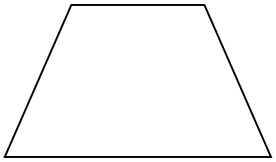
İsim: .....

Köşegenleri: .....



İsim: .....

Köşegenleri: .....



İsim: .....

Köşegenleri: .....

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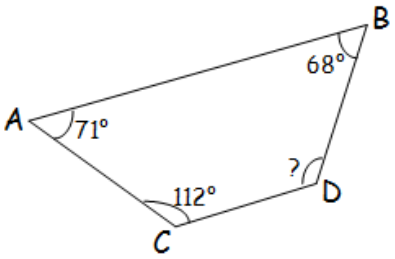
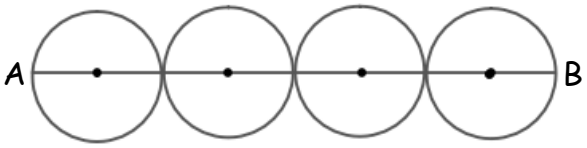
4. Aşağıdaki dörtgende verilmeyen açıyı bulunuz.



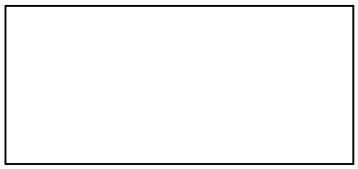
---

5. a) Yandaki eş dairelerin merkezlerinden geçen

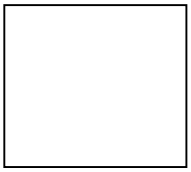


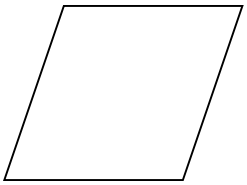
AB doğru parçasının uzunluğu 32 birimdir. Buna göre bir dairenin yarıçapını bulunuz.

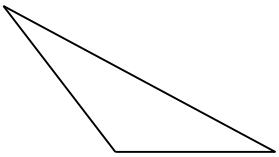
b) Aşağıdaki dörtgenin simetri eksenlerini çiziniz.



c) Aşağıdaki çokgenlerin "a" kenarlarına ait yüksekliklerini çiziniz.







---

6. Aşağıdaki ifadelerden doğru olanların yanına "D", yanlış olanların yanına "Y" yazınız.

a) $\frac{8}{5}$ kesri ile $1\frac{5}{3}$ kesri birbirine eşittir. .....

b) $\frac{12}{8}$ kesri $\frac{3}{2}$ kesrine denktir. .....

c) $\frac{37}{10}$ kesri 4'ten büyüktür. .....

---

7. Aşağıdaki kesirleri <u>büyükten küçüğe</u> <u>sembol kullanarak</u> sıralayınız.

$\frac{8}{12}$, $\frac{4}{3}$, $\frac{7}{6}$, $\frac{13}{24}$

8. Aşağıdaki kesirleri ondalık kesre çeviriniz ve ondalık kesirlerin okunuşlarını yazınız.

a) $\frac{13}{100}$ = ...

Ondalık kesir okunuşu:

.....

b) $1\frac{85}{1000}$ = ...

Ondalık kesir okunuşu:

.....

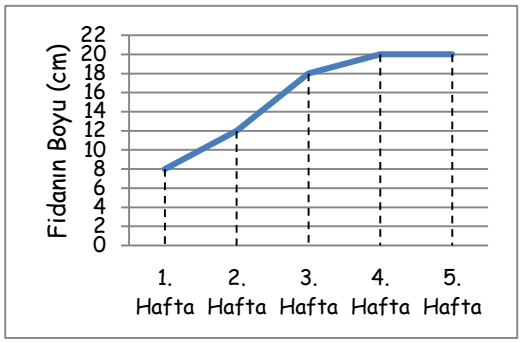
---

9. Tam kısmında 648, binde birler basamağında 8 olan ondalık sayı aşağıdakilerden hangisidir?

a) 648, 780 b) 8000, 648 c) 648, 878 d) 8728, 648

---

10. Aşağıda bir fidanın boyunun zamana göre değişimi verilmiştir. Buna göre aşağıdaki soruları cevaplayınız.



a) Fidan en çok hangi haftalar arasında uzamıştır?

