THE EFFECT OF CREATIVE DRAMA BASED INSTRUCTION ON SEVENTH GRADE STUDENTS' ACHIEVEMENT IN RATIO AND PROPORTION CONCEPTS AND ATTITUDES TOWARD MATHEMATICS

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ABSTRACT

THE EFFECT OF CREATIVE DRAMA BASED INSTRUCTION ON SEVENTH GRADE STUDENTS' ACHIEVEMENT IN RATIO AND PROPORTION CONCEPTS AND THEIR ATTITUDES TOWARD MATHEMATICS

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The main purpose of this study was to investigate the effect of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts and their attitudes toward mathematics. Another purpose of this study was to investigate students' self-reported views related to creative drama based instruction.

The study was conducted in a public school in Körfez-Kocaeli with a total of 58 seventh grade students, lasting 12 lesson hours (three weeks). Thirty of the participants received Creative Drama Based Instruction (CDBI), and twenty-eight received Traditional Instruction (TI).

The data were collected through Ratio and Proportion Achievement Test (RPAT), Mathematics Attitude Scale (MAS), and interviews. The RPAT and MAS were administered as both pretest and posttest. In addition, interviews were conducted with the ten randomly selected students.

The quantitative analyses were carried out by using One-Way Analysis of Covariance (ANCOVA) with covariate preRPAT and dependent variable postRPAT at the significance level 0.05. Moreover, independent samples t-test was performed on gain scores of MAS.

The results of the study indicated that there was a statistically significant mean difference between the students who received creative drama based instruction and traditional instruction in terms of achievement in ratio and proportion concepts and in terms of gain scores of attitudes toward mathematics, in favor of CDBI. Furthermore, according to the interview responses of the experimental group students, significantly better performance of the experimental group students was attributable to the potential of the creative drama based instruction to provide actively involvement, work with friends and collaboratively and providing self-awareness.

Keywords: Proportional Reasoning, Ratio and Proportion Concepts, Attitudes toward Mathematics, Traditional Instruction and Creative Drama Based Instruction

ÖZ

YARATICI DRAMA TEMELLİ ÖĞRETİMİN YEDİNCİ SINIF ÖĞRENCİLERİNİN ORAN ORANTI KONUSUNDAKİ BAŞARILARINA VE MATEMATİĞE YÖNELİK TUTUMLARINA ETKİSİ

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Bu çalışmanın amacı yaratıcı drama temelli öğretimin, geleneksel öğretim ile karşılaştırıldığında yedinci sınıf öğrencilerinin oran orantı konusundaki başarılarına ve matematiğe yönelik tutumlarına etkisini araştırmaktır. Bu çalışmanın diğer bir amacı ise öğrencilerin yaratıcı drama temelli öğretim ile ilgili görüşlerini almaktır.

Çalışma Körfez-Kocaeli'ndeki bir devlet okulunda toplam 58 yedinci sınıf öğrencisi ile yürütülmüş, 12 ders saati (üç hafta) sürmüştür. Çalışmada 30 öğrenci Yaratıcı Drama Öğretimi (YDTÖ), 28 öğrenci ise Geleneksel Öğretim (GÖ) almışlardır.

Veri toplamak amacıyla, Oran Orantı Başarı Testi (OOBT), Matematik Tutum Ölçeği (MTÖ) ve görüşmeler kullanılmıştır. OOBT ve MTÖ ön ve son test olarak uygulanmıştır. Bunlara ek olarak, rastgele seçilen on öğrenci ile görüşmeler yapılmıştır.

Elde edilen nicel veriler, ön OOBT'nin ortak değişken ve son OOBT'nin ise bağımlı değişken olarak kullanıldığı tek yönlü eş varyans analizi (ANCOVA) ile incelenmiştir. Ayrıca, matematiğe yönelik tutum ölçeği son test ön test fark puanları üzerinde bağımsız örneklem t testi uygulanmıştır.

Çalışmanın sonuçlarına göre Oran Orantı Başarı Testinden alınan puanlara ve matematiğe yönelik tutum ölçeği son test ön test fark puanlarına göre yaratıcı drama temelli öğretim lehine istatistiksel olarak anlamlı bir fark bulunmuştur. Ayrıca, deney grubundaki öğrencilerin görüşmelerde ifade ettikleri düşüncelere göre; deney grubu öğrencilerin kontrol grubu öğrencilerine göre daha iyi performans göstermesi yaratıcı drama temelli öğretimin aktif katılıma, işbirliği içinde çalışmaya ve kendine ait farkındalığa olanak sağlaması ile ilişkilendirilmiştir.

Anahtar Kelimeler: Orantısal Akıl Yürütme, Oran Orantı, Matematiğe Yönelik Tutum, Geleneksel Öğretim ve Yaratıcı Drama Temelli Öğretim

To My Family

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LIST OF ABBREVIATIONS

ABBREVIATIONS

CDBI: Creative Drama Based Instruction
TI: Traditional Instruction
EG: Experimental Group
CG: Control Group
RPAT: Ratio and Proportion Achievement Test
MAS: Mathematics Attitude Scale
IEMAT: Interest in and Enjoyment of Mathematics
IMMAT: Instrumental Motivation to Learn Mathematics
AMAT: Mathematics Anxiety
PRT: Proportional Reasoning Test
MES1: First Math Exam Scores in School
MES2: Second Math Exam Scores in School
MoNE: Ministry of National Education
NCTM: National Council of Teachers of Mathematics
SBS: National Level Examination
ANCOVA: Analysis of Covariance
p: Significance Level
t: T value
M: Mean
Md: Median
SD: Standard Deviation

CHAPTER 1

INTRODUCTION

"The school of future will, perhaps, not be a school as we understand it. So, imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."

Albert Einstein

The quote above clearly indicates what is important in a changing world. Human imagination has resulted in expanding border of minds and development of technology with the tracking of time (Gouzouasis, 2006). Nowadays, the requirements of daily life and business life are different from the past, as a result of recent developments in technology. Also, the skills for being successful in education system have changed in the sense that students need to have flexible approaches for solving problems. The necessity of acquiring the problem solving methods that can be adapted to new situations is crucial for understanding. Learning mathematics with understanding develops a sense of when and how to apply mathematics. This is the most useful thing to know in a changing world (Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, Olivier & Human, 1997).

Mathematics education standards in the United States support the deep understanding of mathematical concepts and propose student-centered approach to instruction (National Council of Teachers of Mathematics [NCTM], 1989, 2000). It has been argued that, there should be greater emphasis on active engagement and encouragement for communication in the classroom (NCTM, 1989, 2000). In fact, involving all students in class discussion, respecting students' ideas, being sensitive to students' experience, initiating problem solving with data sets in realistic contexts, using concrete materials and modeling is different ways to provide students' involvement in learning process (Turner, Cox, DiCintio, Meyer, Logan, & Thomas, 1998).

The importance of learning with understanding was also highlighted in the new elementary mathematics curriculum, which was based on the reform movements; in Turkish education system in 2003 (Ministry of National Education [MoNE], 2006, 2007). New elementary mathematics curriculum in Turkey underlines the importance of reasoning, problem solving, communication and connection processes. In these processes, students are encouraged to be cognitively and physically active during their learning process.

On the other hand, paying attention to only isolated facts, skills, memorized rules and practices are not ways to encourage understanding in mathematics (Romberg, 2000). These ways make students poorly prepared to think for different situations from different perspectives (Zuckerman, 2004). Moreover, reasoning is another fundamental skill that requires looking at an event from different perspectives in a knowledgeable way related to a subject area (Umay, 2003). It also helps us to make logical assumptions in order to reach a conclusion, mostly used in mathematics. Reasoning is very important for mathematics learning, it is, in fact, "fundamental to the knowing and doing of mathematics" (NCTM, 1989, p.81). Particularly, mathematics requires exploring patterns, developing and evaluating arguments, to make logical assumptions, selecting and applying new solutions to a problem, reaching and defense a conclusion as a course of its nature (Kramarski & Mevarech, 2003).

Proportional reasoning is one of the most important forms of mathematical reasoning that involves making sense of quantitative and qualitative comparisons by taking into account of relationships between ratios. Lesh, Post and Behr (1988) pointed out that proportional reasoning involves "a sense of co variation, multiple comparisons, and the ability to mentally store and process several pieces of information" (p.93). Moreover, the development of proportional reasoning provides students a substantial base for the development of thinking (Cai & Sun, 2002).

Supplementary evidences that support the importance of proportional reasoning can be found in its area of usage. Proportional reasoning is often utilized in daily life contexts and was claimed to be useful in solving a variety of real life problems (Cai & Sun, 2002; Post, Behr, & Lesh, 1988). For example, comparing goods about which is more favorable at shopping, increasing the size of a recipe to

feed a large number of people, adjusting the amount of water in a medicine to the size of a farmer's field, an architect's scaling of a city plan and a photographer's enlarging a photo to make a poster and such everyday activities need proportional reasoning. Besides use of proportionality in everyday contexts, it is also a critical skill for students' mathematical development. This skill has been referred to as a principal concept of elementary school arithmetic and the cut-off point of more advanced topics in mathematics and beyond (Fuson & Abrahamson, 2005; Lamon, 2007; Lesh et al., 1988). Proportional reasoning ability is not only essential for success in mathematics but also is a significant mathematical tool for science achievement (Akatugba & Wallace, 1999a; Thompson & Fuller, 1972; Wollman & Lawson, 1978).

Despite its efficacy and utility in everyday situations, in mathematics, and in science mastering proportional reasoning is difficult (Lamon, 2005; Lawton, 1993). For this reason, proportional reasoning has been the object of many research studies (Akkuş-Çıkla & Duatepe, 2002; Al-Wattban, 2001; Battista & Borrow, 1995; Boyer, Levine, & Huttenlocher, 2008; Karplus, Pulos, & Stage, 1983; Lamon, 2007; Noelting, 1980; Weinberg, 2002). Recommendations outlined in these researches and their contributions to proportional reasoning are essential. Al-Wattban (2001) put forward the development of proportional reasoning take several years. In essence, understanding proportionality at one level form a sound bases to higher levels of understanding (Lamon, 2007; Noelting, 1980). The mathematical ideas identified in the research studies emphasize that basic knowledge of algorithm is required in order to solve proportional reasoning tasks. Moreover, these tasks should provide students a perspective about ratio and proportion for developing children's proportional reasoning (Battista & Borrow, 1995). In other words, students are involved in proportional thought process when they use and understand the ratios and change terms in one ratio into the equivalent ratios. Also, students must have developed proportional reasoning to be able to conceive the ratio and proportion concepts (Boyer, Levine, & Huttenlocher, 2008; Weinberg, 2002).

Each of these theoretical positions makes an important contribution to understand significance of ratios and proportions for the formation of proportional reasoning. That is to say, ratios and proportions are integral part of proportional

reasoning development and should be taken into account in current mathematics curricula (Chapin & Johnson, 2006; Lobato, Amy, & Charles, 2010). Therefore, mathematics education researchers have studied on children's conceptions of ratio and proportion for a long time to develop students' sense of proportional reasoning rather than formal procedures (Kaput & West, 1994; Kayhan, 2005; Lo & Watanabe, 1997; Singh, 2000; Weinberg, 2000). NCTM (1989) recommends that students should be introduced to these topics earlier throughout grades 5 -8. The standards argue that "it is of such great importance that it merits whatever time and effort must be expanded to assure its careful development" (p.82). Students should be given enough time for understanding equivalence and comparison, see many proportional situations that can be compared and then reach a solution through proportional reasoning (Lamon, 2005; Lo & Watanabe, 1997). Unfortunately, ratio unit is treated for only 2 weeks in sixth grades which is not enough (MoNE; 2006, 2007, 2010). Indeed, students should be allowed to experience with more situations to examine and investigate the multiplicative nature of situations involving ratio and proportion (Lamon, 2005). Students are exposed to computational procedures such as cross multiplication or unit ratio strategy before they make the sense of these algorithms (Chapin & Johnson, 2006). The findings also suggest that teaching how to use cross products to find missing values may not help students to develop conceptual understanding of ratios and proportions (Al-Wattban, 2001, Carpenter, Fennema, & Romberg, 1993; Lo & Watanabe, 1997). The development of proportional reasoning should be given precedence than cross multiplication algorithm (Kaput & West, 1994).

In order to deal with multiplicative reasoning meaningfully and develop an understanding of proportional situations, students should be encouraged to represent ratio and proportions visually (Van de Walle, 2007). Enough time should be given to analyze each proportion situation individually. Also, a discussion atmosphere should be provided to use their informal strategies before being introduced to the cross product algorithm (Kramarski & Mevarech, 2003). Besides these recommendations, cautions make a point of undesirable results of demonstrating students an algorithm or a strategy to solve a ratio and proportion problem before discussing convenience of their alternative strategies. Students who learn these strategies by rote either

generate algorithm without understanding why they are doing or they can not apply the same strategy to problems with different substance (Verschaffel, De Corte, Lassure, Van Vaerenbergh, Bogaerts, & Ratinckx, 1999). As seen a well-constructed conceptual framework is critical to prevent all of these nonsense subscriptions for development of proportional reasoning (Lamon, 2005).

Literature supports value of conceptually oriented curriculum over a procedurally based curriculum and active engagement of students in developing proportional reasoning by the development of ratio and proportion concepts (Hart, 1988; Kramarski & Mevarech, 2003; Lamon, 1994; 1999; Lesh, Hoover, Hole, Kelly, & Post, 2000; Smith, 2002; Thompson, Austin, & Beckman, 2002). Smith (2002) stated that providing variable experiences with ratios and proportions in classroom from all over physical and social world is important for the development of proportional reasoning. Also, the importance of listening students own ideas before teaching some rules for identifying their thinking way and their own knowledge about ratios and proportions was emphasized (Kramarski & Mevarech, 2003). Lamon (1994, 1999) and Smith (2002) indicated that shaping students own ideas and building algorithms on their informal strategies bring construction of knowledge with the variable ways of thinking and make sense of this complex topic. Avoiding from quick paths to computational procedures encourages students think deeply about ratio and proportions. Confronting students with proportional situations provides construction of important ideas that can support more solid understandings of ratios later on to reason proportionally (Thompson, Austin, & Beckman, 2002). Also, there are verifications for the positive effects of collaborative problem solving and student-centered activities on construction of proportion knowledge with respect to traditional teaching methods (Ben-Chaim, Fey, Fitzgerald, Benedetto, & Miller, 1998; Silvestre, 2006).

In this context, creative drama in education can be an important approach to instruction to promote a deep understanding of ratio and proportion concepts since creative drama with purposeful activities let students discuss their reasoning with group members. Creative drama provides participants a chance not only share what they know, but an opportunity to demonstrate their ability to think, feel, and imagine about what they know through active participation (Adıgüzel, 2006). Imagination is

the basic problem for the mathematics lessons. Mathematics can be perceived more abstract from the other lessons (Hiebert et al., 1994). But a teacher can create concrete environment for the mathematics with creative drama activities based on experiences. Constructing daily life problems according to students' experiences with ratio and proportion concepts makes students develop their proportional reasoning skills. Following, enhancing this process from their informal reasoning strategies and their own meanings to constructed meaningful algorithms utilizes techniques or rules that are strange to them (Kent, Arnosky, & McMonagle, 2002). Creative drama based instruction provides an active learning environment that consists of activities from everyday context (Arieli, 2007).

As mentioned before; by means of the new mathematics curriculum in Turkey, reasoning, problem solving, communication and connection processes become important. In order to encourage students cognitively and physically active during their learning process, some teaching methods such as problem based, cooperative learning and creative drama based instruction are mentioned in the new elementary curriculum. Creative drama can be used as an instructional method for allowing students to learn a subject of a lesson by the utilization of drama techniques and the play processes (Adıgüzel, 2010). Creative drama-based instruction makes learning easy and understanding better by providing the opportunity to contextualize concepts and problems, act as a character (role playing), and communicate and study in a collaborative learning environment. It improves attitudes by getting students' attention with an exciting, motivating, and interesting learning environment (Üstündağ, 2006).

Moreover, it was pointed out that creative drama could be used as an instructional method in education (Annarella, 1992, 2000; Ciaburri, 1975; Çokadar & Yılmaz, 2010; Dewey, 1994; Dupont, 1989; Fleming, Merrel, Tymms, 2004; Gallagher, 1997; Karacil, 2009). However, there are few studies on the use of creative drama in mathematics education (Kariuki & Humphrey, 2006; Omniewski, 1999; Saab, 1987; Southwell, 1999).

On the other hand, with the implementation of the new mathematics curriculum based on reformist ideas in primary schools in Turkey, some studies have been conducted to investigate the effects of creative drama based instruction in

mathematics education in Turkey (Duatepe, 2004; Sözer, 2006; Erdoğan, & Baran, 2009). Duatepe (2004) used creative drama as a teaching method in seventh grade geometry classrooms. Also, the aim of Sözer's study was to investigate the effects of creative drama based instruction on fourth grade students' achievement in fractions. Furthermore, the aim of Erdoğan and Baran's study was to examine the effect of mathematics teaching given through the creative drama on mathematical ability of six year old children. The findings showed that mathematics teaching based on the creative drama method has a positive effect on the mathematics achievement of elementary students. However, none of these studies were about ratio and proportion concepts.

