USING TECHNOLOGY IN PREVENTING AND REMEDYING SEVENTH GRADE STUDENTS' MISCONCEPTIONS IN FORMING AND SOLVING LINEAR EQUATIONS

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ABSTRACT

USING TECHNOLOGY IN PREVENTING AND REMEDYING SEVENTH GRADE STUDENTS' MISCONCEPTIONS IN FORMING AND SOLVING LINEAR EQUATIONS

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The purposes of this study was to investigate seventh-grade students' misconceptions related to forming and solving equations and examine the role of technology use in preventing and remedying these misconceptions. A group of 18 seventh grade students was given a diagnostic test before they started the equations unit to determine their misconceptions related to the topic. Students studied equations for 6 weeks and half of the instruction took place in the computer lab where they used various electronic manipulative and activities on the computer. The students were given another diagnostic test at the end of the instruction. After a month, they took another diagnostic test for the third time. The diagnostic tests were equivalent to each other in terms of item structures and contents. The effect of technology use in changing students' performances on the diagnostic tests was determined by repeated-measures ANOVA. Furthermore, changes in students' misconceptions were also analyzed qualitatively. According to the results, no significant effect of technology use on preventing and remedying misconceptions was found. However, technology positively affected students' feelings, thoughts and attitudes towards equations. Outcomes of this study have some implications for teachers, teacher educators, and curriculum writers as solving and forming equations is fundamental for learning algebra and a very significant strand of school mathematics.

Keywords: Misconceptions, Equations, Computer-Assisted Instruction, Technology Integration, Algebra.

ÖZ

İLKÖĞRETİM YEDİNCİ SINIF ÖĞRENCİLERİNİN EŞİTLİKLER KONUSUNDAKİ KAVRAM YANILGILARININ ÖNLENMESİNDE VE GİDERİLMESİNDE TEKNOLOJİ KULLANIMI

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Bu çalışmanın amacı, ilköğretim yedinci sınıf öğrencilerinin denklemler konusundaki kavram yanılgılarını ve bunların önlenmesi ve giderilmesi konusunda teknolojinin rolünü ve etkisini araştırmaktır. Bir grup yedinci sınıf öğrencisi denklemler konusunu işlemeden önce bir kavram yanılgılarını belirleme testi almışlardır. Olası kavram yanılgıları belirlenmiştir. Daha sonra konu bilgisayar destekli etkinlik kullanılarak sanal ortamda işlenmiştir. Hemen sonrasında öğrenciler tekrar kavram yanılgısı testi almışlar ve bir ay sonra üçüncü kez kavram yanılgısı testi almışlardır. Bu testler birbirlerinin eş değer versiyonlarıdır. Bu testler tekrar ölçmeli ANOVA kullanılarak analiz edilir. Teknoloji kullanımının öğrencilerin kavram yanılgıları testlerinden aldıkları puanların ortalamalarının değişimine etkisi incelenmiştir. Bilgisayar destekli etkinlik kullanılarak ders işlenmesi esnasında öğrencilerden niteliksel veri toplanmıştır. Yapılan analizler sonucunda teknolojinin kavram yanılgılarını önleme ve gidermede istatistiksel olarak bir etkisi saptanmamıştır. Ancak öğrencilerin denklemleri konusuna yaklaşımlarının pozitif etkisi gözlenmiştir. Bu çalışma öğretmenler, öğretmen adaylarını yetiştirenler ve müfredat yazanlar için önemlidir, çünkü denklemler konusu okullarda öğretilen matematiğin önemli bir dalı olan cebir öğretimi konusunda temel teşkil etmiştir.

Anahtar Sözcükler: Kavram Yanılgıları, Denklemler, Bilgisayar-Destekli Öğretim, Teknoloji Entegrasyonu, Cebir.

To my family

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CHAPTER 1

INTRODUCTION

1.1 Statement of the Problem

Algebra is one of the five main subject areas in elementary school mathematics. Algebra contains 28 objectives for students to learn. These objectives are related to analytical thinking, critical thinking and problem solving skills of the students. School algebra has goals of not only teaching algebra, but also preparing them to real life by developing their thinking skills (Ministry of National Education [MoNe], 2007).

According to the new elementary mathematics curriculum, students start algebra by thinking on the patterns of objects and number strings. Then, it comes setting the relationship between the numbers and the variables and the concept of equations. Learning about variables and equations lead to further subjects in algebra in high school and university. While teaching algebra, the aim is to teach students to use symbols in solving problems such as mixture, age and rate problems and to improve the students' skills in solving equations. Equations form the base for algebra and algebra form the base for further structural subjects (Ministry of National Education [MoNe], 2007). The importance of equations lies here.

In learning algebra, students have problems that can be divided into two: as problems in operational algebra (algebra as process) and problems in structural (algebra as objects) algebra .In order to be successful in algebra and have conceptual understanding, students should relate operational algebra to structural algebra (Sfard, 1991). In Turkey students have problems and misconceptions such as in equation in learning algebra (Erbaş, 1999, Yaman, Toluk & Olkun, 2003). It is my belief that, students can have conceptual understanding only when these problems can overcome and the misconceptions remedied.

Teaching methods in algebra can change for effective teaching to take place by remedying the misconceptions and solving the problems, since school algebra content does not change. The field of education improves and new approaches to teaching algebra are introduced. New approaches introduce new tools for use in lessons. Indeed, in teaching mathematics, paper and pencil calculations replaced with the calculators and computers (National Research Council, 1990). The computer technology is used in this study.

New approach has an important effect on the student thinking. For instance, the x concept in equations were conceptualized as unknown in past, but by the developing technology the students can solve and graph the equations for many different x values by the graphing calculators and software programs and so the x is conceptualized as variable (Chazan, 1999). The new mathematics curriculum in Turkey is based on constructivism and student centered activities where the use of technology and other tools become important. The need for new and different teaching techniques in mathematics is emphasized by the new curriculum (Ministry of National Education [MoNe], 2007). Moreover, the interest the students have for computers shows that using computers in math teaching can easily be implemented. Although, the improvements in teaching techniques and the tools introduced for mathematics lessons are not enough, the computers and other tools are starting be available at all the schools in our country. These tools and computer laboratories set in the schools are serving for the constructivist approach of the curriculum and student centered activities required in the mathematics books. However, there are not enough studies on that subject in our country. Therefore, investigation on the effect of use of technology in mathematics classes is needed in the field of education in Turkey (Ministry of National Education [MoNe], 2007).

In view of the current mathematics reform and the recent emphasis in using technology in mathematics education in Turkey, this study aims to investigate seventh grade students' misconceptions in equation concepts and examine the role and effect of technology use in preventing and remedying these misconceptions.

The purpose of this study was to investigate the research questions:

- What are the seventh grade students' misconceptions in forming and solving linear algebraic equations in one variable?
- What are the changes in students' scores before and after the computer-assisted instruction?
- How effective are the computer-assisted instruction of equations in remedying, preventing and decreasing misconceptions?
- What are the problems that the teachers meet in computer-assisted instruction?
- Is there a relationship between the attitudes and the diagnostic test scores of the students?

This investigation was done with 18 seventh grade students by implementing pre-test, post-test and delayed-post test with the computer-assisted instruction. The descriptive data was collected for the qualitative analysis of the study.

Null hypothesis of the research are:

- The students' misconceptions in equations do not change before and after the computer-assisted instruction.
- The students' scores do not change before and after the computer-assisted instruction.

1.2 Significance of the Study

The new mathematics curriculum in Turkey started to be implemented in the 6th grades in the 2006-2007 academic years, followed by the 7th grade implementation in 2007-2008 school year and the 8th grade implementation in the 2008-2009 school year. The new curriculum requires new and various techniques, materials, tools and activities to be used in mathematics classroom (Ministry of National Education [MoNe], 2007). Geo-boards, pattern blocks, tangrams, cubes, fraction bars are the tools advised to use in mathematics classes. Additionally, the use of mathematics software is encouraged. Indeed, Ministry of National Education (MONE) put both teacher and students friendly software oriented for both teachers and students on its web site for students and the teachers in order to be used in mathematics classes conducted in computer laboratories.

The construction of computer laboratories for all the schools in Turkey is still continuing and teachers have started to use them depending on the conditions of their schools. Therefore; a new issue, condition of computer laboratories becomes important. The teacher is supposed to know how effectively she or he could use technology in her or his classes. At this point, this study is going to give an idea about the usage of the computer software in mathematics for teachers and parents. Moreover, people who design mathematics software programs for 6, 7 and 8 grades of junior high school can widen their perspective. In addition, the study is also going to provide another viewpoint for the curriculum developers by means of integrating software programs in mathematics course (Chazan, 1999).

Algebra is a school subject, which is not so easy to concretize with tools; for that reason use of software is convenient in teaching algebra. The students do not like the subject matter that they do not understand. However, they like use of software. Thus, the positive effect of the software may be used for remedying the problems and the misconceptions of the students in algebra and the negative effect of the algebra learning for students. It was shown that the poorly designed teaching and learning materials used in algebra classes can cause difficulties for the students in learning algebraic concepts. These difficulties cause misinterpretations of the students in algebra in early years. In coming school years, if these misinterpretations are ignored, then they become errors and misconceptions (Macgregor & Stacey, 1997). Hence, choosing convenient material for the algebra classes is very important. Unfortunately, there are only a few studies done in this subject in Turkey. It can direct researchers for further studies in this area.

The uniqueness of the study lies behind the fact that, the effect of technology was searched for the culture in Beypazarı. That is, the findings can be generalized for the students grown up from the similarly structured families living in Beypazarı. Indeed, there is a relation between the mental process of the students and their common culture and historical background (Vgysotsky, 1978 cited in Molyneux-Hodgson, Rojano, Sutherland and Ursini, 1999). Particularly, the study searches whether or not the technology works for remedying students' misconceptions in equations in such a particular town and culture.

1.3 Limitations of the Study

In qualitative analysis, the interviews might be done not only after but also before the treatment and video recording during the treatment be able to be done but because of the unavailable conditions it was not possible. Despite this fact, the descriptive data was enough because of the action research design of the study. As the researcher is the mathematics teacher of the class for one school year, it provides the study with deeper insight into every student. Since the participants of the research consist of one class of 18 students, the improvement in their performance and reactions were closely followed up. That focus enriches descriptive data of this class taught by computer-assisted instruction. In fact, in that part of the research the aim is gaining meaningful data rather than generalizing data to the population.

Another limitation can be the structure and design of the mathematics teaching software and the content of the website used for the computer laboratory work. Some of the representations in these materials may be difficult for the students in relating the activities in software to the mathematics instructed traditionally in the classroom during the treatment. That is, the result of the way the students perceive the computers. To be more precise, the students think that computers are the only devices to play games and use Internet for some purpose. Therefore, the idea of using computer software in mathematics is not the point for students completely.

The pilot study of the instruments was not implemented. However, the reliability and validity analysis were done statistically and another rater evaluated the papers.

In quantitative analysis, the number of the subjects was not enough to meet the assumptions of the analysis and to generalize the outcomes. However, at that point the data was supported by the qualitative part of the research.

Other point is being the teacher of the group as the researcher. The researcher can be biased in collecting and interpreting data. However, the data is not only composed of classroom observations, but also the interviews and the essay-homework of the students are available for the analysis. The socio-economic-status of the students is known as being the mathematics teacher of them for one year.

The sampling was convenient. The researcher selected a group of schools, which have computer laboratory suitable for the treatment. Then, by the demand the researcher was appointed, by the National Education Priministry of the town, to one of these schools as the mathematics teacher for implementing the treatment. In that school, the researcher studied with the seventh grades.

1.4 Definitions of the Terms

Some of the important terms used in the study are defined as follows:

Misinterpretations: They are the students' understanding of a certain mathematics topic. This understanding is not explained with mathematical facts but it is not permanently located in the general view of the students. (Macgregor & Stacey, 1997, Sigel, 1984). For instance, M2 that is thinking that x^b is equal to the sum of b's. The student signed the choice $x^5 = x + x + x + x + x$ as true. 15 of the students had this misinterpretation in the study. They signed this choice but in after the tests this interpretation was not detected again. Hence, this interpretation of the students was named as misinterpretation.

Misconceptions: They occur if the misinterpretations of the students become general thinking way of the students (Macgregor & Stacey, 1997). Misinterpretations in the study were defined as misconceptions when the same interpretations were detected not only in test papers but also in observations, homework or interviews and matched with related the literature. For instance, M4 that is thinking that $x + ay = c \Rightarrow x = c - a$ or $ax + b = (a + b)$ .For example, the student did this calculation: $x + 4y = 27 \Rightarrow x = 23$ or $4x + 6$ is equal to 10. This interpretation was detected in 9 students not only in tests, but also in observations and interview. Therefore, it was named as misconception matching with the related literature.

Computer-Assisted Instruction: The students are instructed in the computer laboratory by means of related websites and software and also the students' treatment goes on traditionally in the classroom.

Diagnostic Tests: They are composed of open-ended, multiple choice and true-false questions. These tests are designed to diagnose the students' different perceptions and interpretations in solving problems.

Effectance: The effectance is a dimension of attitude measuring the involvement of students in mathematics in order to achieve active enjoyment and searches of challenge (Fennema &Sherman, 1976).

CHAPTER II

REVIEW OF THE LITERATURE

2.1 The Equations in School Algebra

Algebra, in which equations take part, has many definitions in the literature: as the form of generalization of arithmetic, way of solving certain kinds of problems (like equations), relationships between quantities and studying structures (Usiskin, 1988). Algebra is also defined as a subject that deals with the solving of equations and with any manipulations it is necessary to achieve this goal (Katz, 1997). Algebraic expressions are also taking place in the elementary mathematics curriculum (Ministry of National Education [MoNe], 2007). The algebraic expressions in the literature are defined as representations of the algorithms people use in everyday situations to find the measure of quantities (Chazan, 1996).

The concept of equations is placed in the beginning of the algebra. Indeed, the importance of equations in algebra is noticed as the students begin algebra, when they learn to write algebraic structures using letters to stand for numbers (Stacey & Macgregor, 2000). Algebra is declared with the equations in the literature. Equations are in seventh and eighth grade curriculum in the previous curriculum in our country, but in the new curriculum the algebraic conceptions start as patterns in early grades in the primary school and the equations start in the sixth grade. Indeed, algebraic concepts cannot be separated from the equations subject (Ministry of National Education [MoNe], 2007).

2.2 Students' Misconceptions in Learning Equations

The students in a classroom are introduced a concept in the same conditions with their classmates but they all perceive different things from that concept. Constructivism suggests that students by themselves construct their knowledge in their world; by means of interaction with the other people students check their constructs (Sigel, 1984). Everybody has different experience, then everybody learn different things from the same representation (Goldin, 1990). Some of different constructs of the students may not be in line with the scientific facts in (Sigel, 1984). These may lead to misconceptions. The misconceptions in equations start with the introduction of the letters and symbols in operations, equations and formulas.

The children give different meanings to the letters. They use the letters in six different ways of interpreting and using the letters as written below (CSMS Mathematics Team, 1998):

1. Letter is evaluated: The children assign a numerical value to the letter.
2. Letter is not used: The children ignore the letter, or accept the letter but without giving it a meaning.
3. Letter as an object: The children think the letter as a real object.
4. Letter as specific unknown: The children think the letter as a specific unknown number, and make operations with it directly
5. Letter as a generalized number: The children think and take the letter as representation of several values rather than just one.
6. Letter as a variable: The children perceive the letter as representation of a range of unspecified values, and a relationship between two such sets of values.

The children have difficulties in interpreting the letters that are symbols for various purposes in algebra. Most of the difficulties in understanding symbols are sourced from the symbols in standard form. That is, written symbols may take on different meanings in different settings. For instance, in solving $2x+3=4$, x is regarded as an unknown that does not vary but x varies in the equation $2x+3=y$

depending on y (Janvier, Girardon, & Morand, 1993). The students are supposed to understand that concepts which is really hard to achieve.

Erbaş (1999) studied the students' performances, difficulties and misconceptions in elementary algebra. According to his data, there are significant differences between students' scores with respect to school type, grade level and previous year math scores, but there is no significant difference in gender. He states that the students generally use syntactic translation while forming equations from verbal statements, and reversal errors in additive and multiplicative items are determined in forming equations. Moreover, he reports those students' errors and difficulties in solving linear algebraic equations in one unknown especially in having coefficient of unknowns different than one. To sum up, his findings report serious difficulties, errors and misconceptions of students in learning elementary algebra. That shows if the students make conceptual understanding in elementary algebra, it may prevent further difficulties in learning further algebraic subjects.

The case study with the high school students (Haimes, 1993), the students took the letters as objects not as a form of variables. It shows that the misunderstanding of the high school students in algebra caused from their problems in learning variables in equations in elementary school (Noss, 1986 cited in Raymond, & Leinenbach, 2000). It is better to do something different in teaching equations in elementary school to prevent these misconceptions. Changes in teaching algebra can remedy or prevent the deficiency of the students in learning algebra; therefore the students in high school do not get difficulty in algebra. Indeed, any change or improvement in elementary algebra classes can prevent the difficulties in learning algebra, which leads to better learning of algebra in further classes for instance in high school. However, these improvements and changes in algebra classes are supposed to be convenient for students to make better understanding. By this purpose, the students' perception of the algebraic concepts had better to take into account. Awareness of how students think about numerical relationships and how they perceive them will help the teachers in deciding the way of presentation (Stacey & Macgregor, 2000). By this way, better teaching can be provided. For instance, students' difficulties with story problems are harder than the symbolic ones (Nathan

& Koedinger, 2000). That means the students understand better if the problem is presented symbolically rather than verbally. Hence, the format, which a mathematical problem is presented, is important for the students.

Most of the difficulties of the students in elementary algebra are in using and perceiving the concept of letters as symbols. For instance, in test evaluations the algebra test items required letters as generalized number harder than algebra test items required letters as specific unknowns for students (Küchemann, 1981). In this study, the seventh grade students in selected school in Beypazarı also perceived the letters for generalization and the letters for specific value as different concepts. They did not get the whole concept as two forms of using letters in algebra.

2.3 The Effect of Technology on Learning Equations

Technology is used in mathematics classrooms by means of computers and calculators, which are searched in literature. The effect of them is investigated. This effect is the point if the all the students can access the tool. Computer and calculator technologies to have an effect upon the teaching and learning of algebra, every student should have access to the tool (Harwey, Waits & Demana, 1995). The availability of computer based instruction materials in the world is accepted, but in Turkey it is so new to talk about the effect of technology, because it is started to be available in schools in recent years.

The computer technology provides us various kinds of software programs for algebra and equations teaching. Symbolic manipulation programs, computer supported mathematics packages that perform arithmetic and symbolic algebraic calculations have been available for use in secondary schools since 1980s (Heid & Edward, 2001).

Computer Algebra System is common software that designed to be used in the algebra lessons. Computer Algebra System helps students by reducing their anxiety over making mistakes in algebra by reasoning with confidence about symbolic results. The students are flexible in using CAS that helps students in bridging the gap between concrete examples and abstract generalization and in interpreting information gained through the algebraic representations. The students can focus on applications and concepts in using CAS (Lagrange, 1999, Zehavi & Mann, 1999). That focus can be the result of their interest. The students are interested in using CAS, they are more actively participated in the lesson and they spent more time in preparing for the class (Vlachos & Kehagias, 2000). By means of CAS, the students can easily see the representation of the result of any long and complex algebraic computations without loosing time by paper-pencil work. However, this fact does not conclude with lost of the computational skills of the students by paper-pencil. CAS-curriculum students develop superior understanding of concepts with no significant loss of computational skill (Crocker, 1991). Additionally, the CAS allows students handle with the complicated problems that are difficult and tedious to solve by paper-pencil (Kutzler, 1994 cited in Pierce & Stacey, 2004). Keller, Russel, & Thomson (1999) have a CAS assisted curricular approach. They report that CAS group is more successful than the peer group at symbolically solving problems. In summary, the use of CAS in mathematics classes resulted in success in learning not only procedural but also conceptual understanding (Heit et al. 1998 cited in Selden, Dubinsky, Harel, & Hitt, 2003).CAS is not suitable for the seventh grade level so in this study CAS was not used.

Spreadsheets are useful tools for presenting algebraic concepts. Janet Ainley et al. (2005) used spreadsheets for introduction of algebra in secondary school. It was found that, the use of the spreadsheet had a key function by emphasizing the variable concept and the relationship between the variables. The study provided students with setting meaning for algebraic concepts. The structure of the tool used in that study resembles the Algebraic Expressions Activity in Mathematics Set, which used in the first two hours of the treatment in the laboratory in this study. Both tools are designed to present the numbers related to each other and the students are expected to make generalizations according to these relations and set equations.

In Turkey, Özgün-Koca (2001) investigated the effects on student understanding of linear relationships using the linked representation software Video Point as compared to using semi-linked representation software. She reports that, the students like using more than one representation in solving mathematics problems and easily focus on one representation. She adds that, most of the students find Video-point helpful in comparing different representations and checking their answers and in learning mathematics.

In the literature many researchers have suggestions about the benefits of the computer usage in classrooms in mathematics lessons. Technology-rich environments provide students with controlling their mathematical thinking and developing indeed skills in problem solving. (Papert, 1980 cited in Selden, Dubinsky, Harel, & Hitt, 2003.) The introduction of the computer based manipulation utilities provide secondary school classrooms with the deeper conceptual understanding of the students and their ability to apply algebra into real world setting instead of traditional algebraic tasks (Heid & Demana 2001). Noble (1988) gives three reasons for use of computers in schools. First computer literacy requires new skills, second computer-based instruction gives new, effective and efficient ways to present the material and individualize instruction, and third interactions with computers enhance cognitive skills. However, that positive effect of the computer technology is not same for all students. For instance, it is found that the average students perform better with the use of mathematics software but not the weak students (Mayes, 1992). Therefore, the mathematics set and the web sites used in the study were started from the very beginning and from the easiest examples for the weak students. The beginning examples and the visualizations were the simplest ones.

Graphing calculators are the other tools to be used in mathematics and algebra lessons. Graphing calculators help students in developing graphical representations of functions and exhibiting features of those functions without making a table of values and without engaging in tedious computations (Harwey, Waits, & Demana, 1995). A continuous progression from the use of the simplest functionality of a graphing calculator to the full use of more complex mathematics technologies are advised to be beneficial for the students (Harwey, Waits, & Demana, 1995). It is useful to design the applet of the study from activities required basic skills to complex ones. On the other hand, some students may feel out of control when they use calculators (Harwey, Waits & Demana, 1995). At this point, it is better to use computer-based activities that are designed not to make students feel out of control. The electronic teaching materials are more complex designs for students to control themselves and feel that learning something.

Using calculators in algebra lessons can be useful by saving up loaded work of computations. The students do not distract with the long and complex computations and can concentrate more on the thinking. By this way, using calculators provide students develop their conceptual thinking (Bardini, Pierce, & Stacey, 2004) but in this study, the subject area equations were more convenient to computer-assisted instruction because the computations required were not so long and complex.

Computer technology, calculator technology and also manipulative can be used in algebra lessons. However, the computer technology preferred to be used in this study, because the computer screen provides the students with the visual pictures of abstract algebraic concepts. Hence, the students can develop conceptual understanding by looking at concrete pictures, which cannot be achieved by means of other instructional techniques (Sierpinska 1987 cited in Nwabueze, 2004). Furthermore, the interactive computer software makes students thinking better and deeply about the mathematical concepts (Tall, 1991 cited in Nwabueze, 2004,).

In literature, the students in calculus class made deeper conceptual understanding via using microcomputers in graphing than the students in a traditional class (Heid, 1988). Moreover, the computer technology especially designed for educational tasks provides students with various kinds of representations that are difficult and time consuming to set by hand (Chazan, 1999). The traditional teaching methods or the manipulative designed for algebra (like algebra tiles) cannot provide such a representation in a few minutes. Indeed, there are mixed research results about the use of concrete manipulative. One tells that the students instructed algebra with concrete manipulative (also homework and worksheets given) had lower performance than the students instructed algebra with traditional method (also homework and worksheets given) (McClung, 1998 cited in cited in Raymond & Leinenbach, 2000). On the other hand, the other tells that the students' performance was developed and their attitude towards mathematics was positive by means of manipulative in the algebra class (Hinzman, 1997 cited in Raymond & Leinenbach, 2000).

It is better to conclude with the suggestions that technologies are tools to help in accomplishing task that can be accomplished without using technologies but that can more easily, quickly, and accurately be completed with these tools (Harwey, Waits & Demana, 1995). Hence, if the technology is applied in mathematics lessons in a convenient manner, they are helpful for the teachers and the students.

2.4 The Effect of Technology on Remedying or Diagnosing the Students' Misconceptions in Equations

The literature is not so rich in studies pointing on remedying or diagnosing the students' misconceptions in equations. The studies are generally focused on feedbacks of the students about their perception of the subject area instructed by technology. However, the role of technology in shaping the thought of the students is emphasized by the theorists (e.g., Tikhomirov, 1972/1981 cited in Chazan 1999).

Lawrence (2002) uses interactive software that is a study of straight-line equations. This software enhances conceptual understanding, sketching, graphic interpretive and world problem solving skills and making connections to real life and scientific phenomena. The software contains 40 questions (and their feedbacks) and is developed by using Maple and Hyper studio. Lawrence states that straight-line equations are the most basic kind of mathematical function and it has so many applications in science, business and social science. She adds that the lack of students' understanding of straight-line equations has hindered the students' understanding of science. Indeed, it is reported that the students have difficulties in interpreting a graph, determining its algebraic representation, deciding the relationship between two variables. Feedback from the students in this research shows that 91% of the students think that software enhances their learning. In fact, the students agree that the software help them in a better understanding of straight-line equations. The students indicate that they view mathematics as more meaningful and have less fear of problem solving. Moreover, according to the data this software fosters a better understanding of scientific principles and usefulness of mathematics in real world.

Sanad Al-Ghamdi (1987) makes an experimental study with 132 high school students from three schools in Florida. He uses the microcomputers, which help students in order to use the rules of order of operations in numerical computations, simplifying algebraic expressions, evaluating formulas, writing proofs, solving equations, and success on standardized tests with providing activities followed by instant feedback. According to his results the experimental group scored significantly higher than the control group on achievement.

Bang (1999) uses the Pan Balance activity, which is like one of the activity named Balance Activity in mathematics set in this study. The idea and the visualization of the Pan Balance Activity are same as the Balance Activity in this study. Bang's research is a case study. Indeed, her activity is with the objects not the numbers because she is studying with the first graders. She investigates how they construct the equation concept. In fact, they generally think the equation as a resulting tool in the operations. They do not think it as a balance tool. According to her results, the pan balance is useful for some students' construction but cognitive maturation is strongly effective (3+4 = 7).

Chazan (1996) states that such a change that is use of technology in learning equations may not affect the low achieving students. He adds that these students' needs also should be taken into account. In this study, the student with learning disabilities was particularly taken into account in the treatment of computer-assisted instruction.

The success of students in computer environments as was searched experimentally based upon their difficulties and errors in literature. It shows that origins of some of the difficulties and errors of the students in traditional algebra learning are the learning experiences of the students in class independent from their cognitive levels. (Cohors-Fresenborg, 1993; Sutherland, 1991; Tall& Thomas, 1991 cited in Macgregor & Stacey, 1997). Therefore, in technology-supported environments the learning experience of the students can change and the difficulties and the errors sourced from the learning experiences of the students in traditional classes may be remedied. It is also identified some approaches and teaching materials in algebra classes lead to misunderstanding. For instance, the alphabetical interpretation was found to be common in the school where the students were forced to use puzzles and codes in mathematics lessons (Macgregor & Stacey, 1997). Therefore, if the learning experiences changes by the technology use in a convenient manner, then the difficulties and errors can be remedied.

2.5 Collaborative Learning with Technology Use

The interaction of the students with the computers is important in searching for the effect of technology in learning mathematics. However, it is not so possible to check each student in every minute during the treatment. At this point; the students were assigned to peers for cooperative learning, hence they encouraged dealing with the activities in the software and their peers checked automatically whether or not they did their work. In fact, each student is accounted for the computer laboratory activities if they work with collaborative groups (Dubinsky & Schwingendorf, 1997 cited in Selden, Dubinsky, Harel, & Hitt, 2003).

The students learn mathematics better if they argue each other and this is possible in collaborative method (Raymond & Leınenbach, 2000). As the mathematics software used in the treatment is new for the students, it is better to form collaborative groups for students to discuss where they confuse. The constructivist learning, cooperative learning and the use of computers help the teachers in reaching the goal of making students understand the abstract concepts in algebra (Nwabueze, 2004).