.....

b) Hangi haftalar arasında boyu uzamamıştır?

.....

c) 3. ve 4. haftalar arası boyu kaç mm uzamıştır? .....

11. Annesi, Rıfkı'ya bir torba şeker almıştır. Aşağıdaki tabloda torbada bulunan her renkten şekerin sayısı gösterilmiştir. Rıfkı'nın şekerlerin yüzde kaçı kırmızıdır?

Renk	Sayı
Kırmızı	6
Turuncu	5
Sarı	3
Yeşil	3
Mavi	2
Pembe	4
Mor	2
Kahverengi	5

---

12. Aşağıdaki işlemlerin sonuçlarını bulunuz. Sonuçları <u>en sade hali</u> ile yazınız.

a) $\frac{1}{3}+\frac{5}{6}$

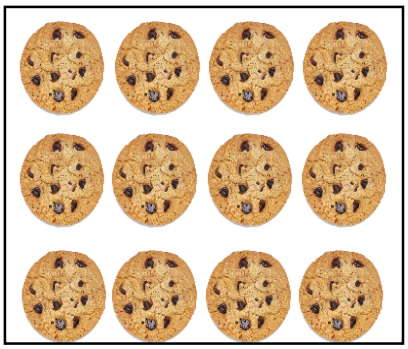
b) $3-\frac{3}{4}$

c) $\frac{8}{25}\cdot\frac{5}{16}$

Cevaplarınızı kontrol ediniz.

ADI, SOYADI: CİNSİYET: Kız / Erkek

OKUL : SÜRE: 40'

13. 

Canan yandaki 12 kurabiyenin $\frac{1}{2}$'inin $\frac{1}{3}$'ini yerse kaç kurabiye yemiş olur?

14. $\frac{3}{4}$'ü 60 TL olan paranın tamamı kaç TL' dir?

15. 12 L zeytinyağı 200 mL'lik şişelere doldurulmak isteniyor. Buna göre kaç şişeye ihtiyaç vardır?

16. Aşağıdaki işlemleri yapınız.

a) 12,95 + 3,2

b) 8,8 – 2, 22

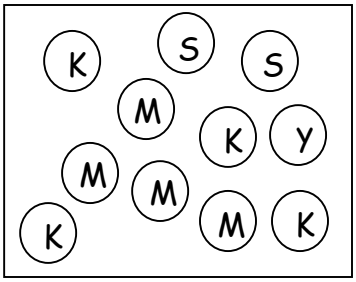
---

17. Mert'in yaşının Zeynep'in yaşına oranı $\frac{2}{3}$'dir. Aşağıdakilerden hangisi Mert ve Zeynep'in yaşları <u>olamaz</u>?

	<u>Mert'in yaşı</u>	<u>Zeynep'in yaşı</u>
a)	8	12
b)	10	15
c)	12	16
d)	14	21

---

18. Aşağıdaki soruları cevaplayınız.



K=Kırmızı, M=Mavi,
S=Sarı, Y=Yeşil

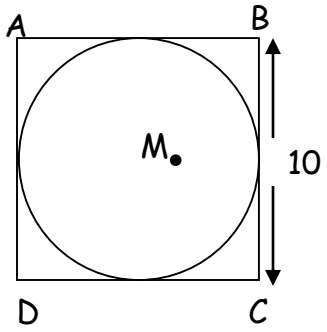
a) Yandaki sarı, yeşil, kırmızı ve mavi renkli bilyeler bir torbanın içerisine konularak rastgele bir bilye çekiliyor.

- ..... bilye gelme olasılığı en azdır.
- Kırmızı ve mavi bilye gelme olasılığı ..... .

b)Cem ve Bora ikiz kardeşlerdir. Cem, haftanın "P" ile başlayan günlerinde, Bora ise diğer günlerde odayı toplayacaktır. Bu olay **adil** midir, değil midir? Açıklayınız.