Having established these facts, the emphasis on cognitive and active constructions of algorithms for conceptual understanding of ratio and proportion concepts and also, the emphasis on active engagement of learners in the new mathematics curriculum make creative drama based instruction remarkable. Therefore, it seems necessary to design an experimental research on the effects of creative drama based instruction and to investigate its effects on students' achievement in ratio and proportion concepts and attitudes towards mathematics.

1.1. Purpose of the Study

The main purpose of this study was to investigate the effect of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts and their attitudes toward mathematics. Another purpose of this study was to investigate students' self-reported views related to creative drama based instruction.

1.2. Research Questions and Hypotheses

1. Is there a statistically significant effect of the creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts when students' prior achievement in ratio and proportion concepts is controlled?

H_0: There is no statistically significant mean difference between the students who received creative drama based instruction and traditional instruction in terms of achievement in ratio and proportion concepts.

2. Is there a statistically significant effect of creative drama based instruction on seventh grade students' gain score of attitudes toward mathematics?

H_0: There is no statistically significant mean difference between the students who received creative drama based instruction and traditional instruction in terms of gain scores of attitudes toward mathematics.

3. What are the students' views related to the creative drama based instruction?

1.3. Definitions of Important Terms

Creative drama based instruction: An instructional method for allowing students to improvise and construct a meaning of a word, a concept, an idea, an experience or an event by the utilization of drama techniques and the play processes (Adıgüzel, 2010). In this study, ratio and proportion topics integrated with creative drama based instruction lasted for 3 weeks and 4 lesson hour per week.

Traditional instruction environment: A regular instruction that includes some characteristics:

- Teacher talk exceeds student talk
- Use of class time is largely determined by the teacher
- Teachers use a textbook to guide curriculum
- Classroom furniture is arranged into rows or chairs, facing a blackboard
- Learning is compartmentalized by discipline
- Competitive relations and individual assessment (Relan & Gillani, 1997, pp. 41-42).

In this study traditional instruction was about ratio and proportion topics and lasted for 3 weeks and 4 lesson hours per week.

Attitude: Tendency to think, feel, perceive and behave cognitively and emotionally toward an object (Aiken, 2000; McLeod, 1992).

Attitude toward mathematics: Liking or disliking of mathematics, predisposition to engage in or avoid mathematical activity, feeling good or bad at mathematics, and believing usefulness or uselessness of mathematics (Ma & Kishor, 1997). In this study, it was measured by Mathematics Attitude Scale (MAS), which

was obtained from National Report of PISA 2003 Project (2005) and consists of 13 items.

Gain score: The difference between the pretest and posttest scores of a measure (Maris, 1998).

Achievement in ratio and proportion: Achievement is something accomplished, especially by means of exertion to attain determined objectives in education (Elliott & Dweck, 1988). In this study, it was measured by a test called Ratio and Proportion Achievement Test (RPAT), which consists of 24 open ended items from ratio and proportion unit of the mathematics course, the content which is determined by the mathematics curriculum.

1.4. Significance of the Study

Elementary school programs designed on the basis of constructivist approach in Turkey. Therefore, implementation of student centered methods gained importance. Namely, how students learn became the main question of the research studies rather than how teacher teach (Clements & Battista, 1990). In this respect, it seems necessary to implement instructional strategies that are student centered. These methods should enable students to actively participate, make reflections and communications (Hiebert et al., 1997). New principles for making teaching and learning process more effective according to constructivism are mentioned in Clements and Battista (1990). Encouragement of students to invent their own strategies and shape and reshape these informal strategies with thinking, reflecting and communicating rather than computational procedures on paper is preferred according to constructivism. In this context, instructions integrated with creative drama activities can render the learning process more effective with provided opportunities to construct students' own knowledge.

There are several of publications which discuss the benefits of creative drama as a learning tool in education. Although there is an increase in the amount of research studies conducted to investigate the effects of creative drama based instruction in mathematics education in Turkey, the number of studies is not enough to include different subjects in mathematics. Most of these studies are about effectiveness of creative drama based instruction on the geometry achievement, attitudes toward geometry and the topic in the geometry area. Difficulty of

integrating mathematics topics with drama activities can be reason of this. Besides, idea for inappropriateness of creative drama based instruction to achieve mathematical objectives can bring deficiency of application examples. And deficiency of example plans discourage attempt to apply creative drama based instruction for mathematics topics. This study offers an answer for appropriateness or inappropriateness of using creative drama based instruction in mathematics.

On the other hand, reasoning is one of the fundamental skills for mathematics that requires looking at an event from different perspectives in a knowledgeable way related to a subject area. Also, proportional reasoning is one of the essential structures of reasoning that can be used to solve a range of real-life problems. Moreover, proportional reasoning is essential for the development of algebraic thinking that has been referred to as a principal concept of elementary school arithmetic (Fuson & Abrahamson, 2005; Lamon, 2007; Lesh et al., 1988). Also, proportional reasoning ability is a significant mathematical tool for science achievement (Akatugba & Wallace, 1999a; Thompson & Fuller, 1972; Wollman & Lawson, 1978). Findings of research studies showed that tasks to develop proportional reasoning should provide students a perspective about ratio and proportion since ratios and proportions are foundation blocks for the formation of reasoning proportionally (Battista & Borrow, 1995; Lamon, 2007; Noelting, 1980). Everyday problems, science problems, percent problems, geometry problems, and many others are solved mostly easily by the use of ratio and proportion. Therefore, ratios and proportions should be taken into account in current mathematics curricula (Chapin & Johnson, 2006; Lobato et al., 2010). Constructing daily life problems according to students' experiences about ratio and proportion concepts is important to make sense of proportional situations. Also, let sharing ideas about proportional situations facilitate to construct meaningful algorithms utilizes techniques or rules that are strange to them about ratio and proportion concepts (Kent, Arnosky, & McMonagle, 2002). In this context, creative drama based instruction provides student-centered activities consists of situations from daily life (Arieli, 2007). Creative drama based activities let students discuss their reasoning with group members and provide opportunities construct their own knowledge related to ratio and proportion concepts. Although there were some studies on the use of creative

drama in mathematics education (Kariuki & Humphrey, 2006; Omniewski, 1999; Saab, 1987; Southwell, 1999) and also some studies in mathematics education in Turkey (Duatepe, 2004; Sözer, 2006; Erdoğan, & Baran, 2009), none of these studies were about ratio and proportion concepts. Hence, it is believed that this study contributes to the literature about the effect of creative drama based instruction on students' achievement in ratio and proportion concepts. In addition, lesson plans of the study will help mathematics teachers who want to use creative drama based instruction for ratio and proportion topic.

1.5. Assumptions

The study is based on the following assumptions:

1. All tests were administered under same conditions.
2. Students who participated in the study answered the questions in achievement tests and interviews sincerely and impartially reflected their opinions.

1.6. Limitations

In this study convenient sampling is used instead of random sampling. Therefore, the findings of the study are limited 7^{th} grade students in one of the public school in Körfez, Kocaeli. Particularly, the results of the study are limited to the population with similar characteristics. The students' achievement in ratio and proportion concepts is limited to the questions asked in the achievement tests. Moreover, the researcher implemented the creative drama based instruction to experimental group and regular mathematics teacher implemented the traditional instruction to control group. The different implementers of instructions do not allow determining whether drama based instruction has an effect on students' achievement regardless of the implementer.

CHAPTER 2

REVIEW OF THE LITERATURE

The main purpose of this study is to investigate the effect of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts and attitudes toward mathematics. Another purpose of this study is to investigate students' self reported views related to creative drama based instruction. In accordance with the purposes, this chapter included a review of related literature by referring to the major studies in the field. The review of literature on ratio and proportion will be presented under five sections: proportional reasoning, development of proportional reasoning, related studies for acquisition of proportional reasoning skills, ratio and proportion, and students' understanding of ratio and proportion. Also, related literature about students' attitudes toward mathematics will be stated. Lastly literature related to creative drama and drama based instruction, phases of drama based instruction, drama techniques, research studies on drama based instruction and research studies related to drama based instruction in mathematics will be mentioned.

2.1. Proportional Reasoning

In the literature, different definitions were used to define proportional reasoning. Difficulty of defining proportional reasoning with a single sentence was indicated by several researchers. Proportional reasoning is not computational procedures that can be done or cannot be done on a paper (Smith, 2002). For instance, Lesh, Post, and Behr (1988) defined proportional reasoning as "a form of mathematical reasoning that involves a sense of co-variation and of multiple comparisons and very much concerned with inference and prediction" (p.93). Ben-Chaim et al. (1998) stated that proportional reasoning is a way of thinking. It is the ability of identification of the mathematical ideas with multiplicative relationship. Reasoning proportionally involves problems that require gathering information

mentally and concluded at the end of both quantitative and qualitative thinking processes (Al- Wattban, 2001; Lesh et. al., 1998).

As seen from the literature, any definition of proportional reasoning is sufficiently inclusive but all definitions are supplementary to each other. The difficulty to define proportional reasoning in a simple sentence comes from its extent with wide variety situations. Namely, proportional reasoning is included from everyday-life phenomena to elementary school arithmetic, higher mathematics and science (Al-Wattban, 2001). Proportional reasoning allows human to develop insight to solve problems of real life (Ellen, Van Dooren, Schaeken, & Verschaffel, 2009). Many everyday-life situations such as comparing car performances, determining the amount of gas needed to drive a specific distance or drawing a map with a scale require thinking proportionally (Akatugba & Wallace, 1999b ; Cai & Sun, 2002). Tournaire and Pulos (1985) stated that proportional reasoning ability is very useful not only inside the school but also outside the school. They indicated that most people need to think proportionally in many situations without being aware of any definition or computation.

Moreover, proportional reasoning makes some valuable contributions to its usage in daily life with developing algebraic thinking. Ability to reason proportionally is the primary step for understanding algebra. Also, this step forms a foundation of being successful in high school mathematics and science (Akatugba & Wallace, 1999a; Beckman, Thompson, & Austin, 2004; Chapin & Johnson, 2006; Lesh et. al., 1988; NCTM, 2000; Van da Walle, 2004). Therefore, development of proportional reasoning became an area of research studies that has a focus on ways of proportional reasoning development over time. In this section, variable definitons of proportional reasoning which are supplementary to each other and importance of proportional reasoning were mentioned, in the following section different conjectures and theories that appear about development of proportion reasoning will be given.

2.2. Development of Proportional Reasoning

Proportional reasoning is a crossing point from formal operational thinking level to concrete operational thought. It is basic for understanding multiplicative relationships (Al-Wattban, 2001; Van de Walle, 2004). Since proportional reasoning is a critical skill for mathematical development, proportional reasoning became an

area of inquiry that has a focus on ways of reasoning proportionally. How proportional reasoning develops over time was the main question of these researches. However, an inclusive and conclusive answer cannot be reached, different conjectures and theories appear.

Noelting's research (1980) indicated that some experiences in childhood initiate proportional reasoning process and bring about the construction of relational numbers. With this initiation, proportional reasoning develops slowly over time. The reason for slow passage of this development is the importance of age and maturity (Stuessy, 1989). Also, Ahe, Moore and Dixon (1992) supported this idea that age is an important variable for development of proportional reasoning. They studied with fifth and eighth grade students which let them make a comparison between different age groups. On the other hand, Lamon (1994) stated the importance of not only individual differences and intellectual maturity but also opportunities to connect prior knowledge and experience with proportional situations in a wide variety.

According to Koellner-Clark and Lesh (2003) proportional reasoning consists of five phases which are foundations of each other. A students' first experience with a problem situation, gathering information intuitively related to the problem and processing with this relevant information constitutes the first phase. Thompson (1994) analyzed students' approaches to problem situations about speed with fixed relationships. Informal opinions for these problem situations involve the application of mathematical concepts and skills to solve real-world problems (Thompson, 1994). Indicating informal notions and adopting these informal notions to variable situations are implications for Piaget's developmental constructs of proportional reasoning (Kramarski & Mevarech, 2003).

Second phase has been handled by Resnick and Singer (1993) and Lesh (1998). This phase of proportional reasoning involves qualitative methods for problem situations. Resnick and Singer (1993) stated that children experience reasoning situations about physical quantities every day. Before coming school, students engage in activities that provide them construction of relational ideas without using numbers. Lesh (1998) also emphasized the influence of second phase on students. Students who are developing proportional reasoning need to gain qualitative thinking ability to develop insight to this topic. Further, development and

foundation of significant strategies can be made by proportional situations. Namely, these situations should involve reasonable answers beyond computational aspects of the problem (Lo & Watanabe, 1997).

Reasoning moves from additive to multiplicative reasoning. Third phase is a transition stage called pre-proportional reasoning (Singh, 2000). Pre-proportional children use additive relationships for reasoning and understand the changing differences with respect to size of numbers intuitively. The ideas from the preceding phase are quantitated. But multiplicative relationships are not used in this quantification (Tourniaire & Pulos, 1985). This developmental stage is followed by realizing the constantly difference and comparing quantities multiplicatively. Comparing ratios and understanding the equivalence of ratios are logical developments of this phase (Karplus et al., 1983; Lamon, 1994). Also, children can recognize the patterns and build strategies to mentally gather information and to process both quantitatively and qualitatively. Gathered information is used to determine patterns like ratio tables, charts or graphs (Kaput & West, 1994; Resnick & Singer, 1993). Combining the determined patterns for two or more relationships and conceptual understanding of proportional reasoning is the last phase.

According to Lamon (1999), ability to reasoning proportionally requires the following characteristics:

- Gather information with a sense of correlated variation. Namely, understanding how variation in one corresponds to the variation in another.
- Differentiate proportional situations from nonproportional situations in daily life.
- Develop various informal strategies for conceptual understanding of solving proportions instead of memorization of some algorithms.
- Compare quantities multiplicatively instead of additive comparisons.

According to these characteristics, many researchers identified that most of the adult population have difficulty with proportional reasoning (Akkuş-Çıkla & Duatepe, 2002; Kent, Arnosky, & McMonagle, 2002; Lamon, 1999; Tourniaire & Pulos, 1985). This shows that development of proportional reasoning is not a natural process that comes true and is not succeed only by getting older. As a result of these identifications, research studies which examine the methods for the improvement of

proportional reasoning skills have gained importance. In the next section, these research studies related with the acquisition of proportional reasoning skills will be given.

2.3. Related Studies for Acquisition of Proportional Reasoning Skills

Literature provides a natural context in which study can be used to improve proportional reasoning skills. These studies are important to suggest teaching methods to provide proportional reasoning skills acquisition. Most of the studies presented an innovative treatment compared to teacher-directed instructions. There is an agreement on development of proportional reasoning accrues in students through grades 5-8. As a consequence of this statement's influence, most of the studies investigated treatments with elementary school children (Ben–Chaim et al., 1998; Çelik, 2010; Heller, Ahlgren, Post, Behr, & Lesh, 1989; Koellner-Clark & Lesh, 2003; Spinillo & Bryant, 1999; Stemn, 2008; Tournaire, 1984). A few studies are beginning to appear with high school students for the improvement ways of proportional reasoning development (McLaughlin, 2003).

Tournaire (1984) examined the effects of treatment with using manipulative on proportional reasoning for 3rd, 4th and 5th grade students. The results showed that there is a positive effect for only 25 % of children and there is no effect for 70% of the children.

On the other hand, most of the reviewed studies indicated there was a significant effect of treatment. To illustrate, Ben – Chaim et al. (1998) conducted a study to compare two group of seventh grade students at averaging 12 years old which experience different curricula : Connected Mathematics Projects (CMP) and traditional curriculum in American middle schools. CMP consists of interacting real-life problem situations. Students observe, process several group of information, determine patterns, mentally gather information with tasks, discuss about tasks, make reflection and communication to generalize the patterns and relationships. They work with collaborative activities in CMP. Students deal with contextual rate problems in both traditional, teacher-directed and CMP curricula. Students' way of learning and knowledge about proportional resoning were observed through analysis of their solution strategies. The results indicated the new CMP approach developed effective strategies for proportional reasoning by the collaborative and costructivist activities

with respect to teacher directed, traditional curricula.These activities make students creative to constitute their own strategies.

Koellner –Clark and Lesh (2003) conducted a promoting study with one group seventh grade students. The focus of this study was the analysis of small group discussion about Footprint problem over the 90 minute block lesson. Footprint problem is an open ended proportional reasoning problem and set within real-life context. Students' mathematical process and levels of thinking proportionally can be identified by their observed notions. Besides, this problem let students observe relationships with cooperative group working and share, extend and revise their ideas in this real-life context. Observations were analyzed by using a typical response document analysis with audio tapes and videotapes recording. The explications showed that proportional reasoning ability development can be seen from additive to multiplicative understandings. Also, a wide range research through Rational Number Project emphasizes the importance of providing opportunities to analyze variable situations and a discussion atmosphere to use their informal reasoning strategies before being introduced mold algorithms (Post, Behr, & Lesh, 1988). Heller et al. (1989) also investigated the study with seventh grade students. The purpose of the study was to examine the effects of two context variables, ratio type and problem setting on the performance of students on a qualitative and quantitative proportional reasoning test. The results indicated the familiarity of problem context have a positive effect on qualitative reasoning.

Stemn (2008) emphasized an innovative method for building proportional reasoning among seventh grade students. The teaching and learning of mathematics with understanding framework was used as a foundation of lessons of 21 seventh grade students in the northeastern region of the USA. Students participated to these lessons for seven days. Teaching and learning mathematics with understanding framework was also used for data analysis. Created class environment provided students enough time and many experiences to build up their own meaningful knowledge. The findings showed that their attention, curiosity and engagement have increased.