2.6 The Theoretical Framework

The theoretical ground of the study is rooted from the constructivist learning approach. According to the Piaget, children construct their knowledge by means of integrating their experience with new knowledge but this action is limited with their thinking level (as cited in Sigel, 1984). At the end, the existing knowledge is the product of the construction (Coppel and the others, 1984 as cited in Sigel, 1984). If the teachers wish a higher level product from the students they should approach to the students with maximum demands in order to force them think deeply and construct mathematical thinking (Sigel, 1984). This approach presents that, learning is not only beyond transmission of knowledge by using teaching, but also it is directing the students in the way of thinking and reasoning. In particular, no one can teach mathematics but encourage and direct the learners in learning mathematics (Clements & Battista, 1990). According to research results, if the student constructs its own mathematical learning then they learn mathematics effectively (MSEB and National Research Council, 1989 as cited in Sigel, 1984). Hence, apart from teaching the teachers are expected to make students think and construct their own learning. Constructivist theorists declared the active learning is in a social environment with maximum interaction is required for understanding (Bookman & Malone, 2003 cited in Selden, Dubinsky, Harel, & Hitt, 2003.) At this point, collaborative learning provides interaction. On the other hand, as the constructivist approaches encourage students in dealing with real world problems, the technology, which helps to visualize real world problems integration into the mathematics classes, is strongly demanded (Bookman & Malone, 2003 cited in Selden, Dubinsky, Harel, & Hitt, 2003.) According to Clements (1997), the constructivist learning has four implementation strategies:

- Students should be active in the lesson.
- Manipulative can be used in constructing knowledge.
- Cooperative learning can be useful.
- The ideas of the students should be stimulated without looking for whether or not it is true.

The use of technology based on the statements of cognitive learning approach computers helps the students in developing their organization of thinking skills (Cooper, 1999 cited in Selden, Dubinsky, Harel, & Hitt, 2003.) Hence, in the study the principles of the cognitive approach were tried to be set. In the treatment, not only the students were encouraged to think on algebraic structures and problems but also they were expected to deal with using computer skills. By means of sitting in front of the computers and using the software the students were active in the lesson and as they were in pairs the cooperative learning was implemented. Furthermore, as the software in the study provided real world problems construction of the knowledge could be possible in the treatment. Indeed, the students must construct their own knowledge by taking the structures presented in the activities of the software in their mind.

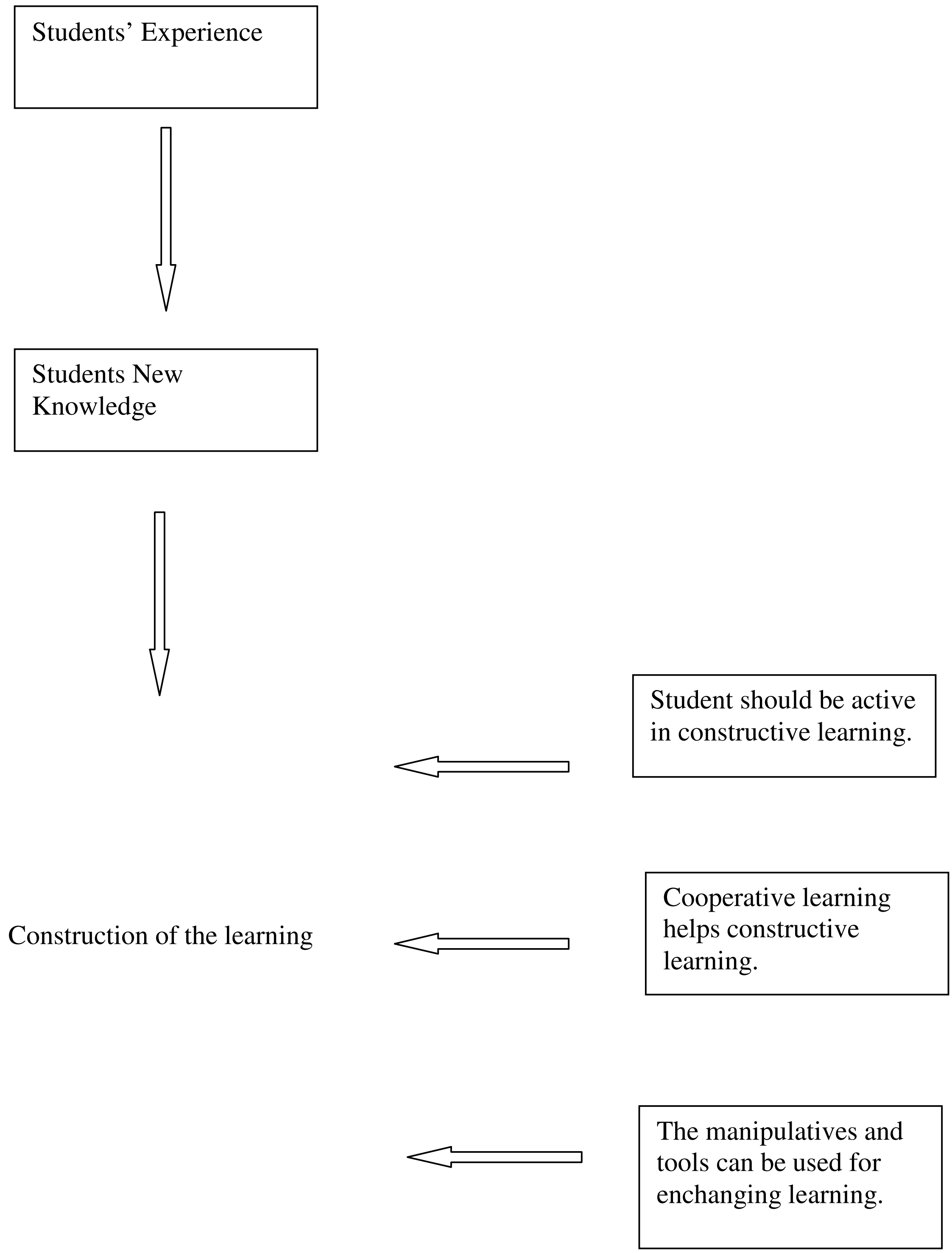

Figure 2.1. Constructivist learning process promoted in the study

2.7 Summary of the Literature

Misconceptions in algebra, technology use in algebra and collaborative learning were frequently maintained issues in the literature. Significant research results exist on misconceptions of the students in algebra and equations and the use of CAS in algebra classes. In general, the technology was used for effective learning and making conceptual understanding. However, significantly less research was done in use of technology in remedying or preventing the misconceptions. This study takes place in more specific point both for the level of the participants (as the research participants are in elementary level) and the procedure concept. The computer-assisted instruction implemented by collaborative peers used in remedying and preventing the seventh grade students' misconceptions in equations was the issue that does not provide us significant research results in the related literature.

CHAPTER III

METHODOLOGY

3.1 Participants

The participants of the study were the 18 seventh grade students in an elementary school in Beypazarı district of Ankara. There was only one class of seventh grade in the school. The school was chosen since it had a technology classroom with 15+1 computers working without a problem. As a mathematics teacher working for the Ministry of the National Education, the researcher asked for permission from the Directorate of National Education of the town to work in the school as mathematics teacher. The directorate appointed the researcher to the school.

The school was located in a neighborhood where the native people of the town live. Since the families living in town thought that the schools at the center of town was better than this school, they tended to send their children to the schools located at the center of the town. For that reason, class sizes were relatively small as the number of the students in the classes ranged from 15 to 25.

There was no building next to the school but the apartments were not so far that most of the students came to school by walking. The school had three floors. The seventh graders were in the second floor just opposite the computer laboratory. The building and the indoor decoration of the school were new. There was a huge garden but there was no construction for physical education activities in the garden. Moreover, there was no social activity, apart from the table tennis at the first floor, designed at school. Hence, being in the computer laboratory was the students' favorite hobby at school. In break time and in lunchtime they even did not eat anything but they used the computers in the laboratory.

The socio economic status of the families of the students was in line with the general socio economic status of the town. Most of the families were middle class people without having any struggle to make a living but also they were not rich. In general, the families were composed father, mother and the children. Some of them had grandparents living with them. The families had two or three children in average. The families were interested in the lesson grades and the behaviors of their children at school. Indeed, most of the families generally joined to the parent meetings. On the other hand, they individually came to the school in order to ask about their children.

The native people in town strictly depended on their culture in their life. Because of the cultural value of the families, the boys did not help their mother at home instead they went to their fathers' office or shop. As being in outdoor places the boys were more likely to go Internet cafes. The girls helped their mothers at home. They looked after their small siblings, cooked, and cleaned house. They also made jewelry. This hobby was so prevalent. Hence, the girls were not interested in computers as the boys. On the other hand, the boys were becoming spoiled people because of their parents and grandparents excess interest on them. Therefore, they generally used computers for entertainment. They got bored from the lessons. This data was obtained from the school registrations, guidance teacher and the administartor of the school.

The success of the school was average due to the other schools at town (This data was obtained from the grades of the students and the scores of the students from the common examinations at town). The seventh graders were 18 students, 9 of them were girls and 9 of them were boys. Particularly the students of this class were more socialized compared with the other classes at school. The students were properly coming to the school so they do join all the classes, but they were so talkative in the lessons. The girls and the boys did not get on well with each other. The noise in the lessons was reasoned from that fact. The girls and the boys criticized each other. However, that fact was good in the way that they compete in their success, too. Both the boys' and the girls' approached to the idea of mathematics lesson in laboratory were positive. Particularly, one of the students, who were so successful and bright in all the lessons, did not want to go laboratory. Indeed, he thought that the instruction could not be done there.

Generally, the school had a mission that the teachers let the students tell their ideas free. The students had friendship relations with the teachers. The idea and the freedom of the students was the priority. Most of the teachers of the class were specialized in their branches for instance; Turkish language, Science, Social Knowledge, Computer, Physical Education, English; Religious Culture and Moral Knowledge, Music, Job Education. The guidance service was also available as the school had a guidance teacher. One of the girls was special as she had a report from the Guidance and Counseling Center of the town. The girl had learning disabilities both in mathematics and some psychomotor skills.

3.2 Research Design

The researcher lived and worked as a mathematics teacher in town for two years. Being a member of the culture of the town, the researcher could present a deep understanding of the students' reactions and feelings during the treatment. In particular, the researcher could interpret the daily activities of this people and their feelings. In conclusion, interpretative research preferred because it was meaningful to explain how these students learn equations.

The main design of the research was an interpretive research (Merriam, 1998). That means by collecting detailed information from the group who took the computer-assisted instruction. The researcher aimed to get information about the implication of the experiment, the atmosphere of the class and the development of the students. In conclusion, the goal of this qualitative research was description of the computer-assisted instruction and how it was effective on misconceptions. Being the part of the computer-assisted instruction the researcher was the action researcher because she applied the study as mathematics teacher of the group. The process observed and by this way recommendations could be done for changing practice. (Bogdan & Biklen, 1998)

Experiencing different styles and tools in mathematics can prevent the misconception and the learning of the students can be improved, too. The differences in teaching style, amount of time in class spent on algebra, amount of homework, recent revision or practice before the test, and the general tone of the learning environment, the teacher's choice of textbooks and approach is related to the academic skills of the students (Stacey & Macgregor, 2000). By this purpose, the characteristics of the sample and the treatment were collected qualitatively for explaining the success of the students via diagnostic test scores in the study. The analysis of the attitude scales and the tests also supported the descriptive data by numerically.

3.3 Instruments

The study was implemented in the computer laboratory and in the classroom. Classroom work followed by the laboratory work. The students were in the laboratory for two hours and after that they were in the classroom for two hours. In particular, the mathematics was four lesson hours for one week. The group was in the classroom at the beginning of the treatment, because they took the Mathematics Attitude Scale for the purpose of controlling their attitude towards mathematics. Furthermore, the group took the Diagnostic Test in the classroom before the treatment in order to detect the misconceptions of the students in equations if they know the subject. At the end of the six weeks the computer-assisted-instruction ended and the students took the equivalent form of the Diagnostic Test in the classroom. Additionally, the teacher out of lesson interviewed the students one-by-one. The students took the equivalent form of the Diagnostic Test one month after finishing the treatment.

3.3.1 The Diagnostic Tests

The researcher prepared the diagnostic tests. Each test was composed of two parts. One test contained 7 questions and the other test contained 10 questions. The reason of such a division was for the motivation of the students. Since most of the questions required clear and long solutions and explanations, the test should have option to implement separately if needed. Additionally, the tests were composed of structurally different questions. First test was composed of number based and symbolic problems; on the other hand, the second test was composed of verbal problems. The questions were prepared to measure the understanding of the students and detect possible misconceptions. The test with 7 questions was the first test to implement. It included 2 multiple-choice questions, 1 True-False question and the others were open-ended. The last question required a creative objective that means the students should form a table according to their own equation. The second test included 3 multiple-choice questions and 7 open-ended questions. Two of these open-ended questions required descriptive explanations for the students' solutions. The researcher had an aim to be more reliable on detecting the misconceptions by means of these explanations.

The diagnostic tests in the study include both result unknown and start unknown problems as Nathan and Koedinger (2000) define. As the result unknown problems were arithmetical based the students who have problems not only with equations but also with arithmetic was separated from the students who have problems only with equations (rank ordering). The questions in the study were prepared in line with this concept. By means of separating the tests, the students who have problems with symbolic representation in algebra can be grouped apart from the students who have problems with contextualized questions.

The questions of the diagnostic tests were prepared according to the possible misconceptions detected in the literature. Additionally, the questions in the diagnostic tests were prepared to measure the objectives taught in the lessons. Indeed, only the objectives related to premises, placed at the beginning of the objectives list in the mathematics curriculum were not directly measured in the questions but the students could not solve the other questions if they did not know these basic structures. Table of specification was added in the Appendix J. The diagnostic tests were evaluated due to a scoring key (see Appendix K). The answers and the solutions of the students were not scored as true false rather they took partial points. The scoring key contains the scoring of the questions step by step. The student took her/his partial point depending on which step s/he came in the calculation. The other rater also evaluated the papers according to this key.

The reliability analysis of the diagnostic tests was done. The internal consistency of the scales was analyzed with SPSS. The Cronbach alfa coefficients ($\alpha_{posttest}$ =. 74, $\alpha_{retention}$ = .77) were above .7 so that the scales can be considered to be reliable with our sample.

In measuring the interrater reliability, the Pearson correlation value indicated ($r = .75$) that there was a strong relationship between the scores of two raters.

3.3.2 The Attitude Scales

The mathematics attitude scale was Fennema-Sherman Mathematics Attitude Scales, which were developed by Elizabeth Fennema and Julia Sherman in 1976. These scales were composed of nine separate scales. (Fennema & Sherman, 1976 cited in Perry, 1998) The scales of Mathematics Attitude Scale and Effectance Motivation in Mathematics Scale were used in this study. These two scales were in one test as 24 statements, 12 for effectance and 12 for anxiety. Therefore, the students had two scores for both scales. Each scale had 12 statements: six were positively worded and the other six were negatively worded. Each statement required five choices to respond: strongly agree, agree undecided, disagree, and strongly disagree. In that Likert type scale the high score on one scale means a positive attitude, whereas a low score means a negative attitude. As the scale was Likert type, the students got 12 to 60 from the scale of 12 statements. The high score from the effectance scale indicates high effectance, but the high score from the anxiety scale indicates low anxiety. The group was 18 students; hence the researcher converted the reverse questions by hand before entering to the SPSS.

The reliability analysis of the attitude scales was done. The internal consistency of the scales was analyzed with SPSS. The Cronbach alfa coefficients for anxiety (α = .71) and for effectance (α= .74) were above .70 so that the scales can be considered to be reliable with our sample. As the scale was Likert type calculating the cronbach alfa was suitable for analysis. The original scales were written in English and the researcher translated it to Turkish. A Turkish language teacher checked the grammar and Turkish grammar of the statements after the translation.

3.4 Procedures

Computer-assisted-instruction was implemented in computer laboratory and also the lesson went on in the classroom totally for 6 weeks as summarized in Table 3.1. The students were treated 4 lesson hours (40+40+40+40 minutes) per week. Two lesson hours were implemented in the classroom and the other two lesson hours were implemented in the computer laboratory. Furthermore, the lessons plans are added in Appendix G.

Computer-assisted-instruction was used in laboratory work by utilizing *Mathematics Set* (Karakirik, 2007). The *Balance Activity* and *Algebraic Expressions Activity* were used in this applet. The Mathematics Set had been installed in all the computers in the laboratory by the researcher before the study began. The students, by means of the directions of the researcher, opened the Mathematics Set and reached the selected activity. Furthermore, students also used some selected electronic manipulative from two web sites prepared by the Ministry of National Education (MoNe) in laboratory work: http://bep.meb.gov.tr/eicerikDis/default.aspx and http://skoool.meb.gov.tr. The students worked on the selected activity from these web sites in the laboratory work according to the instructions of the researcher

The researcher prepared a handout including the links and steps to be followed about how to use the activity in http://bep.meb.gov.tr/eicerikDis/default.aspx as it was a complex one (see Appendix H). The students used their handout both for the lesson in which the related activity was done and for their homework. At the beginning of the first lesson the homework was given. The students were assigned to make the calculations of the activities on Web site http://bep.meb.gov.tr/eicerikDis/default.aspx for the homework on a paper. Additionally, they were assigned to add their ideas about the mathematics lessons in the laboratory for the homework.

Table 3.1. Computer-Assisted Instruction Treatment Table

Lesson Number	Place	Brief Description	Duration (40+40 minutes)
Lesson 1	Computer laboratory	Algebraic Expressions Activity was implemented from the Mathematics Set.	2 lesson hours
Lesson 2	Classroom	The students studied expressing any algebraic expression verbally and writing the circumstances of the geometric shapes by using symbols.	2 lesson hours
Lesson 3	Computer laboratory	Balance Activity was implemented from the Mathematics Set.	2 lesson hours
Lesson 4	Classroom	The students studied premises verbally and symbolically. They calculated the true and the false values of the premises due to the given numbers. They wrote and explained linear equations in one and two variables.	2 lesson hours
Lesson 5	Computer laboratory	The students entered the Web sites http://bep.meb.gov.tr/eicerikDis/default.aspx. The equations subject was selected. The Ship Problem Activity and Distance-Velocity Problem Activity in this website were implemented.	2 lesson hours
Lesson 6	Classroom	The students expressed the degree of the equation and the number of the unknowns in an equation. They solved the equations like $x + 4 = 6$ and $4x = 20$.	2 lesson hours
Lesson 7	Computer laboratory	The students entered the Web sites http://bep.meb.gov.tr/eicerikDis/default.aspx. The equations subject was selected. The Paint Problem Activity in this website was implemented.	2 lesson hours
Lesson 8	Classroom	The students wrote the solution set of the linear equations in one variable. They checked the given number whether or not it makes the equation true.	2 lesson hours
Lesson 9	Computer laboratory	The students entered the Web sites http://skoool.meb.gov.tr. The algebraic expressions subject was selected. Algebraic Expressions Activity in this website was implemented.	2 lesson hours
Lesson 10	Classroom	The students solved the linear equations in one variable with parenthesis and rational expressions included. They wrote the solution set of these equations.	2 lesson hours
Lesson 11	Computer laboratory	The students entered all the activities quickly as a summary and then they studied with their favorite activity.	2 lesson hours

The researcher widened the content of the homework for students who want to use the Web site http://skoool.meb.gov.tr for the homework. The homework was given in order to support the treatment. The students gave their homework at the end of the treatment. They attached their thoughts as essays about studying mathematics by using these sites. For 6 six weeks the researcher both in the classroom and in the laboratory observed the class. The interviews made after the treatment. The observations were done during the treatment in deep but continued till the end of the term (see Appendix I).

The mathematics set was used in the treatment. This set was uploaded to all the computers in the laboratory before the students came to the treatment. The two parts of the set was used. Algebraic Expressions Activity was the writing formula for algebraic expressions. This activity contained cells like excel. The students defined formulas for the cells and by this formula the cells were linked each other. If the students ticked on the cell the numbers according to related formulas were highlighted. The activity presented the changes in the numbers when the formulas changed. The Balance Activity in the set contained pair of scales. The students put the numbers and the unknowns into the pans in order to provide the balance. Moreover, the activity had an option for the students as assigning numbers to the unknowns.

The Mathematics Set and the electronic manipulative in related web sites were designed for the 6^{th} grade since the algebraic expression and the equations were planned to instruct in 6^{th} grade in the new curriculum. However, in that year the seventh grades were instructed by the previous curriculum and the concept of equations was presented in seventh grade in that curriculum. Therefore, the activities were suitable for the students.

In the literature, the students taught with pattern-based approach were not better in the algebra items in the test (Stacey & Macgregor, 2000). Therefore, in this study, pattern-based activities were not used. The activities used in this study were the concept of equations, forming equations and solving problems by means of equations. The subjects were presented from the simplest thinking skills and enlarged with the interactive examples. The presentations were colored, interactive and related to daily contexts. The examples were designed in a game. The students won the game if they calculated the wanted answer correctly and also they could see the correct answer and the solution if they wanted.

The treatment started in the computer laboratory. The laboratory was designed in U-shape. The door was on the left hand side and the researchers' computer was at the right hand side near the window. The whiteboard was between the door and the researchers' computer. The researcher could easily see the screens of the students' computers from any point of the laboratory. As there were tick curtains the screens were easily seen.

In the break time before the lesson the researcher prepared the laboratory and started to take the students in the laboratory. The students worked in collaborative pairs in front of the computers, as the use of computers in mathematics classes is more effective in collaborative learning than other learning and teaching methods (Cooper, 1999 cited in Selden, Dubinsky, Harel, & Hitt, 2003). The students' pairs were determined. Indeed, the student's partner and their computer were fixed. The students knew whom to share his or her computer for all laboratory studies. The researcher assigned them according to the students' collaborative learning skill. Indeed, the pairs were assigned due to performance of the students who could best learn with whom according to the observations and impressions of the researcher. The pairs who may deal with something other than the activities were not next to each other. If there was any problem any small change was done by the researcher.

Ringing the bell, the researcher was sure that all the students were ready for the lesson and turned on their computers. The researcher wrote the selected web site on the whiteboard or if the activity was from the Mathematics Set the researcher explained one-by-one how to select the required activity. If there were students having problems in opening the activity the researcher helped them individually. (The students were free in helping each other at that point.) Then, they started to read and listen to the subject from the computer and deal with the interactive software. The researcher made students do the activities step by step and altogether. Indeed, the students who were quickly or so slowly could disturb the whole class. At certain points, the researcher wanted them to stop at any special step and asked questions to the students about activity. Hence, a discussion started, at that time the students who were out of that step could realize where they had to be and came to the indented point. These discussions were between the students and the researcher. The researcher asked them how they dealt with the exercise or what they understood from the activity.

The students interacted with the computer, other students and the researcher during the treatment. If there was any problem they could not deal with, they could call the researcher. The researcher helped them. Unless there was a big problem, the students could not stand up and leave the computer. The researcher walked around to the students and checked them one-by-one. She supported the activities by explaining them in detail for the students who did not get them.

The researcher directed the students finishing by the activities before the other students. These students were advised to think about the activities in deep. This advice was supposed to make some of them think creatively. At the end of the lesson, every student was planned to finish by the activity. The students turned off the computers; they put the chairs in order and left the laboratory at the end of the lesson.

The students worked by themselves in the laboratory work if and only if they dealt with the selected activity. The researcher interfered under certain conditions. Firstly, the researcher helped the students if they had problems with computer use. Secondly, the researcher dealt with students who quickly passed the activities or who were so slow and behind the whole class. Third, she made the students think on the activity by starting a discussion after the activity finished. Fourth, she dealt with the students who were out of the activity and started to do something else like opening messenger. Fifth, the researcher gave directions for the pairs who did not share the work equally for example one did everything and the other just sat down and observed. The researcher wanted all of them to be active in the activity.

In the classroom, the lesson was traditional. The discussion, questioning, problem-solving methods were used. In the classroom, the researcher reminded the students about the activities done in the laboratory. The relations between the topics presented in the classroom and the activities done in the laboratory were discussed.

The subjects instructed in the laboratory and in the classroom were not independent. They were related to each other. Generally, the classroom work started by reminding and intensifying the laboratory work. Then, the subject matter continued according to the behavioral objects of the curriculum. All the objectives included in the curriculum were met by computer-assisted instruction. The activities in laboratory work and the classroom work were designed according to the objectives. For instance, some of the objectives were met in the laboratory, where the others were met in the classroom.

The students noted the important points of the subject matter in short sentences into their notebooks. Most of the exercises were done by the students on the whiteboard with the directions of the researcher if necessary. In the discussions, the interaction between the students and the researcher was important. The researcher let the students make their conclusions by themselves. The researcher was not the presenter but the director. After the subject matter was discussed, as many as examples were solved. The students were not permitted to talk about something other than the lesson. However, they could discuss the examples. The students could stand up and walk around the classroom if and only if they solved the problem on the whiteboard.

The desks in the classroom in 7A were designed traditionally as three lines. The researcher's table was next to the whiteboard opposite to the door. The students were located in their desks by the researcher. She made the close friends not to sit together, behind or in front of each other. By this way, the researcher wanted to prevent unnecessary talking and noise.

The treatment ended after six weeks and also the classroom finished by the equations. The students were observed both in the classroom and in the laboratory during the treatment. The observation notes were taken right after the lesson (see Appendix I).

The mathematics teacher worked as the action researcher. She implied the tests, scales, and the computer-assisted instruction, conducted the interviews and observations. The effect of using technology in changing the means of students' scores on the diagnostic tests was determined statistically

3.5 Data Collection

3.5.1 Quantitative Data Collection

Before the implementation the students took the diagnostic test in order to learn how much they know about the equations and what were their misconceptions in equations if they learned the subject matter before. Also, the students were implemented the Mathematics Attitude Scales in order to learn how they felt about mathematics. The students were treated by computer-assisted instruction. At the end of the 6 weeks the students take the diagnostic test. Right after one month, the students took the diagnostic test, again.

3.5.2 Qualitative Data Collection

Qualitative data collection was done by means of observations, interviews and the information about the students, their families and the town was obtained from the school administration and National Education Priministry. The information about the student, their families and the town was obtained orally from the guidance teacher, the school administrator and the National Education Priministry. These data was in written form in student information files at school and in National Education Priministry. The grades of the students and the success of the students in common achievement tests were took into account. In the study, the students' real names were not used but coded by some other names.

3.5.2.1 Observations

The observations were done intensively in laboratory but went on in classroom, too. The researcher wrote the observation notes after lessons (see Appendix I). There was no structured observation form, however there were points that the researcher was careful about: The relationship between the pairs, between all the students and between the researcher and the students, the problems met in laboratory work, the reactions of the students in using computers and also the changes in their performance and motivation in classrooms after laboratory work. Additionally, the comparison of the students' behaviors in classroom and in laboratory, how they learn the subject, how they solve the problems, how they integrate their learning to the paper pencil learning were studied. Indeed, the focus of the observation was how the learning happened. The researcher tried to interact with all of the students in order to obtain information from the whole class. As the researcher was the mathematics teacher of the students, she knew the students. Therefore, the observation was possible while implementing the treatment.

3.5.2.2 Interviews

The purpose of the interview was to validate and support the data obtained from the scales, tests and observations. The researcher aimed to talk about possible misconceptions of the students, their feelings about the computers and their learning in computer laboratory.

The interview was semi-structured. The interview protocol used during the interviews is presented in Appendix E. Addltional questions were asked according to the answers of the students. Some of the added questions were related to the subject area that is equations. The questions asked apart from the protocol provided the data with detailed information. In the structure of the interview, the two interview series were used. At first, the details of the students' experience were talked and secondly the students' reflections on the meaning were talked, (Seidman, 2006). The chronology of the interviews is designed as beginning, middle and end. At the beginning, the details of their experience were asked. The students explained what they do in the computer laboratory, which web sites they visit, which activities they do, which problems they remember. These subjects were talked in detail; by this way the students remembered their treatment duration. In the middle, the students' reflections on being in the computer laboratory in mathematics lesson were talked. Their preferences, interpretations, feeling and thoughts about the treatment were asked. Then, by asking algebraic questions their possible misconceptions were detected. During the interview the questions asking with the same purposes were asked two times in different words for consistency.