19. Yandaki şekilde çemberin çevresi karenin kenarlarına değmektedir.

Buna göre;



a) Karenin çevresi kaç cm'dir?

b) Çemberin çevresi kaç cm'dir? ($\pi = 3$ alınız.)

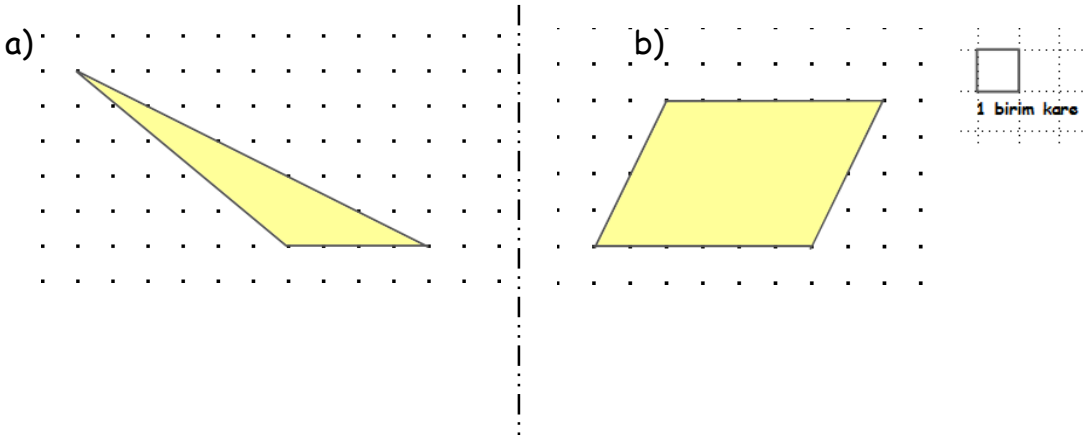
---

20. Aşağıdaki üslü olarak verilen sayıları çarpım şeklinde yazınız.

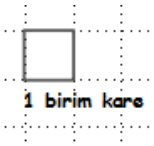
a) 2^3 = ... b) 4^2 = ...

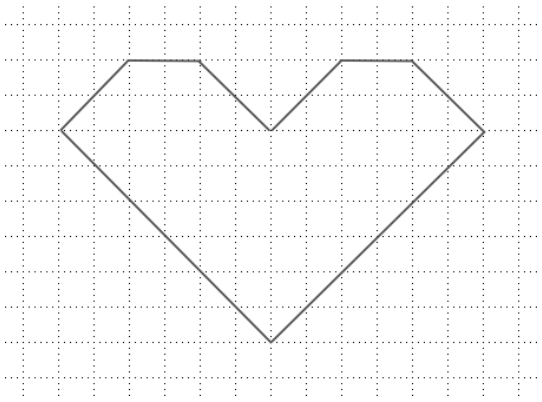
---

21. Aşağıda noktalı kağıt üzerinde verilen şekillerin alanlarının kaçar birim kare olduğunu hesaplayınız.



22. Yandaki şeklin alanının kaç birim kare olduğunu bulunuz.





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23. Aşağıdaki ifadelerin doğru ya da yanlış olduklarını başına "D" veya "Y" yazarak belirtiniz.

( ) Kare prizmanın 6 yüzü vardır.

( ) Kare piramidin yan yüzleri üçgensel bölgedir.

( ) Kare piramidin ayrıt sayısı kare prizmanın ayrıt sayısından fazladır.

( ) Kare prizmanın tüm yüzleri karesel bölgedir.

( ) Prizmaların yan yüzleri üçgen, piramitlerin ise dikdörtgendir.

( ) Prizma ve piramitler taban şekillerine göre isimlendirilirler.

---

24. Aşağıdaki ifadelerde eksik bilgileri doldurunuz.

a) Küpün ..... tane köşesi vardır.

b) Üçgen prizmanın ..... tane köşesi vardır.

c) Dikdörtgen piramitin ..... tane yüzü vardır.

d) Kare piramidin yan yüzleri ..... şeklindedir.

Cevaplarınızı kontrol ediniz.