Additionally, Norton (2005) stated that ability of reasoning proportionally is a crucial skill for mathematics learning. For instance; part-part ratios, between and

within relationships in ratio were underlined in the learning process of fractions. Thus, a study was conducted with an integrated approach to investigate the effect of Lego construction activities for representing fractions and ratios visually on 46 sixth grades. Students interacted with objects, peers and teachers while planning, constructing and explaining their ideas during activities. Data were collected from observing these activities and written pre-post tests. Results of the study revealed that there was a positive effect of this integrated approach on students' proportional reasoning applications.

Furthermore, Çelik (2010) conducted a study to investigate the relationship between proportional reasoning skills in Turkey and problem posing for 204 seventh grade students and 188 eighth grade students. In this study, test developed by Akkuş and Duatepe (2006) and problem posing test developed by the researcher were used to collect data. The results indicated that % 60 of students were lack of ability to think proportionally. Also, there is a statistically significant relationship between proportional reasoning and problem posing skills.

As seemed, most of the innovational studies suggest that students' informal experiences are one of the strongest factors that influencing foundation of their proportional reasoning development for elementary students (e.g., Ellen et al., 2009; Koellner-Clark & Lesh, 2003; Post, Cramer, Harel, Kieran, & Lesh, 1998 ; Spinillo & Bryant, 1999). There is also a wide agreement that calculation procedures or some mold algorithms should not be exposed to students before construction of their informal strategies (Lamon, 1994, 1999; Lo & Watanabe, 1997; Van de Walle, 2007).

In addition to these studies done with elementary school students, there is an innovative study performed with 21 ninth grade students in the control and 21 ninth grade students in experimental group (McLaughlin, 2003). The purpose of the study was to compare traditional math instruction to instruction that is consistent with Modeling Method of physics instruction and findings from proportional reasoning research. The experimental group treatment consisted of proportional reasoning tasks let students prescribe an algorithm, talk about all steps of their working, calibration of their solution according class discussion inductions. In the study pretest-posttest

control group design was used. The experimental group which treatment applied was more successful compared to the control group.

In brief, to sum up, most of the examined studies which indicated that proportional reasoning could be developed through treatment (Ben–Chaim et al., 1998; Çelik, 2010; Ellen et al., 2009; Koellner-Clark & Lesh, 2003; Heller et al., 1989; McLaughlin, 2003; Norton, 2005; Post, Behr, & Lesh, 1988; Post et al.,1998; Spinillo & Bryant, 1999 ; Stemn, 2008). These studies could be accepted as evidence for proportional reasoning could be improved by student-centered instructions.

2.4. Ratio and Proportion

It is hard to find a commonly agreed definition for the concept of ratio. Lamon (2005) defined ratio as "a comparison of any two quantities" (p.164). Smith (2002) defined it as the "relational numbers that has two properties: (1) it relates two quantities in one situation, and (2) it projects that relationship onto a second situation in which the relative amounts of the two quantities remain the same" (p.14). In addition, Cai and Sun (2002) stated that ratio is a multiplicative relationship between two entities. As seen from the literature, definition of ratio was changing according to researchers. In other words, there were different definitions existed in literature for the same term but we could say that ratio can be described as a way to compare quantities multiplicatively (Abdounur, 2002). Ratio concept is important since it forms a foundation for proportions and proportional reasoning (Lobato, Amy, & Charles, 2010).

Proportion can be described typically as "equality of two ratios" (Lamon, 2005, p. 224). Similarly, Chapin and Johnson (2006) stated "proportions tell us about the equivalence of ratios" (p.165). Besides, Levin (1998) defined proportion as a "statement of equal fractions or equal ratios" (p.13). Sense of co-variation is necessary to solve proportion problems. Understanding the multiplicative relationships between quantity changes that affect each other is the main point (Cai, Lo, & Watanabe, 2001).

Although mathematical definitions of ratio and proportions are not known by most of the people, many everyday problems are solved by the use of ratio and proportion (Tourniaire & Pulos, 1985). For instance, thinking about performance of a worker, efficiency of a machine or concentration of an orange juice require being

aware of ratios and proportions (Choate, 1970). So, understanding ratio and proportion topics is one of the most important objectives in elementary mathematics curriculum. Also, interaction of ratio and proportion concepts to other disciplines such as science, geography, architecture and art makes these concepts important mathematical tools in the secondary school (Hart, 1988)

Moreover, development of proportional reasoning depends on conceptual understanding of ratios and proportions through grade 5-8. Understanding numeric transformation of the terms to ratio and to proportion as equivalent ratio is essential. Namely, ratios and proportions form a foundation for proportional reasoning development (Battista & Borrow, 1995).

2.5. Students' Understanding of Ratio and Proportions

There is a wide agreement on the importance of ratio and proportion among school mathematics topics (Battista & Borrow, 1995; Cai & Sun, 2002; Choate, 1970; Kenney, Lindquist, & Heffernan, 2002, Lamon, 1993; Lo & Watanabe, 1997). Also, there is an agreement about cognitive difficulty and complication for teaching and understanding of these topics (Boyer, Levine, & Huttenlocher, 2008; Cai & Sun, 2002; Chapin & Johnson, 2006; Smith, 2002; Hart, 1988). Therefore, students' understanding of ratio and proportion has been the object of many studies and articles. The examination of literature can be helpful to understand students' concepts of ratio and proportions and can gain different perspectives about treatment of these concepts.

Additive and multiplicative relationships are the ways to compare different quantities (Cai & Sun, 2002). Children begin to make comparison additively at early ages before formal schooling (Chapin & Johnson, 1996). Lamon (1999) pointed out that young children make inferences from their natural framework and experiences when they encounter with a comparison situation. Relative thinking is a transition phase between additive reasoning and multiplicative reasoning (Lamon, 1993).There is also many situations on the basis of everyday experiences that necessitate making comparison between any two quantities with respect to multiplicative relationship (Chapin & Johnson, 1996). For instance, sharing amounts of anything between friends, measuring a friends' height with a stick and dividing a cake among friends provide construction of nonnumerically reasoning about relations (Resnick & Singer,

1993; Smith, 2002). These situations and distribution of entities provide preconditions for development of proportionality for children before classroom instruction (Resnick & Singer, 1993). Therefore, the classroom tasks should also provide opportunities to connect these intuitive origins of ratio and proportion concepts to experiences in the classroom (Lamon, 1993). Ignorance of students' informal strategies and exposing some formulas primarily result in superficial understanding of algorithms (Lamon, 1999).

Children should be given opportunities to experience a wide variety of proportional situations. These opportunities should allow students to make reflection and communication about their work and think deeply about utility of their strategies. Mechanically applying algorithms provides solving problems without any reasoning (Jitendra et al., 2009).

Lo, Watanabe and Cai (2004) indicated some key ideas that should be gained to get ratio and proportions concepts. Recognizing additive and multiplicative relationships and use them appropriately and realizing the importance of units to compare ratios are these key points. Some helpful recommendations are outlined to be gained mentioned ideas. These recommendations show the focus points to provide acquisition of proportional reasoning skills and to improve students' conceptual understanding of ratios and proportions (Siegler et al., 2010). Recommendations outlined in the panel are as follows:

- Focus on the construction of ratio and proportion concepts build on students' informal understandings.
- Wait students to make sense of the fundamental concepts before exposing them standard formulas.
- Provide use of visual representations of ratio and proportions.
- Encourage students to reflect and communicate about their alternative solutions to ratio and proportion problems and also to shape, and reshape their solutions according to discussion inferences.

In the literature, there are some studies consistent with these recommendations. Fujimura (2001) conducted a study with 76 fourth grade students who received no instruction about ratio and proportion before intervention. There

were three intervention groups: filling in condition, in which each child was asked to calculate and to fill in the amount of concentrate per unit of water; manipulative condition, in which each child was prompted to manipulate and to compare concrete isomorphic objects to cups of concentrate equally spaced in the area; and control condition, in which each child was asked to complete mathematical calculations that had no relation to proportional reasoning. Assignment of 76 children to the one of three intervention conditions was randomly made according to their pretest scores. The results showed that use of manipulative had a positive effect on fourth graders' ability of visualization of two ratios. Students made more successful comparisons and solved mixture problems easily with respect to the students who had no manipulative.

In another study, Terwel, van Oers, van Djik, & van den Eeden (2009) investigated the effectiveness of collaborative construction of pictorial representations on 238 fifth grade students' learning about ratio and percents with respect to teacher- made representations. A pretest-posttest control group design was used. While experimental group and control group had instruction with the same content, experimental group students were constructing mathematical representations for solving complex problems. They were also working actively on real-life open ended problems. An adapted version of the PERCIA-questionnaire (PERception of the Curriculum in Action) and new designed "Model Construction" scale were used to collect data. According to the results there is a significant effect of collaboratively constructed representations on students' learning of percents and ratio. Similarly, Sellke, Behr and Voelker (1991) conducted a study to examine the effects of an instructional strategy that provide students a way to represent multiplicative story problems. Representations of missing value proportion problems consisted of data table underlines the multiplicative relationship between quantities. The subject was 110 seventh grade students. The results indicated intuitive representations of information in problems had a positive impact on students' ability to solve missing value proportion problems. These studies can be thought as an evidence for effectiveness of representations and manipulative for ratio and proportion topic in a mathematics instruction. Also, Kent, Arnosky and Mcmonagle (2002) supported that

encouragement of students to make their own representations is crucial for extending their ideas about ratio and proportions.

Moreover, there are studies that address the effectiveness of word story problems involving ratio and proportion (Carpenter, Fennema, & Romberg, 1993; Jitendra et al., 2009; Lesh et al., 1988; Litwiller & Bright, 2002; Xin, Jitendra, & Deatline-Buchman, 2005). Jitendra et al. (2009) conducted a study to investigate the effectiveness of schema-based instruction on ratio and proportion word problem solving on seventh grade students. Similar study was conducted with learning disabled students (Xin et al., 2005). In both studies, the schema-based instruction was containing to teach strategies for solving word problems by comparing different strategies. The results showed schema- based instruction involving ratio and proportion word problems has a positive effect on adequacy of students' solution compared to general strategy instruction. Also, Bottge (1999) suggested providing opportunities to experience different situations and problems, identify key points of a problem, indicate their own strategies, make comparison between different strategies and reshape their own knowledge.

In summary, all of these studies showed that student-centered instructions provide deep understanding of ratio and proportions compared to customary, teacher-directed instructions (Carpenter et al., 1993; Fujimura, 2001; Jitendra et al., 2009; Kent et al., 2002; Lesh et al., 1988; Litwiller & Bright, 2002; Sellke et al., 1991; Terwel et al, 2009; Xin et al., 2005). These studies could be accepted as evidence for the importance of the encouragement of students' reflection and communication about their intuitive solutions related to ratio and proportion problems for extending their ideas about ratio and proportions Also, shaping and reshaping their solutions with visual representations of ratio and proportions are essential for the construction of ratio and proportion concepts.

2.6. Students Attitudes toward Mathematics

Everyday thought of attitude is someone's liking or disliking of a known target and represents way of reaction toward a particular situation (Hannula, 2002; Thompson, 1993). Mouly (1973) and McLeod (1992) stated that attitudes are learned predisposition of an individual to feel for or against something and can be modified. In addition to statements about attitudes that are directly related to emotions, Aiken

(2000) sustained that attitudes are tendency to think, feel, perceive and behave toward a cognitive object.

According to McLeod (1992), attitudes are one of the descriptive factors of the affective domain in mathematics education. Ma and Kishor (1997) stated that attitude toward mathematics related to liking or disliking of mathematics, predisposition to engage in or avoid mathematical activity, feeling good or bad at mathematics, and believing usefulness or uselessness of mathematics. Brassel, Petry and Brooks (1980) offered to see attitudes toward mathematics as a process that involves learning mathematics and the place of mathematics in society. In addition to definitions only involve affective tendencies, Aiken (2000) pointed out that attitude toward mathematics consists of cognitive (knowledge or intellective), affective (emotional and motivational), and performance (behavioral or action) components of this process. Particularly, atttitudes toward mathematics can be seen as a link between students' emotional, perceptual, motivational and cognitive process and students' feelings and ideas toward mathematics (Haladyna, Shaughnessy, & Shaughnessy, 1983). In general, attitudes toward mathematics include level of ability, understanding, liking or disliking mathematics, and interest in mathematics, as well as classroom factors such as the amount of fun in classes, level of difficulty, and the teacher (Clinton-Sullivan, 2008).

Although, inclination of attitudes toward mathematics is seen associated with mathematics achievement, there are no consistent findings about the relationship between attitudes toward mathematics and mathematics achievement (Ma & Kishor, 1997). A number of researchers have found that there is no significant relationship between attitude towards mathematics and mathematics achievement (Cain-Caston, 1993; Kiely, 1990; Wolf & Blixt, 1981). Some researchers demonstrated weak relationship (Aiken, 1970; Reynolds & Walberg, 1992; Wolf & Blixt, 1981), while others investigated statistically significant relationship attitude and achievement (Aiken, 1976; Davis, 2002; Haladyna, Shaughnessy, & Shaughnessy, 1983; Hammouri, 2004; Kulm, 1980; Ma, 1997; Ma & Kishor, 1997; Pearce, Lungren, & Wince, 1998, Schoenfeld, 1989; White, 2001). In general, a positive relationship is seen if there is a statistically significant relation. Namely, negative attitude related

with low achievement and positive attitude related with high achievement in mathematics (Ruffell, Mason, & Allen, 1998).

According Ma and Kishor (1997) as students grow, the attitudes toward mathematics tend to decline. On the other hand, second elementary school grades are the most critical period in development of lasting attitudes toward mathematics (Catsambis, 1994; Davis, 2002; Ma & Kishor, 1997; Middleton & Spanias, 1999; Utsumi & Mendes, 2000). Students develop strong feelings toward mathematics around six and seventh grade (Middleton & Spanias, 1999; Utsumi, & Mendes, 2000).

In the crucial period for the development strong attitudes toward mathematics, clarity of material explanations, feedbacks and emphasis on understanding rather than reviewing lots of subject and questions, expending more time on topics, funny classes consist of not only theoretical concepts but also everyday context are the influential factors to develop a positive attitude toward mathematics (Clinton-Sullivan, 2008). Also, belief about usefulness of mathematics, directly involvement to mathematics activities and structure of classroom provide reflection and communication influence students' attitudes toward mathematics in a positive way (Bergeson, Fitton, & Bylsma, 2000; Haladyna et al., 1983). Moreover; collaborative activities and feeling of achieve can be used in mathematics to develop positive attitudes among students (Boaler, 1998, 2002).

In this section, effects of different instructional methods on students' attitudes toward mathematics were mentioned. It is stated that active participation, collaborative activities and feeling of achieve motivate students and enable them participate in the teaching and learning process eagerly. Also, it is stated that attitudes play an important role in learning mathematics. There are many studies conducted to examine relationship between attitudes toward mathematics and mathematics achievement. But there are no consistent findings. According to the results of some studies, there is no significant relationship between attitude towards mathematics and mathematics achievement, whereas in some studies there is statistically significant relation.

2.7. Creative Drama and Creative Drama Based Instruction

The term “creative” is used with drama to differentiate the theatre and drama. Actually, need to explain sense and opinions in different ways rather than using words is the starting point of both drama and theatre (Annarella, 2000). Techniques such as improvisation or role playing can be used in both theatre and drama. Nevertheless, the aim of “creative drama” is not to create a play or to act to show a product (Yeh, 2008). The difference of theatre and drama comes from their focus point. Audience and production are crucial elements for theatre. However, creative drama cares about not only production but also learning and self-discovery of an individual in a process (Annarella, 1999). Another difference between creative drama and theater from artistic aspects is that the creative drama proceeds without depending on a written text. In theatre, players are usually districted with a given text while doing their arousals. Some restrictions come with this given text. On the contrary, there is no given text that is written before in creative drama. Also, participants can set out their improvisations from their own experiences with their own creative findings, ideas and knowledge (Randall, 1967). This feature of creative drama does not make it abstracted from the art. Although, that feature provides creative drama be more convergent to art. In other words, the products of creative drama are not only improvisations or games but a drawing; a rhythm can also be the products of this creative process. Moreover, these products are created in the process and can be seen just as process completed (Deasy, 2002).

There are many definitions about what creative drama is. Wessels (1987) stated that “creative drama is something we all engage in daily” (p.7). Therefore, creative drama experiences are affected from our past and daily experiences and individual opinions (Annarella, 1992). American Alliance of Theatre and Education (AATE) (as cited in Yeh, 2008) defined creative drama as a process of creating plays and representing ideas, events from daily life under the guidance of a leader, using the theatrical techniques of pantomime and voice improvisation; it is improvisational, non-exhibitional, reflective, and most importantly, process-oriented. Creative drama is improvisational activities that emphasis on self-expression with the choice of characters or flow of events without a teacher direction. Teacher is only guidance not a director in drama activities (Catterall, 2002). Similarly, San (1998) defined creative

drama as animating and representing any subject with a group by the help of techniques like improvisation, role play or other act statements that are created by the participants without a written text. Cognitive patterns related to past experiences of participants direct the foundation of improvisations. Freeman, Sullivan, and Fulton (2003) also stated that internal reflections affected by cognitive, affective, aesthetic and moral domains are exhibited by external representations in drama activities. All of the participants are active in drama activities. They live a sense of emotional release with a physical expression (Danielson, 1992).