The students were taken for the interview in lunchtime in the guidance room. All the students that are 18 were interviewed. Each student was taken for the interview one-by-one. During the interview no one was in the room except the researcher and the student. The mobile phones were closed and since it was a special room for special meeting no one disturbed the interview. Some students were really talkative in answering questions but some of them gave short answers and did not want to explain. An interview took 25 minutes in average. Totally, the interviews finished at the end of three weeks.

3.6 Validity and Reliability

In qualitative data analysis, justifiability was an alternative to reliability and validity. Justifiability requires three properties of the data. First, the data should be transparent. The interviews, test papers, student essays and observations were all recorded in this study. Indeed, all the records were available for what was done related to the study. Second, the communicability was needed. As there was a clear schema appears after the analysis, it should be meaningful to other researchers. Third, a coherent story was need. As the outcomes of the treatment can be explained by the characteristics of the subjects, this story appears at the discussion of the study. (Auerbach & Silverstein, 2003)

There were some factors affected on the atmosphere of the class during the treatment. As the researcher was the mathematics teacher of the students, there was an emotional relationship between the students and the researcher. This relationship could affect the students and they might react as their researcher wanted. However, at this point the researcher did not declare or show them her viewpoint. On the other hand, this relationship worked for the researcher in understanding the students' reactions and feelings during the treatment. In particular, the researcher was not biased as she also wanted to know whether or not the computer-assisted treatment works. In particular, there were problems with high-level students and the teacher.

For instance, Kerem, who had higher level learning ability, was also good at using computer. Therefore, he was unmotivated because he was finished with the activities before the class. As he did not get feedback from the researcher because of his correct results, his motivation decreased. Additionally, as he was always positively motivated in the classroom because of his correct answers he liked the classroom lessons. Therefore, Kerem did not feel that he made learning in the computer laboratory. At this point, the researcher presented his work about activities to the class as sample in order to motivate him. Furthermore, she appointed him for helping the students who were struggled by doing the activities and dealing with the keyboard or mouse problems. Hence, the motivation of Kerem increased.

In order to set the internal validity of the data, the researcher used three data sources, which were the observations (from the researcher), the interviews, homework (from the students) and the data obtained from the school administration and the Education Directorate of Beypazarı District of Ankara. Additionally, the researcher used two research methods in the study, one is interpretative qualitative research and the other was quantitative by using tests and scales. Indeed, no data can be 100 % objective, but the researcher tried to minimize the biases by discussing the students' interpretations even after the treatment. At this point, it is better to declare the background of the researcher. Even though in her university education she learned about different teaching and learning methods, she was not taught by computer-assisted instruction in her elementary education. In addition to this, she did not have a chance to use computers in her instructions for five years of being mathematics researcher. Hence, she was searching about the computer-assisted instruction but really she thought that whether or not it was an alternative for effective learning and for dealing with the misconceptions. On the other hand, the researcher did not prepare the electronic material and Mathematics Set used in the study, so she does not need to prove the benefit of them. Hence, there was no bias at that point.

In setting the external validity, the researcher had no attempt to generalize her findings to the population. However, findings could be generalized to the people resembles the characteristics of the sample in the study.

As the sample was from one school, the subject characteristics could be threat to internal validity. Therefore the data about socio economic status and ability of the subjects in sample was collected in detail.

Mortality threat was not so serious because the sample size was not so large and the students were obligated to come to the school unless they had a health report in the semester. The students were always ready with the whole class both for treatment and for scales and tests. Since the diagnostic tests were equivalent forms of each other and as the tests had a unique scoring key, in scoring the instrumentation and testing threats were minimized. Because the time interval was 6 weeks, maturation threat was not so serious.

On the other hand, in checking the validity of the tests another rater scored approximately 10% of the papers. This rater was a mathematics teacher of an elementary school. Consistency estimates of interrater reliability were used. In order to calculate the degree of consistency between scores of two raters the Pearson correlation coefficient was calculated (r =. 75). The feature of the Pearson correlation coefficient was used, as the scores on the rating scale are continuous in nature.

The reliability analysis of the attitude scales and diagnostic tests were done. According to Cronbach alfa values the diagnostic tests of the posttest and the delayed post test (r = .74, r =. 77) and the attitude scales for anxiety and effectance (r = .71 and r = .74) are reliable. Another mathematics researcher as the other rater evaluated the papers according to the rubric. The scores of two raters were strongly related according to the Pearson correlation value (r = .75). Only for one score of the student the other rater thought that the student copying from another student during the test. However, there was no evidence for that assumption as the researcher implied the tests. Hence, for that score the two scores had a 10 point difference out of 92 which was the greatest difference between two measurements.

The attitude scores of the students were analyzed through calculating bivariate correlation. There was strong correlation between the anxiety-posttest (r = .67), anxiety-delayed posttest (r = .61), effectance-posttest (r = .63) and effectance-delayed posttest (r = .50).

3.7 Data Analysis

3.7.1 Variables

In diagnostic tests as pretest, posttest and delayed-post test; the achievements of the students were measured and also the misconceptions were detected. The pretest scores were independent variables to control the background of the students. The posttests were dependent to the treatment and the delayed-post tests were given for controlling the time factor.

Two attitude scales were taken as independent variables: Students' anxiety levels towards mathematics and their effectance in mathematics. The relation between these scales and the test scores were investigated.

Table 3.2. Variables Used for the Data Analysis

Name of the Variable	Dependent	Independent
Effectance of the Students in Mathematics		X
Anxiety of the Students towards Mathematics		X
Pretest Scores of the Diagnostic Test		X
Posttest Scores of the Diagnostic Test	X	
Delayed-post test Scores of the Diagnostic Test	X	

3.7.2 Quantitative Data Analysis

The one-way repeated measures of ANOVA were used for the analysis of the scores of the diagnostic tests because in the study there was one group of subjects measured on the equivalent forms of scale on three different occasions in the study. This technique told us whether or not there was a significant difference among the three sets of scores. The scores of the attitude scales and the diagnostic tests were analyzed through bivarite correlation because of the design and the sample size. Pearson Coefficient indicated the relation between the scores of the attitude scales and the diagnostic test. All statistical inferences were based on significance level of .05.

3.7.3 Qualitative Data Analysis

During the treatment one of our lessons was the New Year and Religious Festival holiday. Therefore, that day the treatment was not implemented and after that it went on. This holiday was a chance for them to deal with their homework.

Observation notes, homework papers and the interview notes were arranged. The misinterpretations of the students and the common expressions of the students were coded and counted from the data. Interview protocol is given in Appendix E and the common points of the students' answers are given in Appendix F. Observation notes are presented in Appendix I. While analyzing the papers the headings of the analysis appeared. Then the researcher read and coded the data from the observation notes, homework-essay, and interview notes again according to following headings: Technological problems, software, background of the students, comparison of high-low achieved students, cooperative work. The data obtained from the student files, guidance teacher, school administration and National Education Priministry were used at that point and some results and interpretations were supported by that data.

CHAPTER IV

RESULTS

4.1 The Results of the Quantitative Data

4.1.1 The Results of the Attitude Scales

The scores of the attitude scales are given in Appendix L. The relationship between the anxiety towards mathematics scores and posttest scores, anxiety towards mathematics scores and delayed-post test scores, effectance in mathematics scores and posttest scores, effectance in mathematics scores and delayed-post test scores were investigated using Pearson-product-moment correlation coefficient. There was a strong positive relationship between the anxiety towards mathematics scores and posttest scores, $r = .67$, $p = .01$. There was a strong relationship between the anxiety towards mathematics scores and delayed-post test scores, $r = .61$, $p = .01$. There was a strong relationship between the effectance in mathematics scores and posttest scores, $r = .63$, p = .01. There was a strong relationship between the effectance in mathematics and delayed-post test scores, $r = .50$, $p = .03$. There were problems in assumption of the analysis, however; that was possibly reasoned from the small sample size. Even in such a sample size of 18 there was correlation found. Table 4.1 presents the correlations.

Table 4.1. Correlations between Posttest Scores, Delayed-post Test Scores and Anxiety towards Mathematics, Effectance in Mathematics

	Anxiety	Effectance
	Students (n = 18)	
Posttest	.67	.63
Delayed-post test	.61	.50

4.1.2 The Results of the Diagnostic Test Scores

The assumptions of the one-way-repeated measures of ANOVA were analyzed. First the independence of the observation for each treatment was taken into account during the treatment. Second, the normality of the distributions was detected. Normality of the tests was measured by SPSS. Kolmogorov-Smirnov Statistic assessed the normality of the distribution of the scores. The non-significant results $D = .20$ for pretest, $D = .14$ for posttest and $D = .20$ indicated the normality. The assumption of equality of variances, which becomes sphreity assumption in repeated measures of ANOVA was violated but an option for this violation that using multivariate table was used (Field, 2005).

The descriptive data with the mean scores and the standard deviations of the diagnostic scores is given in Table 4.2. The mean of the diagnostic test scores increases by 5 points after the treatment as expected. The mean of the diagnostic test scores in delayed-post test scores increases by 3 points.

Table 4.2. The Descriptive Statistics for Diagnostic Test Scores for Pretest, Posttest and Delayed-post test

	M	SD	N
Pretest	12.94	7.06	18
Posttest	17.94	14.44	18
Delayed-post test	20.94	15.87	18

The inferential data is presented in Table 4.3. A one-way-repeated measures ANOVA was conducted to compare scores on the Misconception Diagnostic Test at Pretest, Posttest, and Delayed-post test. The results showed that the scores of the students were not significantly affected by time. $F(2, 16) = 1.70$, $p = .21$.

Table 4.3. Analysis of Variance for Diagnostic Test Scores

Source	df	p	F	η^2
		Between Subjects		
Time	1	.01	56.29	.77
		Within Subjects		
Time	1	.17	3.55	.08

4.2 The Results of the Qualitative Data

Any significant effect of technology in remedying the misconceptions of the students was existed as indicated in the related literature (Jean, Delozanne, Jacoboni & Grugeon, 1998). In this study, the misinterpretations of the students did not decrease significantly and the diagnostic test scores of three implementations had no significant difference between them. The results of the analysis are given in the tables below. The students' solutions and the explanations that cannot be explained by mathematical facts are named as misinterpretations in the study. The misinterpretations matched with the literature are translated to misconceptions or difficulties in the result part of the study. In Table 4.3 the misinterpretations of the students are presented. The coding depends on the analysis of the diagnostic test papers, homework-essay and interviews. The misinterpretations in first part of the test (symbolical or numerical) are coded with M and in the second part of the test (verbal) are coded with L. The numbers next to the M and L have no meaning only for discrimination of the misinterpretations.

Table 4.4. Misinterpretations of the Students

Codes for Misinterpretations	Explanation
M1	Thinking that x^b is equal to b·x. For example, signing the choice $x^5 = 5x$.
M2	Thinking that x^b is equal to the sum of b x's. Signing the choice $x^5 = x + x + x + x + x$
M3	Thinking the statement $\frac{1}{a+b} = \frac{1}{a} + \frac{1}{b}$ is true.
Letter not used (M4)	Thinking that $x + ay = c \Rightarrow x = c - a$ or $ax + b = (a + b)$ For example, $x + 4y = 27 \Rightarrow x = 23$ or $4x + 6$ is equal to 10.
Letter evaluated (M5)	Thinking that x (and/or y) is always 1 in equations and c=1, d=1 in algebraic expressions.
M6	Thinking the statement $\frac{1}{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}} = \frac{a.b.c}{a+b+c}$ is true
L1	Calculating the area of the square with side (a + 2) as equal to 8.
L2	In calculating the area of the square, which has a side (a + 2), calculating the circumstance and finding (a + 8).
L3	In calculating the area of the square, which has a side (a + 2), adding 2 and 2 and finding 4.
L4	Computing that (a + 2 + a + 2 + a + 2 + a + 2) is equal to a + 8
L5	If the older sister 4 years older then translating it as 4x.
Letter not used (L6)	Computing that (a + 1 + a + 1 + a + 2 + a + 2) is equal to 6
L7	Computing that (a + 2)(a + 1) is equal to 3

CSMS mathematics team (1998) suggests that children give different meanings to the letters. Children used the letters in six different ways of perceiving the letters but only three of them were seen in the students in this study.

➢ <u>Letter evaluated (M5)</u>

In this category the letter is assigned a number from somewhere else. One of the students in the study named Emel wrote 1 for both x and y in the diagnostic test. On the other hand, Ceren also told that she can replace x and y by 1 in some equations during the interview. In fact, it was observed that the students thought that, if the coefficient of the x was 1 that we did not write but know that it was 1, that 1 was the value of the x. In other words, the coefficient and the value of x are not clear for the students.

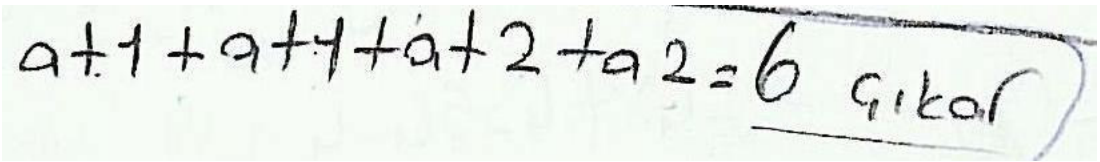

Figure 4.1 an Example for Letter not Used Misconception

➢ <u>Letter not used (M4)</u>

In here the children ignore the letter, or realize its existence but without giving it a meaning. This misconception was so common in the study and could not remedy. The students went on doing their operations, as the letter was not there. In the Figure 4.1 the test paper of Mehmet shows this misconception.

➢ <u>Letter used as a specific unknown</u>

Children regard a letter as a specific but unknown number, and can operate upon it directly. Most of the students in this study were persistent that the x value was 1.

The diagnostic tests were in two parts: One was composed of symbolically presented problems and the other was composed of contextualized presented problems. According to the solution and the explanations of the students in diagnostic test papers, it is clear that the students did not prefer to solve the contextualized problems by means of algebra. They generally used arithmetical solutions before and after the treatment. Therefore, the computer-assisted instruction did not help students in thinking on the verbal problems as well as symbolic ones.

Most of the students were not being able to calculate area of a square not only because of their deficiency in algebra but also in geometry. On the other hand, three of the students calculated the circumstance of the square where they were supposed to calculate the area, but they found the correct circumstance value.

In Table 4.5, the misinterpretations of the students detected in diagnostic tests, interviews, and observations are presented. The misinterpretations of the students detected two or three times are repeated in the table.

In Table 4.6, the number of misinterpretations of the students is presented according to the diagnostic tests, interviews, and observations. In the total column, the number in parenthesis shows the total number of each type of misinterpretations detected. The number of students who did that misinterpretation is presented in the following column.

In these tables it is seen that the number of misinterpretations detected was greater than the number of the misconceptions detected because most of the misinterpretations detected in the test papers were not detected in observations and interviews. It shows that the misinterpretations of the students remained as interpretation of the students that cannot be explained by mathematical facts. These misinterpretations did not become misconception except from two of them. The number of misinterpretations of the students are not seems to decrease after the treatment according to the table. The possible reasons of this result are discussed in the discussion and conclusion part.

Table 4.5. Misinterpretations of the Students Detected in Diagnostic Tests, Interviews and Observations

Name of the Student	Pretest 1	Pretest 2	Posttest 1	Posttest 2	Delayed-post test 1	Delayed-post test 2	Interview	Observation
Aysu	M1		M1					
Selçuk	M5,M2,M2		M3,M3,M3,M4		M2,M3		M4	M4
Aydan	M2		M2		M2			
Toprak	M1	L1	M1,M3,M3	L4,L4,L4,L6	M2,M3,M6			
Mine	M1,M1		M1,M3	L4,L5	M1,M2,M3			
Ufuk					M2,M3,M6			
Deniz	M2,M6		M3		M2,M3		M4	M4,M5
Emel	M2	L1	M2,M3,M3,M5	L4	M2,M3,M4	L2	M5	M4, M5
Serkan	M2,M3	L1	M2,M3,M3	L4	M2,M3	L24	M4	M4
Kerem	M3		M3,M3		M3			
Turgut	M1		M1,M3,M3,M4		M2,M3		M4	M4

Table 4.5 (continued)

Murat	M2,M3,M6	L2	M2,M3,M3	L4	M2,M3,M3,M4,M6		M4
Ceren	M2,M3	L3	M2,M3,M4		M2,M3,M4	M4	M4
Emre	M2	L3	M2,M3		M2,M3	M4	M4
Nalan	M6		M3				
Ayşe					M2		
Tufan					M2		
Mehmet	M2		M2,M3,M4		M2		M4

Table 4.6. The Number of Misinterpretations of the Students

Number of Errors detected due to Diagnostic Tests	Pretest1	Pretest 2	Posttest1	Posttest2	Delateposttest1	Delateposttest2	Interview	Observation	Number of Students Detected the Misinterpretation	Total
M1	5		4		1				4	10
M2	10		7		15				15	32
M3	4		21		13				14	38
M4			4		3		6	9	9	22
M5	1		1					2	3	4
M6	3				3				5	6
L1		3							3	3
L2		1				1			2	2
L3		2							2	2
L4				7					5	7
L5				1					1	1
Total	23	6	37	8	35	1	6	11	63	127

In Table 4.7 the scores of the students took from the diagnostic tests are presented. The total score of the test is 92 (42+50) points.

Table 4.7. The Diagnostic Test Scores of the Students

	Pretest	Posttest	Delayed-post test
Aysu	2	9	11
Selçuk	25	14	18
Aydan	9	1	2
Toprak	15	45	31
Mine	16	18	29
Ufuk	6	2	7
Deniz	15	5	3
Emel	26	26	21
Serkan	3	39	40
Kerem	14	38	58
Turgut	6	3	32
Murat	4	36	42
Ceren	19	28	18
Emre	18	21	12
Nalan	12	8	10
Ayşe	10	5	2
Tufan	18	5	9
Mehmet	15	20	32

Most of the scores of the students did not increase in diagnostic tests after the treatment. Kerem and Hakan had increase as expected, however they were successful and skilled students. Toprak is also good in mathematics, but she has a small decrease in delayed posttest, probably she forgot the topic. Mine has an increase in the test scores. This student was a silent and passive student in the classroom; hence such an increase showed that she was better in the treatment. On the other hand, Mehmet had an increase in scores. He was a so talkative student in the classroom, but it seems that the treatment was good for him. Murat, for instance, was so interested in mathematics and computer use. Hence, he had an increase in scores. Ufuk and Turgut, for example, were low-achieved students, their scores were not meaningful. Therefore, the treatment was not so suitable for these students.

This does not present that the computer-assisted instruction was not effective for them. In particular, it shows that there are some other effects that should be considered and explained in implementing the treatment. In fact, the students did have problems in reaching the activities and accomplishing the tasks because of downloading problems and hardware problems with the computers but at the end all of them finished the activities. That means the problems met with the computers did not prevent the students from completing the activities as found in the literature before (Bookman & Malone, 2003 cited in Selden, Dubinsky, Harel, & Hitt, 2003). The teacher was a full director in reaching the selected link, as the level of the students was low in use of computers. Since, most of them told in the interviews that they had no computer at home (see Appendix F); they did not know how to use it effectively. Despite this fact, the students who were good in using computers were more integrated to the instructional tasks used in the computer-assisted treatment and the others used some of the treatment time for dealing with how to use computers. Hence, the problems with the computers usage did not prevent the students from finishing the exercises at the end of the lesson, but their performance was surely affected.

The students, in general, expressed their positive feeling about the treatment. In particular, that positive feeling was about equations and related to the treatment process that they used computers; they were out of the classroom where the traditional boring lesson instructed just like in the literature (Jean, Delozanne, Jacoboni & Grugeon, 1998, Pierce, & Stacey, 2004). The colored and interactive environment in mathematics lessons was interesting for most of the students. Moreover, they were pleased to use computers and to do mathematics by themselves with the help of the activities. Many of them, at the end of the treatment mentioned that they understand better with the computer-assisted instruction.

In the homework, for example Ceren wrote that;

> "In computer laboratory if there is a point we can not understand, then we may ask our teacher. If we do not understand again then we can return the activity back and back 10 times even 100 times till we understand." (Ceren, Homework)

Many of them wrote in their homework that, they learned from the ship problem in Internet that if we add or subtract the same number for both sides of the equation the equality does not change.

Computer-assisted instruction was attractive for the students but they have special intends for the activities used during the treatment. For instance, they told that distance problem was hard for them because the distance formula was required to be explained.

Aysu told that,

> "The activities are not suitable for our hobbies. For instance, there can be a toy baby and her clothes' numbers on them. Then we pick the clothes and release on the baby, so make the baby wear. If there is something wrong, a piece of her clothes goes. For boys, there can be a football match…" (Aysu, Interview)

The students were in collaborative pairs and they shared their duties for instance who used the keyboard or mouse. The students had no serious problem in collaborative work; in contrast they help each other, and that result is in line with literature (Bookman & Malone, 2003 cited in Selden, Dubinsky, Harel, & Hitt, 2003). In the interviews also most of the students told that their pairs help them (see Appendix F). Only one pair (Selçuk & Murat) had a problem because one of them did not understand the task. The teacher interfered and solved the problem. In conclusion, the problems with hardware or software of the computers have effect on the performance of the students in computer-assisted instruction. However, the collaborative work does affect the study positively as the students easily share their duty and help each other.

CHAPTER V

CONCLUSIONS AND DISCUSSION

5.1 The Impact of Students' Backgrounds on their Achievement

According to the analysis and results the diagnostic test scores of the students were increased after the treatment (however the scores were so low to accept them successful) but the misconceptions were not remedied. Hence the students' conceptual and deep understanding could not be achieved as indicated in the literature (Papert, 1980 cited in Selden; Dubinsky, Harel, & Hitt, 2003; Heid & Demana, 2001; Noble, 1988). The students in this study as they were not used to be instructed mathematics lesson on computer before, they were not so good at integrating their learning in the treatment to the paper-pencil learning in diagnostic tests. At this point, the literature indicates that when the students are presented a new subject, the students are unable to relate or differentiate two applications as exercises in the laboratory and in the classroom (Macgregor & Stacey, 1997). Computers defined as playing games or chatting with unknown people in the culture of these students. For instance, Toprak in her homework wrote that, if there was a person on Internet opposite us included in the activity, and then we interact with her or him it might be better. Hence, the learning process with the computers was not widely occurring in their perception. They thought that they were out of lesson. After the treatment, some of them realized that they learned equations just as in the classroom. Therefore, in the first step the students should perceive the computer-assisted instruction as a way of instruction. On the other hand, the attitudes of the students could affect their performance. According to the results, the students who had positive attitude toward mathematics had high test scores.

Additionally, most of the students had problems with exponential notations and remembering the area formulas in geometry as indicated in the literature

(Macgregor & Stacey, 1997). Because of their lack of knowledge about exponentials and geometry, they could not solve the questions and do the exercises. Therefore, in evaluating the success of the students before and after the treatment their background knowledge should be taken into account not only for algebra but also for other topics in mathematics. If the sample has a weak backgroud in mathematics, the test items interrelated to these topics should be taken away. The students may get the algebraic calculations well but they have problems in integrating it to the geometry because their geometry background was so poor.

5.2 The Impact of Software on their Achievement

It was observed that the main problem in equations generally was sourced from the symbolic representations. In different equations the variables have different functions. For instance, in 2x+5=7 x has a unique to validate the equation, but in x=v.t x represents the distance and its value depends on the time velocity. The students cannot perceive the letters as representative form of the variables since they were not so successful in distance problem in the treatment just like the related literature (Haimes, 1993; Küchemann, 1981; Janvier, Girardon, & Morand, 1993). At the end, they related it with science lesson and completed the activity, but in general apart from science formulas that included the velocity, distance or the time, the students did not generalize the letter in mathematics in equations. In particular, the students did not think the representative property of the variables. They categorized the formulas and equations separately. An activity that presents the x symbol both as a variable and as a representation of a general value; (for instance, distance) can be useful for comparing these two concepts. Indeed, the activities in electronic material for algebra lessons are better to be designed as presenting the topic conceptually with representative examples rather than lots of exercises. After the topic, the exercises may be added. These exercises should be more on verbally presented problems, because the students' diagnostic test papers showed that they could think more on the symbolical problems than verbal problems before and after the treatment. In analyzing the test papers it was observed that the students made more calculations in first parts (symbolical parts) than the second parts (verbal part). Indeed, students could start to think about anything about the solution of the symbolically represented problems. However, in word problems, many of them generally stood and waited for the teacher to give them direction. In brief, the students are more successful in numerical and symbolically represented problems than the problems given in context .In the literature; it is also found that the students were more successful in symbolic problems than word problems (Nathan & Koedinger, 2000). Hence, the word problems or the problems presented in context in materials should be prepared in the aim of forcing the students make thinking on the solutions of these problems.

The treatment included exercises in activities that expected to be solved by the students in computer laboratory. For instance, the students were expected to solve the equation and calculated the x value. It was observed that the students needed to use paper and pencils in order to calculate the wanted value and then signed it to the computer just like the results of a similar study in literature (Kieran & Drijvers, 2006). Hence, the students were not so comfortable in making calculation with paper pencil while sitting on a chair in front of the keyboard. By this way, instead of teaching and learning mathematics on computers easier than the traditional methods, the students struggle in doing computations on their keyboards with paper and pencil. This is another issue to be taken into account in designing activities for teaching and learning mathematics on computers.

5.3 Technological Problems Encountered in the Treatment with Computers

There were problems with the software and the computers in the implementation of the treatment. The students were to deal with these problems. The students who were good in using computer and finding several options in dealing with such problems could easily accomplish the tasks, whereas the others were trying to solve their problems and they wanted help from the teacher. The results may be different if the students were at the same level in using computers. The literature tells about the point that it is better to train the students in using computers before these kinds of treatments of computer-assisted instruction (Bookman & Malone, 2003 cited in Selden; Dubinsky, Harel, & Hitt, 2003). The computers in the laboratory were not regularly checked whether or not they work properly. Therefore, the preceding questions of the students came from using keyboard or mouse in order to deal with these problems as happened in similar studies in the literature (Jean, Delozanne, Jacoboni, Grugeon, 1998). Because of the problems with the computers the students lost their high motivation to the laboratory works, even if these problems were solved in shortest time. In that respect the literature indicates that for use of computer based activities in optimum level the students and the teachers know how to use the software and computer effectively (Pierce & Stacey, 2004). This affected the performance of the students in the treatment. The students who had to deal with the problems about usage of the computers could be more successful if they were to deal with the activities on computer.

Unless the teachers design their instruction methods in the light of the students' perception of mathematical concepts, better understanding is not seemed to be possible. Therefore, the literature tells that, the students' perception of the mathematics will direct the teachers in deciding the way of their instruction (Stacey & Macgregor, 2000). The performance of the students directly related to how the teachers' instruction methods meet the students' needs. Hence, the mathematics set and the web sites in the instruction in this study were used in the aim of visualizing the mathematics. Indeed, according to the observations the students were far from mathematics because they could not imagine what they learn. By means of computer-assisted instruction they became closer to mathematics but it was not sufficient to remedy their misconceptions because of problems they met in the laboratory and their perception about the computers, as they cannot be tools for learning. If the electronic material in the treatment is more detailed and rich the performance of the students was beyond developing positive feelings to mathematics, the students' misconceptions may be remedied.

5.4 Comparison of High-Low Achievers

The perception of the students about the computers and algebra changed after the treatment. For instance, the students were observed as searching for more mathematics topics on Internet and they told the treatment process was exciting (see Appendix F). The students came and told the researcher that apart from equations they found websites about the new topic they were presented after the equations. They visited these websites, as they realized that Internet could be used for learning mathematics in addition to making researches for the homework. The students told in that these sites were helpful. Also in the similar Turkish literature, the students told that the treatment was helpful (Özgün-Koca, 2001). Moreover, it is known that generally the students do not like x in the operations. In contrast, on computers the students did not develop such a negative feeling to the x value. Even in the interviews they told that they prefer using x and y in solving equations (see Appendix F). However, the treatment was not so effective for the low-achieving students. As the literature tells the cognitive maturation of the students are effective in the success of the students in treatment (Bang, 1999). Also, the literature provides us with the results that this kind of computer-based treatments in equations may not be effective for low-achieving students (Chazan, 1996).

5.5 The Role of Cooperative Work in Computer-Assisted-Instruction

The seventh graders in this study were a special property that they were so talkative and easily distracted students in all the lessons. However; while the students were working on computers, they were as quiet as they never be before. They were concentrated on the activities. Indeed, they were not interested in the lessons in such a manner in the classroom work before. That was sourced from the electronic materials, the Mathematics Set used in the treatment and the benefit of the cooperative work in computer-assisted instruction. The students helped each other, instead of talking about unnecessary things.