APPENDIX D

MATHEMATICS ATTITUDE SCALE

MATEMATİKLE İLGİLİ DÜŞÜNCELERİNİZ

Adı, Soyadı: **Doğum Tarihi:**

Okul: **Sınıf:**

Cinsiyet:

AÇIKLAMA: Aşağıdaki maddeleri dikkatlice okuyunuz. Her madde sizin matematikle ilgili görüşünüzü almaya yöneliktir. Lütfen bu maddelerdeki durumların sizin için ne kadar geçerli olduğunu belirtiniz.

0=Asla, 1=Nadiren, 2=Bazen, 3=Sık Sık, 4=Her Zaman

	0	**1**	**2**	**3**	**4**
1. Matematik dersleri zevkli geçer.					
2. Matematik dersinde canım sıkılır.					
3. Matematiğim kuvvetlidir.					
4. İleride matematik öğretmeni olmak istiyorum.					
5. Matematik dersinde başka şeylerle ilgilenirim.					
6. Matematik dersinde konuları anlayamam.					
7. Matematik bilgisi gerektiren konularda başarılıyımdır.					
8. Matematik dersi benim için keyifli bir oyun saati gibidir.					
9. Matematik dersi yerine ilgilendiğim başka bir derse girmeyi tercih ederim.					
10. Matematik bilmek ileride işime yarayacak.					

0=Asla, 1=Nadiren, 2=Bazen, 3=Sık Sık, 4=Her Zaman

	0	**1**	**2**	**3**	**4**
11. Belirli temel bilgilerin dışında matematik bilmek gereksizdir.					
12. Matematik ödevlerinden nefret ederim.					
13. Matematik başarılı olduğum bir derstir.					
14. İleride matematikle ilgili bir alanda çalışırsam başarılı olabilirim.					
15. Matematiği neden okumak zorunda olduğumuzu anlayamıyorum.					
16. Matematik insanı daha iyi düşünmeye zorlar.					
17. Matematik dersi beni bunaltıyor.					
18. Matematik bilgisi iyi olan bir kişi diğer bilimleri rahatça anlar.					
19. Çalışırsam matematikten iyi notlar alabilirim.					
20. Matematik öğretmenleri çalışkandır.					

APPENDIX E

IN-CLASS QUIZZES

Adı, Soyadı: Tarih:
Sınıf - No:

QUIZ-1

1. "Yediyüz dokuz milyon beşyüz altı bin yedi" sayısını rakamlarla yazınız.

2. Avusturya'nın nüfusu 8 022 379'dur. Bu sayının okunuşunu yazınız.

3. Güney Amerika kıtasının en kalabalık ülkesi Brezilya'dır. Brezilya'nın nüfusu 188 078 261'dir.

a) "078" hangi bölükte bulunmaktadır?

.....

b) Onbinler basamağındaki rakamın sayı değeri ile yüzbinler basamağındaki rakamın basamak değeri arasındaki fark kaçtır?

.....
.....

4. "0, 2, 3, 5, 8, 9" rakamları ile oluşturulacak 6 basamaklı 500 000'den büyük en küçük doğal sayıyı yazınız.

5. "2, 6, 18, 54, ..., 486" örüntüsünde örüntünün kuralını yazınız ve "....." yerine gelmesi gereken sayıyı bulunuz.

Adı, Soyadı: Tarih:
Sınıf - No:

QUIZ-2

1. 14 yüzlük, 20 onluk ve 15 birliğin oluşturduğu sayı kaçtır?

2. Aşağıdaki işlemleri yapınız.

a)
$$\begin{array}{r} 24627 \\ +\ 13487 \\ \hline \end{array}$$

b)
$$\begin{array}{r} 36421 \\ -\ 1714 \\ \hline \end{array}$$

3. Aşağıdaki çıkarma işleminde ◊, Δ, ¤ ve ☺ sembolleri ile ifade edilen yerlere gelmesi gereken sayıları bulunuz.

$$\begin{array}{r} 4\lozenge720 \\ -\ 144\Delta7 \\ \hline 26¤2☺ \end{array}$$

4.