Creative drama activities provide participants opportunities to improvise of a goal or an idea determined by group members' personally meaningful forms and concerns of a situation. An act statement is constructed through drama techniques such as role playing, improvisation. This improvisation process is guided by an experienced drama leader/ trainer with the execution of spontaneous self-expression of the participants, the make believe play environment and the principle of being here and now. In creative drama activities, the general features of the game are used directly (Adıgüzel, 2010). Creative drama is applicable in each location for each age group. Creative drama activities are based on spontaneous self-expression of the participants, not scripted. It is a group process and works from the strength of the group and enriches the lives of everyone concerned (McCaslin, 2006).

Creative drama not only provides an opportunity for individual development but also creates a group dynamic for participants. Group dynamic makes individuals feel as participant of the process individually and socially. Both in group work and in evaluation part, individuals find the opportunity for examining and shaping the social values. These opportunities improve their vision (Üstündağ, 2001)

Beside the artistic and social benefits of creative drama, it has also educational site. McCaslin (2006) defined creative drama as "a way of learning; a means of self expression; a therapeutic technique; a social activity; or an art form" (p.22). One of the aims of creative drama in education is to affect and stimulate all cognitive, sensorial and psychomotor attitudes (Dupont, 1992). Creative drama requires the participation of the group members. Members of the group should be open to create ideas, to share, to interrogate, to criticize and to judge. One of the most critical skills gained in drama is to establish empathy for understanding others'

feelings, ideas and behaviors while recognizing both themselves and other members of the group. Another aim of creative drama is to create individuals who interrogate, express themselves well physically and linguistically. All these experiences serve to a natural learning (Anderson-Poston, 2008). Creative drama experiences provide a wide variety of learning situations for learners by enacting naturally. Moreover, learners gain permanent behaviors as a consequence of determining and studying content actively (Adıgüzel, 2006).

Imagination of concrete concepts is the basic problem for students in concrete operational thought stage (Ziegler & Yan, 2001). However, creative drama lessons can create a learning environment based on experiences for these students. In drama based activities, students act as a character (role playing), communicate with each other and study in a collaborative learning environment. These experiences provide opportunities to contextualize concepts and problems (Sağlamöz, 2006).Since drama links the real life and the mathematics, the lessons become scientifically and personally meaningful for the students (Andersen, 2000). The improvisational process in creative drama based instruction allows students to analyze and synthesize information and to translate educational concepts into a personally meaningful form (Arieli, 2007).

Annarella (2000) supported that creative drama is one of most effective ways to teach and rich the curriculum objectives. Use creative drama in a subject area is very effective for students since creative drama activities in a classroom setting create energy in the classroom. This natural energy encourages students to participate to activities and identify their own notions. Being active in the learning process let students asking questions to discover in an investigation way to learning (Gallagher, 1997).

Creative drama based learning environment provides students focused learning rather than teacher directed environment. Teacher is only a guidance or facilitator that let students take the responsibility of their own learning on a personal level (Adıgüzel, 1994; Wilhelm, 1998). The use of creative drama in the classroom for any curriculum fosters experiential learning (Andersen, 2000). The basic purpose of experiences in drama based learning is to help students to improve inventive creativity with whole participation (Flynn & Carr, 1994). By using the physical and

oral representations as a reflection of their past experiences and share these experiences with whole group give opportunity to incorporate student in a group atmosphere. Learning in this genuine atmosphere serves to understanding and to form divergent thinking skills (Annarella, 2000). Also, included in the learning process and internalize knowledge foster understanding. By this way the learning of concepts were facilitated.

Furthermore, creative drama based instruction has a positive effect on students' attitude toward lessons by getting students' attention with an exciting, motivating, and interesting learning environment. Creative drama based instruction provides learning in a holistic way that increases creativity, sensitivity, flexibility, emotional stability, cooperation and develop cognitive and divergent thinking and communicational skills (Anderson-Poston, 2008; Anneralla, 1999; Baker, 1996, McCaslin, 2006; Üstündağ, 2006).

2.8. Phases of Creative Drama Based Instruction

Creative drama based instruction should follow three stages: Introduction, Development, and Evaluation (Heining, 1988 cited in Duatepe, 2004). In Turkey, the stages were determined on the basis of obtained creative drama experiences as: Warming-up, Improvisation and Evaluation-Discussion (Adıgüzel, 2010). Both staging type is consistent with each other.

In the warming up part, participants are adopted to the process. Warming up activities are preparation activities that are used to adjust students for working together and encourage their concentration to the subject. These activities can contain basic movement patterns to settle the group down and make them feeling relaxed. Also, some activities provide participants opportunities to trust each other and construct a group dynamic. In this part, participants are more directed by leader compared to other part of the lesson. The aim of this process is not only to make participants enjoy from the process but also prepare participants to the rest of the lesson (Adıgüzel, 2007a; Randal, 1967).

Improvisation is a part that constructs a subject through process. In this process, some drama techniques such as improvisation and role playing are used according to the subject and objectives. In improvisation part, actions and objects are used symbolically in a make believe environment. Make believe statements consist

of dramatic moments and imaginations. Dramatic moment provide participants conflict statements. Employed strategies or approaches through dramatic moments are affected from participants' ideas, personality and past experiences (Adıgüzel, 2010).

Lastly, the evaluation-discussion part is a synthesis of objectives and acquisitions. Feelings, ideas about activities are shared and key points of the activities are summarized in this part (Adıgüzel, 2010).

2.9. Creative Drama Techniques

In creative drama; improvisation and role playing are the basic techniques. Improvisation is the fundamental technique used for creative drama. Namely, it is a creative action without any given text or any design process. Process is within the product through improvisation. Who?, with whom?, what? and where? are the questions direct the improvisation. Students correlate the events with respect to their real life perceptions and consciousness (Farris & Parke, 1993; Öztürk, 2007).

Role playing provides students to accept and understand different characters, different identities and functions of others through improvisation of a different character or identity (Adıgüzel, 2010). And this encourages students and gives a chance to them for reflecting and creating their truths about real life in different perspectives (Öztürk, 2007). Role playing requires sincerety and spomtaneity in the improvisation process. Therefore, each improvisation process includes role playing. However, each role playing does not necessary to include improvisation (Adıgüzel, 2010).

Improvisation and role playing are the techniques that are essential components of creative drama process. Other techniques can be used in the process or to develop the process according to topic and objectives of the lesson. Some of these techniques are Still Image, Teacher in Role, Letters, Space Between, Conscience Alley, Split Screen, Gossip Circle, Forum Theatre, Moment of Photo, Moment of Truth, Flash Back, Inner Voice, Small Group Improvisation, Dramatization, Private Property, Writing in Role, Role cards, Hot Sitting, Interviews and Interrogations, Pantomine, Telephone Conservations, Holding a Meeting and Whole Group Improvisation (Boal, 2010; Öztürk, 2007; Somers, 1994). On the other hand, techniques used in the creative drama based lessons of this study were;

Still Image is one of the alternative techniques provide opportunities for group members to improvise a situation through forming and reflecting motionless, non-verbal and quiet displays with their own bodies. These displays may be in the form of a photograph, sculpture or a posture (Adıgüzel, 2010). In this technique focusing on crucial points is important and these images should be understandable by other students. A short term analysis is made about these images and process by other students (Öztürk, 2007).

Teacher joins the group with Teacher in Role. Heathcote (1991) says that it is a good technique when a new group starts drama exercises. Teacher can organize and describe the role or can direct the dramatic state through the objectives by being a member of the group.

Writing in role represents activities involves wrting a letter or diary in role which reflects participants' subjective ideas (Adıgüzel, 2010)

Improvisation and role playing were the basic techniques and also, still image, teacher in role and writing in role were the other techniques used in the creative drama lessons of this study. On the other hand, other techniques can be used according to the objectives of the lesson. In the following section research studies related with creative drama based instruction that provide supportive examples of use of creative drama as an instructional approach will be mentioned.

2.10. Research Studies on Creative Drama Based Instruction

Research studies discovered relation between creative drama based instruction and science education (Arieli, 2007; Bailey & Watson, 1998; Gail & Rosalind, 1993; Kamen, 1991; Kase-Polini & Spector, 1992; Metcalfe, Abbott, Bray, Exley, & Wisnia, 1984).

Arieli (2007) carried out a study to examine inclusion of creative drama activities into science teaching as an instructional strategy for enhancing elementary school students' understanding of scientific concepts about mixture and solutions. Study was conducted with two group sixth grade students. Treatment group received activity-based science instruction integrated with creative drama, and the control group treated with activity based science instruction without drama activities. Pretest-posttest experimental design was used to collect quantitative data. Also, interviews with students and teacher, class observation and video records were used

to collect qualitative data. Analysis of these data indicated that treatment group who received science instruction through creative drama exhibited a greater understanding than control group students. Interviews also showed that treatment group students enjoyed participating in the activities with their friends and felt they learned more about abstract concepts of science with these activities. Similarly, Kamen (1991) conducted a study with two elementary classrooms to investigate the effectiveness of creative drama on students' understanding of science concepts. Students and teacher are interviewed to collect data. Also, written tests and direct observations are another tool to investigate the effectiveness of creative drama. As a result, the researcher found that creative drama improved students' achievement on the content test. Moreover, benefits and positive effects on motivation and interest are mentioned in the interviews.

Additionally, KasePolisini and Spector (1992) conducted a two week summer program for high achieving and math middle school student. These programs consisted of the use of movement, improvisation and role playing while learning specific math and science concepts. The results indicated creative drama has a positive effect on instruction and assessment in science classes.

There were also studies in which opportunities provided to understand life and contributions of scientists. Gail and Rosalind (1993) carried a study with sixth grade students to provide students opportunities to understand the role of scientists in our life with creative drama activities. Pre-drama discussions, students in role, teacher in role, questioning in role and experts meet in small group techniques are used in drama activities. Observations are made to collect data during the instructions. The results showed that participants acquired the knowledge about the role of scientist in our life in a meaningful way by acting and internalizing the concepts with creative drama activities. Moreover, Metcalfe et al. (1984) conducted an experimental study about the effectiveness of creative drama activities on a chemistry subject compared to traditional teaching methods. Life and contributions of a scientist who furthered the discipline of chemistry was the subject of the lessons. No statistically significant difference was detected in factual recall between the experimental and the control groups. However, creative drama activities resulted to

more meaningful understandings of the concepts with opportunities to reflection and communication.

Furthermore, a pilot study was carried out by Bailey and Watson (1998). The main purpose of the study was to investigate the advantages of utilizing a strategy based on creative drama and role play on development of understanding basic ecological concepts. The subjects of the study were 50 six year old children in treatment group and 50 six year old children in control group. Treatment group received the instruction integrated with creative drama and role play activities. Control group received habitat studies. All students were asked to complete a questionnaire to collect data about their level of understanding after the topic. Treatment group scored higher than control group.

The reviewed studies showed there were studies related with creative drama based instruction and science education. Also, there are some corresponding studies done in Turkey (Çokadar & Yılmaz, 2010; Erkoca-Akköse, 2008; İspir & Üstündağ, 2008; Özdemir & Üstündağ, 2007; Sağırlı & Gürdal, 2002). A recent study by Çokadar and Yılmaz (2010) was conducted with 45 seventh grade students. The effect of creative drama based instruction in the ecology and matter cycles unit and on the students' attitudes toward science were examined. The experimental and control group were randomly selected. Creative drama based instruction was used in the experimental group and traditional science instruction was used in control group. Ecosystem and matter cycles topics were the subject of the instruction for 3 weeks. Ecology Concept Achievement Test (ECAT) was administered to both of the groups as a pretest and posttest. The analysis showed that scores of the experimental group after the treatment is significantly different from control groups' scores with respect to achievement in the ecology concepts and attitudes toward science.

Likewise, Sağırlı and Gürdal (2002) studied the effects of creative drama techniques on sixth grade students' electricity achievement and retention of learning. Control group received teacher directed instruction and experimental group received instruction integrated with creative drama techniques. Electricity Achievement test was implemented to collect data as pre and posttest and also retention of learning test. The results revealed that experimental group was significantly better on

achievement test and using creative drama techniques integrated to lesson provides the retention of the learned concepts.

In addition to these studies done with elementary school students in Turkey, there are also few studies performed with preschool students, high school students and preservice science teachers. Erkoca-Akköse (2008) investigated the effectiveness of creative drama in preschool science activities about the reason-result relations in nature events. 14 six year old children were in the experimental group and 14 six year old children were in the control group. Pretest and posttest experimental design was used. Also video records were used to collect data. Findings of the video records and statistical analysis of pre and post tests indicated that there was a significant difference between experimental and control group. Particularly, creative drama based instruction in preschool science and nature activities improved the determining reason-result skills.

Furthermore, İspir and Üstündağ (2008) studied on the effects of creative drama based instruction on chemical substances and history of periodic table understanding with 20 ninth grade students. Sessions took seven week consist of 21 hours. Observations and students interviews were made to collect data. Findings showed that creative drama method had a positive effect on students' knowledge and attitude towards chemistry lesson.

Another study was conducted by Özdemir and Üstündağ (2007) that was designed as a study on 21 pre service science teachers. Life story and the contributions of famous scientists in science and technology was the subject of the treatment with creative drama based instruction. The treatment lasted five weeks totally 15 hours. Preservice science teachers group were asked to take a survey consisting three open ended questions as a pretest and posttest. Besides, journals kept by participants during creative drama activities in each lesson and interviews with participants were used to collect data. Answers to the pre and posttest and analysis of journals and interviews indicated that knowledge about life story and the contributions of famous scientists is acquired and internalized by the participants.

In addition to studies about science and drama based instruction, there were some studies about effectiveness of creative drama based instruction on reading comprehension skills, oral communication skills and writing skills (Dupont, 2002;

Kyriakopoulos, 2008; Moore and Caldwell, 1993; O'Gara, 2008). Dupont (2002) designed a creative drama program incorporated with children's reading literature to investigate the effectiveness of the program on fifth grade students' reading skills. The sample was 36 kindergarten children. They were randomly assigned to three groups. First group received instruction with creative drama activities, second group received instruction with reading traditional methods and third group was the control group continued to regular kindergarten activities with respect to their curriculum. The results of the Metropolitan reading comprehension test showed that imaginative plays with creative drama activities developed the children's reading comprehension skills.

Additionally, the effectiveness of creative drama based instruction on students' oral communication in English lessons was examined (Kyriakopoulos, 2008). This study consists of English lessons integrated with improvisation and drama. According to analysis of observations on their reactions and discussions, participants' use of English language and fluency of their speaking affected positively. Also, participants mentioned that they felt less stressed about using English language for communication. Similarly, O'Gara (2008) conducted a quantitative research to investigate the effectiveness of creative drama based instruction on students' understanding of verb tense compared to traditional methods. The participants were native Italian speakers. One control group and one experimental group received instruction for three weeks. Pretest and posttest experimental design was used. The results indicated that creative drama based instruction has a positive effect on understanding language tenses compared to conventional teaching methods.

Furthermore, Moore and Caldwell (1993) designed a study to investigate effectiveness of thought organizing activities integrated with creative drama on narrative writing compared to traditional writing activities. The sample consisted of three groups. First group was required to include in creative drama activities which focused on participants' ideas for stories. Second group was required to include in drawing activities which focused on figures for stories. Third group was control group which received the traditional instruction for narrative writing. The results

showed that creative drama and drawing activities improved the writing skills with more qualified and imaginative writings.

Apart from these studies, Çalışkan & Üstündağ (2010) investigated the effects of creative drama on Measurement and Evaluation course instruction with 27 pre service science teacher. Content analysis was conducted to analyze the answers of the participants to open ended questions on pre and posttest. In addition to pre and posttests, portfolios of the participants were used to gather data to analyze. The findings indicated that creative drama had positive effects on cognitive domains about Measurement and Evaluation course and self-concept of participants.

In summary, studies showed that drama based instruction had many educational benefits in learning science concepts, life and contributions of scientists, ecological concepts, measurement and evaluation concepts and also on reading comprehension skills, oral communication skills and writing skills. The research studies also indicated that drama based instruction had positive effects on students' understanding of science concepts, development of the children's reading comprehension skills, on understanding language tenses, improvement of the writing skills with more qualified and imaginative writings and cognitive domains about Measurement and Evaluation course. There are also studies related with effects of drama based instruction, specifically in mathematics education, will be mentioned in the next section.

2.11. Research Studies on Creative Drama Based Instruction in Mathematics

There are few studies on the use of creative drama in mathematics education (Kariuki & Humphrey, 2006; Omniewski, 1999; Saab, 1987).

Kariuki and Humphrey (2006) examined the effectiveness of creative drama on the performance of at risk elementary students in mathematics education. There were 26 at risk fourth grade students in control and experimental group. Control group received teacher directed instruction on geometry and experimental group received instruction integrated with drama activities on geometry. Instructions lasted fifty minute per day for one week. Multiple choice test including 20 questions about geometry and measurement concepts implemented to students as pre and posttest. Secondly, a questionnaire was used to collect data about students' interest and attitudes towards mathematics. The results indicated that there was significant

difference between achievement of the experimental and the control group. Moreover, there was no difference between attitudes and interests of two groups.