5.6 Implications

This research, which searches the effect of computer-supported-treatment on remedying and preventing the students' misconceptions in equations, has implications for teachers, teacher educators and curriculum writers. If any teacher, researcher or curriculum developers wish to enrich the mathematics-learning environment with software; there were some important points to insist on. One of them is such that, if the software activities prepared for mathematics lesson should be strictly in line with the curriculum, it may be better for the students in perceiving the laboratory work as lesson. As the background and ideas of the students are so limited among the computers and the Internet in Turkey, the structure of the software using in lesson is so important. Apart from being parallel with the curricula, the software may be interesting, enjoyable and make the students feel that they are in the lesson.

The Internet networks in school laboratories are not so strong and fast in Turkey, it will be easier to use software, which is set by using simple programs. Hence, the teachers, who want to use Internet or software programs in lessons, should be sure that their laboratory has a speedy network and their computers are prepared to work with the indented software. Furthermore, the students may be informed about the usage of the computers in the lessons. In fact, the students and the teachers should practice in computer usage before implementing such a treatment.

5.7 Recommendations for Further Research

This study includes treatment of computer-assisted instruction in remedying and preventing the misconceptions of the students in equations. It may be better measured if the treatment is full computer-based instruction rather than computer-assisted instruction. In this study, the benefit and effect of the software is studied in partial. However, if the treatment was fully in laboratory the effectiveness may be observed and measured clearer.

The problems with the structure of software affect the results of the study. Hence, any effective and convenient software can be designed for use in mathematics classes in equations in father research.

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APPENDICES

APPENDIX A

MATHEMATICS ATTITUDE SCALE
(MATEMATİK TUTUM ÖLÇEĞİ ANKET)

	Kesinlikle katılmıyorum	Katılmıyorum	Bilmiyorum	Katılıyorum	Kesinlikle katılıyorum
1) Matematik beni hiç korkutmaz.					
2) Bazı insanların matematiğe nasıl bu kadar zaman harcadıklarını ve bundan hoşlandıklarını anlamıyorum.					
3) Matematik dersi genellikle benim için kolay geçer.					
4) Matematik dersi benim için eğlenceli ve heyecan vericidir.					
5) Matematik bulmacaları sıkıcıdır					
6) Matematik beni zorlar ve aklımı karıştırır					
7) Matematik dersi eğer bir soru cevaplanmadan bırakılmışsa dersten sonra onun hakkında düşünmeye devam ederim.					
8) Matematik kendimi rahatsız, yorgun, sinirli ve sabırsız hissetmeme neden olur					

9) Matematik sınavları beni korkutur					
10) Matematik problemlerinin beni geliştirdiğine inanıyorum ama hemen anlayamıyorum					
11) Matematik bulmacalarını seviyorum					
12) Bir matematik problemi ile karşılaştığımda hemen çözemiyorum, çözümü bulana kadar uğraşıyorum					
13) Matematik dersimizin sayısı artsa sıkılmam					
14) Matematik problemlerini çözmek bana göre hiç çekici değil					
15) Zor matematik problemlerinde kendi başıma uğraşmak yerine birinin çözümü vermesini tercih ederim……					
16) Matematik problemlerinin bize sundukları ve faydaları bana hiç çekici gelmiyor					
17) Zor matematik problemlerini çözmeye çalışırken boğuluyor gibi oluyorum					
18) Genellikle matematik problemlerini çözebilme konusunda endişeli değilim					
19) Genellikle matematik sınavları bana kolay gelir					
20) Matematik sınavlarında hiçbir zaman kafam allak bullak olmaz					
21) Matematik çalışırken net düşünemiyorum kafam karışıyor					
22) Matematiğe mümkün olduğunca az çalışırım					
23) Genellikle matematik rahatsız ve sinirli hissetmeme neden olur					
24) Bir kere bir matematik bulmacasıyla uğraşmaya başladım mı bırakamıyorum					

APPENDIX B

PRETEST
(KAVRAM YANILGILARI TESTİ 1)

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. $\dfrac{c-d}{\frac{1}{d}-\frac{1}{c}} = ?$ (5 puan)

a) $\dfrac{c-d}{d.c}$ b) $\dfrac{d.c}{c-d}$ c) d · c d) –d · c e) $\dfrac{1}{d.c}$

2. Hangi ifade x^5 e eşittir? (5 puan)

a) x + x + x + x + x

b) x · x · 3x

c) $x \cdot x^4$

d) $x^2 + x^4$

e) 5x

3. Eşitlik, eşittir ifadesinin iki tarafının aynı değerde olmasıdır.

Örneğin, 3a = 2a + a ifadesi bir eşitliktir.

Aşağıdaki ifadelerin her iki tarafının eşit olup olmadığını birer cümle ile açıklayınız. (8 puan)

1) $\dfrac{1}{a+b} = \dfrac{1}{a} + \dfrac{1}{b}$ ……………………..

2) $\dfrac{1}{\frac{1}{a} + \frac{1}{b}} = \dfrac{a.b}{a+b}$ ……………………….

3) $\dfrac{1}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c}} = \dfrac{a.b.c}{a+b+c}$ ……………………….

4) $\dfrac{a+b}{c-d} = \dfrac{a}{c.d} + \dfrac{b}{c.d}$ ……………………….

4. 4x – 6 = 3x + 8 denklemini çözünüz. (5 puan)

5. $\dfrac{y-b}{x-a}$ ifadesinin değerini y = 1, b = 3, x = 4, a = 7 için hesaplayınız. (5 puan)

6. Aşağıdaki tabloyu y = x + 2 denklemine göre doldurur musunuz!

İlk kutucuk örnek olarak gösterilmiştir. (4 puan)

x	**y**
2	4
4	?
5	?
7	?
10	?

7. Siz de böyle bir tablo oluşturur musunuz ! (10 puan)

x	**y**

(KAVRAM YANILGILARI TESTİ 2)

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. Aşağıdaki ifadeleri matematiksel ifadelere dönüştürünüz. (5 puan)

- x' in 2 katının 3 eksiği 15'tir =
- $\frac{2}{5}$ sinin 3 katından 7 eksiği 83 olan sayı b' dir =

2. Üç ardışık çift sayının toplamı 72 olduğuna göre bu sayıları bulunuz. (5 puan)

3. Bir üniversitede profesör sayısının altı katı kadar öğrenci vardır. Öğrenci ve profesör sayıları arasındaki ilişkiyi bir denklemle ifade ediniz. (5 puan)
(At this university there are six times as many students as professors." Use *S* for the number of students and *P* for the number of professors.)

4. Aralarında 600 km fark olan iki araç birbirlerine doğru geliyorlar. Hızları 70 km/sa ve 80 km/sa olduğuna göre kaç saat sonra karşılaşırlar? (5 puan)

- Bu iki araç aynı yönde gitselerdi hızlı olan önde yavaş olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi? Açıklayınız.
- Bu iki araç aynı yönde gitselerdi yavaş olan önde hızlı olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi? Açıklayınız.

5. Aynı anda, aynı şehirden ters yönde hareket eden araçlardan birinin saatteki hızı 70 km, diğerinin 60 km.dir. 4 saat sonra bu iki araç arasındaki uzaklık kaç km. olur? (5 puan)
a) 500 b) 520 c) 510 d) 530 e) 540

6. İki kız kardeşten biri diğerinden 5 yaş büyüktür. Bu kardeşlerin yaşları toplamı 45 olduğuna göre: (5 puan)

a) Abla kaç yaşındadır?

b) 7 sene sonra aralarındaki yaş farkı kaç olur?

c) Bu sorunun başka çözüm yolu var mı? Nasıl?

7. Birer sene ara ile doğmuş olan üç kardeşin yaşları toplamı 30 ‘dur. Bu kardeşlerden en büyüğünün yaşını hesaplayınız. (5 puan)

8. Boş bir havuzu 1.musluk 18 saatte 2.musluk 36 saatte dolduruyor. İki musluk birlikte boş havuzu kaç saatte doldurur? (5 puan)

a)12 b)11 c)10 d)13 e) 15

9. Bir işi 1. işçi 20 günde, 2. işçi 15 günde bitiriyor. İki işçi birlikte aynı işi kaç günde bitirir? (5 puan)

a) $10\frac{1}{3}$ b) $7\frac{1}{2}$ c) $4\frac{3}{4}$ d) $8\frac{4}{7}$ e) $15\frac{2}{8}$

10. Bir kenarı a+2 olan bir karenin alanını a cinsinden hesaplayınız. (5 puan)

APPENDIX C

POSTTEST

(KAVRAM YANILGILARI TESTİ 3)

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. $\dfrac{a-b}{\frac{1}{b}-\frac{1}{a}} = ?$ (5 puan)

a) $\dfrac{a-b}{b.a}$ b) $\dfrac{b.a}{a-b}$ c) b.a d) –b.a e) $\dfrac{1}{b.a}$

2. Hangi ifade a^5 e eşittir? (5 puan)

a) a + a + a + a + a

b) a · a · 3a

c) $a \cdot a^4$

d) $a^2 + a^4$

e) 5a

3. Eşitlik, eşittir ifadesinin iki tarafının aynı değerde olmasıdır.

Örneğin, $3a = 2a + a$ ifadesi bir eşitliktir.

Aşağıdaki ifadelerin her iki tarafının eşit olup olmadığını birer cümle ile açıklayınız. (8 puan)

1) $\frac{1}{c+d} = \frac{1}{c} + \frac{1}{d}$ …………………

2) $\frac{1}{\frac{1}{c}+\frac{1}{d}} = \frac{c.d}{c+d}$ …………………………….

3) $\frac{1}{\frac{1}{c}+\frac{1}{d}+\frac{1}{e}} = \frac{c.d.e}{c+d+e}$ …………………………

4) $\frac{c+d}{e-f} = \frac{c}{e.f} + \frac{d}{e.f}$ ……………………………

4. $6x - 8 = 5x + 10$ denklemini çözünüz. (5 puan)

5. $\frac{z-d}{w-c}$ ifadesinin değerini $z = 1$, $d = 2$, $w = 3$, $c = 2$ için hesaplayınız.(5 puan)

6. Aşağıdaki tabloyu $y = x - 2$ denklemine göre doldurur musunuz!

İlk kutucuk örnek olarak gösterilmiştir. (4 puan)

x	**y**
2	0
4	?
5	?
7	?
10	?

7. Siz de böyle bir tablo oluşturur musunuz ! (10 puan)

x	**y**

(KAVRAM YANILGILARI TESTİ 4)

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. Aşağıdaki ifadeleri matematiksel ifadelere dönüştürünüz. (5 puan)

a) y'in 3 katının 2 eksiği 52'dir =

b) $\frac{2}{5}$ sinin 5 katından 8 eksiği 38 olan sayı c'dir =

2. Üç ardışık tek sayının toplamı 51 olduğuna göre bu sayıları bulunuz. (5 puan)

3. Bir üniversitede profesör sayısının altı katı kadar öğrenci vardır. Öğrenci ve profesör sayıları arasındaki ilişkiyi bir denklemle ifade ediniz. (5 puan)

(At this university there are six times as many students as professors." Use *S* for the number of students and *P* for the number of professors.)

4. Aralarında 500 km fark olan iki araç birbirlerine doğru geliyorlar. Hızları 70 km/sa ve 30 km/sa olduğuna göre kaç saat sonra karşılaşırlar? (5 puan)

- Bu iki araç aynı yönde gitselerdi hızlı olan önde yavaş olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi? Açıklayınız.
- Bu iki araç aynı yönde gitselerdi yavaş olan önde hızlı olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi? Açıklayınız.

5. Aynı anda, aynı şehirden ters yönde hareket eden araçlardan birinin saatteki hızı 50 km, diğerinin 30 km.dir. 3 saat sonra bu iki araç arasındaki uzaklık kaç km. Olur? (5 puan)

a) 200 b) 240 c) 210 d) 230 e) 800

6. İki kız kardeşten biri diğerinden 4 yaş büyüktür. Bu kardeşlerin yaşları toplamı 54 olduğuna göre: (5 puan)

a) Abla kaç yaşındadır?

b) 9 sene sonra aralarındaki yaş farkı kaç olur?

c) Bu sorunun başka çözüm yolu var mı? Nasıl?

7. Birer sene ara ile doğmuş olan üç kardeşin yaşları toplamı 63'tür.Bu kardeşlerden en büyüğünün yaşını hesaplayınız. (5 puan)

8. Boş bir havuzu 1.musluk 18 saatte 2.musluk 9 saatte dolduruyor. İki musluk birlikte boş havuzu kaç saatte doldurur? (5 puan)

a)6 b) 8 c) 10 d) 9 e) 15

9. Bir işi 1. işçi 18 günde, 2. işçi 9 günde bitiriyor. İki işçi birlikte aynı işi kaç günde bitirir? (5 puan)

a) 9 b) 8 c) 10 d) 6 e) 15

10. Kısa kenarı a+1 ve uzun kenarı a+2 olan bir dikdörtgenin alanını a cinsinden hesaplayınız.(5 puan)

APPENDIX D

DELAYED-POST TEST

(KAVRAM YANILGILARI TESTİ 5)

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. $\dfrac{e-f}{\dfrac{1}{f}-\dfrac{1}{e}} = ?$ (5 puan)

a) $\dfrac{e-f}{f.e}$ b) $\dfrac{f.e}{e-f}$ c) f.e d) –f.e e) $\dfrac{1}{f.e}$

2. Hangi ifade b^5 e eşittir ? (5 puan)

a) b + b + b + b + b

b) b · b · 3b

c) $b \cdot b^4$

d) $b^2 + b^4$

e) 5b

3. Eşitlik, eşittir ifadesinin iki tarafının aynı değerde olmasıdır.

Örneğin, 3a = 2a + a ifadesi bir eşitliktir.

Aşağıdaki ifadelerin her iki tarafının eşit olup olmadığını birer cümle ile açıklayınız. (8 puan)

1) $\frac{1}{e+f}=\frac{1}{e}+\frac{1}{f}$ ………………………………..

2) $\frac{1}{\frac{1}{e}+\frac{1}{f}}=\frac{e.f}{e+f}$ ………………………

3) $\frac{1}{\frac{1}{e}+\frac{1}{f}+\frac{1}{g}}=\frac{e.f.g}{e+f+g}$ ………………………………

4) $\frac{e+f}{e-f}=\frac{e}{e.f}+\frac{f}{e.f}$ ……………………………

4. 3x – 8= 4x + 6 denklemini çözünüz. (5 puan)

5. $\frac{g-e}{m-y}$ ifadesinin değerini y = 1, g = 3, e = 4, m = 7 için hesaplayınız.(5 puan)

6. Aşağıdaki tabloyu y = 2 ·x denklemine göre doldurur musunuz!

İlk kutucuk örnek olarak gösterilmiştir. (4 puan)

x	**y**
2	4
4	?
5	?
7	?
10	?

7. Siz de böyle bir tablo oluşturur musunuz ! (10 puan)

x	y

(KAVRAM YANILGILARI TESTİ 6)

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. Aşağıdaki ifadeleri matematiksel ifadelere dönüştürünüz. (5 puan)

a) y'in 3 katının 2 eksiği 15'tir =

b) $\frac{2}{5}$ sinin 7 katından 3 eksiği 83 olan sayı w'dur =

2. Üç ardışık çift sayının toplamı 84 olduğuna göre bu sayıları bulunuz. (5 puan)

3. Bir üniversitede profesör sayısının altı katı kadar öğrenci vardır. Öğrenci ve profesör sayıları arasındaki ilişkiyi bir denklemle ifade ediniz. (5 puan)

(At this university there are six times as many students as professors." Use *S* for the number of students and *P* for the number of professors.)

4. Aralarında 800 km fark olan iki araç birbirlerine doğru geliyorlar. Hızları 70 km/sa ve 90 km/sa olduğuna göre kaç saat sonra karşılaşırlar? (5 puan)

- Bu iki araç aynı yönde gitselerdi hızlı olan önde yavaş olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi? Açıklayınız.
- Bu iki araç aynı yönde gitselerdi yavaş olan önde hızlı olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi? Açıklayınız.

5. Aynı anda, aynı şehirden ters yönde hareket eden araçlardan birinin saatteki hızı 50 km, diğerinin 40 km.dir. 3 saat sonra bu iki araç arasındaki uzaklık kaç km. Olur? (5 puan)

a) 500 b) 270 c) 150 d) 350 e) 450

6. İki kız kardeşten biri diğerinden 7 yaş büyüktür. Bu kardeşlerin yaşları toplamı 55 olduğuna göre: (5 puan)

a) Abla kaç yaşındadır?

b) 5 sene sonra aralarındaki yaş farkı kaç olur?

c) Bu sorunun başka çözüm yolu var mı? Nasıl?

7. Birer sene ara ile doğmuş olan üç kardeşin yaşları toplamı 81‘dur.Bu kardeşlerden en büyüğünün yaşını hesaplayınız. (5 puan)

8. Boş bir havuzu 1.musluk 12 saatte 2.musluk 24 saatte dolduruyor. İki musluk birlikte boş havuzu kaç saatte doldurur? (5 puan)

a) 8 b) 12 c) 24 d)10 e) 15

9. Bir işi 1. işçi 12 günde, 2. işçi 24 günde bitiriyor. İki işçi birlikte aynı işi kaç günde bitirir? (5 puan)

a) $10\frac{1}{3}$ b) 12 c) $4\frac{3}{4}$ d) 8 e) $15\frac{2}{8}$

10. Bir kenarı a+2 olan bir karenin alanını a cinsinden hesaplayınız.(5 puan)

APPENDIX E

INTERVIEW PROTOCOL

1. Evinizde bilgisayar var mı? (Do you have computer at home?)
2. Evinizde Internet var mı? (Do you have Internet at home?)
3. Internet kafelere gidiyor musun? Neden? Ne sıklıkta? (Do you go to Internet cafe? Why? How often?)
4. Bilgisayar kullanabiliyor musun? (Can you use computer?)
5. Bilgisayarda neler yapıyorsun? (What kind of things you do by computers?)
6. Hangi programları kullanıyorsun? (Which programs can you use on computers?)
7. Ne kadar sıklıkta bilgisayar kullanıyorsun? (How often do you use computers?)
8. Ne amaçla bilgisayar kullanıyorsun ? (What purpose do you have for using computers?)
9. x ve y nedir sence ? (What means x and y for you?)
10. Problemleri x ve y'li çözmek mi daha kolay yoksa denklem kullanmadan ya da x,y,a,b,c, kullanmadan çözmek mi ? (Which one is easier solving problems with x,y,a,b,c or without any letter or equation?)
11. Kavram yanılgıları testini çözmekte yardımcı oldu mu laboratuvar çalışmalarında yaptıklarımız? (Was the laboratory work helpful for you in solving diagnostic test?)
12. Bilgisayar laboratuvarına gitmeyi seviyor musun? (Do you like going to computer laboratory?)
13. Konu mu yoksa sorular mı daha iyi anlatılıyor kullandığımız matematik setinde ve sitesinde? (Which one subject matter or questions is better explained in mathematics set and website?)

14. Laboratuvar çalışmalarımız yani setimiz matematik sitelerimiz konuyu anlaman için yeterli geldi mi? (Is the laboratory work I mean set and the mathematic web sites enough for you to understand the subject?)
15. Sınıf ve laboratuvar ortamını karşılaştırırsan hangisi daha iyi? Neden? (Which one is better if you compare classroom or laboratory? Why?)
16. Laboratuvar çalışmalarında en çok ilgini çeken ve en iyi anladığın kısım hangisiydi? (What is your most favorite subject or problem and which subject or problem do you understand best in laboratory work?)
17. Bir matematik konusunu anlayabilmek için sadece laboratuvarda mı öğrenelim, sadece sınıfta mı, yoksa hem laboratuvarda hem sınıfta mı? (Where do you prefer best to learn only in laboratory, only in classroom or both of them?)
18. Beraber çalıştığın arkadaşın laboratuvar çalışmaları sırasında sana yardımcı oldu mu? Sen ona yardımcı olduğunu düşünüyor musun? (Do you get help from your partner in laboratory work or do you think that you help her or him?)
19. Laboratuvarda benim direktiflerimi takip ettin mi? (Do you follow up my directions in laboratory?)
20. Laboratuvar çalışmalarımız sırasında karşılaştığımız teknolojik sorunlar hakkında ne düşünüyorsun? (What do you think about the technological problems of the computers in laboratory work?)
21. Matematik öğretimiyle ilgili bir set ya da web sitesi hazırlasan etsen nasıl olurdu? (If you design a mathematics teaching set or website how would it be?)
22. 5a artı 7 kaç eder? (What is 5a plus 7?)
23. 5x artı 7 kaç eder? (What is 5x plus 7?)
24. 5a artı 7a kaç eder? (What is 5a plus 7a?)
25. 5x artı 7x kaç eder? (What is 5x plus 7x?)
26. Bir annenin yaşı kızının yaşının 3 katı ise bunu harflerle nasıl ifade ederiz? (How do we represent if the age of mother is 3 times of her daughter?)

APPENDIX F

COMMON POINTS OF THE INTERVIEW PROTOCOL

Below the common points of the students' answers given for the interview questions are represented. The number, given in parenthesis at the end of each phrase, indicates how many students used this phrase in the interviews.

1. Yes, we have personal computer at home. (4)
2. No, we do not have Internet at home. (3)
3. I write on the computer what we do in the lesson in equations for instance. (2)
4. I use WordPad and excel. (3)
5. I sometimes or rarely use computer. (1)
6. I use computer for learning. (1)
7. X and y are used instead of unknowns in equations. (7)
8. I prefer using x and y in solving problems because it is easier. (10)
9. Using computer is exciting. (13)
10. It's noisy in the classroom. I cannot understand the lesson. (5)
11. Answering questions is exciting at computer. (1)
12. Solving problems by paper, pencil is boring. (1)
13. I can understand better and find answers to my questions in computer environment. (4)
14. Using computer is an active action. (2)
15. By solving problems in an interactive environment I can learn better. (2)
16. I can be more successful in the diagnostic test after we do the lesson in computer environment. (4)
17. The computer programs are colored. (1)
18. It is better to do lesson both at classroom and at computer laboratory. (9)
19. I prefer interactive lesson subjects in computer rather than traditional essay type questions in the mathematics set or website. (2)

20. The problems with the hardware of the computers are not good. (8)
21. I follow up the teacher’s directions at computer laboratory. (11)
22. My partner does not help me in computer laboratory. (3)
23. I help my partner in computer laboratory. (8)
24. I feel more comfortable in asking my questions in computer laboratory. (1)
25. No, we do not have computer at home. (12)
26. I do not go to Internet cafe. (1)
27. X and y tell us how to solve an equation. (2)
28. Computer is better because there is visual explanation. (6)
29. The main topic is better explained than the questions in computer. (1)
30. I prefer computer because of questions in it. (1)
31. I prefer answering questions rather than reading the subject in computer. (1)
32. If I design a mathematics set or mathematics website I will put questions in colored and with voice. (5)
33. I go to Internet cafe (at weekends). (9)
34. I use Internet for research for my performance, project homework. (13)
35. I can use computer. (2)
36. I prefer to be in the classroom rather than in computer laboratory. (4)
37. Interactive problems at computer are exciting. (1)
38. I like going to computer laboratory. (9)
39. The content of the Internet site and mathematics set is enough. (1)
40. I prefer to be in the computer laboratory rather than in classroom. (7)
41. My partner helps me in the computer laboratory. (10)
42. I cannot use computer. (1)
43. Solving problems by x and y is difficult. (2)
44. The student prefers the socialization by his friends in the classroom rather than in computer laboratory. (2)
45. I prefer to be in the classroom because the teacher is lecturing. (3)
46. I prefer to be in the classroom because we solve more questions. (1)
47. I ask my questions and find answers in the classroom rather than in the computer laboratory. (3)

48. The content of the Internet site and mathematics set is not enough. (1)
49. I prefer to be in the classroom because we our mind can be mixed in computer activities. (1)
50. I prefer to be in the classroom because the computers have hardware problems. (2)
51. Any letter like x, y, z, a can be used instead of the unknown numbers in equations. (4)
52. I can understand the lesson in the classroom but not in the computer laboratory. (1)
53. The other properties of the computers distract me I mean I cannot concentrate on the lesson because of the properties of music, plays. (1)
54. I can use paint. (2)
55. I use Internet. (1)
56. I can use Microsoft word. (2)
57. I prefer studying by software rather than books at home while doing homework. (1)
58. I would prefer computer laboratory rather than classroom if I were able to use computer better. (1)
59. x, y, z only differ in their values I mean differ in numbers they represent. (1)
60. We have Internet at home. (1)

APPENDIX G

LESSON PLANS

DERS PLANI 1

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Matematiksel İfadeler

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 20.12.06

HEDEF: Matematiksel ifadeleri kavrayabilme

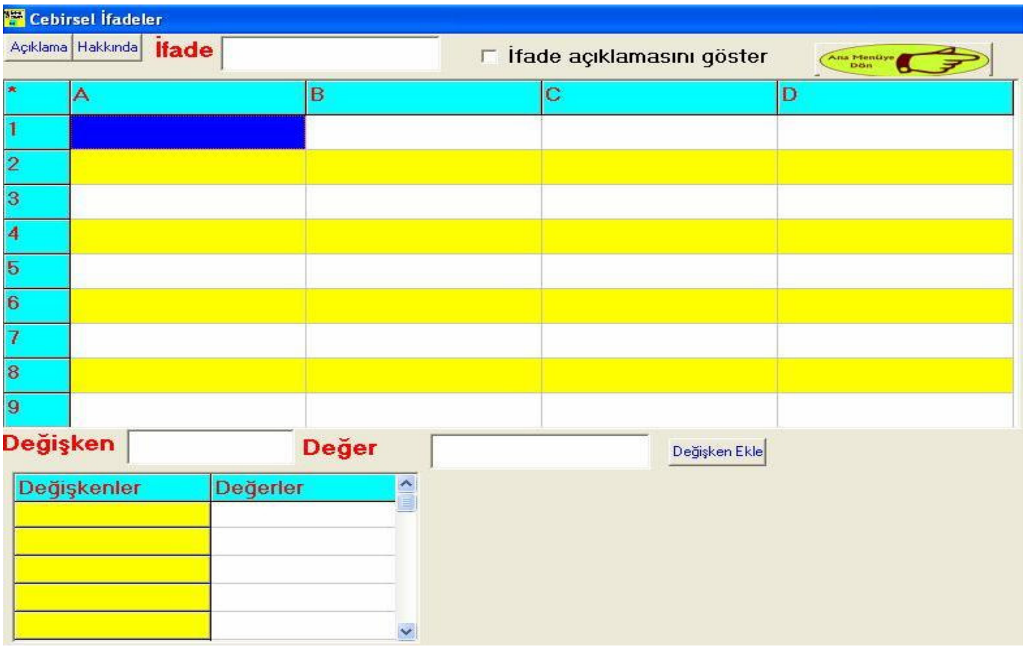
1. Bir sayının belirtilen bir sayı kadar fazlasını, eksiğini, katını, kesrini veya bunların birkaçını birlikte içeren ifadeyi sembollerle yazma
2. Sözlü olarak verilen bir ifadeyi sembollerle yazma

METOD: Bilgisayar destekli eğitim

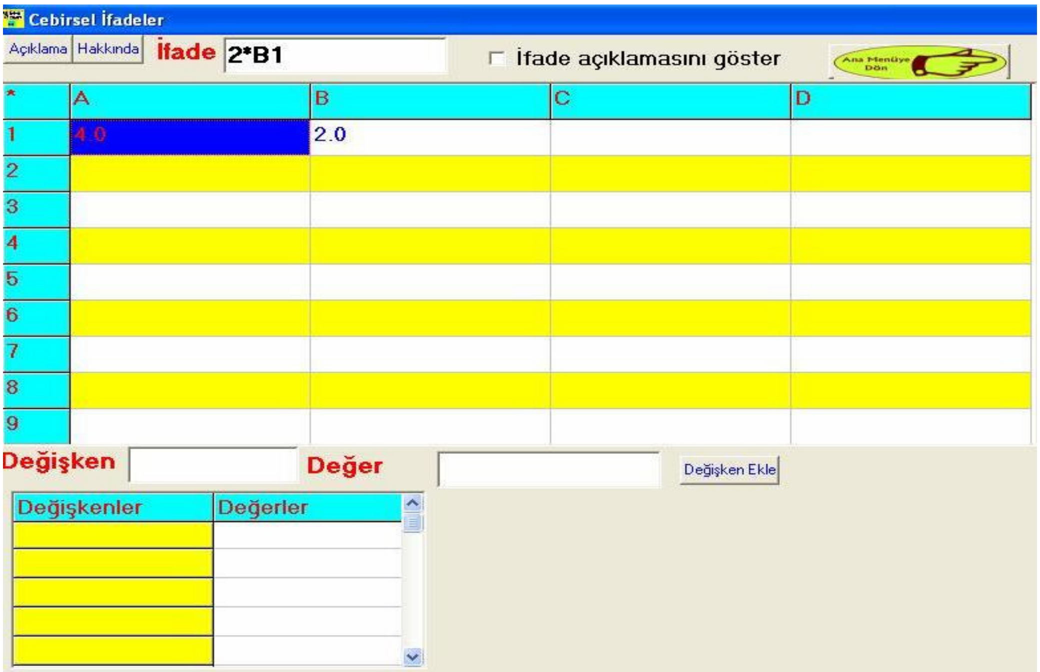
MATERYAL: Öğrenciler eşler halinde bilgisayarlara otururlar. Matematik Setinin Cebirsel İfadeler Etkinliği ile çalışılır.