Koşular	1. Koşu	2. Koşu	3. Koşu	4. Koşu	5. Koşu
Koşma Süreleri (dk)	15	18	12	11	14

Yukarıdaki veri tablosunda bir koşucunun belli bir mesafeyi 5 ayrı koşuda koşma süreleri gösterilmiştir. Tablodaki verilere göre koşucu bu mesafeyi ortalama kaç dakikada koşmuştur?

5. Dört sayının aritmetik ortalaması 52'dir. Bu sayılardan birincisi 70, ikincisi 38, üçüncüsü 69 olduğuna göre dördüncü sayı kaçtır?

6. Ortalamaları 36 olan 5 sayıya hangi sayı eklenirse yeni ortalama 40 olur?

Adı, Soyadı: Tarih:
Sınıf - No:

QUIZ-3

1. Yaşları 20, 24, 28 ve 12 olan dört kişinin yaş ortalaması kaçtır?

2. 5 sayının aritmetik ortalaması 18 ise bu sayıların toplamını bulunuz.

3. 4 sayının ortalaması 21'dir. Bu sayılara hangi sayı eklenirse yeni ortalama 22 olur?

4. 6 sayının ortalaması 18'dir. Bu sayılardan hangi sayı çıkarılırsa yeni ortalama 20 olur?

Adı, Soyadı: Tarih:
Sınıf-No:

QUIZ-4

1) 749 x 23 işleminin sonucunu bulunuz.

2) Aşağıdaki çarpma işlemlerini zihinden yapınız. Yönteminizi açıklayınız.

Yöntem:

Yöntem:

3) Bir çiftlikteki inekler bir yılda 4345 litre süt veriyor. Sütün litresi 180 Kr'a satıldığına göre bir yılda elde edilen süt geliri kaç Liradır? (1 TL=100 Kr)

4) Bir aile litresi 199 kuruş olan sütten ayda 23 litre tüketmektedir. Bu ailenin bir yıllık süt tüketimi toplam kaç TL'dir?

5) Ali'nin yaşı Hasan'ın yaşının 2 katıdır. İkisinin yaşları toplamı 45 ise Ali kaç yaşındadır?

6) Nazlı'nın parası kardeşinin parasının 4 katından 35 TL daha fazladır. Nazlı ve kardeşinin toplam 470 TL'si olduğuna göre Nazlı'nın kaç TL'si vardır?

APPENDIX F

FINAL TEST

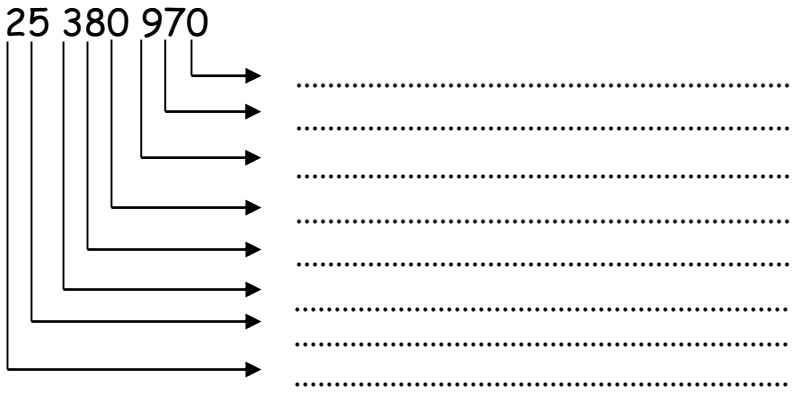
Adı, Soyadı: Tarih:
Sınıf - No:

1) **"1 410 086"** sayısının okunuşunu yazınız.

2) **"Elli altı milyon beş yüz iki bin"** sayısını rakamlarla yazınız.

3) **"25 380 970"** sayısının basamak isimlerini yazınız.

<u>Basamak İsimleri</u>



4) **"67 900 125"** sayısının <u>bölüklerini</u> gösteriniz ve isimlendiriniz.