A corresponding study was conducted to investigate the effectiveness of creative drama methods on sixth grade mathematics achievement, attitudes toward mathematics and levels of creativity (Saab, 1987). There were 87 students. 29 of them were in control group and 59 of them were in experimental group. Pretest and posttest was implemented for each three dependent variables. Also, reflections of the experimental group students for every lesson were used to collect data. The results indicated that creative drama activities had a positive effect on mathematics achievement compared to textbook orientation consist of computations. Although, there is no significant difference between attitudes and level of creativity of experimental and control group.

Moreover, Omniewski (1999) conducted a study to emphasize the effectiveness of arts infusion approach integrated with creative drama and dance activities and innovative manipulative approach on mathematics achievement of second grade students compared to traditional textbook approach. The study lasted for six weeks. The sample consisted of three groups which were randomly assigned. Two of them were experimental group that used arts infusion approach and innovative manipulative approach and the other group was control group used traditional textbook approach. Textbook Unit Math Test and Number Patterns Test were used to collect data among these three groups. Administration of the test became as pretest and posttest 1 and posttest 2 after six weeks from the treatment. The results showed that there was a statistically significant difference between pretest and posttest scores of the Textbook Unit Math Test for all groups. But scores of the group instructed with art infusion approach outperformed the scores of other two groups. Also, there was no significant difference between the scores of the groups for the result analysis of Number Pattern Test.

On the other hand, with the beginning of educational programs, implementation based on constructivist approach in primary schools in Turkey, some studies have been conducted for investigating the effects of drama based instruction in mathematics education in Turkey (Akkuş & Özdemir, 2006; Cantürk-Günhan & Özen, 2010; Duatepe, 2004; Sözer, 2006; Erdoğan, & Baran, 2009; Özsoy, 2003).

Duatepe (2004) used drama as a teaching method in seventh grade geometry classrooms. In this study creative drama based instruction and traditional teaching were compared in two classes for the topic of angles and polygons and circles. The results of this study revealed that creative drama based instruction had a significant effect on experimental groups' geometry achievement, retention of achievement, van Hiele geometry thinking levels and attitude towards mathematics and geometry.

There are also other studies conducted by Özsoy (2003) and Cantürk-Günhan and Özen (2010) about effectiveness of creative drama based instruction on the geometry achievement. Özsoy, (2003) conducted a study to investigate the effectiveness of creative drama on eight grade students' achievement about volumes of vertical prisms. Pretest and posttest that consist of national exam questions about volumes of vertical prisms were implemented. The results showed that there is an increase on students' scores on achievement test. Recently, a similar study was conducted to investigate effectiveness of drama methods on self-efficacy towards geometry of 20 sixth grade students (Cantürk-Günhan & Özen, 2010). Surface areas and volumes of vertical prisms were the lesson subjects integrated with creative drama activities. In this study, both experimental and survey study were used. Self-efficacy towards Geometry Scale and interviews with students were used to collect data. Pretest and posttest one group design was used. According to results, creative drama was found as an entertaining method but there was no significant difference on students' self-efficacy towards geometry.

Corresponding studies were carried out by Sözer (2006) and by Erdoğan & Baran (2009). The aim of Sözer's study was to investigate the effects of creative drama based instruction on fourth grade students' fractions achievement. In the study, pretest-posttest control group design was used. The experimental group which the drama method has been applied was more successful compared to the control group. The aim of Erdoğan and Baran's study was to examine the effect of mathematics lessons given through the creative drama on mathematical ability of six year old children. Also, this study showed that mathematics teaching based on the drama method has a positive effect on the mathematical ability of six year children.

In addition to studies done with early elementary and elementary school students, there was a study performed with pre service mathematics and science

teachers (Akkuş & Özdemir, 2006). Creative drama activities integrated on a subject about life story and contributions of famous scientist in mathematics and science. Treatment lasted totally 15 hours. A questionnaire consists of three open ended question and diaries of participants were used to collect data. According to findings, conceptual understanding of scientist' life stories and contributions to the science and mathematics was determined.

In brief to sum up, related studies which were examined indicated that creative drama based instruction had positive effects in learning mathematics. In spite of the benefits of creative drama based instruction in the mathematics, number of studies done with mathematical topics was very limited.

2.12. Summary

In summary, proportional reasoning, development of proportional reasoning, related studies for acquisition of proportional reasoning skills, ratio and proportion, and students' understanding of ratio and proportion were discussed. Also, related literature about students' attitudes toward mathematics was stated. Lastly literature related to creative drama and creative drama based instruction, phases of creative drama based instruction, drama techniques, research studies on drama based instruction and research studies on drama based instruction in mathematics was mentioned.

Review of literature demonstrates that proportional reasoning is a critical skill for mathematical development. Ability to reason proportionally is the primary step for understanding algebra. Also, this step forms a foundation of being successful in high school mathematics and science (Akatugba & Wallace, 1999a ; Beckman et al., 2004, Chapin & Johnson, 2006; Lesh et al., 1988; NCTM, 2000; Van da Walle, 2004). The mentioned research studies indicated that proportional reasoning is a crossing point from formal operational thinking level to concrete operational thought. It is basic for understanding multiplicative relationships (Al-Wattban, 2001; Van de Walle, 2004). In brief, most of the research studies which were examined in this chapter related with improvement of proportional reasoning skills indicated that proportional reasoning could be developed through treatment. Moreover, development of proportional reasoning depends on conceptual understanding of ratios and proportions through grade 5-8. Namely, ratios and proportions form a

foundation for proportional reasoning development (Battista & Borrow, 1995). There were different definitions existed in literature for the ratio concept but in this study, it is described as a way to compare quantities multiplicatively (Abdounur, 2002).Also, proportion concept was handled as "equality of two ratios" (Lamon, 2005, p. 224). The interaction of ratio and proportion concepts to other disciplines such as science, geography, architecture and art makes these concepts important mathematical tools. To provide deep understanding of ratio and proportions, researchers recommend student-centered instructions. Most of the research studies demonstrate that lessons including activities for encouragement of students' reflection and communication about their intuitive solutions related to ratio and proportion problems extend their ideas about ratio and proportions. Research studies also indicate that shaping and reshaping students' intuitive solutions with visual representations of ratio and proportions are essential for the construction of ratio and proportion concepts.

Additionally, in the literature it is stated that attitudes play an important role in learning mathematics. There are many studies conducted to examine relationship between attitudes toward mathematics and mathematics achievement. But there are no consistent findings. According to the results of some studies, there is no significant relationship between attitude towards mathematics and mathematics achievement, whereas in some studies there is statistically significant relation. Moreover, it is stated that active participation, collaborative activities and feeling of achievement motivate students and enable them participate in the teaching and learning process eagerly.

In this context, creative drama could be used as an instructional method in education (Annarella, 1992, 2000; Ciaburri, 1975; Çokadar & Yılmaz, 2010; Dewey, 1994; Dupont, 1989; Fleming, Merrel, Tymms, 2004; Gallagher, 1997; Karacil, 2009). Creative drama based instruction provides an active and collaborative learning environment that consists of activities from everyday context (Arieli, 2007). However, there are few studies on the use of creative drama in mathematics education (Kariuki & Humphrey, 2006; Omniewski, 1999; Saab, 1987; Southwell, 1999). On the other hand, with the implementation of the new mathematics curriculum based on reformist ideas in primary schools in Turkey, some studies has conducted to investigate the effects of creative drama based instruction in

mathematics education in Turkey (Akkuş & Özdemir, 2006; Duatepe, 2004; Sözer, 2006; Erdoğan & Baran, 2009). The findings showed that mathematics teaching based on the creative drama activities has a positive effect on the mathematics achievement of elementary students. In this aspect, this study was conducted to investigate the effect of drama based instruction on seventh grade students' achievement in ratio and proportion concepts and attitudes toward mathematics and also to examine students' self-reported views related to drama based instruction after receiving creative drama based instruction on ratio and proportion concepts.

CHAPTER 3

METHODOLOGY

This chapter was organized to introduce the research design, participants, data collection instruments, data collection procedures, development of teaching / learning materials, treatment, data analysis and internal and external validity of the study.

3.1. Research Design of the Study

The research questions that were designed to explore the effects of drama based instruction on 7th grade students' ratio and proportion achievement and attitude toward mathematics are given below:

1. Is there a statistically significant effect of the creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts when students' prior achievement in ratio and proportion concepts is controlled?

2. Is there a statistically significant effect of creative drama based instruction on seventh grade students' gain score of attitudes toward mathematics?

3. What are the students' views related to the creative drama based instruction?

Having established to these research questions, the main purpose of the study was determined as to investigate the effect of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts and their attitudes toward mathematics. Also, examining students' self reported views related to creative drama based instruction was another purpose of this study. This study benefited from both quantitative and qualitative methods to examine the research questions.

For the quantitative part of the study, the nonrandomized pretest-posttest control group design was used. "Two already existing, or intact groups" are used in that design (Fraenkel & Wallen, 2006, p. 272).

This study utilized the nanrondomized pretest-posttest control group design as outlined in Table 3.1. The meanings of abbreviations are following: EG represent experimental group, which received "Creative Drama Based Instruction" (CDBI); CG represents the control group, which received "Traditional Instruction" (TI).

Table 3.1 Research Design of the Present Study

Group	Pre-test	Treatment	Post-test
EG	PRT, preMAS, preRPAT, MES1,MES2	CDBI	postMAS, postRPAT
CG	PRT, preMAS , preRPAT, MES1,MES2	TI	postMAS, postRPAT

The data collection instruments in Table 3.1 are the followings: MAS-Mathematics Attitude Scale; RPAT- Ratio and Proportion Achievement Test; PRT-Proportional Reasoning Test; MES1-First Math exam scores in school; MES2-Second Math exam scores in school. The MAS and RPAT were administered as pretests and posttests to both EG and CG. 2010-2011 first and second mathematics exam scores were taken from the school administrations. MES1 and MES2 were used to test the equivalency of the treatment groups in terms of mathematics achievement at the beginning. Besides, as seen in Table 3.1, PRT was administered before treatment to determine the achievement levels in proportional reasoning of both groups at the beginning. Both CDBI for experimental group and TI for control group lasted for 3 weeks and 4 lesson hours per week.

The qualitative data were obtained through the interviews conducted with 10 randomly selected students from experimental group after receieving creative drama based instruction on ratio and proportion concepts in order to examine the third research question.

3.2. Participants of the study

The study was conducted in a public elementary school in Körfez, Kocaeli. There are 29 public elementary schools in this region. However one school from this

region which the researcher got permission from school administrations is determined as the accessible population of this study. Since it was difficult to select a random sample of individuals, convenience sampling was used in this study. The sample was the 7th grade students in a public elementary school in Körfez, Kocaeli. In this school, the students were assigned to classes without any ability or interest grouping by school administrators at the beginning of the school year. So, the classes were assumed to be heterogeneous. There were two mathematics teachers in the school and one of them volunteered for the study. The number of seventh grade classes taught by this teacher was five. These five classes had followed same mathematical content in the same period of time with the same mathematics teacher. The two groups of this study were determined randomly among these five classes as EG and CG. Then, equivalency of these groups was tested in terms of MES1, MES2 and PRT by using independent samples t-tests. Since there were no significant mean differences between the treatment groups with respect to MES1, MES2 and PRT ($p > 0.05$) at the beginnig, study was conducted with these randomly selected groups. The participants of the study were 58 seventh grade students, 28 (48.3%) of which were in CG and 30 (51.7 %) were in EG. The researcher taught in the EG and school mathematics teacher taught in the CG at the time of the study since school administrators allowed researcher taught for only EG. The distribution of the participants in the EG and CG is given in Table 3.2.

Table 3.2 The Distributions of the Participants in the EG and CG

	Frequency
CG	28 (48.3 %)
EG	30 (51.7 %)
Total	58 (100.0 %)

Table 3.2 illustrates the participants of the study, and also the number of students in CG and EG. The next section gives detailed information about the data collection instruments.

3.3. Data Collection Instruments

The purpose of this study was to investigate the effects of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts, attitude toward mathematics and students' self-reported views related to creative drama based instruction. The data in this study were gathered by proportional reasoning test, ratio and proportion achievement test (equivalent form achievement tests as pretest and posttest were implemented to the 7th grade students before and after the instruction), mathematics attitude scale and student interviews.

The data collection methods, development process of each instrument and procedures are explained below in detail.

3.3.1. Proportional Reasoning Test

Proportional Reasoning Test (PRT) was developed by Akkuş and Duatepe (2006) (see Appendix A). Proportional reasoning test was constructed "in order to use determining students' achievement level in proportional reasoning, the weakness and misconceptions of students in this topic" (Akkuş & Duatepe, 2006, p.2). The aim of PRT use in this study was to determine the achievement levels in proportional reasoning of both control and experimental groups at the beginning to continue the study with determined groups. This test consists of 15 open-ended questions related to proportional reasoning skills. This test involves three parts. First part consists of 7 questions related to missing value and inverse proportion, second part consists of 3 questions that are related to quantitative comparison, and the third part consists of 5 questions that are related to qualitative comparison. Content validity of the PRT was mentioned as checked by four experts with respect to consistency of items with objectives and type of the questions and clarity of the items. Also, the alpha reliability coefficient of the PRT with 15 items was reported as 0.86 (Akkuş & Duatepe, 2006). In this study the alpha reliability coefficient of the PRT was found as 0.88. The answers of students in this study were evaluated according to rubric developed by Akkuş and Duatepe (2006) (see Appendix B). The maximum score of PRT was 56 according to this rubric.

3.3.2. Ratio and Proportion Achievement Test

The Ratio and Proportion Achievement Test (RPAT) was developed specifically for this study by the researcher (equivalent forms were administered as pretest and posttest). RPAT was prepared to measure the differences in the students' scores before and after the study depending on the instructional approaches used. The original forms of pretest and posttest can be seen in Appendix C. First, the objectives related to ratio and proportion topic in the elementary mathematics curriculum of Ministry of National Education were examined to determine the test content. The objectives given in the curriculum under the Ratio and Proportion topic for 6^{th} grade and 7^{th} are given in Table 3.3.

Table 3.3 The Objectives Related to Ratio and Proportion Concept for 6^{th} and 7^{th} Grade in MoNE Curriculum

Grade Level	**Objectives**
6^{th}	• State comparison of two quantities as ratio. • Solve ratio problems by using tables. • Use ratio to compare two quantities and reveal the ratio in different ways • Explain proportion and relationship between proportional quantities.
7^{th}	• Explain proportion and relationship between proportional quantities • Explain relationship between directly and inversely proportional quantities. • Solve and pose problems related to direct and inverse proportion.

Since each objective in the curriculum stated more than one performance, the objectives were reorganized and the questions in the RPAT were determined based on these revisions. Table of specifications was prepared including the objectives and the number of questions in pretest and posttest. These are presented in Table 3.4.

Table 3.4 Table of Specification of RPAT

Objectives \ Content	Ratio	Proportion	Direct Proportion	Inverse Proportion	TOTAL
State comparison of two quantities as ratio.	Q1-Q11				2
Use ratio to compare of two quantities.	Q3-Q12				2
Solve ratio problems.	Q7a-Q7b-Q14a-Q14b				4
Explain proportion.		Q2			1
Explain relationship between proportional quantities.		Q4a-Q4b-Q13			3
Explain relationship between directly proportional quantities.			Q5-Q6a		2
Explain relationship between inversely proportional quantities.				Q6b-Q6c	2
Solve problems related to direct proportion.			Q8-Q15		2
Solve problems related to inverse proportion.				Q9a-Q9b-Q9c-Q16	4
Pose problems related to direct proportion.			Q10a		1
Pose problems related to inverse proportion.				Q10b	1

An item bank was formed with 32 open ended questions. 16 questions were chosen from the item bank by taking into consideration the table of specification and expert judgments. The first 10 questions were conceptual questions. Conceptual

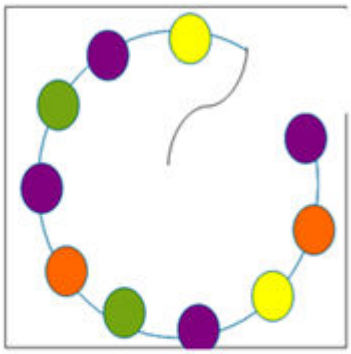
knowledge leads to understanding interrelations between units of knowledge in a domain implicitly and explicitly (Siegler & Crowley, 1994). Creative drama can be used to make students identify a mathematical concept, examine a mathematical idea and develop students' conceptual understanding (Southwell, 1999). The last 6 questions are procedural questions that are more based on operations. Procedural knowledge is widely assessed through solving standard arithmetic computations since students are inclined to use previously learned step by step solution methods to solve the problems (Rittle-Johnson, Siegler, & Alibali, 2001). The last 6 questions were the parallel operational question forms of the conceptual questions with respect to objectives. Most of the students are used to solve procedural questions for exercising to prepare themselves for MoNE National Level Determination Examination. Also, students in this school are used to solve procedural questions that it is seen from their homework and school exams. Conceptual and procedural questions are constituted in the test to prevent the effect of unfamiliarity of the questions on students' achievement.