ARAÇ-GEREÇ-KAYNAKÇA: Erol Karakırık tarafından hazırlanan Matematik Eğitimi Seti.

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Öğrencilerden bilgisayarlara daha göre yüklenmiş olan matematik setinin açılması istenir. Her öğrenci seti açtıktan sonra Cebirsel İfadeler Etkinliğini tıklamaları istenir. Öğrencilere etkinlik açıklanır. Eşlerden biri formülü yazıp, x değerlerini girerken; diğeri bu değerlere bağlı çıkan y değerlerine □ore formülü bulmaya çalışır. Örneğin, öğrenci 2x+1 ifadesini ekrandaki hücrelere □ore $2*A_1+1$ şeklinde yazar. A_1 x yerine girilecek olan hücrenin adıdır. Rastgele girilen değerlere göre diğer öğrenci bu formülü tahmin etmeye çalışır. Formüller geliştirilirken öğrencilere direktifler verilir. Bir sayının üç katının beş eksiği gibi.Bu direktifler örnek olarak tahtaya da yazılır. Öğrenciler çalışırken gözlemler ve kontroller yapılır. İkili diyalogları dinlenir. Örnekleri incelenir. Zorlandıkları noktalarda yardımcı olunur.



Cebirsel İfadeler
Açıklama
Hakkında
İfade
İfade açıklamasını göster
Değişken
Değişkenler
Değer
Cebirsel İfadeler
Cebirsel İfadeler...
Bu etkinlikte Bir hesap tablosu (spreadsheet) yardımıyla cebirsel ifadeler tanıtılır. Hesap tablosu benzeri bir yapı aracılığıyla hücreler arasında ilişki kurulması sağlanır. Mesela B1 hücresi 2*A1 hücresi olarak tanımlanabilir. Ayrıca ekranın altında hesaplamalarda kullanılacak farklı değişkenler de tanımlanabilir. İstenirse bir hücrenin güncel değeri ve tanımı aynı anda görülebilir. İfade kutucuğu hesap tablosundaki bir kutucuğun gerçek içeriğini göstermekte ve bu içeriğin hesaplanan değeri hesap tablosunda gösterilmektedir. İstenirse İfade açıklamasını göster
Bu ekranı kapatmak için ONAY(ENTER) tuşu , KAÇIŞ(ESC) tuşu veya BOŞLUK tuşuna basınız...



Cebirsel İfadeler
Açıklama
Hakkında
İfade
2*B1
İfade açıklamasını göster
4.0
2.0
Değişken
Değer
Değişken Ekle
Değişkenler
Değerler

BİREYSEL DEĞERLENDİRME: Çalışma ikili yapıldığı için öğrenciler birbirini değerlendirip sonucu öğretmene iletirler.

GRUP DEĞERLENDİRME: Ders sonu tartışmasında hemen her öğrenciye soru sorulur, dönüt alınır.

ÖDEV: Tüm laboratuvar etkinliklerini işlerken neler hissettikleri ve neler öğrendikleri hakkında bir ödev verilir. Ayrıca bu ödeve interaktif ortamda işlenen konuların ve soruların çözümleriyle beraber yazmaları istenir.

DERS PLANI 2

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Matematiksel İfadeler

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 21.12.06

HEDEF: Matematiksel ifadeleri kavrayabilme

1. Sembollerle verilen bir ifadeyi söyleme
2. Eşkenar üçgenin, karenin, düzgün beşgenin, dikdörtgenin, ikizkenar üçgenin ve düzgün altıgenin çevreleriyle kenarları arasındaki ilişkileri sembollerle yazma

METOD: Soru-cevap, tartışma

ARAÇ-GEREÇ-KAYNAKÇA: Ders kitabı

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Ders 1 de yapılan laboratuvar çalışması hatırlatılarak derse giriş yapılır. Sembollerle ifade edilen matematik cümlelerini söze, kelimelerle ifade edilen matematik cümlelerini sembollerlere çevirme işlemleri yapılır. Eşkenar üçgenin, karenin, düzgün beşgenin, dikdörtgenin, ikizkenar üçgenin ve düzgün altıgenin çevreleri sembollerle ifade edilir. Kenar uzunluğuna değer verilip çevre, çevreye değer verilip kenar uzunluğu bulunur. Arada kurulan ilişkinin matematiksel ifadesi konuşulur.

BİREYSEL DEĞERLENDİRME: Tek soruluk küçük sınav yapılır.

Soru: a’nın beş katının iki fazlasının üçte biri ifadesini matematiksel olarak ifade ediniz.

DERS PLANI 3

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Eşitliklerde Denge

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 27.12.06

HEDEF: Önerme, açik önerme ve denklemleri kavrayabilme

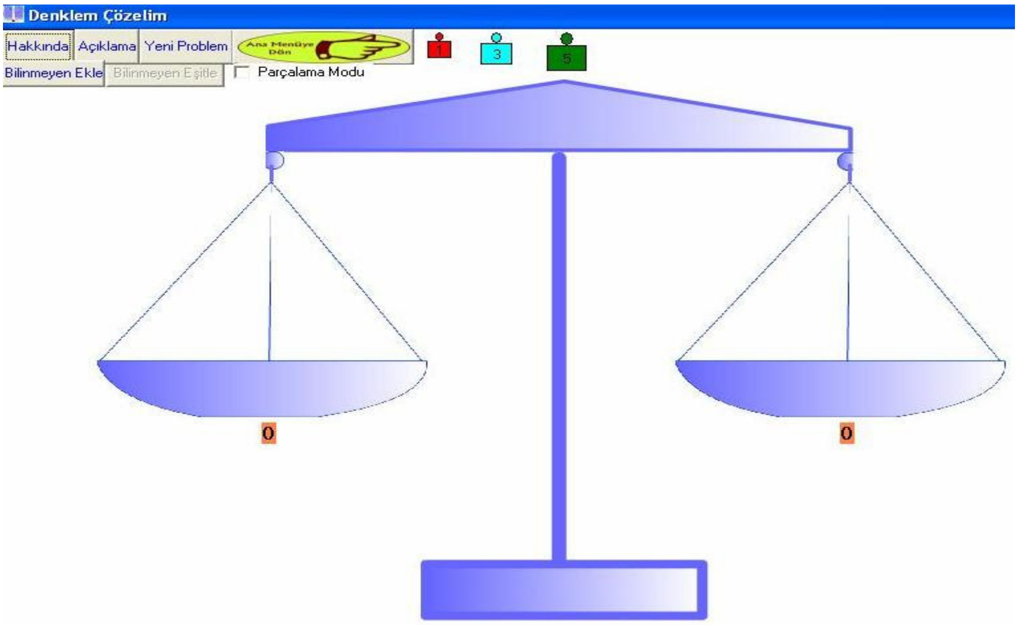
1. Denklemi açıklama
2. Birinci dereceden bir bilinmeyenli denklemi örneklerle açıklama
3. Birinci dereceden bir bilinmeyenli denklem yazma

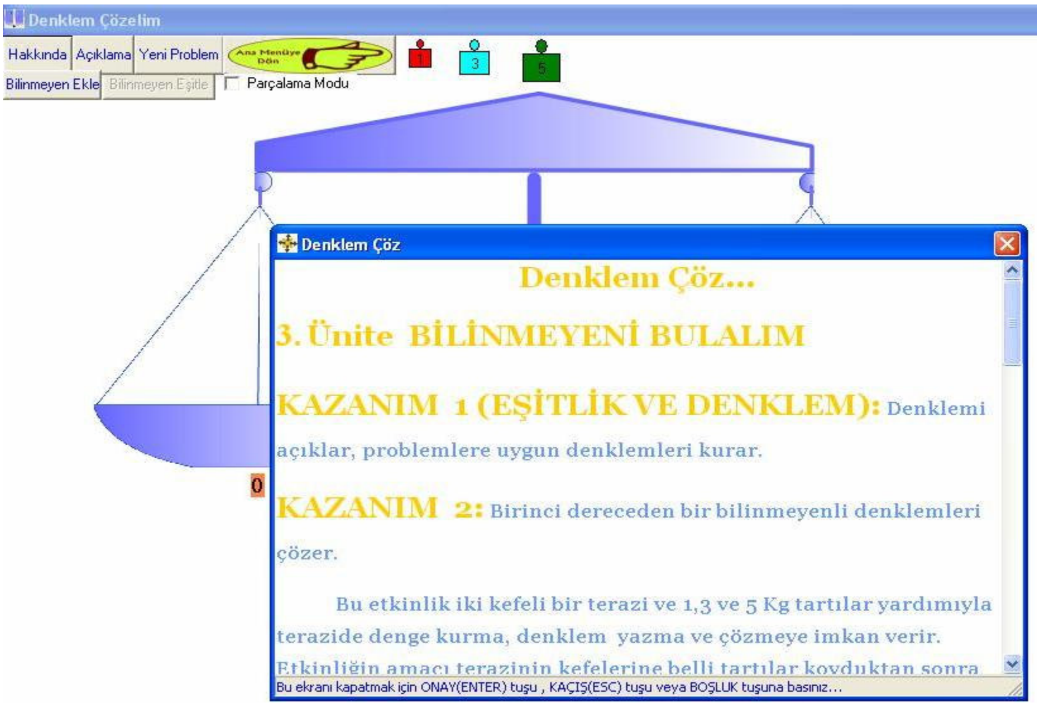
METOD: Bilgisayar destekli eğitim

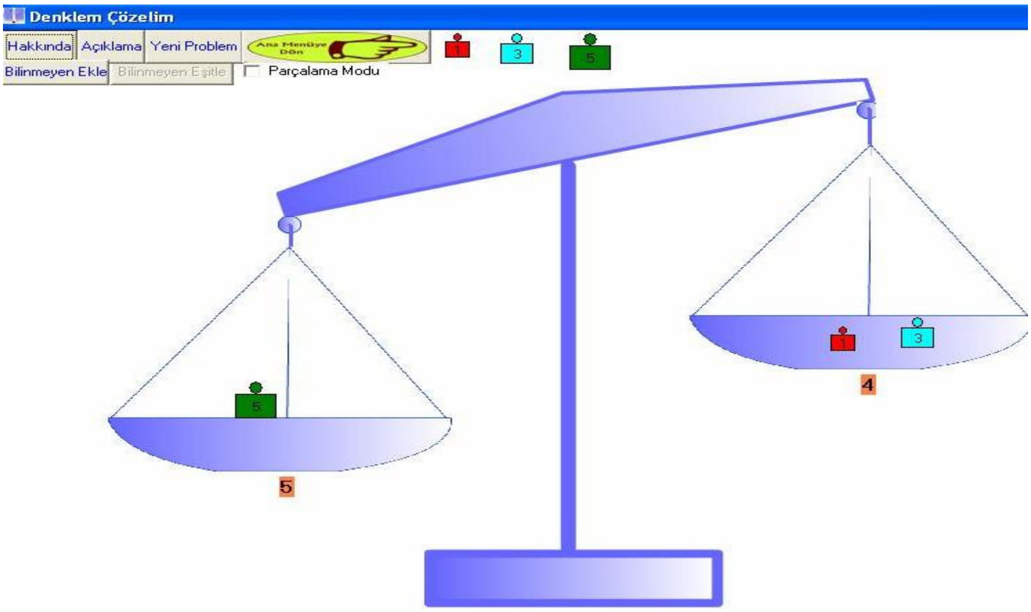
MATERYAL: Öğrenciler eşler halinde bilgisayarlara otururlar. Matematik Setinin Denge Etkinliği ile çalışılır.

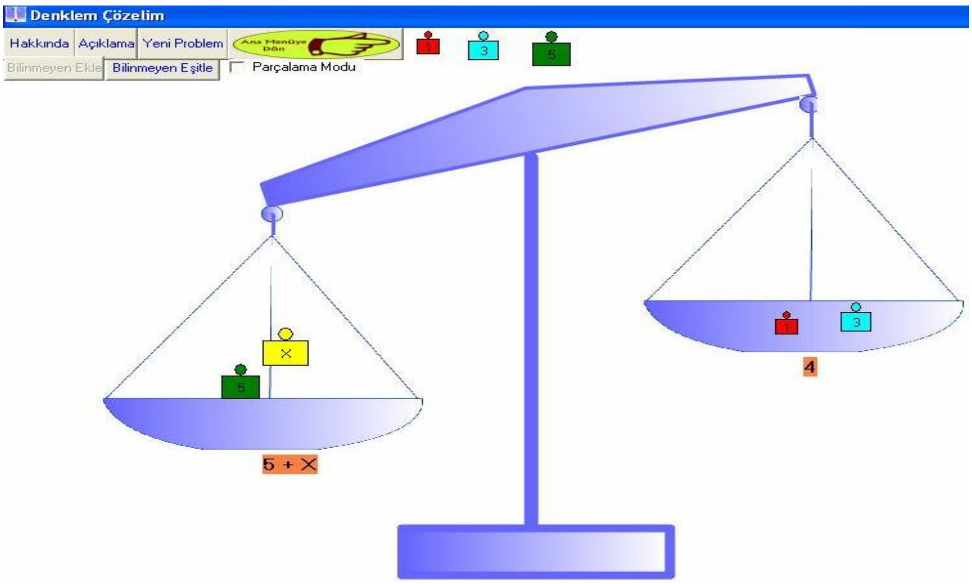
ARAÇ-GEREÇ-KAYNAKÇA: Erol Karakırık tarafından hazırlanan Matematik Eğitimi Seti.

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Öğrencilerden bilgisayarlara daha önce yüklenmiş olan matematik setinin açılması istenir. Her öğrenci seti açtıktan sonra Denge Etkinliğini tıklamaları istenir. Öğrencilere etkinlik açıklanır. Terazinin iki kefesine sayı ve bilinmeyen modelleri fare ile seçilerek tutulur ve istenilen kefeye bırakılıp denge kurulmaya çalışılır. Sayılar istenirse üzerine çift tıklanıp parçalanıp da kefelere yerleştirilebilir. Öğretmen denge modeli ile denklemlerdeki eşitlik kavramı arasındaki ilişkilendirmeyi yapabilmeleri için öğrencilere yardımcı olur, ipuçları verir, düşüncelerinde yönlendirmeler yapar.









BİREYSEL DEĞERLENDİRME: Çalışma ikili yapıldığı için öğrenciler birbirini değerlendirip sonucu öğretmene iletirler.

GRUP DEĞERLENDİRME: Ders sonu tartışmasında hemen her öğrenciye soru sorulur, dönüt alınır.

DERS PLANI 4

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Matematiksel İfadeler

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 28.12.06

HEDEF: Önerme, açik önerme ve denklemleri kavrayabilme

1. Önermeyi örneklerle açıklama
2. Verilen bir ifadenin önerme olup olmadığını sebebiyle birlikte söyleme
3. Sayılarla ilgili bir önerme söyleyip yazma
4. Sayılarla ilgili bir önermenin doğru veya yanlış olduğunu bulup söyleme
5. Açık önermeyi örneklerle açıklama
6. Açık önerme yazma
7. Verilen bir açık önermenin, sembollerin belirtilen değerlerine göre değerini bulup yazma
8. Verilen bir açık önermeyi doğru veya yanlış yapan değerleri bulup yazma
9. Birinci dereceden bir ve iki bilinmeyenli denklemleri örneklerle açıklama
10. Birinci dereceden bir ve iki bilinmeyenli denklemleri yazma

METOD: Soru-cevap, tartışma

ARAÇ-GEREÇ-KAYNAKÇA: Ders kitabı

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Ders 3'te yapılan laboratuvar çalışması hatırlatılarak derse giriş yapılır. Önerme açıklanırken güncel örnekler verilir ve öğrencilerden örnekler vermeleri istenir. Birinci dereceden bir bilinmeyenli ile iki bilinmeyenli denklem arasındaki fark açıklanır. Tahtaya örnekler yazılarak kaç bilinmeyenli denklem olduğunu bulmaları istenir.

BİREYSEL DEĞERLENDİRME: Tek soruluk küçük sınav yapılır.

Soru: Aşağıya bir bilinmeyenli birinci dereceden bir denklem yazınız.

DERS PLANI 5

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Denklem Kurma ve Çözme

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 04.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

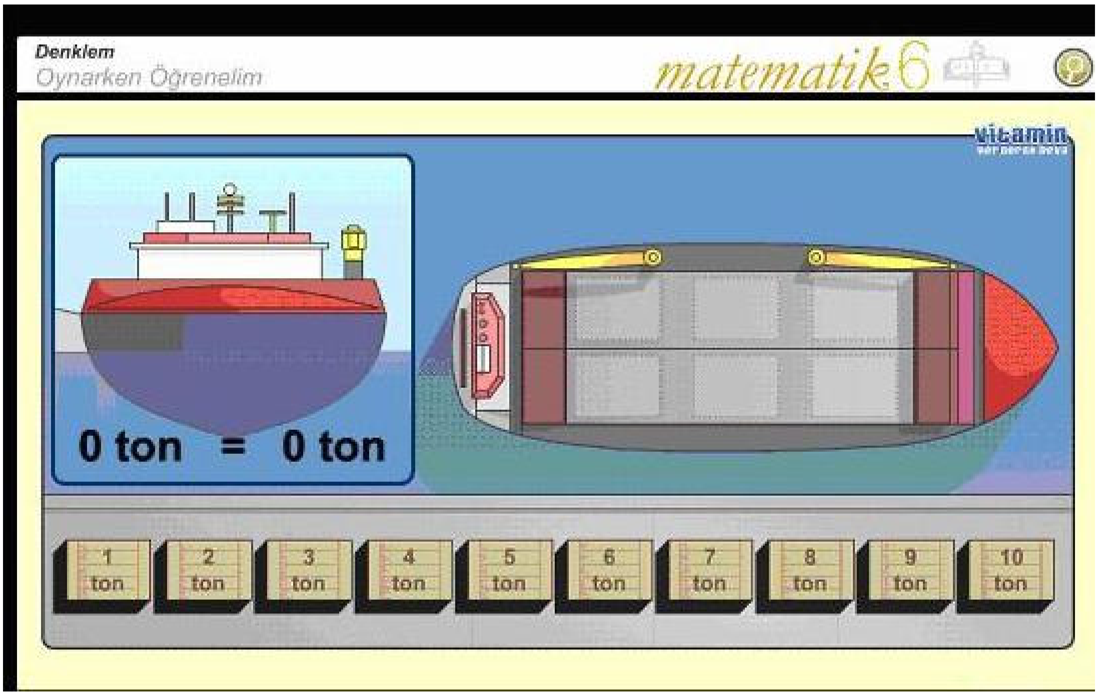
1. Bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme

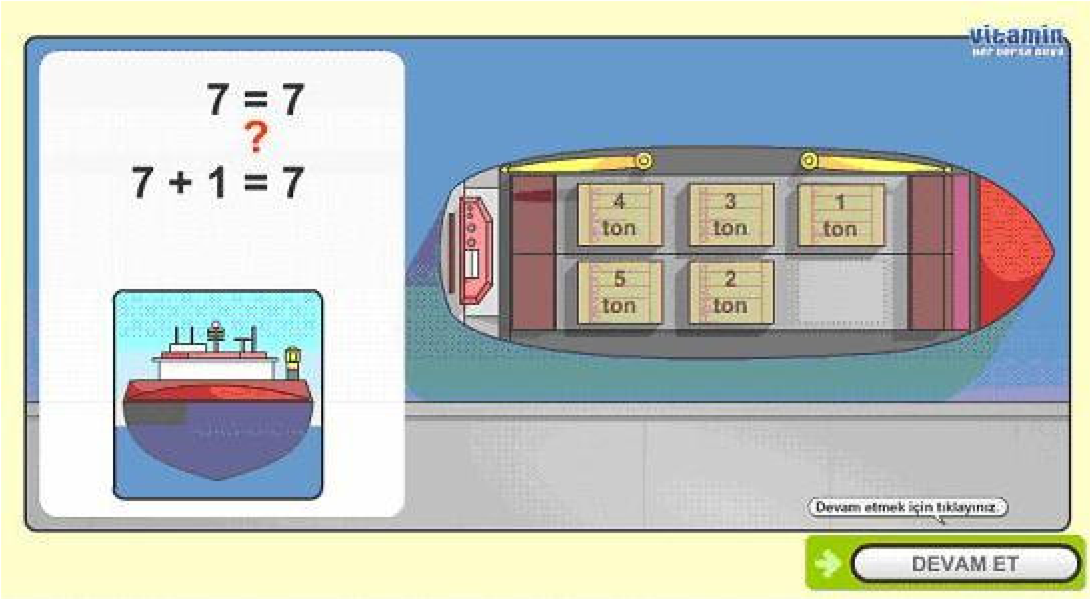
METOD: Bilgisayar destekli eğitim

MATERYAL: Öğrenciler eşler halinde bilgisayarlara otururlar. Millli Eğitim Bakanlığının sitesinin eğitim portalındaki cebir etkinliği ile çalışılır.

ARAÇ-GEREÇ-KAYNAKÇA: http://bep.meb.gov.tr/eicerikDis/default.aspx adlı web sitesi kullanılır. Öğrencilere etkinlikliğe girmekte kullanılan web sitesi adresinin ve tüm linklerin sırasıyla yazılı olduğu bir yönerge verilir.

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Öğrencilerden http://bep.meb.gov.tr/eicerikDis/default.aspx adlı siteye girmeleri istenir. Adresin yazımında zorlanan öğrencilere yardımcı olunur. Bu sitenin ilgili linklerinin yazılı olduğu yönerge kullanılır. Gemi problemi etkinliği açılır. Bu etkinlik appletin ilk etkinliğidir. Öğrencilere etkinlik açıklanır. Daha önce yapılan denge terazi etkinliği gibidir. Ancak bu defa geminin iki yanındaki yüklerin sayısal değeri eşitlik halinde yazılmıştır. Öğrencilerden bu yükleri seçip gemiye yerleştirerek dengeyi sağlamaları istenir. Daha sonra uzaklık problemi etkinliği tıklanarak seçilir. Yol formulü denklem halinde verilmiştir. Öğrencilerin yol-hız-zaman ilişkisi üzerine denklem kurarak çalışmaları istenir.

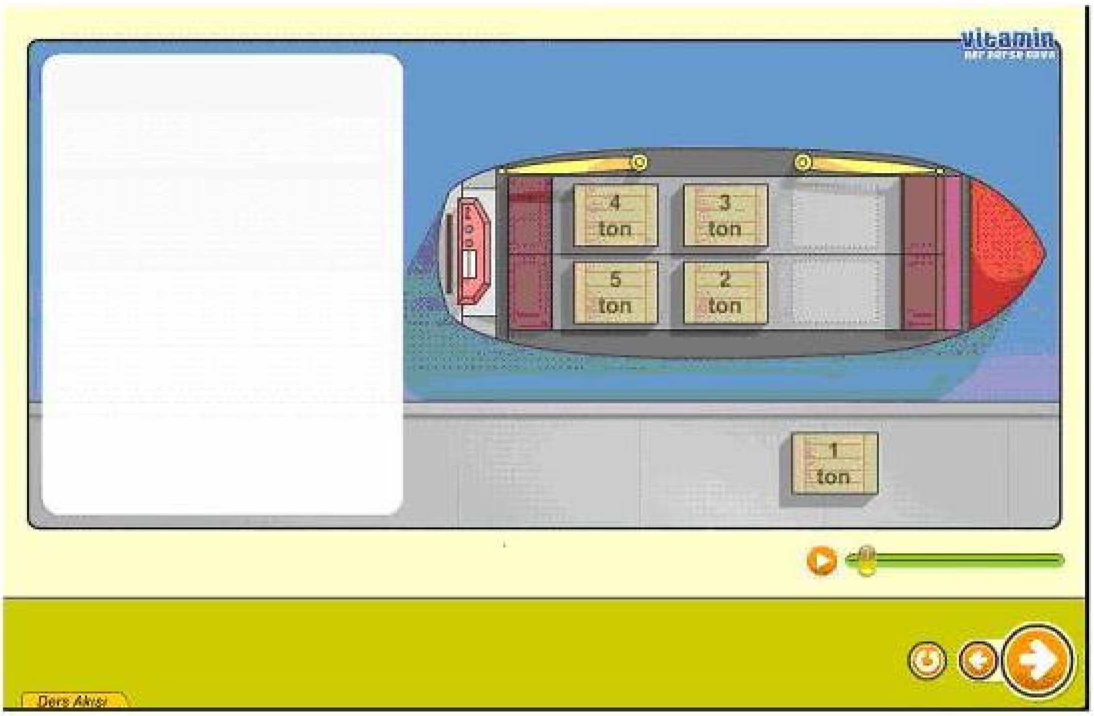


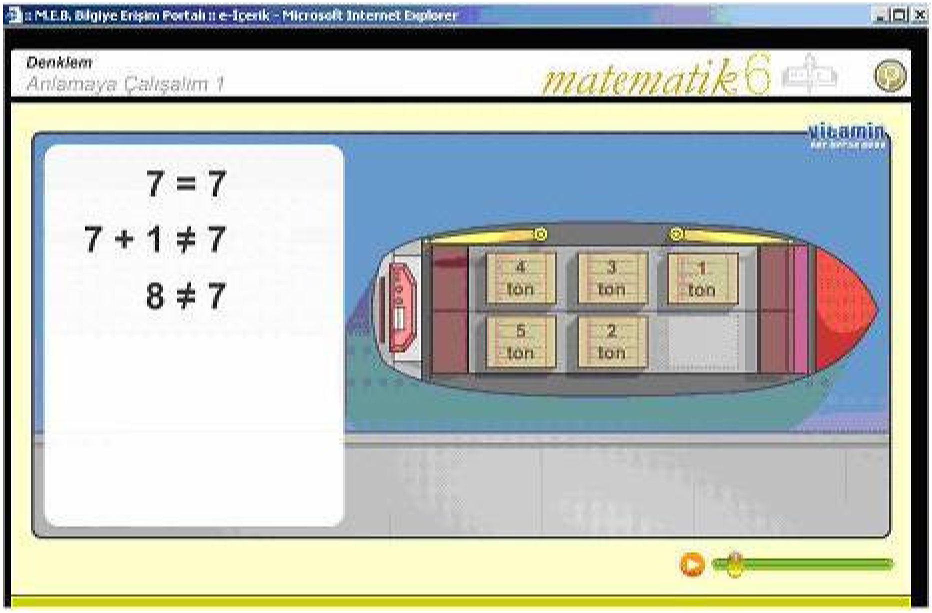


7 = 7
?
7 + 1 = 7
4 ton
3 ton
1 ton
5 ton
2 ton
Devam etmek için tıklayınız.
DEVAM ET

4 + b = 6
4 + 1 ≠ 6
5 ≠ 6
"1" bu denklemi sağlar mı?
4 ton
b
6 ton


vitamin
4 + b = 6
4 + 1 ≠ 6
5 ≠ 6
"1" bu denklemi sağlamaz!
4 + 2 = 6
6 = 6
"2" bu denklemi sağlar.
4 ton
b
6 ton
Oynat


vitamin
4 ton
3 ton
5 ton
2 ton
1 ton
Ders Akışı



BİREYSEL DEĞERLENDİRME: Çalışma ikili yapıldığı için öğrenciler birbirini değerlendirip sonucu öğretmene iletirler.