5) "856 403 217" sayısında "0" ve "3" rakamlarının sayı ve basamak değerlerini yazınız.

	Sayı değeri	Basamak değeri
0		
3		

6) Aşağıdaki örüntülerde boş bırakılan yerlere gelmesi gereken sayıları bulunuz.

a) 181, 201, 221, 241, ..., 281, 301

b) 1, 4, 9, ..., 25, 36, 49

7) Aşağıdaki toplama ve çıkarma işlemlerini yapınız.

$$\begin{array}{r} 49656 \\ 243 \\ 1965 \\ +\quad\quad \\ \hline \end{array}$$

$$\begin{array}{r} 26470 \\ -\ 19368 \\ \hline \end{array}$$

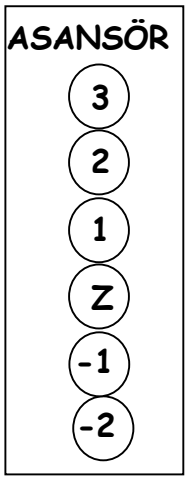
8) Yandaki tabloda bir ineğin bir hafta boyunca her gün kaçar litre süt verdiği gösterilmiştir.

Buna göre bu inek bir haftada ortalama kaç litre süt vermiştir?

Günler	Süt miktarı (L)
Pazartesi	24
Salı	20
Çarşamba	18
Perşembe	26
Cuma	24
Cumartesi	28
Pazar	28

9) Yandaki asansör panelinde "-2"düğmesi ne anlama gelmektedir?

Açıklayınız. (Z = Zemin Kat)



10) Bir tatil beldesine haziran ayında 12 895, temmuz ayında 29 145, ağustos ayında 24 130, eylül ayında ise 5045 turist gelmiştir. Buna göre;

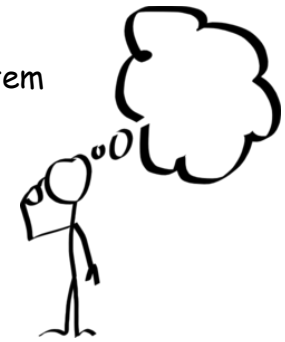
a) Tatil beldesine dört ayda toplam kaç turist gelmiştir?

b) Ağustos ve temmuz aylarında gelen turist sayısı haziran ve eylül aylarında gelen turist sayısından ne kadar fazladır?

11) 1'den 29'a kadar olan sayıların toplamını bulunuz.

12) Son basamakları "0" olan sayıları zihinden toplarken nasıl bir yol izlersiniz?

Örneğin: 50 000 + 70 000 'i zihinden toplarken nasıl bir yöntem kullanırsınız?



13) **"8743 – 4236"** işleminin sonucunun yaklaşık değerini tahmin etmede kullanılabilecek bir yöntem yazınız.

14) 864 x 32 işleminin sonucunu bulunuz.

15) ☺x 34 = 646 işleminde "☺" yerine gelmesi gereken sayıyı bulunuz.

16) 9707 : 17 işleminin sonucunu bulunuz.

17) Aşağıdaki işlemleri yapınız

a) 245 x 1000 =

b) 132 x 300 =

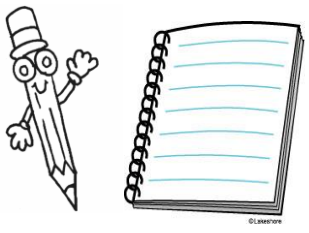
c) 67000 : 100 =

d) 4500 :150 =

18) Bir şirketin üç aylık geliri 28 075 TL'dir. Şirketin geliri birinci ay 10 500 TL, ikinci ay 9745 TL olduğuna göre üçüncü ay geliri kaç TL'dir?

19) Günde 24 saat çalışılan ve her bir saatte 150 gömlek dikilen bir fabrikada, 5 günde toplam kaç gömlek üretir?

20) Bir kırtasiyeci, 45 Kr'a aldığı kalemi 75 Kr'a, 2TL'ye aldığı defteri 4TL'ye satıyor. Kırtasiyeci, 20 kalem ve 48 defter satarsa kaç TL kar eder?



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