There were 16 open ended questions in RPAT to see students' solutions in detail. The 4^{th}, 7^{th} and 14^{th} questions have 2 sub items and the 6^{th} and 9^{th} questions have 3 sub items. While developing RPAT, some of the questions were quoted from different resources. For example the questions 2, 4 and 6 (see Appendix C) were quoted from MoNE (2010). In addition question 7 was quoted from Van de Walle (2007). Question 14 was adapted from Noelting (1980). Besides, question 5 was adapted from 7^{th} grade MoNE National Level Determination Examination in Turkey (SBS, 2010). As a result, to assess students' performance on ratio and proportion topic, equivalent forms of the RPAT were prepared. Posttest consists of similar questions with changed numbers in questions to prevent recalling of the results. One form was administered as a pretest before instruction and the other equivalent form was administered as a posttest after the instruction. Students were given 50 minutes for both tests to complete.

The rubrics of RPAT were prepared to eliminate subjectivity. Literature was reviewed to prepare the rubric consistent with the content and objectives of ratio and proportion topic (Akkuş & Duatepe, 2006; Ben-Chaim, Fey, Fitzgerald, & Miller, 1998; Lamon, 1993; Noelting; 1980, Thompson & Saldanha, 2003). Items were

graded by using an analytic approach taking into consideration of ideas from reviewed literature, opinions of two elementary mathematics teachers and a mathematics educator. The answers of questions 1, 4a, 6c and 13 were not appropriate to give partial credits. Therefore, the answers of these questions were scored as 1 for correct responses and 0 for incorrect ones. Figure 3.1 illustrates one of the questions scored as 1 for correct responses and 0 for incorrect ones.

Fill in the blanks to ensure the desired options in the sentences.



You see a incomplete necklace in the shape. If you desire the ratio of the number of orange beads to the number of green beads to be equal to 4:3, you should add ..... orange.....green beads to the necklace.

Figure 3.1 Sample Question Scored as 1 or 0

The other questions in RPAT were scored as 2, 1 and 0. Figure 3.2 illustrates one of the questions scored as 2, 1 and 0.

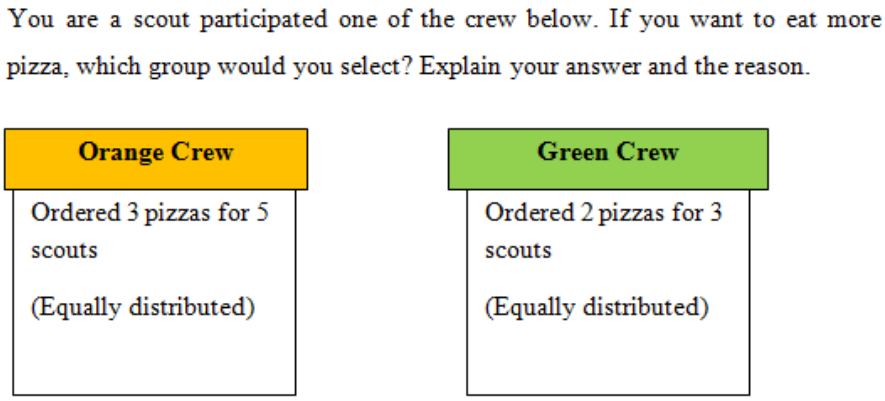


Figure 3.2 Sample Question Scored as 2, 1 or 0

Since there are questions with different content and objectives, the RPAT consists of different dimensions for the answers. A single rubric was not enough to evaluate the students' answers in a sensitive and detailed way. Hence, five analytic rubrics were developed for RPAT (see Appendix D).

3.3.2.1. Pilot Study of RPAT

Pilot study of the RPAT was conducted in one of seventh grade classes of another elementary school in Körfez with 34 students. Also, the students were assigned to classes without any ability or interest grouping by school administration at the beginning of the school year in this school. Only the pretest form of the RPAT was administered to the students. The purpose of the pilot study was to check the clarity and legitimacy of questions determine the appropriateness of the duration for the test and revise questions according to students' opinions and responses. The administration of the test took 40 minutes due to the time school administrators allowed for the pilot study. In the pilot study, there were 16 open-ended questions including sub-questions. Although the objectives and corresponding questions in the pilot study were the same as in Table 3.4, some adjustments were made in pretest and equivalent form posttest according to observations and interviews with students about questions.

First adjustment was about the time of application. 40 minutes time period was not enough for students to answer all the questions. So the time for the test was extended to 50 minutes from 40 minutes. Other adjustments were made on questions

according to students' responses and opinions. For instance, in the 1st question in pilot pretest, students were given an incomplete necklace with different colored beats. Filling in the blanks according to given ratio was wanted from students. But there was no direction at the beginning of the questions. "Fill in the blanks" direction was added at the beginning of the question. The ratio value changed and "the least" statement was taken out from the question according to answers of the students. Also, there was a bead box near the question. Students tried to count the number of the beads in the box that was unnecessary. Therefore, bead box was removed from the question.

In the 3rd question, there was a bicycle photograph and an application form for a bicycle race. Students were asked "Write the scale of the bicycle photo to put inside the application form of the bicycle race". The third question in the pilot form of the RPAT is given in Figure 3.3.

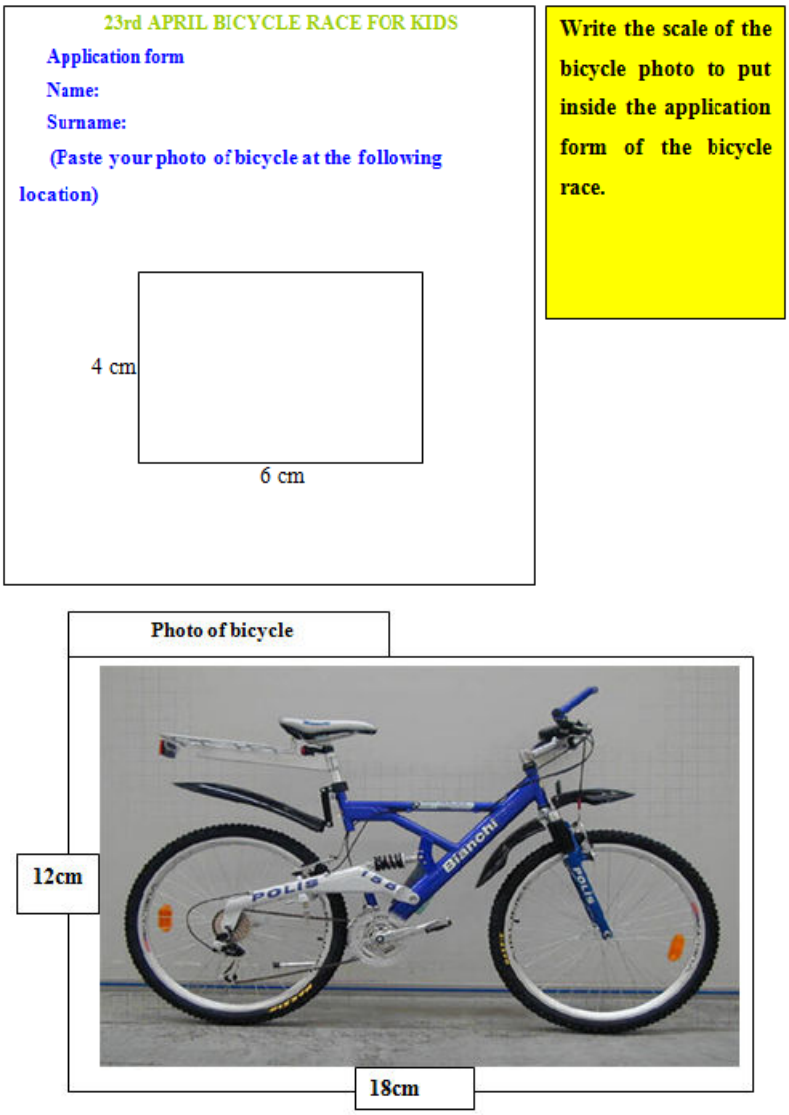


Figure 3.3 Third Question in the Pilot Form of RPAT

The students tried to fill the application form with their names and draw bicycle picture on the application form instead of writing only scale. Hence, the name and surname blanks of the application form were filled with a name and surname and a smaller photo of bicycle was pasted on application form inside the given part. Then, question was changed as "Write the scale of bicycle photo that Mustafa put inside the application form of the bicycle race". The third question in the last form of pre RPAT is given in Figure 3.4.

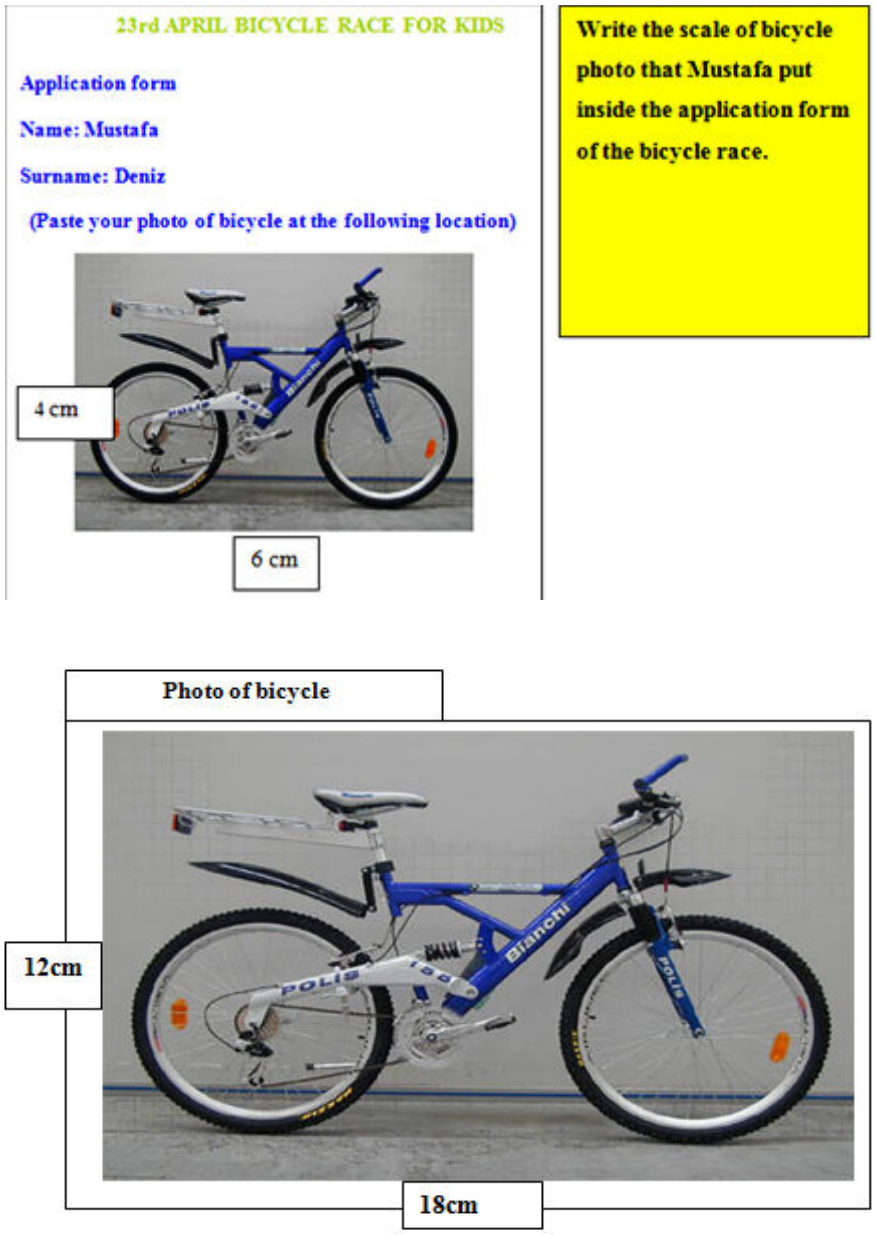


Figure 3.4 The Third Question in the Last Form of preRPAT

In the 4th question in which the students had to use given ratio of the number of flower seeds for every part of their garden. They were wanted to complete the number of flower seeds of the empty parts of their garden and also explain relationship between the numbers of seeds for every part. It was seen that the students had difficulty in understanding explanatory sentence of this question. Therefore, the explanatory sentence of this question was adjusted according to students' feedback of pilot study. In the 5th question, there were four statements to be determined either as directly or inversely proportional. But the number of statements

decreased to two for scoring consistency. Finally, the 10th question which was related to posing direct and inverse proportion problems with given numbers. There were two numbers for each proportion type to use. Since they need at least three numbers to pose a direct proportion problem, students asked adding number is allowed or not. Therefore, in the final version of the RPAT, three numbers were given to clarify this situation. The last forms of pretest and posttest are given in Appendix C respectively.

3.3.2.2. Validity and Reliability

Validity is the "appropriateness, correctness, meaningfulness and usefulness of the inferences" (Fraenkel & Wallen, 2006, p.151). In this study, the content related validity of the instrument was established by researcher and an elementary mathematics teacher with use of the table of specification based on the objectives in the elementary mathematics curriculum. The questions were developed by using this table. Also, content validity of the instrument was checked by two mathematics educators and two elementary mathematics teachers by reviewing the course content, course objectives and table of specification.

Reliability is the consistency and repeatability of assessments (Linn & Miller, 2005). The Cronbach alpha reliability coefficient for dichotomously scored items of RPAT was found as 0.72 and as 0.93 for ternary scored items.

One of the types of reliability is inter-rater reliability that is the degree of agreement among raters (Shrout & Fleiss, 1979). Three elementary mathematics teachers scored the answers of the test according to RPAT rubric for extending consensus on using RPAT rubric. Interclass correlation coefficient (ICC) for three raters was used to measure inter-rater reliability. The value of ICC was 0.99 indicated a high inter-rater reliability for three raters. Also the correlation between three scores was conducted to test the reliability of the instrument. The Pearson Product Moment correlation coefficient was computed as 0.99 with 24 items.

3.3.3. Mathematics Attitude Scale

The Mathematics Attitude Scale (MAS) was obtained from National Report of PISA 2003 Project (MoNE, 2005) (see Appendix E). It was developed by applying the scale to students in Turkey by PISA 2003 Project. It was taken from MoNE 2005 National Report. It consisted of 8 positive and 5 negative items about attitude

towards mathematics. Items were scaled on a four-point Likert Type Scale: Strongly Disagree, Disagree, Agree and Strongly Agree. The positively worded items were coded from Strongly Agree as 4 to strongly disagree as 1 and items that are negatively worded were reversed to a positive directions for scoring purposes.

The MAS had three dimensions. 1st to 4th items were about interest in and enjoyment of mathematics (IEMAT), 5th to 8th items were about instrumental motivation to learn mathematics (IMMAT) and 9th to 13th items were about mathematics anxiety (AMAT). National Report of PISA 2003 Project reported that the first dimension indicated .90, the second dimension .84 and the third dimension indicated that .82 Cronbach alpha reliability estimate. The possible scores on this scale range from 13 to 52. Also, the alpha reliability coefficient of the MAS with 13 items was reported as 0.86.

3.3.4. Student Interviews

The main purpose of the study was to investigate the effect of creative drama based instruction on 7th grade students' achievement in ratio and proportion concepts and attitudes toward mathematics. In order to achieve this purpose, quantitative analysis were used. Besides, to examine students' self reported views related to drama based instruction, qualitative method was used. For this purpose interviews were conducted with 10 students at the end of 3 week treatment for EG after implementing posttests. 6 of students were boys and 4 of them were girls.

Interview questions were quoted from Duatepe (2004) (see Appendix F). Students' opinions about the effect of CDBI on their learning, their relationship between friends, awareness of themselves and negative aspects of the CDBI or difficulties that students encountered in CDBI activities, comparison of the role of students in CDBI with in TI were investigated by the interview questions (Duatepe, 2004).

Interviews were conducted with each student individually in an empty class in the school. The time for each interview was approximately 10 minutes. Students' responses were audio recorded to record the data under permission of students. At the beginning of each interview, the student was informed about the goal of the interview and they were informed that their names would not be used in the research report and their answers would not be given to their teachers to grade. Also, they

were told that they have an exemption about leaving at any time they would want to. All students wanted to participate in interview. They were volunteered. They were told that each interview would be recorded and they accepted it. A speech recorder was used while interviewing to record tha data under permission of students. Then, the structured questions were asked. Besides, some sub-questions were asked spontaneously in some interviews to provide clarity for students' responses. Then, audio recorded responses of students were transcribed into writing to analyze. Results of the interview were also analyzed by another person, a Master of Science in the department of Educational Sciences at METU. Comparison of the codes also gave evidence for inter reliability. There was a % 99 correlation between the codes in the beginning, and then it increased to % 100 after discussing the codes. Therefore, the reliability of coding the interview was enabled.

3.4. Data Collection Procedure

The purpose of the study was to investigate the effect of creative drama based instruction on 7th grade students' achievement in ratio and proportion concepts and attitudes toward mathematics and also to investigate students' self reported perceptions related to creative drama based instruction.

At the beginning of the 1st semester of the academic year 2010-2011, the school was visited by the researcher, and the administrators of the school and the mathematics teacher was informed about the purpose and the nature of the study. Teacher volunteered for the study and necessary permission was taken from school administrators for the application. In the mean time, the official permission was taken from Middle East Technical University Human Subjects Ethics Committee.

At the beginning of the Fall Semester of the academic year 2010-2011, the time schedule for experimental design was planned with the school administrators and mathematics teacher as presented in Table 3.5.