GRUP DEĞERLENDİRME: Ders sonu tartışmasında hemen her öğrenciye soru sorulur, dönüt alınır.

DERS PLANI 6

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Denklem Çözme

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 10.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

1. Verilen bir denklemin derecesini ve bilinmeyenlerin sayısını söyleyip yazma
2. Denklemi sağlayan bilinmeyenin değerini bulma işinin, denklem çözme olduğunu söyleme
3. x + 4 = 6 şeklindeki bir denklemi, reel sayılar kümesinde toplama işleminin ters eleman özeliğinden yararlanarak çözüp, çözüm kümesini yazma
4. "4x = 20" şeklindeki bir denklemi, reel sayılar kümesinde çarpma işleminin ters eleman özeliğinden yararlanarak çözüp, çözüm kümesini yazma

METOD: Soru-cevap, tartışma

ARAÇ-GEREÇ-KAYNAKÇA: Ders kitabı

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Ders 5'te yapılan laboratuvar çalışması hatırlatılarak derse giriş yapılır. Farklı derecede, bilinmeyen sayısı farklı denklemler tahtaya yazılarak öğrencilerin bulmaları istenir. Akıldan x değerini bulabilecekleri denklemler yazılır. Öğrenciler x değerini bulur. Akıldan bu değeri bulamazsak denklem çözmemiz gerektiği belirtilir. Denge kuralına göre x+4=6 ve 4x=20 denklemleri tarzında denklemler çözülür.

BİREYSEL DEĞERLENDİRME : Tek soruluk küçük sınav yapılır.

Soru : 7.a = 84 denkleminin çözüm kümesini yazınız.

DERS PLANI 7

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Denklem Çözme

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 11.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

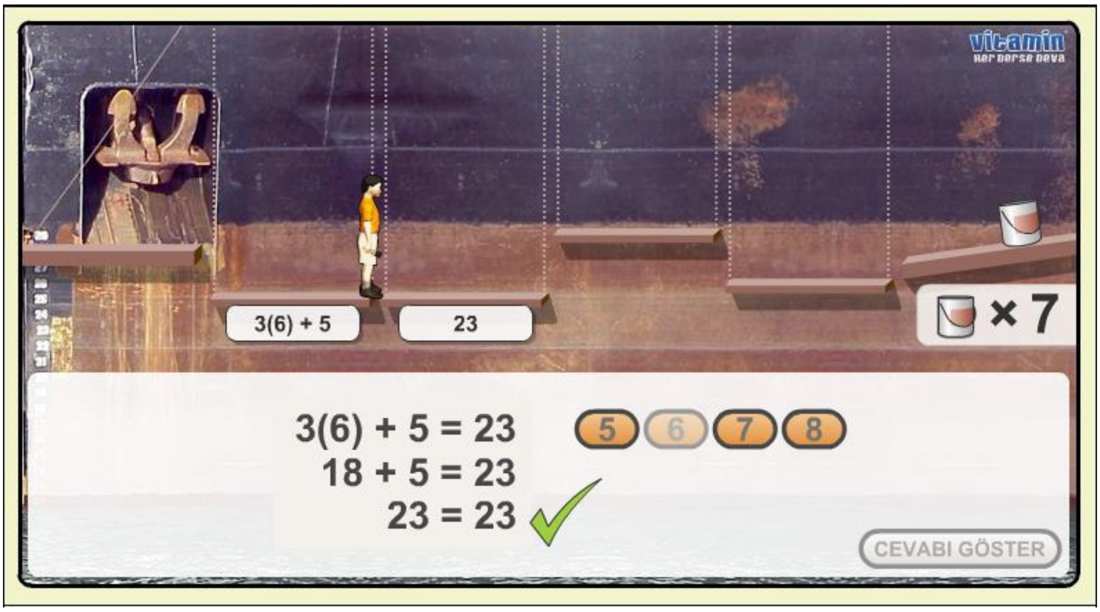
1. Birinci dereceden bir bilinmeyenli, $ax + b = c$ ($a, b, c \in Z : a \neq 0$) biçimindeki bir denklemi, reel sayılar kümesinde toplama ve çarpma işlemlerinin özeliklerinden yararlanarak çözüp,

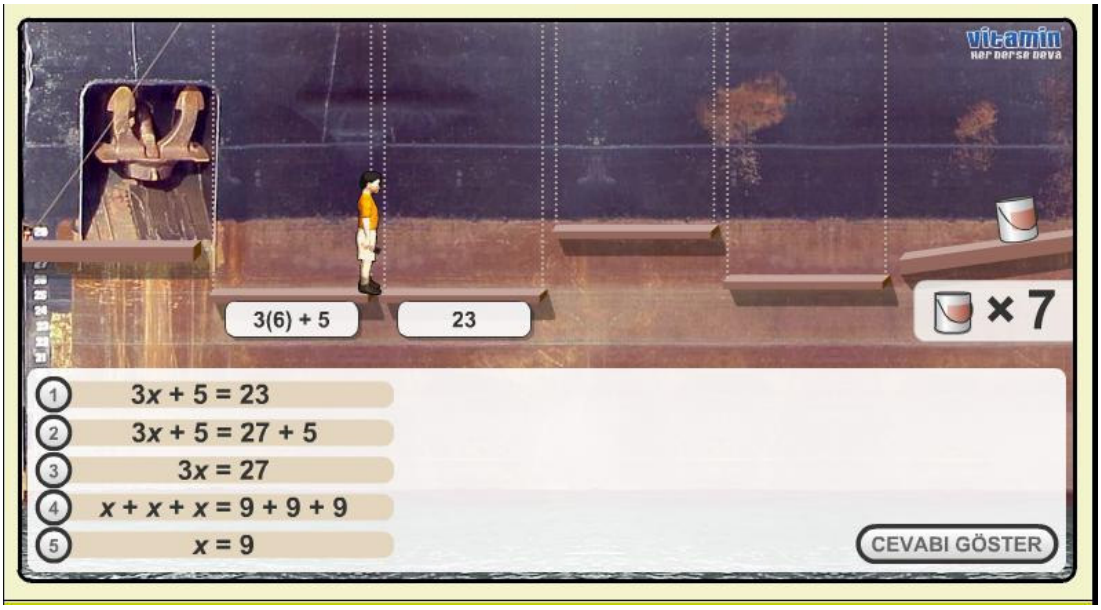
METOD: Bilgisayar destekli eğitim

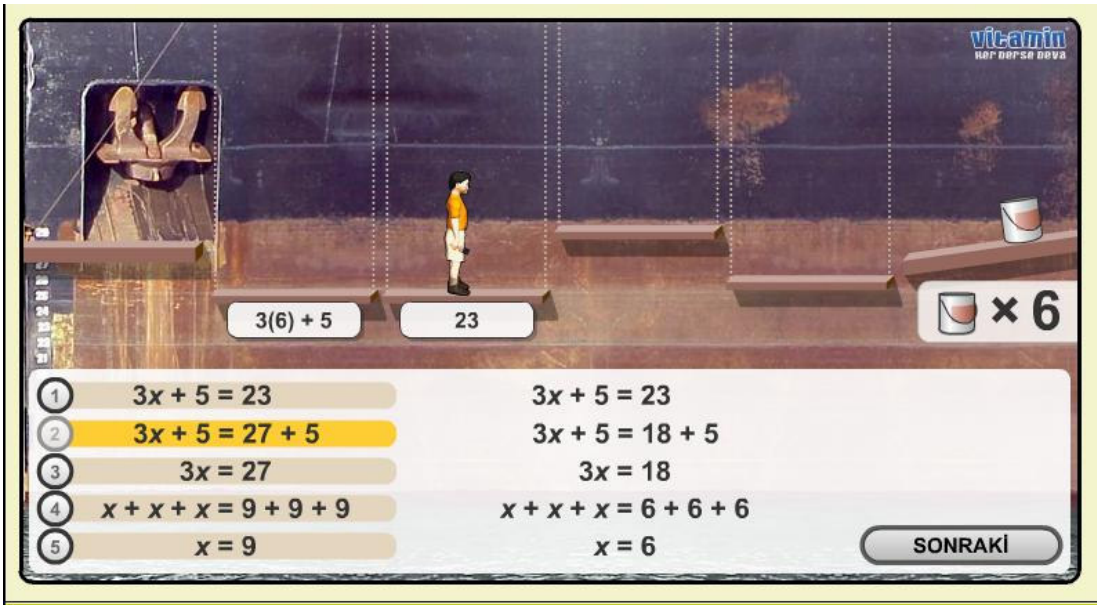
MATERYAL: Öğrenciler eşler halinde bilgisayarlara otururlar.Ministry of National Education nın eğitim portalındaki cebir etkinliği ile çalışılır.

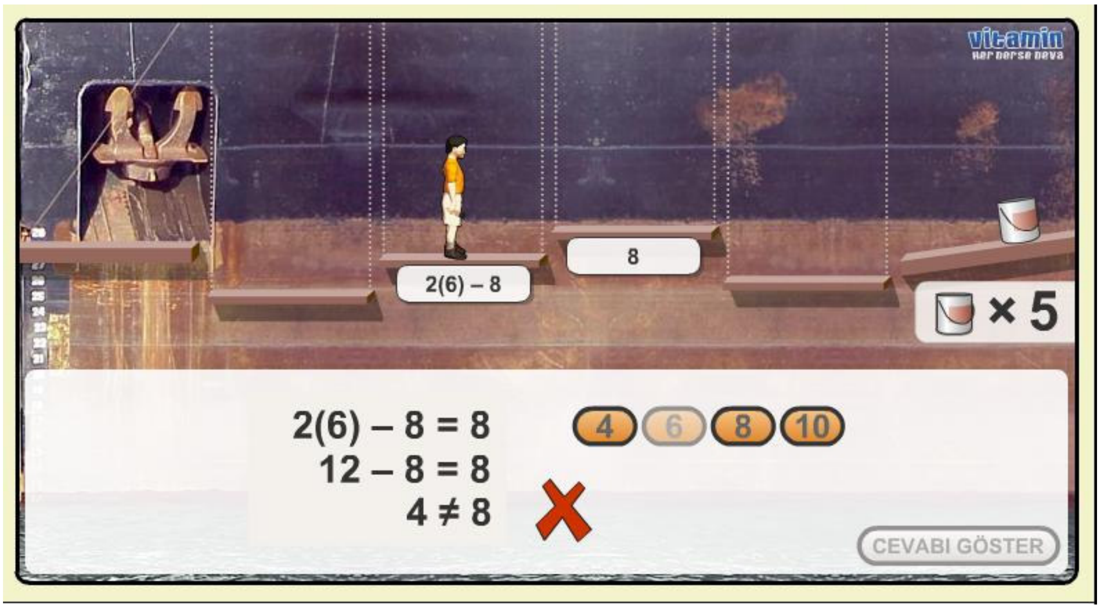
ARAÇ-GEREÇ-KAYNAKÇA: http://bep.meb.gov.tr/eicerikDis/default.aspx, Öğrencilere etkinliklere girmekte kullanılan web sitesi adresinin ve tüm linklerin sırasıyla yazılı olduğu bir yönerge verilir.

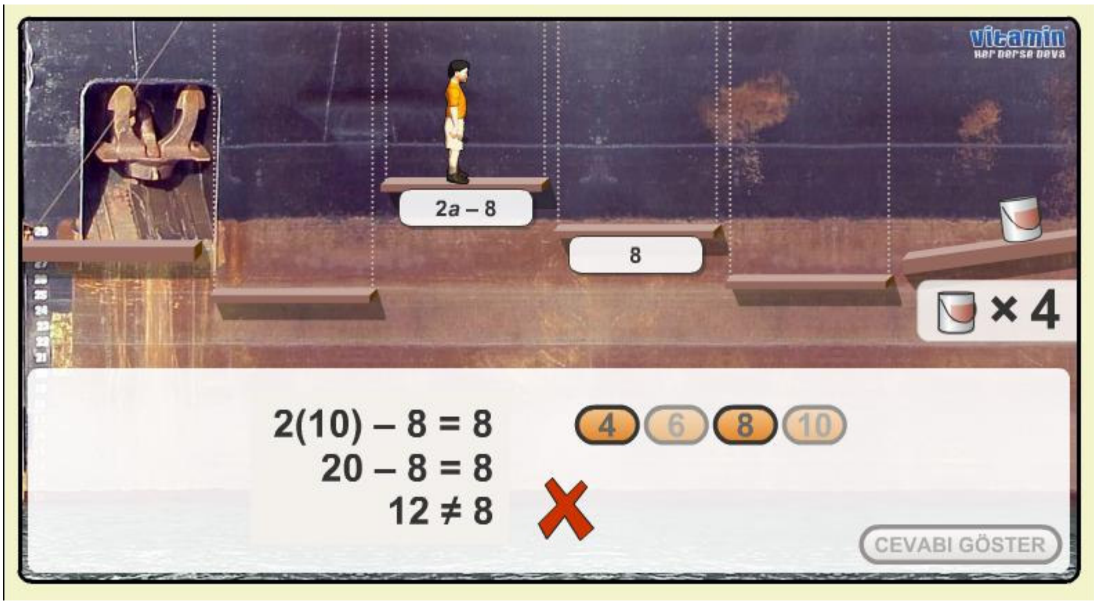
ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Öğrencilerden http://bep.meb.gov.tr/eicerikDis/default.aspx adlı siteye girmeleri istenir. Adresin yazımında zorlanan öğrencilere yardımcı olunur. Bu sitenin ilgili linklerinin yazılı olduğu yönerge kullanılır. Boya problemi etkinliği açılır. Öğrencilere etkinlik açıklanır. Öğrenci sorulan denklemi çözüp doğru x değerini bulduğunda bir sonraki basamağa atlar.Ancak doğru x değerini bulamazsa boya kutusu dökülür. Ayrıca çözemedikleri takdirde çözüm verilmiştir, tıklayıp bakabilirler. Etkinlik anlaşıldıktan sonra öğrencilerin kendi başlarına çalışmaları beklenir.

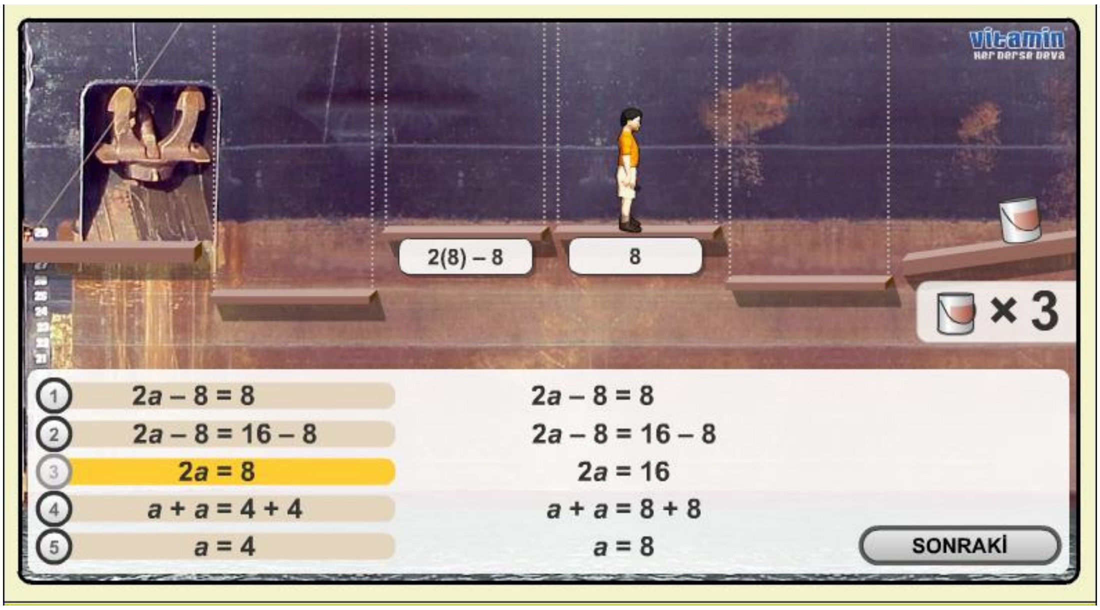


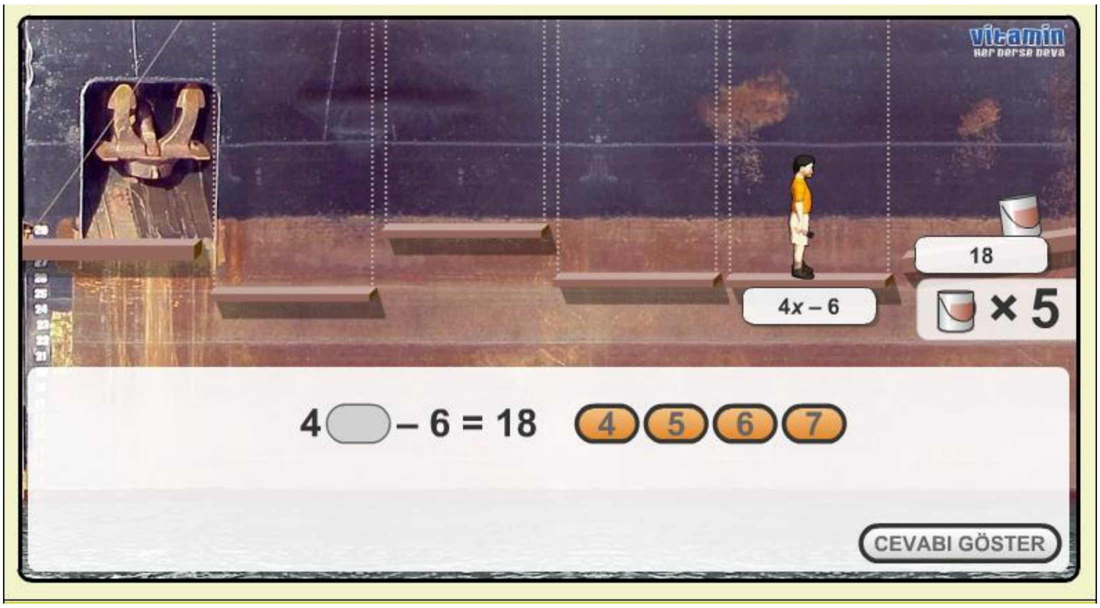

vitamin
Her derse deva
3(6) + 5
23
× 7
3x + 5 = 23
3x + 5 = 27 + 5
3x = 27
x + x + x = 9 + 9 + 9
x = 9
CEVABI GÖSTER

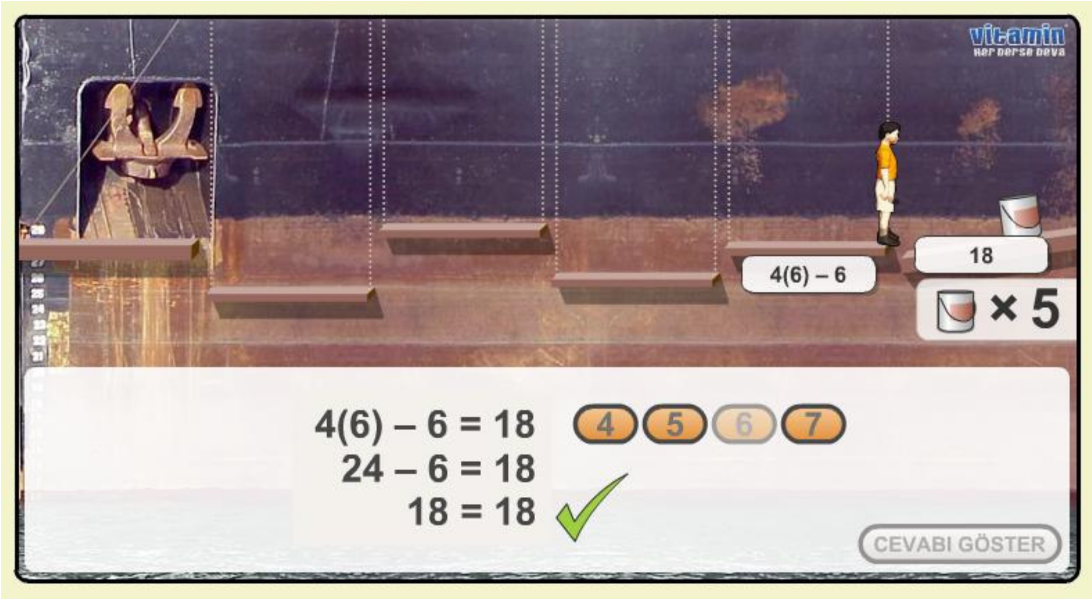

vitamin
Her derse deva
3(6) + 5
23
× 6
3x + 5 = 23
3x + 5 = 27 + 5
3x = 27
x + x + x = 9 + 9 + 9
x = 9
3x + 5 = 23
3x + 5 = 18 + 5
3x = 18
x + x + x = 6 + 6 + 6
x = 6
SONRAKİ

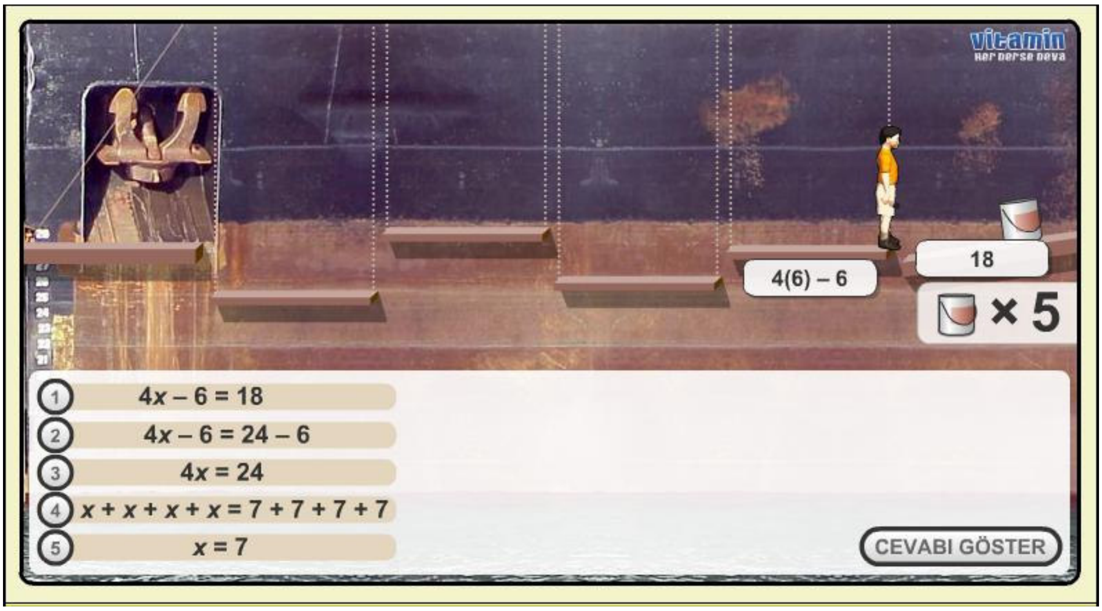

vitamin
Her Derse Deva
8
2(6) – 8
× 5
2(6) – 8 = 8
12 – 8 = 8
4 ≠ 8
4
6
8
10
CEVABI GÖSTER

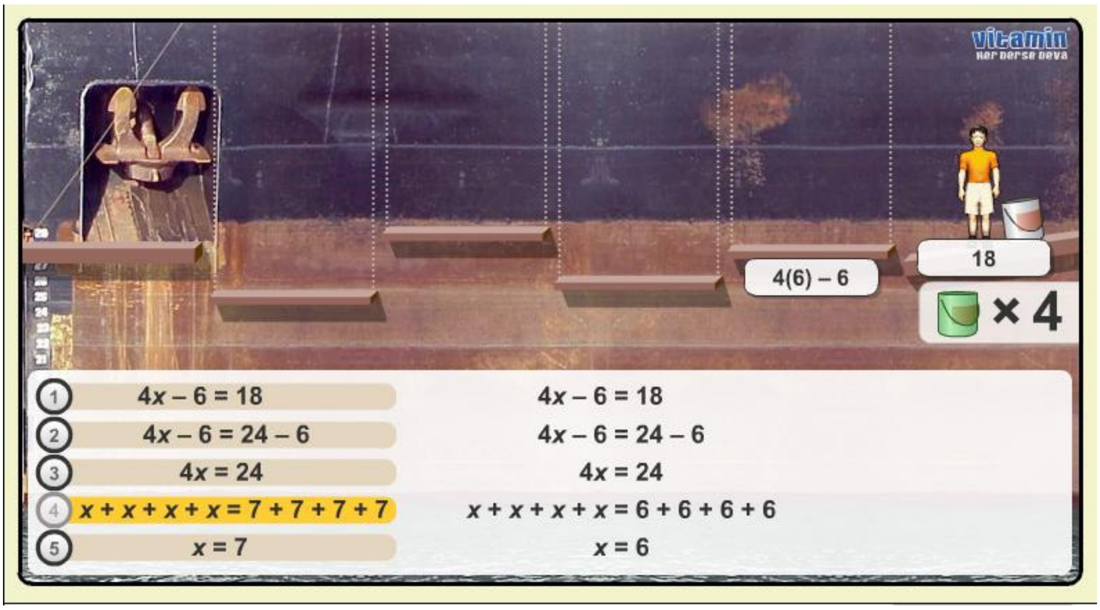

vitamin
Her Derse Deva
2a – 8
8
× 4
2(10) – 8 = 8
20 – 8 = 8
12 ≠ 8
4
6
8
10
CEVABI GÖSTER


vitamin
Her Derse Deva
2(8) – 8
8
× 3
1 2a – 8 = 8
2 2a – 8 = 16 – 8
3 2a = 8
4 a + a = 4 + 4
5 a = 4
2a – 8 = 8
2a – 8 = 16 – 8
2a = 16
a + a = 8 + 8
a = 8
SONRAKİ


vitamin
Her Derse Deva
18
4x – 6
× 5
4 – 6 = 18
4 5 6 7
CEVABI GÖSTER


vitamin
Her derse deva
4(6) – 6
18
× 5
4(6) – 6 = 18
24 – 6 = 18
18 = 18
4
5
6
7
CEVABI GÖSTER


vitamin
Her derse deva
4(6) – 6
18
× 5
1 4x – 6 = 18
2 4x – 6 = 24 – 6
3 4x = 24
4 x + x + x + x = 7 + 7 + 7 + 7
5 x = 7
CEVABI GÖSTER



BİREYSEL DEĞERLENDİRME: Çalışma ikili yapıldığı için öğrenciler birbirini değerlendirip sonucu öğretmene iletirler.

GRUP DEĞERLENDİRME: Ders sonu tartışmasında hemen her öğrenciye soru sorulur, dönüt alınır.

DERS PLANI 8

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Denklem Çözme

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 17.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

1. Denklemde çözüm kümesi yazma
2. Verilen bir sayının verilen bir denklemi sağlayıp sağlamadığını sebebi ile birlikte söyleme
3. Birinci dereceden bir bilinmeyenli denklemi çözüp, çözüm kümesinin doğruluğunu kontrol etme

METOD: Soru-cevap, tartışma

ARAÇ-GEREÇ-KAYNAKÇA: Ders kitabı

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Ders 7'de yapılan laboratuvar çalışması hatırlatılarak derse giriş yapılır.Örnekler üzerinden gidilerek denklem çözümünde çözüm kümesi yazma ve çözüm kümesinin doğruluğunu kontrol etme çalışılır. Öğrenciler tahtaya kaldırılarak sorular çözülür.

BİREYSEL DEĞERLENDİRME: Tek soruluk küçük sınav yapılır.

Soru: $2x + 5 = 29$ denklemini 5 sayısı sağlar mı? Neden?

DERS PLANI 9

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Matematiksel İfadelerle İşlem Yapma

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 18.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

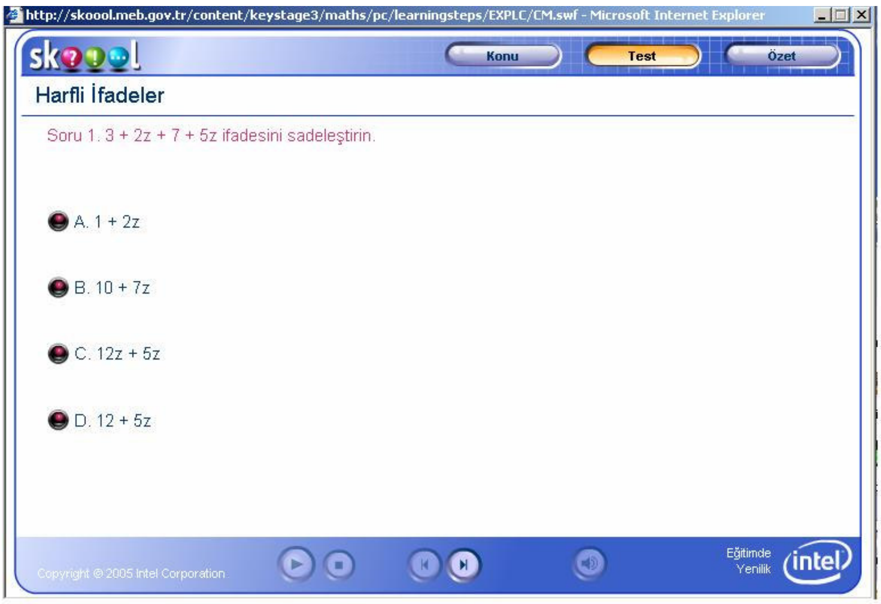
METOD: Bilgisayar destekli eğitim

MATERYAL: Öğrenciler eşler halinde bilgisayarlara otururlar.Ministry of National Education nın skool.tr adlı sitesindeki cebirsel ifadeler etkinliği ile çalışılır.

ARAÇ-GEREÇ-KAYNAKÇA: http://www.skoool.tr adlı web sitesi.

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Öğrencilerden www.skoool.tr adlı siteye girmeleri istenir. Adresin yazımında zorlanan öğrencilere yardımcı olunur. Cebirsel İfadeler Etkinliği tıklanır. Öğrencilere etkinlik açıklanır. Etkinlik konu anlatımı ve sorular şeklinde devam etmektedir. Harfli yani cebirsel ifadelerde toplama ve çıkarma ağırlıklı bir etkinliktir. O yüzden anlaşılması zor bir etkinlik değildir. Sorular sırayla çözülür ve sınıfta hep beraber tartışılır. Örneğin, neden 8u çıktı, u'lu bir sayı ile t'li bir sayı toplanır mı gibi.


7. Kartezyen Koordinat Sisteminde Noktaların Gösterilmesi
Kartezyen düzlemde, koordinatlar kullanılarak noktaların nasıl işaretleneceğini öğrenin.
adım
Kartezyen Koordinatlarda Noktaların Gösterilmesi
8. Açı Çeşitleri
Farklı türlerdeki açıların nasıl belirleneceğini, dar açı, geniş açı, yansıma kavramlarını öğrenin.
adım
Açı Çeşitleri
sim
Açı Çeşitleri
9. Doğrunun Orta Noktasını Bulma
Açıların ve doğruların orta noktalarının tespitinde pergel ve cetvel kullanımını öğrenin.
adım
Doğrunun Orta Noktasını Bulma
10. Pisagor Teoremi
Pisagor Teoremini öğrenin.
adım
Pisagor Teoremi
sim
Pisagor Teoremi
11. Cebirsel İfadeler
Cebirsel ifadeler olarak tanımlanan denklem gruplarının nasıl sadeleştirileceğini öğrenin.
adım
Cebirsel İfadeler
12. Cebirsel Fonksiyonlar
Pay ve paydanın cebirsel ifadeler içerdiği kesirlerin nasıl kullanılacağını öğrenin.
adım
Cebirsel Fonksiyonlar
13. Birinci Dereceden İki Bilinmeyenli Denklem Sistemleri
Birinci dereceden iki bilinmeyenli denklem sistemlerinin yok etme metodu ile nasıl çözümleneceğini öğrenin.
adım
Birinci Dereceden İki Bilinmeyenli Denklem Sistemleri


http://skoool.meb.gov.tr/content/keystage3/maths/pc/learningsteps/EXPLC/CM.swf - Microsoft Internet Explorer
Konu
Test
Özet
Harfli İfadeler
Soru 1: 3 + 2z + 7 + 5z ifadesini sadeleştirin.
A. 1 + 2z
B. 10 + 7z
C. 12z + 5z
D. 12 + 5z
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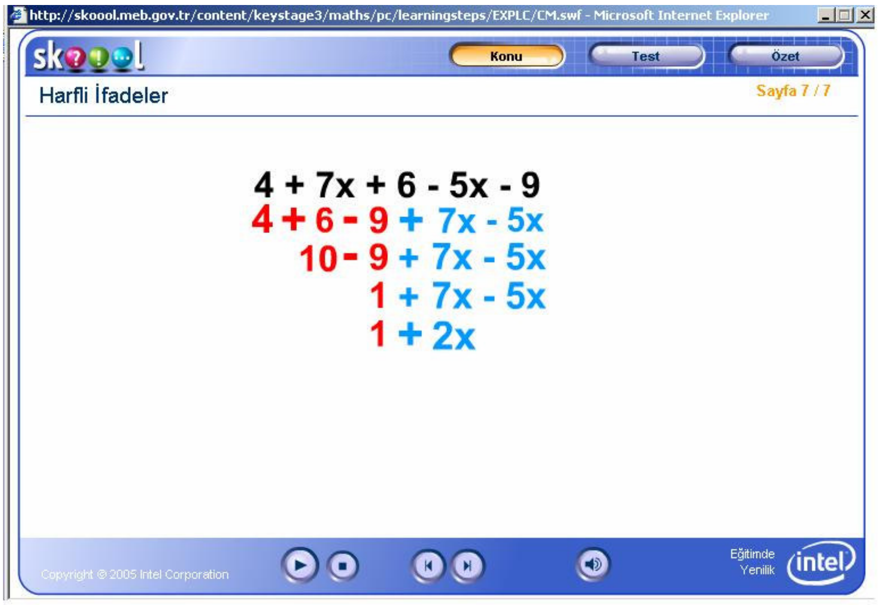
Eğitimde
Yenilik
intel


http://skoool.meb.gov.tr/content/keystage3/maths/pc/learningsteps/EXPLC/CM.swf - Microsoft Internet Explorer
Konu
Test
Özet
Harfli İfadeler
Sayfa 7 / 7
4 + 7x + 6 - 5x - 9
4 + 6 - 9 + 7x - 5x
10 - 9 + 7x - 5x
1 + 7x - 5x
1 + 2x
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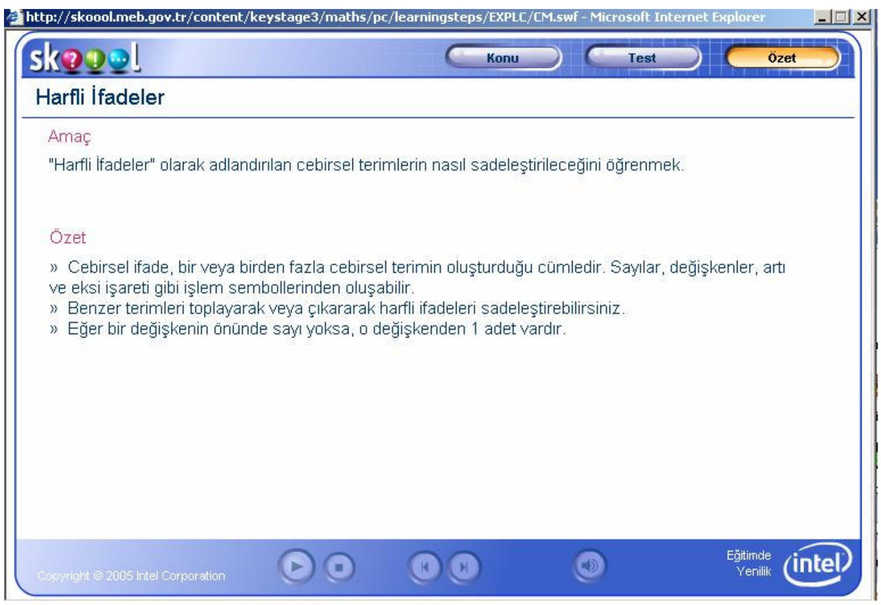
intel


http://skoool.meb.gov.tr/content/keystage3/maths/pc/learningsteps/EXPLC/CM.swf - Microsoft Internet Explorer
Konu
Test
Özet
Harfli İfadeler
Amaç
"Harfli İfadeler" olarak adlandırılan cebirsel terimlerin nasıl sadeleştirileceğini öğrenmek.
Özet
» Cebirsel ifade, bir veya birden fazla cebirsel terimin oluşturduğu cümledir. Sayılar, değişkenler, artı ve eksi işareti gibi işlem sembollerinden oluşabilir.
» Benzer terimleri toplayarak veya çıkararak harfli ifadeleri sadeleştirebilirsiniz.
» Eğer bir değişkenin önünde sayı yoksa, o değişkenden 1 adet vardır.
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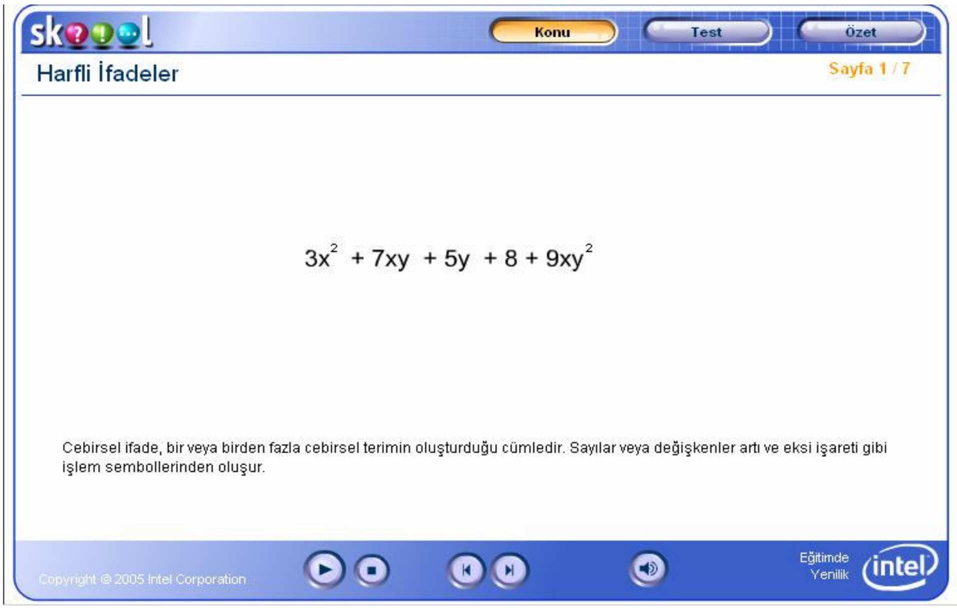
intel


skool
Konu
Test
Özet
Harfli İfadeler
Sayfa 1 / 7
$3x^2 + 7xy + 5y + 8 + 9xy^2$
Cebirsel ifade, bir veya birden fazla cebirsel terimin oluşturduğu cümledir. Sayılar veya değişkenler artı ve eksi işareti gibi işlem sembollerinden oluşur.
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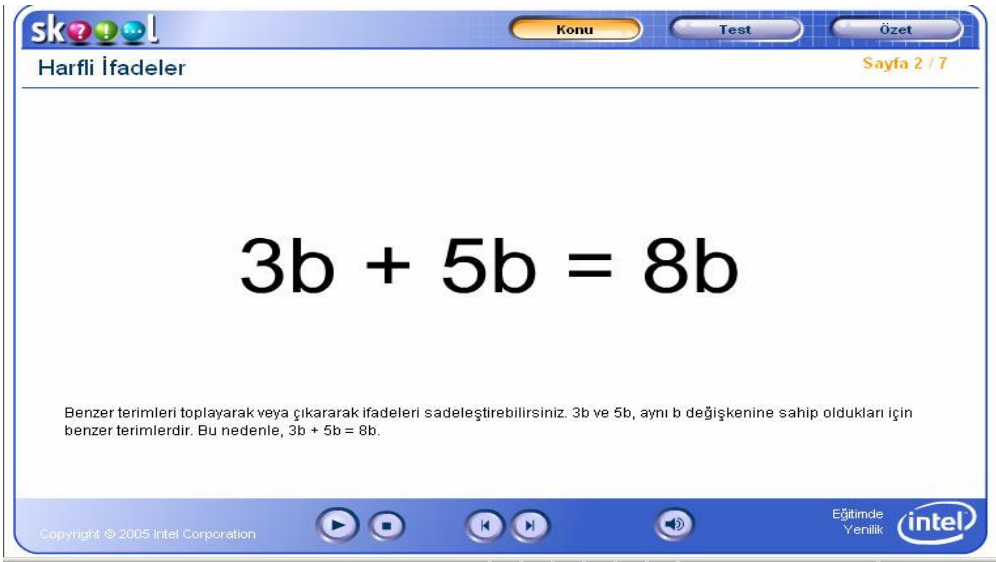
intel


skool
Konu
Test
Özet
Harfli İfadeler
Sayfa 2 / 7
$3b + 5b = 8b$
Benzer terimleri toplayarak veya çıkararak ifadeleri sadeleştirebilirsiniz. 3b ve 5b, aynı b değişkenine sahip oldukları için benzer terimlerdir. Bu nedenle, 3b + 5b = 8b.
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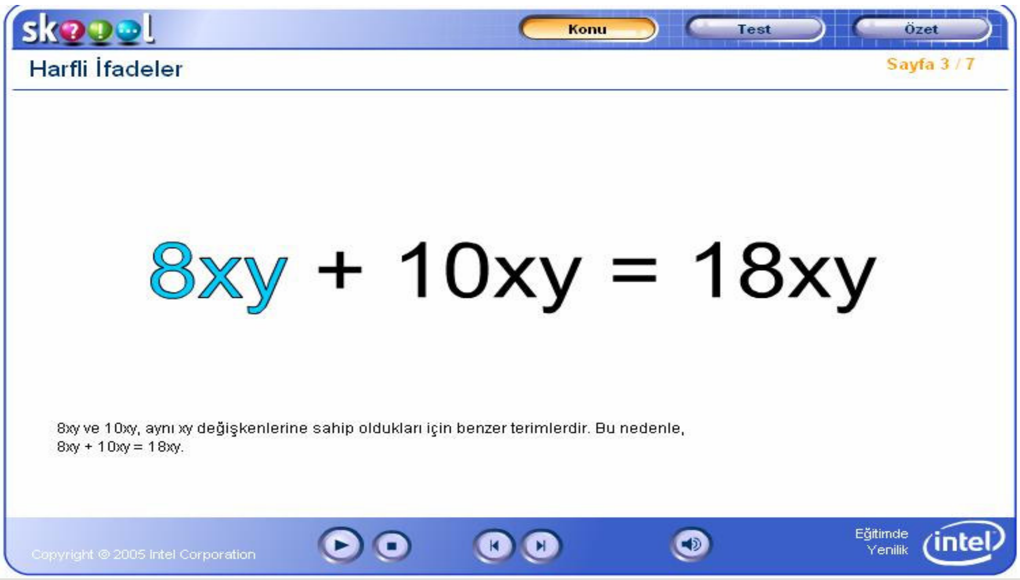
intel


skool
Konu
Test
Özet
Harfli İfadeler
Sayfa 3 / 7
8xy + 10xy = 18xy
8xy ve 10xy, aynı xy değişkenlerine sahip oldukları için benzer terimlerdir. Bu nedenle,
8xy + 10xy = 18xy.
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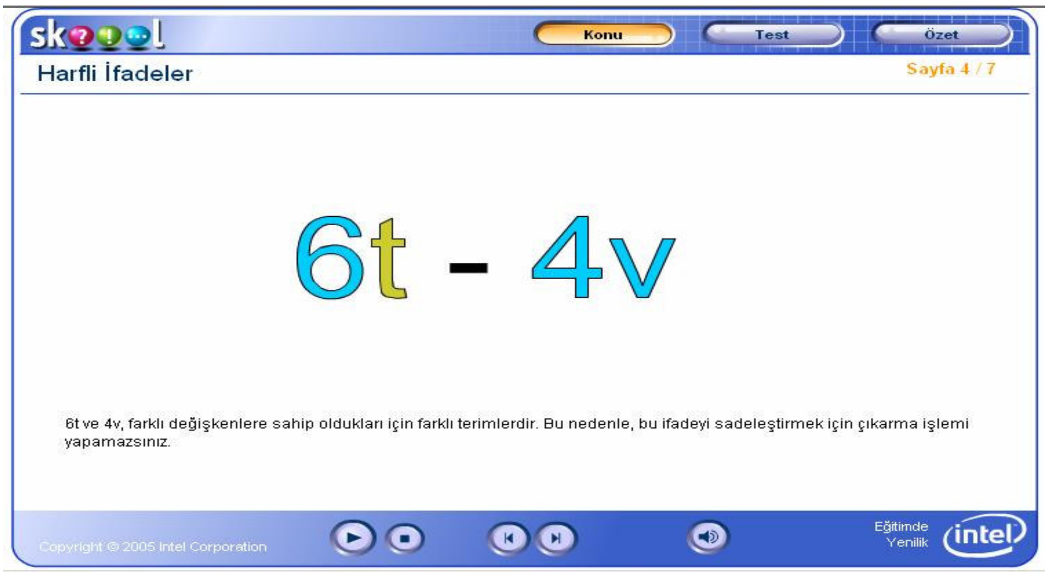
skool
Konu
Test
Özet
Harfli İfadeler
Sayfa 4 / 7
6t - 4v
6t ve 4v, farklı değişkenlere sahip oldukları için farklı terimlerdir. Bu nedenle, bu ifadeyi sadeleştirmek için çıkarma işlemi yapamazsınız.
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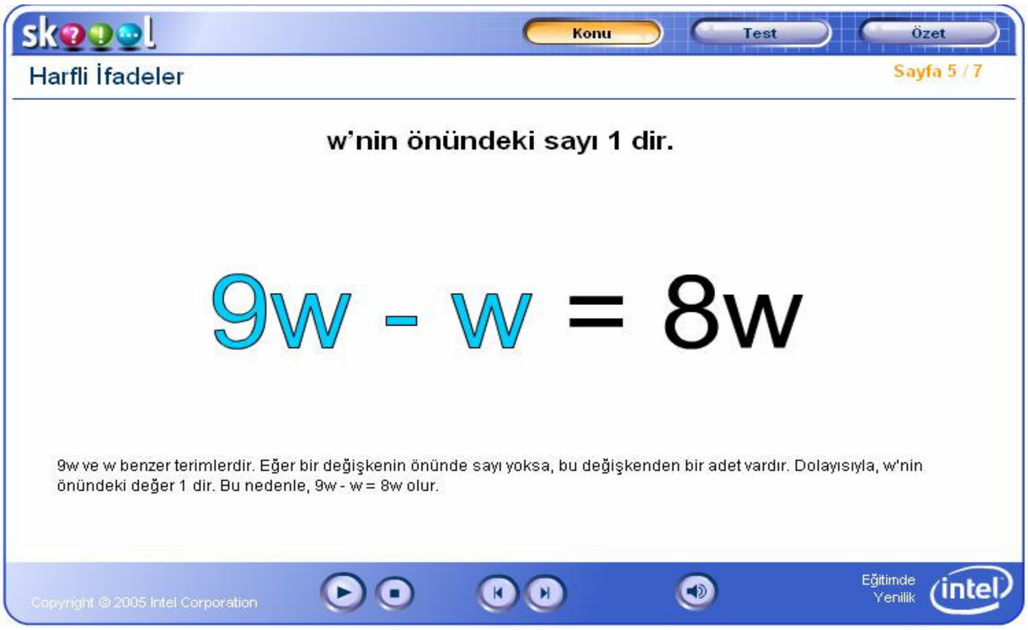
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Özet
Harfli İfadeler
Sayfa 5 / 7
w'nin önündeki sayı 1 dir.
9w - w = 8w
9w ve w benzer terimlerdir. Eğer bir değişkenin önünde sayı yoksa, bu değişkenden bir adet vardır. Dolayısıyla, w'nin önündeki değer 1 dir. Bu nedenle, 9w - w = 8w olur.
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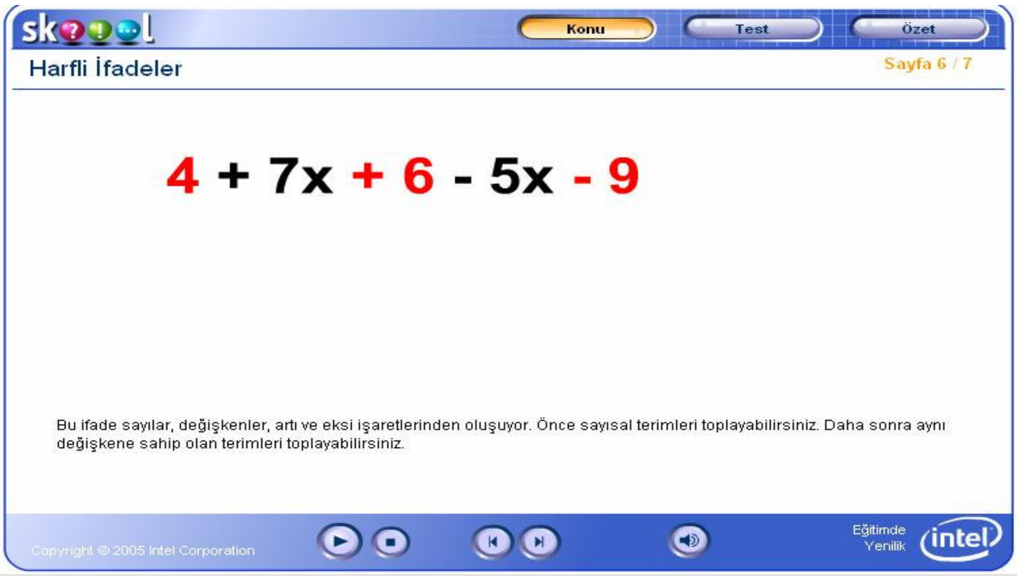
skool
Konu
Test
Özet
Harfli İfadeler
Sayfa 6 / 7
4 + 7x + 6 - 5x - 9
Bu ifade sayılar, değişkenler, artı ve eksi işaretlerinden oluşuyor. Önce sayısal terimleri toplayabilirsiniz. Daha sonra aynı değişkene sahip olan terimleri toplayabilirsiniz.
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skool
Konu
Test
Özet
Harfli İfadeler
Soru 1. 3 + 2z + 7 + 5z ifadesini sadeleştirin.
A. 1 + 2z
B. 10 + 7z
C. 12z + 5z
D. 12 + 5z
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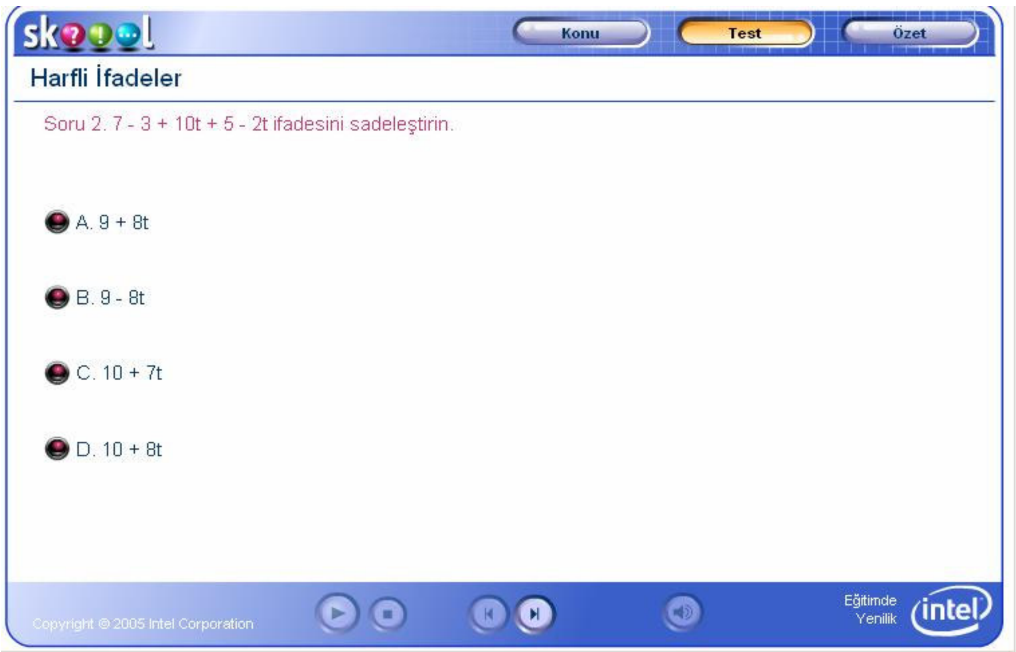
skool
Konu
Test
Özet
Harfli İfadeler
Soru 2. 7 - 3 + 10t + 5 - 2t ifadesini sadeleştirin.
A. 9 + 8t
B. 9 - 8t
C. 10 + 7t
D. 10 + 8t
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BİREYSEL DEĞERLENDİRME: Çalışma ikili yapıldığı için öğrenciler birbirini değerlendirip sonucu öğretmene iletirler.

GRUP DEĞERLENDİRME: Ders sonu tartışmasında hemen her öğrenciye soru sorulur, dönüt alınır.

DERS PLANI 10

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Denklem Çözme

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 24.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

1. İçerisinde bir parantezli ifade bulunan birinci dereceden bir denklemi çözüp çözüm kümesini yazma

2. $\frac{3x+12}{5}=6$ = d(a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) biçiminde verilen bir denklemi çözüp, çözüm kümesini yazma

METOD: Soru-cevap, tartışma

ARAÇ-GEREÇ-KAYNAKÇA: Ders kitabı

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Ders 9'da yapılan laboratuvar çalışması hatırlatılarak derse giriş yapılır. Parantezli ve rasyonel ifadeler içeren denklemler seçilir. Öğrenciler tahtaya kaldırılarak sorular çözülür.

BİREYSEL DEĞERLENDİRME: Tek soruluk küçük sınav yapılır.

Soru: $\frac{3x+12}{5}=6$ denkleminde x değerini bulunuz.

DERS PLANI 11

DERSİN ADI: Matematik

ÜNİTE: Denklemler ve Doğru Grafikleri

KONU: Matematiksel İfadeler ve Denklemler

SINIF: 7A

SÜRE: 2 ders saati

TARİH: 25.01.07

HEDEF: Birinci dereceden bir bilinmeyenli denklemleri çözebilme

METOD: Bilgisayar destekli eğitim

MATERYAL: Öğrenciler eşler halinde bilgisayarlara otururlar. Tüm etkinlikler kullanılır. Öğrencilere etkinliklere girmekte kullanılan web sitesi adreslerinin ve tüm linklerin sırasıyla yazılı olduğu bir yönerge verilir.

ARAÇ-GEREÇ-KAYNAKÇA: http://bep.meb.gov.tr/eicerikDis/default.aspx, http://www.skoool.tr adlı websiteleri.

ÖĞRETME VE ÖĞRENME ETKİNLİKLERİ: Tüm laboratuvar çalışmalarında yapılan etkinlikler hızlı bir şekilde tekrar edilir. Öğrencilerin en çok sevdikleri etkinlikleri tekrar yapmaları istenir.

BİREYSEL DEĞERLENDİRME: Çalışma ikili yapıldığı için öğrenciler birbirini değerlendirip sonucu öğretmene iletirler.

GRUP DEĞERLENDİRME: Ders sonu tartışmasında hemen her öğrenciye soru sorulur, dönüt alınır.

APPENDIX H

HOMEWORK

ÖDEV

Ödeviniz aşağıda adresi verilen internet sitesinden yararlanılarak yapılacaktır. Yapmanız gerekenler adım adım belirtilmiştir.

- http://bep.meb.gov.tr/eicerikDis/default.aspx adresli siteye giriniz.
- Sayfanın sol tarafındaki dersler menüsünden **Matematik 6'yı** seçip tıklayınız. (Denklemler ünitesi yeni müfredatta 6. sınıfa alındı.)
- Gelen menüden **Üniteler** yazısının altından **Cebir-Eşitlik ve Denklem'i** tıklayınız.
- Sayfanın yine aynı yerinde (solda) **Denklemler** dosyası çıkacak karşınıza tıklayınız.
- Sayfanın sağ tarafında **Çoklu Ortamda Ders İşleyişi** başlığında bir resim gelecek. Resmin kenarındaki **Dersi Başlat'**ı tıklayıp izlemeye başlayınız.
- Sonraki kısımlarda okları takip ederek dersi izleyip soruları cevaplandırabilirsiniz.
- Dersi istediğiniz kadar izleyin.
- İzledikten sonra bir rapor hazırlamanız gerekiyor. Rapor iki kısımdan oluşacaktır.
    - İlk kısımda internet sitesindeki derste yer alan alıştırmaları kağıt üzerinde çözmeniz gerekiyor.
    - İkinci kısımda da bu dersten neler öğrendiğinizi ve ne kadar yararlı olduğunu anlatmanız gerekiyor.