Table 3.5 Time Schedule of the Data Collection and Implementation of CDBI Activities

Week	**Date**	**EG**	**CG**
1st	10 December	PRT	PRT
2nd	13 December	preRPAT preMAS	preRPAT preMAS
	13-17 December	Introduction of Creative Drama Lessons	-
3rd	20-24 December	CDBI related with Ratio and Proportion (1st and 2nd lesson plan)	TI related with Ratio and Proportion
4th	27-31 December	CDBI related with Direct and Inverse Proportion (3r and 4th lesson plan)	TI related with Direct and Inverse Proportion
5th	3-7 January	CDBI related with Solving and Posing Proportion Problems (5th lesson plan) Assessment of CDBI and Ratio and Proportion Topic (6th lesson plan)	TI related with Solving and Posing Proportion Problems General Assessment of Ratio and Proportion topic
6th	10 January	postRPAT postMAS	postRPAT postMAS

In the first lesson after talking about the purpose of the study and giving brief information about creative drama based instruction in both CG and EG, researcher administered the PRT to students in both CG and EG. The aim of PRT administration in this study was to determine the achievement levels in proportional reasoning of both CG and EG at the beginning to continue the study with the selected groups. Then, preRPAT and preMAS was administered to both CG and EG. Students were given 50 minutes for RPAT and 10 minutes for MAS. Implementation of CDBI continued for three weeks with four lesson hours for each week. Lessons in CG were also observed by researcher. Before observing the lessons about Ratio and Proportion topic, the researcher was also present in the CG classroom for one week to familiarize the CG students with the researcher. At the end of the implementation postRPAT and postMAS were implemented both to CG and EG. At the end of the treatment for EG and implementation of postRPAT and postMAS 10 students asked about their views related to creative drama based instruction.

3.5. Development of the Creative Drama Based Ratio and Proportion Lesson Plans

In developing the lesson plans, the objectives of the 6^{th} grade and 7^{th} grade mathematics course on Ratio and Proportion unit defined by Turkish Ministry of Education were considered. The same content with the same objectives was supplied for both the EG and the CG. There were six lesson plans including 12 lesson hours (see Appendix G). While preparing the lesson plans, phases of creative drama based instruction and sub-criteria of these phases were taken into consideration. During the preparation of lesson plans, related literature was reviewed for developing appropriate creative drama based lesson.

Creative drama based instruction should follow three stages: Warming-up, Improvisation and Evaluation-Discussion that are determined on the basis of obtained creative drama experiences in Turkey (Adıgüzel, 2010). Warming-up part consisted of activities to make students adapted to the process, adjust students for working together and encourage their concentration to the subject. The aim of these warm up activities was not only to make students enjoy from the process but also prepare students to the rest of the lesson about ratio and proportion topic. In improvisation phase of lesson plans, students were required to use events and objects

symbolically in a make believe environment. Conceptual understanding was tried to be constructed in improvisation phase. Some drama techniques such as improvisation and role playing were used according to objectives. In some activities in improvisation phase, dramatic moments provided students to be conflicted about statements related with ratio and proportion and got attention of the students. Confliction, secrecy, mystery, an obstacle to overcome, time, being responsible from one another, being dependent to a situation, problems about personal situations are examples of dramatic moments that make students enthusiastic about learning (Neelands, 1991). Also, connections between daily life and ratio and proportion topic were provided in the activities. These connections from everyday context are called as Social Metaphor that makes learning more meaningful (McCaslin, 2006). One sub-criteria of creative drama based instruction is Make-Believe play that is pretending as something, someone or in some situation (Adıgüzel, 2007b). Make-Believe play was provided by taking in role to make people treat in a situation as their own. Also, it provided natural behaviors in improvisation part and so a natural learning. Also, activities in improvisation phase provided students work together for preparing their performances. Lastly, in the discussion part, opportunities were provided students for sharing their ideas, feelings and acquisitions about activities and key points of Ratio and Proportion subject. During the process, the activities should be consistent with the objectives of Ratio and Proportion topic and each other. Besides, all students should be active participants of the lesson. Group work provides this active participation for every student and develops communication and interaction between students. Teacher should be a facilitator and guide during the whole process (Üstündağ, 2007). In all activities, active participant of students and group work was provided. Besides, the role of teacher was a guide that encourages students to communicate and express their feelings and ideas. Also, teacher participated in the process by taking role in some activities. The two mathematics educators who are also a specialist on drama checked the lesson plans to determine whether they were appropriate for creative drama based instruction. Two creative drama instructor examined the lesson plans to determine appropriateness of activities to the phases of drama. Besides, two elementary mathematics teachers controlled the lesson plans for whether they were consistent with the mathematics objectives or not.

The six lesson plans were reviewed with their comments and recommendations. Some adjustments were made in the activities according to their criticism and suggestions;

- Lesson plans prepared separately for each objective. Drama based instruction consists of phases which are continuation of each other (Öztürk, 2007). One activity related to direct proportion and one activity related to inverse proportion for the same plan can disrupt the integrity and flow of the lesson for drama based instruction. Then, activities were checked whether they are consistent with objectives or not.

- Warm-up activities were changed because they took a long time and they were not appropriate for the classroom environment or the age of the students. Number of activities which involves dance with the rhythm of the music was decreased.

- Also, warm up activities were made more related to the Ratio and Proportion topic and more excite full to provide curiosity for the rest of the lesson. For example in lesson plan 1, orienteering activity was added.

- Activities of improvisation phase were revised to make them consist of dramatic moments, social metaphors, make-believe in play and drama techniques. For example, role of bargainer was added to be insisting on disrupting the ratio for price of products sell in the bazaar for lesson plan 3.

- Activities in improvisation part were like dramatization of mathematics problems. They are modified in more creative situations that let students be freer about expressing their ideas and feelings.

- Alternative activities also prepared to experience in pilot study and decide about their appropriateness for the characteristics of the group, number of students, properties of the application area and time.

Pilot study was carried out with 32 seventh grade students from different class in the same school. The number of students was consistent with the number of students in EG that had 30 students. The purpose of pilot study was to control the

applicability of the activities in a crowded classroom with the opportunities of the same school, appropriateness of the activities to the age of this group, clarity of the directions, achievement of objectives with these activities and accomplishment of the classroom management. Besides, pilot study provided researcher to be experienced about the application and use of lesson plans. According to experiences during pilot study, some activities were revised, some activities were changed and some activities were cancelled.

- In the lesson plan 1, orienteering activity was made in class with some arrangements with desks and cartoons but classroom was too narrow for doing this activity in the classroom with a crowded group. Therefore, this activity was decided to take place in the hall of the school at the bottom floor of the school in the main application. Also, time was kept separately for each group in this activity since if they exit at the same time to find the concept papers there could be conflictions and loud noise during the activity. In the second warm up activity for lesson plan 1, there were distributions of different colored cards to students and dancing with the rhythm of the music and be groups according teacher directions. While doing this activity, there were conflictions because some students wanted to be group with their best friends. For this reason, this activity was cancelled and for the new second activity in lesson plan 1, dancing with the rhythm of the music was modified with walking with the rhythm of the music. Because they became spoiled when they were dancing and some of them felt embarrassed. Also, music was chosen with a slow motion and relaxed mood. In development part of lesson plan 1, there were three alternative activities to choose most appropriate one according to characteristics and number of the students. One of them was chosen since the others took a long time and was not appropriate for availability level for drama. Teacher needed to take Ministry of Culture role in order to control and direct the students.

- In the second lesson plan, number of warm-up activities was decreased to two. One of them was cancelled because it took a long time. In other warm-up activity, students wrote different numbers which is whispered to members

of group A in the hand of couple in group B. And then different numbers which is whispered to members of group B was written on the hand of couple in group A. Some students tickled from writing to hand. Therefore, writing on hands changed with writing on the back of couple. In improvisation part, students' aim was restricted with a given situation on the improvisation card but this caused to students' repetition of writings on the paper. Hence, students' aim was stated with more extensive sentences. In the evaluation activity, groups were wanted to collect objects distributed to classroom for constructing given ratio but some students wanted to collect the same objects and dissension occurred. So, the objects changed with colored cards in main application.

- In the third lesson plan, the newspaper game in the warm up activity was played by separating students into two groups and beginning number of newspaper decreased to eight. Music is changed with the hands clapping of teacher to manage to classroom more effectively. Second warm up activity, walking intricately in the classroom and being groups in a given number was cancelled. Instead of walking intricately, this activity modified in a form applied by sitting on the desk and raising fingers appropriate to supply wanted ratio as a vegetable seller. Teacher took in role as a customer whose one hands clapping equals to unit of currency. This modification provided more applicable game for a crowded classroom. In the improvisation part, there were two alternatives for improvisations. The first one was chosen because of its convenience with social economic status of the students. The second improvisation was about producing a credit card advertisement film to introduce its advantages but credit card using was not an extensive context for students' daily life in this school. Most of the students' family was a worker in an agricultural products factory. So, first activity was chosen which is about selling agricultural products.

- In the lesson plan 4, number of warm up activities decreased from three to two because of time convenience.

- In the fifth lesson plan, lemonade game was playing by arranging as nested three circles. While forming the nested three circles, students squeezed each other because of narrow place for thirty-two students. For this reason this activity was modified by separating students as two groups and then by arranging students back to back three line. In the second warming activity, students were wanted to arrange in two lines. They were said that each of them was a chick of a hatcher and the first student was the hatcher. The aim of hatcher was to catch a chick from other line of chick and add this chick to own chicks. But there was confusion if the first student of the line was a boy. Because boys did not want to be a hatcher. Hence, hatcher was modified to caterpillar and chick modified to its rings to prevent this confusion. In improvisation part, the role of a film producer for introducing "Direct Proportion Country" and "Inverse Proportion Country" was cancelled since students could not narrow the scope of the topic to prepare an improvisation. After an activity about writing related situations with direct proportion and inverse proportion from everyday context in groups, students could narrow the scope of the topic to prepare an improvisation about this topic.

- In the lesson plan 6, the warm up activities were consisting both directly and inversely proportional situations. Also, improvisation part was consisting of writing a game about both direct and inverse proportion. Students could write games about direct proportion but there was confusion about writing games about inverse proportion and time was not enough for synthesizing two games. So, in the main application, students were wanted to write games only about direct proportion and playing of these games were improvised in improvisation part.

All modifications were completed after the pilot study in the lesson plans and they were ready to be used.

3.6. Treatment

The control group (CG) was instructed with traditional instruction and the experimental Group (EG) was instructed with creative drama based instruction. Physical arrangement of the classroom, role of teacher and students, interaction

between students are dimensions of a classroom environment. Application of these dimensions was different according to the instruction as given in Table 3.6.

Table 3.6 The General Comparison of EG and CG Classroom Environment

Group / Dimensions	EG	CG
Physical arrangement of the classroom	Students' desks were combined two by two so that the students could work in groups, and move easily. This arrangement provided more empty space.	Regular classroom arrangement of the desks
Role of teacher	Teacher selected tasks related to objectives. Facilitator of conceptual understanding, establishment of classroom culture, let students discuss and reflect on their answers and encouraged students for communicating, sharing feelings and ideas.	Teacher selected tasks related to objectives. Teacher was responsible to tell students mathematical information about ratio and proportion topic, demonstrate the procedures and then asked students to practice what they had seen and heard.
Role of students	Students were sharing ideas and feelings, members of a group, reflecting and communicating. Every student participated actively to the activities.	Students were taking notes, listening given information and some students were solving or answering questions asked by teacher.
Interaction between students	Group work	Individual work

Treatment took twelve lesson hours and it was completed in three weeks. The first and second lessons of EG were applied at the bottom floor of the school since its appropriateness for orienteering activity and other activities. The other phases of this drama based lesson continued in an empty saloon at this floor. But this floor was at the bottom of the school and was very cold. Therefore, other lessons of treatment were implemented in the math and music class. Third lesson was applied in math class. Music classroom was wider than math class. So, other lessons were implemented when this class was empty. Regular math classroom organization was changed as in Figure 3.5.

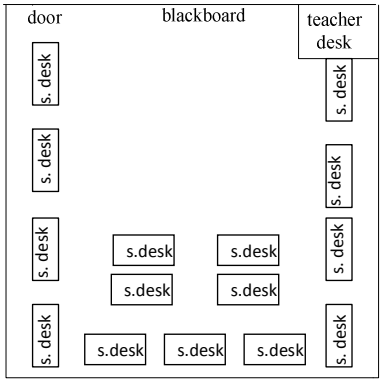


Figure 3.5 The Arrangement of the Math Classroom for Creative Drama Activities

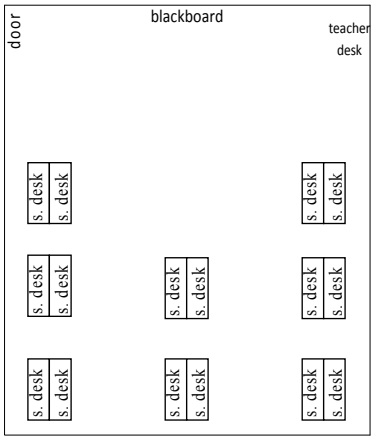


Figure 3.6 The Arrangement of Music Classroom for Creative Drama Activities

This arrangement provided more space for creative drama based activities. Students' desks were combined two by two so that the students could work in groups and move easily. Both EG and CG received 12 hours instruction during three weeks.

The comparison of the EG and the CG in terms of order of the covered topics and test administrations can be seen in Table 3.7.

Table 3.7 The Comparison of the EG and the CG in Terms of Order of the Covered Topics and Test Administrations

Group / Lesson Hour	**EG**	**CG**
1	PRT	
2	preRPAT, preMAS	
3		
4	Ratio (Lesson Plan 1)	Ratio and Proportion
5	Ratio (Lesson Plan 1)	Ratio and Proportion
6	Proportion (Lesson Plan 2)	Multiple choice test with 25 items related to Ratio and Proportion topic was given students to solve
7	Proportion (Lesson Plan 2)	Solution hour of multiple choice test with 25 items related to Ratio and Proportion topic was given students to solve
8	Direct Proportion (Lesson Plan 3)	Direct Proportion
9	Direct Proportion (Lesson Plan 3)	Solving questions related to direct proportion written on the blackboard
10	Inverse Proportion (Lesson Plan 4)	Inverse proportion
11	Inverse Proportion (Lesson Plan 4)	Solving questions related to inverse proportion written on the blackboard

Table 3.7 (Continued)

12	Solving and posing problems related to direct and inverse proportion (Lesson Plan 5)	Solving exercises about direct and inverse proportion in the exercise book of the main book
13	Solving and posing problems related to direct and inverse proportion (Lesson Plan 5)	Solving exercises about direct and inverse proportion in the exercise book of the main book
14	Evaluation activities of acquisition of drama based instruction related to Ratio and Proportion topic (Lesson Plan 6)	Multiple choice test copied from a textbook and consists of 25 items related to ratio, proportion, direct and inverse proportion topic was given students to solve
15	Evaluation activities of acquisition of drama based instruction related to Ratio and Proportion topic (Lesson Plan 6)	Solution of a multiple choice test copied from a textbook and consists of 25 items related to ratio, proportion, direct and inverse proportion topic
16	postRPAT, postMAS	
17		

3.6.1. Treatment of the Control Group

The instruction given to the control group (CG) was Traditional Instruction (TI). All of the traditional instruction process was observed by the researcher. During this instruction process, the teacher taught concepts and skills directly to the whole class. Although, lessons were based on the textbook context by using chapters related to ratio and proportion topic, some student centered activities in the textbook left out of account. Instead of using these suggested student centered activities, teacher centered method was used to solve more questions. The only interaction between students and the teacher occurred while solving first questions of the topic. First questions of the topic were solved with the interaction of students and teacher and answering of most of the students. On the other hand, volunteered students were

mostly chosen to solve other problems. But one could observe that same students were active during the process. There was no interaction between students. Particularly, students worked individually during the class. Teacher taught the curriculum by only lecturing. Although posing problems related to direct and inverse proportion was one of the objectives of 7^{th} grade curriculum, there was no problem posing activity in the control group during three weeks. Instead of posing problem, several questions were solved with copied multiple choice tests. Lessons related to objectives began with defining the concepts by writing on the blackboard or by drawing if necessary and let students to write them on their notebooks. For instance; ratio was defined as "comparison of same kind of two quantities and stating these two quantities as a fraction". Also, proportion was defined as "equality of two ratios and stating these two equal ratios as equivalent fractions". Besides, cross products were given to find missing values in a proportion as a rule. Writing rules or questions from the blackboard was the way of students' participation to the lesson. Then, lesson continued with teachers' solving questions and ended with letting students to solve similar questions solved by teacher. An example question was finding missing values in a given proportion and this type of questions were solved by the rule of cross product. Then other lesson related to same objectives, copied multiple choice tests with 25 questions were given students to solve in one lesson hour. In the second lesson, their answers were told to the students. They were asked to control their answers and asked about the solutions for wrongs. Questions that could not be solved or solved in a wrong way were solved on the blackboard by teacher. Sometimes, teacher asked who wanted to solve this question and a volunteered student solved that questions. In generally, students were passive receivers that were listening to the teacher, recording the teacher's writings from the blackboard and answering the questions. There was some classroom management problems since some students could not solve the problems inclined to spoil in the lessons. Teacher general attitude toward those students was shouting to them and continue to the lesson with successful students.