Size verilen süre 6 haftadır ve teslim tarihi duyurulacaktır.

İyi Çalışmalar

APPENDIX I

OBSERVATION NOTES

- ✓ *Lesson 1 $\Rightarrow$ Mathematics Set-Algebraic Expressions Activity (2 lesson hours)*

The students were excited and enthusiastic, as they know they would go to computer laboratory. Even it was explained to the students that they would not play games in the laboratory, they thought that they would behave like they were in the Internet cafe. That may be reasoned from the fact that the students were studying free in the computer lesson. That information was obtained from the school administration and the students. In other words, they thought that they would be free in the mathematics lesson by going to the computer laboratory. They thought they would be away from the lesson. At this point, it was observed that they were disappointed, because laboratory was not so different from the classroom. It was the lesson. It seemed that it would be hard to make the students love and like the activities if they continued feeling like that.

Some of the computers gave error and did not open in the laboratory. The other teachers in the school helped and the other computers were also started to use. Those problems with the computers negatively affected the students. They started to complain about the computers. The class started to study the algebraic expressions activity of the mathematics set, as all the computers work properly. The teacher tried to explain the structure of the activity by drawing a picture of it on the whiteboard.

They were writing formulas in order to link the cells just like working on excel. This linking was the relation between the unknowns. For instance, for B1 you could write 2*A1 or 2+A1, which means 3 for A1, is 6 or 5 for B1 according to your formula. Therefore, according to the formula when the student wrote the independent variable in A1, then entering the B1 cell, the dependent variable automatically appeared.

The students were working in pairs. One of the students set the formula and entered the variables and the other student tried to guess the formula by searching for the relation between the variables. That relation was the equation.

It was surprising that I didn't expect such a motivation to the activity as I was instructing to this class since the beginning of the term. Then I thought maybe this high motivation was reasoned from first experience in the laboratory for mathematics. The motivation of the students not only to mathematics but also to other lessons was very low in the classroom. Indeed, the students of the class were so active and talkative but were not so successful. However, in this activity in laboratory, the only voice coming from the students was the guesses of their equations. When they guessed the correct equation, I realized that they were so excited and proud of their selves. The pair Kerem and Mehmet was the first pair using letters in variables. Next Murat and Emre started to use letters. As I explained this part of the activity, immediately Emel and Ceren understood and applied the letter using. The students worked till the break time. Some of them even did not leave the laboratory in the break time.

They were so pleased and wanted to continue in the next lesson. They were experienced in the next lesson. In this lesson, the students worked in the laboratory until I warned them that they should close the computers because the bell was going to ring. Ufuk who was the most uninterested student in the classroom was one of the students dealing with the activity and trying to do something.

In the classroom the students were distracted from anything in ten or fifteen minutes, but in the laboratory the control of the students was easier. The most important thing was that all of the people were inside of the activities.

At the end of the lesson, they said that they liked this activity. This time they didn't loose time in order to learn how to deal with it. They just sit and worked on it. In the beginning they were guessing the 2x=y or 3x=y but later on even the pair Nalan & Aysu, whom I didn't have so much expectation, started to guess the 7x-5=y equations.

The other important point was the structure of the classroom. There were two groups in the classroom. One of the groups consisted so relax and active students. In the lesson, they could easily speak and do something like that without permission. That negatively affected the other group, which was shy and silent. Because of the other group the silent group became more silent in the classroom. However, in the laboratory this silent group became active. They showed their selves. (For instance Toprak and Deniz.)

The other point, I wish to add even opening the mathematics set I said them what they would do step-by-step. I even said which link they would enter. Also they had a handout prepared by me in order to help them. However, I did not think that they did not know what to do. In my opinion, their behavior was the result of my warnings before going to the laboratory. I had warned so much that they did not do anything other than the activity without permission. I realized my fault, but I had thought that it would be so difficult to control such an active and talkative class in the laboratory. That was the opposite I experienced.

During the activity, I observed that the students help each other in using the computer. The socialization of the students helped the duration in means of using computers. If one was getting difficult to go beyond the previous step, without waiting my help the other came near to help him/her.

For instance, when they entered an invalid formula, a small warning grey window opened and it was not closed so easily. However, Ceren discovered that by pushing the enter button the window was closed. She told it to her other friends. In fact, in this lesson they learned how to deal with the problems they faced in using computers.

By this activity, we had learned that the unknowns or variables linked each other by means of equations. In fact, they did the computations without being aware of searching that relation. Therefore, I reminded them that the names of the cells like A1, A2 and B1 were the x and y's in the equations. Interpretation and making inferences were not the activities they were used to do before. At this point, their difference from the 6^{th} graders appeared. The 6^{th} graders who were instructed by the new curriculum were more appropriate to this activity, because they properly did activities and make inferences. If I had done this activity with the 6^{th} graders, the students maybe made inferences easier.

We did two-lesson hour's laboratory activity, but we went on our lesson in the classroom for the rest of the two hours also. I wanted to make a summary of our work in the classroom and I surprised. They remembered anything about the laboratory work even if they did not go there. If they made the conclusion by themselves maybe they could remember. Indeed, when we started to talk I realized that they remembered anything they did in detail, but it was difficult to relate the laboratory work to the classroom work for them. They did not think that we did the same thing in the laboratory just like in the classroom.

The relation between the variables was seemed understood by some of the students but they couldn't practice it with paper and pencil. I concluded that the success of the activity for this kind of students was depended how parallel the classroom work to the laboratory work. In other words, the laboratory work was not enough without supporting it in the classroom.

The laboratory work attracted the students and the specific learning outcomes of the lesson were reached but the permanent learning was not obtained. For permanent learning, the activity in the laboratory should be strictly in line with the classroom activities because the students couldn't make conclusions from the activities.

- ✓ *Lesson 2⇒Mathematics Set-Balance Activity*

Just like the previous lesson, again some of the computers gave error and did not open. We tried to deal with it and opened it.

Despite the work of the previous lesson, the students were not so successful in dealing with the problems in using the computers. In this week, some of the keyboards were somehow changed. The students didn't write even the address of the website because they typed a, but it wrote ç. It was so difficult to control the students. Most of them did not know what to do and came near me or called me.

Since we could not type the address of the website, we went on our work with the mathematics set. We did balance (Solve Equation) activity. While they were doing the activity I repaired the keyboards one by one. That time I thought that I could tell them how to do this by themselves but this time I realized that they would disturb and that would be time consuming.

That problem with the keyboards and the problems in opening the computers affected the students negatively. Even the most successful student of the class told that he hadn’t wanted to come to the laboratory again. The reason of his idea was so obvious he thought that the lesson was free I mean we did not do lesson.

Despite this, more than half of the students were pleased with being in the laboratory. However, the negative attitudes of the students affected the others.

The Balance Activity was set on the balance rule. The pans of the scale should be equal. The students were working on this purpose. In line with this balance rule we had to learn that if we added, subtracted, multiplied or divided one side of the equation by one number or letter we should do the same operation for the other side in order to catch the balance.

That time I was more experienced I had to help students in integrating this balance rule to the equation solving as the students were getting difficulty in that integration at most.

The balance activity was easy for them. They immediately understood and set the balance. Then they asked me what they would do. X had not got an active function in the balance activity, probably for this reason they got difficulty in integrating balance rule to the equation solving.

In the class while we were solving the equations I reminded them this activity. I thought by this way they got the topic more than the first activity. I wish to add that if the balance activity were supported by equation solving problems after the scales screen it would be better.

This time most of them used the breaking mode. They were using their creativity by using that mode. They could break 5 or 3 in 1’s. By this way they used the division idea in equation solving. After they divided the big number into pieces then they replaced these pieces from scales to scales for getting balance.

In class while we were solving equations there was no need to talk about pans of scales in grocer. Most of the students were ready to get the balance idea. The scales represented the equation sign and the pans represented the sides of the equation.

While doing the exercises in solving equations they said loudly "we should add 3 for both sides, if we multiply it by 7, then we should multiply the other side by 7, too."

Apart from the activity I had to remind the students why we were doing these operations. For instance, why we were multiplying the sides by 3. I told them that we wish to get the value of x or y, by leaving x and y alone in one side of the equation.

In lesson 2, not only me but also the students were more experienced. They used the same computers in previous lesson. Their peers were also fixed. Most of them used the computers in peers because the number of working computers was not sufficient. The number of the irrelevant students was less than the lesson 1. Moreover, the students, who did not know what to do or understood, the activity later than the others like Selçuk, were more interested in the activity.

I realized their experience from the questions they asked. In lesson 2 their questions were less than the lesson 1. More than this, they concentrated the activity in less time than the lesson 1. Therefore, we can conclude that the students are easily adapted the new condition if and only if they like to do it.

The interactive structure of the activity had a positive effect on the students. That the pan of the scale came down it had heavier load than the other pan. The students were just like dealing with real scales.

Indeed, the equation idea could be instructed in many ways, but in my opinion, the best way is balance concept. In fact, the daily representation of the equation concept can be pans of scale.

- ✓ *Lesson 3*⇒ http://bep.meb.gov.tr/eicerikDis/default.aspx - The Ship Activity

In that lesson, the Internet was slow in setting the net. That problem created few free minutes apart from the lesson. In these minutes the students were distracted. At this time, being in pairs was disadvantage for the study. In fact, the students started to talk to each other in pairs. Additionally, the listening problems with some computers disturbed the students as the subject was presented by voice in the activity.

The activity in information reaching portal (bep) had a loading problem that occurred in the laboratory computers at school. The web page was loading slowly. For instance, while one student was starting to the activity the other was even did not see the picture on the screen. Therefore, this one started to deal with the other one's loaded page. I had difficulty in controlling the students.

The unity between the students in laboratory was as important as the unity in class or even more than in class. While the student whose computer was loaded quicker was passing through the questions, the other student whose computer was loaded slower still are listening the subject. Hence, each student asked question from different step.

I could not give directions because they were not at the same step because of loading problems. It was concluded; studying by Internet was more difficult than studying by mathematics set. Therefore, I should prepare the web page ready in all the computers in laboratory before the lesson started. By this way, the problem would be solved.

Another solution could be using one loudspeaker for unity in listening, but this would not work because again the pages were loading in different times in different computers.

Comparing with mathematics set, the ship problem was more exciting for the students. The students whose web page loaded later panicked and were upset because all of them had desired to see the activity and study.

Again the ship activity was set on the balance rule in solving equations. By replacing the loads between two sides of the ship, the balance of the ship was obtained. The students picked the numbers up and left it to one side of the ship.

This activity was better than the balance activity in mathematics set because it was supported with the operations after the ship. Indeed, the visual concept was integrated by the operations. Therefore, this activity took much more time than the previous one and it was more effective.

This activity had such a schemata that all students remembered even at the last day of the school. In my opinion, the design of the activity was convenient for the age of the students and it was attractive enough for them.

The distance-velocity problem was the subject for the lesson. As the subject was in the science curriculum, the students were not far from it. They comprehended the concept without getting difficulty.

In this lesson, the generalization of the equation in distance-velocity formulations was the concept. However, this integration did not have an important place in the curriculum. Indeed, the relation between the equations and the formulation was not emphasized in dept; hence, this concept was not easy to talk about; the students were foreigner for such an interpretation. Anyway, the lesson was effective because the students were familiar to the subject from the science. The lesson was successful in relation with the other lessons.

Most of them were multiplying velocity by the time elapsed in order to calculate the distance without thinking about the daily concept of it. By this activity, they visualized the reality of the problem. Also in interviews, I noticed that they could not remember the name of the boy in distance problem but they all remembered the structure of the problem. That means the activity reached its purpose.

Another point I wish to emphasize, the velocity problems were so boring for the students in class. However, while studying on this activity I didn't hear them complaining about the lesson.

The students were studying mathematics without being aware of this at the laboratory. They thought they were wasting the lesson hour. Therefore, it seemed that the anxiety towards mathematics actually was not towards mathematics but the way only they had to sit and listen something, which they did not understand.

I should talk about one special student whose name is Ayşe. She was diagnostic in learning. She could not decide which psychomotor ability she was going to use if someone did not tell. For instance, if you did not tell her to add 25 and 87, she could not think to do any operation in order to solve the problem. That student was bored in the laboratory for all the lessons. Also she told me this. Of course, some special programs should be prepared for these kinds of students.

✓ *Lesson 4*⇒ http://bep.meb.gov.tr/eicerikDis/default.aspx - Paint Problem

Paint problem was set on the exercises of equation solving. These equations were not the easy ones for beginning students. Indeed, after the ship problem the exercises were a little bit complex. Just doing activities was not enough. Hence, in class I had to make some examples before the activity.

In the first lesson, they learned the structure of the activity. In this lesson, most of them dropped the paint boxes as they were not so successful in calculating the x and y values.

Anyway, the structure of the activity was interesting for them. Especially, the physically active students liked it. They just felt like playing games in the Internet café. Those made them realize that mathematics could be just like playing games.

If the student could not find the correct answer, the paint box was dropped. That means the student could not pass the next step. This structure was motivating for the students. The conception of the activity was convenient for the students. However, that conception was on practice. Therefore, the students should know the solutions of the questions. On the other way, being mistaken and looking for the solution all the time made the students lose their motivation.

After we did some practice in the classroom, the student's motivation was higher. As it was clear from the interviews, most of the students remembered this paint problem. The structure of the activity affected them.

If these exercises were on the book, probably the students did not want to do them, as they were all different versions of the same operations. However, the exercises in software attracted them.

✓ *Lesson 5*⇒ www.skoool.tr - Algebraic Expressions

While solving the equations, Algebraic Expressions Activity was a useful activity to learn how to operate the algebraic expression with the numerical expressions.

Although we did equation-solving exercises, we learned that the algebraic expressions were added or subtracted only with the algebraic expressions and the numerical expressions were added or subtracted only with the numerical expressions after this activity.

We did the multiple-choice problems. However, it was so difficult to control the students. Indeed, they did not deal with the same problem at the same time. Some did easier and passed the next exercises.

Moreover, some computers were slowly loaded. Some students especially the girls were typing slower than the boys. On the other hand, I had a student Kerem, who could convert f keyboard to q keyboard and could type easily as he knew well the places of the letters in q keyboard. Thus, it was so difficult to catch the unity between students in doing the exercises.

The students felt desire for the activity. Looking at their friends who reached the website and the questions before them, they tried to enter the website filling with desire.

After they typed the name of the website, the page was loaded easily. They read the subject. Then, we discussed the questions altogether but even consisting on which problem we were discussing get four minutes. At that point, the students produced practical solutions. For instance, they called the problems like “the problem with u” or “the problem with t”.

The students were helping each other. I mean they were in an unbelievable cooperative working environment. The students, who were talking each other in some other topics rather than the subject matter, were helping their friends that have problems in computers.

On the other hand, the Murat-Selçuk was not a good-working pair. Selçuk told that Murat was always playing and he did not let him to play. That could be thought in two ways. One was that these activities were still meaning for some them as playing games. The other was if the pair was composed of the students who were different from each other in computer using abilities there were problems. The student with high ability might not let the other one to use the computer. Hence, the student with low ability got lower and the student with high ability got higher. However, this was not the case for all them. The only obvious peer was Murat-Selçuk . At that point, I check their study closely in order to complete the study.

When there was a loading problem in the computer, they did not know what to do and immediately called me.

- ✓ *Lesson 6⇒ Overview*

In that lesson, they study the activity, which they did not understand well and needed to repeat. I observed that they were not bored to do the exercise again. In fact, as they knew how to enter and what to do they were studying independent from me. I mean by not asking questions such as what to do now.

As they knew what to do, they were concentrated and effectively worked. Even some of them discovered that there were the other mathematics subjects in the web. The students who completed the activities started to do the activities of the other subjects. However, because of the purpose of the study I warned them to deal with equations.

APPENDIX J

TABLE OF SPECIFICATION

Test 1 Question1	To write addition, subtraction, multiplication and division of any two numbers or to write the expression including any two or three of them with symbols. (Bir sayının belirtilen bir sayı kadar fazlasını, eksiğini, katını, kesrini veya bunların birkaçını birlikte içeren ifadeyi sembollerle yazma) To solve any equation in form of $\frac{ax+b}{c}$ equals d (a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) and to write the solution set of it. ($\frac{ax+b}{c}$ equals d (a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) biçiminde verilen bir denklemi çözüp, çözüm kümesini yazma)
Test 1 Question2	To write addition, substraction, multiplication and division of any two numbers or to write the expression including any two or three of them with symbols. (Bir sayının belirtilen bir sayı kadar fazlasını, eksiğini, katını, kesrini veya bunların birkaçını birlikte içeren ifadeyi sembollerle yazma) To solve any equation in form of $\frac{ax+b}{c}$ equals d (a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) and to write the solution set of it. ($\frac{ax+b}{c}$ equals d (a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) biçiminde verilen bir denklemi çözüp, çözüm kümesini yazma)
Test 1 Question3	To write addition, substraction, multiplication and division of any two numbers or to write the expression including any two or three of them with symbols. (Bir sayının belirtilen bir sayı kadar fazlasını, eksiğini, katını, kesrini veya bunların birkaçını birlikte içeren ifadeyi sembollerle yazma)

	To solve any equation in form of $\frac{ax+b}{c}$ equals d (a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) and to write the solution set of it. ($\frac{ax+b}{c}$ = d(a, b, c, d $\in$ Z: a $\neq$ 0, c $\neq$ 0) biçiminde verilen bir denklemi çözüp, çözüm kümesini yazma) To tell whether or not a premise is true. (Bir önermenin doğru veya yanlış olduğunu bulup söyleme) To tell that any number whether or not validates an equation with its reason (Verilen bir sayının verilen bir denklemi sağlayıp sağlamadığını sebebi ile birlikte söyleme)
Test 1 Question4	To solve the equation in form x + 4 = 6 under reel numbers by the help of using the inverse element of the addition and to write the solution set of it. (x + 4 = 6 şeklindeki bir denklemi, reel sayılar kümesinde toplama işleminin ters eleman özeliğinden yararlanarak çözüp, çözüm kümesini yazma) To solve the equation in form 4x = 20 under reel numbers by the help of using the inverse element of the multiplication and to write the solution set of it. (4x = 20 şeklindeki bir denklemi, reel sayılar kümesinde çarpma işleminin ters eleman özeliğinden yararlanarak çözüp, çözüm kümesini yazma) Birinci dereceden bir bilinmeyenli denklemi çözüp, çözüm kümesinin doğruluğunu □ore□ss etme Birinci dereceden bir bilinmeyenli, ax + b = c(a, b, c $\in$ Z : a $\neq$ 0) biçimindeki bir denklemi, reel sayılar kümesinde toplama ve çarpma işlemlerinin özeliklerinden yararlanarak çözüp, çözüm kümesini yazma
Test 1 Question5	To find and write the value of any given open premise according to given values. (Verilen bir açık önermenin, sembollerin belirtilen değerlerine □ore değerini bulup yazma)
Test 1 Question6	To explain the linear algebraic equations in one variables by examples (Birinci dereceden bir bilinmeyenli denklemi örneklerle açıklama) To write the linear algebraic equations (Birinci dereceden bir bilinmeyenli denklem yazma)

Test 1 Question7	To explain the linear algebraic equations in one variables by examples (Birinci dereceden bir bilinmeyenli denklemi örneklerle açıklama) To write the linear algebraic equations (Birinci dereceden bir bilinmeyenli denklem yazma)
Test 2 Question1	To write any given verbal expression in symbols (Sözlü olarak verilen bir ifadeyi sembollerle yazma) To tell any verbally given expression (Sembollerle verilen bir ifadeyi söyleme) To tell and write any premise with numbers (Sayılarla ilgili bir önerme söyleyip yazma)
Test 2 Question2	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme)
Test 2 Question3	To write any given verbal expression by symbols (Sözlü olarak verilen bir ifadeyi sembollerle yazma)
Test 2 Question4	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable. (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme) To explain the equations (Denklemi açıklama)
Test 2 Question5	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable. (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme)
Test 2 Question6	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme) To explain the equations (Denklemi açıklama)

Test 2 Question7	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme)
Test 2 Question8	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme)
Test 2 Question9	To solve and to tell the result of any given problem by forming linear algebraic equations in one variable (Verilen bir problemi birinci dereceden bir bilinmeyenli denklem kurarak çözüp sonucu söyleme)
Test 2 Question10	To write the relation between the circumstances and sides of equilateral triangle, square, regular pentagon, rectangle, isosceles triangle and regular hexagon by symbols. (Eşkenar üçgenin, karenin, düzgün beşgenin, dikdörtgenin, ikizkenar üçgenin ve düzgün altıgenin çevreleriyle kenarları arasındaki ilişkileri sembollerle yazma)

APPENDIX K

SCORING KEY FOR THE DIAGNOSTIC TESTS

PRETEST
KAVRAM YANILGILARI TESTİ 1

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. $\dfrac{c-d}{\frac{1}{d}-\frac{1}{c}} = ?$ (5 puan)

a) $\dfrac{c-d}{d.c}$ b) $\dfrac{d.c}{c-d}$ c) d · c d) –d · c e) $\dfrac{1}{d.c}$

The student takes 5 points if s/he marks c.

2. Hangi ifade x^5 e eşittir? (5 puan)

a) x + x + x + x + x
b) x · x · 3x
c) $x \cdot x^4$
d) $x^2 + x^4$
e) 5x

The student takes 5 points if s/he marks c.

3. Eşitlik, eşittir ifadesinin iki tarafının aynı değerde olmasıdır.

Örneğin, 3a = 2a + a ifadesi bir eşitliktir.

Aşağıdaki ifadelerin her iki tarafının eşit olup olmadığını birer cümle ile açıklayınız.

(8 puan)

1) $\frac{1}{a+b}=\frac{1}{a}+\frac{1}{b}$ ……………………..The student takes 2 points if s/he writes False for this question.

2) $\frac{1}{\frac{1}{a}+\frac{1}{b}}=\frac{a.b}{a+b}$ ………………………. The student takes 2 points if s/he writes True for this question.

3) $\frac{1}{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}}=\frac{a.b.c}{a+b+c}$ ……………………… The student takes 2 points if s/he writes False for this question.

4) $\frac{a+b}{c-d}=\frac{a}{c.d}+\frac{b}{c.d}$ ……………………… The student takes 2 points if s/he writes False for this question.

4. 4x – 6 = 3x + 8 denklemini çözünüz. (5 puan)

4x – 6 = 3x + 8

4x – 3x – 6 = 3x + 8– 3x

x – 6 = 8

x – 6 + 6 = 8 + 6

x = 14

Each step is five points.

5. $\frac{y-b}{x-a}$ ifadesinin değerini y = 1, b = 3, x = 4, a = 7 için hesaplayınız. (5 puan)

$\frac{1-3}{4-7}=\frac{-2}{-3} = \frac{2}{3}$

Replacing the letters with the related numbers were 3 points and then calculating the right rational number is 2 points.

6. Aşağıdaki tabloyu y = x + 2 denklemine göre doldurur musunuz!

İlk kutucuk örnek olarak gösterilmiştir. (4 puan)

x	**y**		
2	4		
4	?	⟶	6
5	?	⟶	7
7	?	⟶	9
10	?	⟶	12

Each true number is 1 point.

7. Siz de böyle bir tablo oluşturur musunuz ! (10 puan)

x	**y**

Each true set pair of numbers is 2 points.

KAVRAM YANILGILARI TESTİ 2

Sınıfı

Okulu

Aşağıda denklemlerle ilgili bilgi ve becerinizin ölçüldüğü bir test yer alıyor. Testteki soruları çözünüz ve çözümünüzü bir ya da iki cümleyle açıklamaya çalışınız. Net olarak sonucu bulamasanız bile mutlaka düşüncenizi yazınız. Çözümler için boş kağıt verilecektir. Yapılacak değerlendirme ders notu ortalamanıza katılmayacaktır.

1. Aşağıdaki ifadeleri matematiksel ifadelere dönüştürünüz. (5 puan)

x' in 2 katının 3 eksiği 15'tir = $2x - 3 = 15$ is 2,5 points.

$\frac{2}{5}$ sinin 3 katından 7 eksiği 83 olan sayı b' dir = $\frac{2}{5}b.3 - 7 = 83$ is 2,5 points.

2. Üç ardışık çift sayının toplamı 72 olduğuna □ore bu sayıları bulunuz. (5 puan)

$a + a + 2 + a + 4 = 72$ $3a + 6 = 66$ $a = 22$ $a + 2 = 24$ $a + 4 = 26$

Each step is 1 points.

3. Bir üniversitede profesör sayısının altı katı kadar öğrenci vardır. Öğrenci ve profesör sayıları arasındaki ilişkiyi bir denklemle ifade ediniz. (5 puan)

$6p = ö$

(At this university there are six times as many students as professors." Use *S* for the number of students and *P* for the number of professors.)

4. Aralarında 600 km fark olan iki araç birbirlerine doğru geliyorlar. Hızları 70 km/sa ve 80 km/sa olduğuna göre kaç saat sonra karşılaşırlar? (5 puan)

70 + 80 = 150 km /sa

X = V . t 1 point

600 = 150. t

t = 4 saat 1 point

- Bu iki araç aynı yönde gitselerdi hızlı olan önde yavaş olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi ? Açıklayınız. Yetişemez. 1 point

- Bu iki araç aynı yönde gitselerdi yavaş olan önde hızlı olan arkada olsa arkada olan öndekine kaç saat sonra yetişirdi ? Açıklayınız.

80 –70 = 10 1 point

X = V. T

600 = 10. t

t = 60 saat 1 point

5. Aynı anda, aynı şehirden ters yönde hareket eden araçlardan birinin saatteki hızı 70 km, diğerinin 60 km.dir. 4 saat sonra bu iki araç arasındaki uzaklık kaç km. olur? (5 puan)

a) 500 b) 520 c) 510 d) 530 e) 540

The student marks b takes 5 points.

6. İki kız kardeşten biri diğerinden 5 yaş büyüktür. Bu kardeşlerin yaşları toplamı 45 olduğuna göre: (5 puan)

a) Abla kaç yaşındadır?

A + a + 5 = 45 1 point

2a = 40 0.5 point

a = 20 0.5 point

a + 5 = 25 1 point

b) 7 sene sonra aralarındaki yaş farkı kaç olur?

Aynı kalır. 1 point

c) Bu sorunun başka çözüm yolu var mı? Nasıl?

Yoruma bağlı. 1 point

7. Birer sene ara ile doğmuş olan üç kardeşin yaşları toplamı 30 'dur.Bu kardeşlerden en büyüğünün yaşını hesaplayınız. (5 puan)

a + a +1 + a + 2 = 30 1 point

3a + 3 = 30

3a = 27 1 point

a = 9 1 point

a +1 = 10 1 point

a + 2 = 11 1 point

8. Boş bir havuzu 1.musluk 18 saatte 2.musluk 36 saatte dolduruyor. İki musluk birlikte boş havuzu kaç saatte doldurur? (5 puan)

a) 12 b) 11 c) 10 d) 13 e) 15

The student marks a takes 5 points.

9. Bir işi 1. işçi 20 günde, 2. işçi 15 günde bitiriyor. İki işçi birlikte aynı işi kaç günde bitirir? (5 puan)

a) $10\frac{1}{3}$ b) $7\frac{1}{2}$ c) $4\frac{3}{4}$ d) $8\frac{4}{7}$ e) $15\frac{2}{8}$

The student marks d takes 5 points.

10. Bir kenarı a+2 olan bir karenin alanını a cinsinden hesaplayınız.(5 puan)

Alan = (a +2)(a+2)

$= a^2+2a+2a+4$

$=a^2+4a+4$

APPENDIX L

THE SCORES OF THE ATTITUDE SCALES

Students	Anxiety	Effectance
Aysu	35	36
Selçuk	39	41
Aydan	37	33
Toprak	49	50
Mine	31	36
Ufuk	30	34
Deniz	45	47
Emel	41	30
Serkan	51	49
Kerem	44	45
Turgut	39	34
Murat	54	52
Ceren	37	48
Emre	36	43
Nalan	37	34
Ayşe	32	35
Tufan	39	37
Mehmet	49	57