3.6.2. Treatment of the Experimental Group

Students had no experience with creative drama before this research. In order to make students learn what creative drama is, get used to the researcher, make

improvisation and share ideas and feelings, they had creative drama sessions for two lesson hours. These introduction sessions for creative drama also provided researcher to observe some characteristics of the group, develop communication with students and see the critical points to continue the flow of the lesson with this group. After two lesson hours creative drama experience, students continued ratio and proportion drama based instruction. Interview responses of the EG students and video recordings of the creative drama based activities were reckoned as treatment verifications.

The lessons of creative drama based instruction began with warm-up activities to make students adapted to the process. Played games in the warm up part related to the objectives of the lesson introduced the subject matter to students. They got enthusiastic about the rest of lesson through the warm-up activities. Also, they had the opportunity to discuss the statements in the games. Secondly, improvisation phase continued with improvisations and role playing. Students provided opportunities to make connections between daily life and ratio and proportion topic by taking roles. Also, conceptual understanding was tried to be constructed through improvisations. Finally, activities in the evaluation-discussion phase provided feedback and review of what they learned. These activities also called as quieting activities provides summary of the key points of the concept and opportunities to share ideas, feelings and acquisitions. Quieting activities can be made in all phases of drama after some activities (Güneysu, 2006). During the process, the teacher sometimes participated in the activities by taking in role in order to encourage students.

Make-believe play, student role, teacher role, group work, warm-up activities, dramatic moments, drama techniques and evaluation/quieting activities should be handled in lessons of drama based instruction (Andersen, 2002). Hence, these all sub-criteria were paid attention during the treatment. The direct activities of the lesson plans in terms of the phases and sub-criteria of creative drama based instruction can be seen in Appendix H.

Lesson 1

The aim of the first lesson was to make students state comparison of two quantities as ratio and use ratio to compare of two quantities. At the beginning of the

lesson, orienteering game was played in the hall of the school at the bottom floor for finding concepts about ratio and proportion with different scaled plans of the hall. The students were grouped into five teams consisting of six students in this game. Teacher timed for finding all of the concepts for each group. Group which brings all of the concepts in the least time was congratulated. Each group showed their plans to whole class. They mentioned about the places where they found their concepts while showing their plans. The researcher guided them to focus on size of plans. A student said hall is the same hall for all of the plans but one plan is big or one plan is small. Other student said finding concepts with small sized plan was more difficult. Quieting activity was particularly about the difference between the size of plans, the reasons of these differences. Students found out different scale of a plan for the same place caused different sizes of plan. Also, students said real size of columns, doors or heater by computing according to the scale of the plan.

Secondly, Colored Circle game was played in the warming-up part of the lesson. Circles were drawn on the classroom floor with different colored piece of chalks. Different colored pieces of papers were distributed randomly to the students. Students wanted to walk intricately in the classroom with the rhythm of the music and were paralysed when the music stopped. Students were in the same group stand in the same circle. They compared the number of students stand in two different colored circles to each other or in one colored circle with in the whole class. Also, each group made a garnish with their papers and shows their garnish papers to whole class. Students decided about which comparison was part to part comparison or which comparison was part to whole comparison. And teacher asked them about the concept used in mathematics to compare two quantities. Groups decided the concept as ratio that means comparison of two quantities. This part was aimed to make the students get ready for the rest of the lesson.

In the improvisation part, there were some photos of Miniaturk artifacts on the wall of the saloon. Students looked over all of them carefully and they were separated groups of five. Teacher participated to this activity by taking Minister of Culture role. Students shared their ideas about photos in drama circle arrangement. Teacher gave some information to students as the Minister of Culture. Information was about Miniaturk Park, scaled models of artifacts in Miniaturk and scale of these

models .The students were said to be in role of exploiter of Miniaturk Park and they could change scale of the models to 1/50. They were required to choose an artifact that is the most suitable for representing the culture of Turkey with their individual reason and explain this reason to other groups by producing an introduction film of this artifact. Students worked in six groups and they formed different scaled models of some Miniaturk artifacts with their bodies and explained their reasons in their introduction film. For instance, one group selected the Maiden's Tower (Kız Kulesi) photo and formed 1/25 and 1/50 scaled model of this artifact with their bodies and their reason for selecting this artifact was shown in their introduction film. Being in İstanbul and knowing about its legend story from Turkish lesson was their choosing reason. Another group selected Anıtkabir photo and formed 1/25 and 1/50 scaled model of Anıtkabir with their bodies. They introduced their reason for choosing this artifact in their introduction film. Their reason for choosing Anıtkabir was being symbol of Atatürk and being Atatürk leader of Turkey. Teacher fostered communication within groups and encourage some students to say their ideas within groups while animations were being prepared.

In the evaluation-discussion part, students are wanted be in groups in the first warming up activity. The concepts collected by each group distributed to the groups. Students were wanted to separate the concepts related to the first lesson and unrelated ones, make comparison between related and unrelated concepts or between related and all of the concepts and define ratio concept in their own words.

The following figures consist of photographs taken in the classroom during first lesson of CDBI.

Figure 3.7 Researcher Gives Directions About Orienteering Activity

Figure 3.8 Students Collect Concept Cards in Orienteering Activity

Figure 3.9 Students Forming Different Scaled Model of Galata Tower with Their Bodies

Lesson 2

In lesson 2, students were aimed to explain proportions and relationship between proportional quantities. In the warming up part of the lesson 2, String skein game and Numbers on the back game were played for warming up. Firstly, students were separated groups in four. They opened a skein of string through the four members of the group while the beginning of the group holding the beginning edge of the string. When the skein of string arrived at the end of the group, it was wrapped again by the members of the group. Teacher recorded the time for the first finishing group. This game played again with groups of eight, groups of sixteen and groups of thirty-two. Time was recorded for every situation. Discussion was made about the comparison of time and group members and relationship between all of the comparisons.

In the Numbers on the back game, students were grouped as A and B. Students in group A arranged in a line and students in group B arranged in B in front of the group A. Hence every students arranged as a couple; A and B. Different numbers (2, 4, 6, 8, 16, 32, ...) which were whispered to members of group A was written on the back of couple in group B. And then different numbers (3, 9, 27, 81, …) which were whispered to members of group B was written on the back of couple in group A. Discussion was made about the comparison of numbers for each couple and relationship between the ratios of couples' numbers. In this part of the lesson, students realized the multiplicative relationship between ratios.

In the second phase of the lesson, students were separated as a group of two, a group of four, a group of six, a group of eight and a group of ten. Improvisation cards were given to students. Group of two was in the role of customer for buying bus ticket and tried to persuade the responsible officer for buying bus ticket for only one person. Teacher took in role of responsible officer for the bus ticket. One student said that "I have an exam tomorrow. So, you should sell this ticket to me" and other student said "I am a doctor and have an operation tomorrow. So, you should sell this ticket to me". They tried to persuade ticket officer. At the end of the improvisation, ticket officer said one customer cancelled the ticket so both of you can go. Group of four was in the role of tenant and teacher was in the role of householder. Four people tried to persuade householder to cancel the house contract since house has only two rooms. Householder said "You can stay two people in a room" but they said" We do not want to stay two people in a room. We want to rent a house with four rooms. In the house renting announcement, four roomed was one of the properties of this house". Householder said "No, that was not this house announcement. You had looked wrong renting announcement". Group of six was in the role of customer for buying cinema ticket. They tried to persuade ticket salesman for entering the cinema with 3 empty spaces. Group of eight in the role of customer for buying theatre ticket and tried to persuade ticket salesman for entering the theatre with 4 empty spaces. Ticket salesman was a volunteer student from other groups and teacher was in the role of management manager in the cinema and theater. Group of ten in the role of customer in a café and tried to persuade waiter to find place for 10 people with only 5 empty spaces. Teacher was in the role of owner of café. In all of improvisations,

teacher encouraged students to be in role by taking in role and also, emphasized the number of empty space and the number of people for every situation. Students compared the number of people and the number of empty place in each improvisation and relationship between equal ratios. Some of them said only ratios, some of them said number of empty space doubled to reach number of people and some of them said there were $\frac{1}{2}$ ratio between the number of empty space and the number of people in all of the improvisations.

In evaluation-discussion phase of the lesson, different colored cards were distributed to different places of the classroom. Besides, students distributed cards written on different ratios ($\frac{1}{5}$, $\frac{2}{7}$, $\frac{3}{8}$, $\frac{3}{27}$, $\frac{10}{35}$, $\frac{21}{56}$, $\frac{4}{20}$). Discussion was made about constructing ratios with large numbers and about different ways to construct these ratios, equal forms of these ratios and the concept for expressing equal ratios.

The following figures consist of photographs taken in the classroom during second lesson of CDBI.

Figure 3.10 Students Play “Skein of a String” Game

Figure 3.11 Students Play “Numbers on the Back” Game

Figure 3.12 Students Improvise the Cinema Ticket Animation

Figure 3.13 Students Collect Cards in a Given Ratio for Evaluation Part

Lesson 3

The aim of the third lesson was to make students explain relationship between directly proportional quantities. First activity of the lesson 3 was Newspaper game. Students are divided into two groups since they were crowded and newspaper game was played twice. Eight piece of newspaper were laid out on the floor of the classroom. Students were wanted to walk intricately in the classroom and find a place in this living area from newspapers when teacher clapped the hands. Students that could not find a place on the living area were benched. They were wanted to image like a tree around of the living space. Number of newspapers was decreased with ½ ratio for each time. Students talked about the difficulty of finding place when area of living space decreased with the guidance of teacher. Discussion was made about the relationship between chance of finding place and area of living space.

Secondly, Carrot seller game was played as a warming up activity in the introduction phase of lesson 3. Teacher was a customer and her once hands clapping were one unit of currency. Students were vegetable seller and their hands were one packet of carrot and each finger was one carrot in same size. 3 carrots was 1 unit of currency. Students were wanted to raise three fingers for when teacher clapped the hands once and form an image of vegetable seller in a bazaar. Then, students were wanted to raise six fingers when teacher clapped the hands twice and form an image of customer in a bazaar. The same process was done for three hands clapping and raising nine fingers. Then numbers of hands clapping were intricately as like 3, 1, or 2 times. Discussion was made about the numbers of raising fingers if we have more number of fingers on our hands with 4, 5, 6 or 80 hands clapping. The purpose of these warm up activities was to make students be ready for the rest of the lesson and think about direct relationship between quantities.

The improvisation part began with a dance and motion activity. Two students were volunteered to be a farmer and others were divided into two groups. They were seed products in a field. One of the fields was a narrow space drawn on the classroom floor with a piece of chalk and other place was more extensive space drawn on the classroom floor with a piece of chalk. Farmer was wanted to plan seed of products in these fields with equal distances. Each group was given three minutes time for talking about a farmer planting seed of products and growing process of these products with dancing and motion. Since place for the first was narrow, products was stuck while growing and some products could not grow. But place for the second group was wider, all products could grow and each student could move easily.

Furthermore, in the second activity of the improvisation phase students were wanted to form a circle with whole group. Teacher talked them to think about shopping in feudal period that money was not used for shopping and asked them how shopping was made. Most of them said with barter of objects. Every student was wanted to close their eyes and to think that they were living in feudal period. They were seller or a customer shopping in a bazaar with barter of products. Teacher placed the names of stall of different products such as potato stall, sugar stall, and rice stall. Pictures of different products were distributed to students. Students with

the same pictures came together in the same group. They were wanted animate a bazaar environment with customers and sellers shopping in a bazaar with barter of products. Teacher took in role of bargainer as participant and tried to disrupt the ratio of the products. Some of the groups were consistent about the price of products to a bargainer and some of them disrupted the ratio with saying “Ok. You are a familiar person or you are an unceasing customer”.

In evaluation-discussion part, tables were distributed to students to fill in about the product ratios in their own animation. They talked about the relationship between quantities of products. One of the groups said if quantity of one product increases the quantity of product also increase. Another group said, also if the quantity of one product decreases the quantity of other product decreases in our table. Teacher asked about relationship between the area of place and distance between products. Students in narrow place talked about their feeling while growing. They said the place was too narrow so distance was short. Some of them said the relationship was same as relationship between quantities of products that “Narrow place made distance between products short and wide place made distance between products long”. Teacher asked about this type of proportion that makes quantities change in the same direction and students answered as direct proportion.

The following figures consist of photographs taken in the classroom during third lesson of CDBI.

Figure 3.14 Students Play "Newspaper" Game

Figure 3.15 Students Play "Carrot Seller" Game

Figure 3.16 Students are Sellers and Customers in a Bazaar

Lesson 4

The aim of the fourth lesson was to make students explain relationship between inversely proportional quantities. Warm-up phase of the lesson four began with playing Long tree, short tree game. Students were wanted to stand up when teacher said short tree and wanted to sit down when teacher said long tree. Students mixed up the statement were benched.

Secondly, Turning circle game was played. Students were grouped to form two circles with 20 and 4 students. The starting points of these circles were determined. Students moved one forward with each handle clapping in each circle. Students counted the number of tour with 20 handle clapping. Discussion was made about first and second warm up activities. Students mentioned about the inverse relationship between their height and the statement through the meaning of the word in the first activity. Also, teacher asked to think about the relationship between the numbers of people formed the circles and tour number. Inverse relationship between

these quantities was examined that students said the number of tour of a circle decreased while the number of people formed the circles increasing. Teacher asked why 20 hands clapping were counted and what could be thought about this behavior. One of the students said there were two circles. Teacher said think about their starting. One of the students said they began at same time. The other one said 20 hands clapping could be thought as a second of a clock, tick, tick. Teacher asked about the time. One of the students said time was 20 hands clapping for both big and small sized circles and the time was same for each circle turning around. The importance of starting at the same time and finishing the turning at the same time was underlined.

In the improvisation part, students worked in six groups to form machine parts with their bodies. They were said that imagine being a member of a village and forming machines to provide yield increase and solve thirst problem of the fields. They produced a film for introducing the machine to the village members. Teacher took in role of machine factory manager. Factory manager wanted students to think about the ratios between the parts of the machine and time of finishing a work while using this machine. Students were given 8 minutes to talk about their animation. Groups introduced their machines.

Then teacher asked about time of finishing a work while increasing the number of the same machine used to do this work. Table of machines were distributed to groups and wanted to fill in to see the relationship between the number of the same machine to do a work and day of finishing the same work. In evaluation-discussion part, students took a paper from a bag and discussed about the type of proportion of a situation written on a piece of paper taken from a bag.

The following figures consist of photographs taken in the classroom during fourth lesson of CDBI.

Figure 3.17 Students Play "Long Tree-Short Tree" Game

Figure 3.18 Students Play "Turning Circle" Game

Figure 3.19 Students Introduce Their Machine to the Village Members

Figure 3.20 Students Discuss About the Type of Proportion of a Situation Written on a Piece of Paper Taken from a Bag

Lesson 5

The aim of the fifth lesson was to make students solve problems related to direct proportion, solve problems related to inverse proportion, pose problems related to direct and pose problems related to inverse proportion. Game of lemonade was played. Students were demonstrated a lemonade recipe. Students were wanted to count as water, lemon juice and sugar. Students said water was arranged in a line, students said lemon juice was arranged in a line in front of the water line and students said sugar was arranged in a line in front of the lemon juice line. Every three supplies for lemonade was a group for making lemonade and tried to make delicious lemonade with ratios consistent with the supply ratios in the recipe. Group distorted the supply ratios was benched. Some of the groups said ratio consistent with the supplied ratio in recipe during game. They were congratulated.

In the second warm up activity, students were arranged in two lines. First line was consisting of eight rings and second line was consisting twelve rings. Other

remained students were the members of chamber of arbitrage. They were the controller of trueness of procedures. Students in lines were said that each of them was a ring of a caterpillar and the first student was the head of caterpillar. The aim of caterpillar head was to catch a ring from other caterpillar and add this ring to own rings. But each caterpillar had a weak point that divided caterpillar in a $\frac{1}{3}$ ratio. The catching ring could be done after this weak point. Teacher gave caterpillars a ratio according to number of students to determine the place of weak point. Game was played after group members calculated the weak point and advertising the place of weak point to other group. Members of chamber of arbitrage gave a decision about the correctness of computation and appropriateness of game playing to the rules.

In the improvisation phase, teacher took in role as an announcer of a sightseeing program in a TV channel. She introduced the "Proportion Country" as "Directly Proportional" and "Inversely Proportional" citizens were living in this country together. Blackboard was separated into two as "Directly Proportional" and "Inversely Proportional". Sticky papers were divided to students. They were wanted to write situations that are directly proportional in everyday context and stick it on the "Directly Proportional" part of the blackboard and then the same procedure was implemented for inversely proportional situations. Students were grouped of five. Papers on the blackboard were distributed intricately to the groups. They were said they could be whether "Directly Proportional" and "Inversely Proportional" citizens. They were wanted to talk about these situations and prepare an improvisation about situations from daily life related to their proportion type. The improvisations were about taps to fill a pool, wall painter workers, friends in birthday celebration and sharing a cake, racers in a running competition, a jitney driver and passengers in the jitney, an advertisement producer about credit card and GSM operator.

In evaluation-discussion part, they were wanted to pose a direct proportion problem and inverse proportion problem. They showed their problems and their solutions. Discussion was made about critical points of the problems and type of proportions.

The following figures consist of photographs taken in the classroom during fifth lesson of CDBI.

Figure 3.21 Students Play “Lemonade” Game

Figure 3.22 Students Play “Caterpillar” Game

Figure 3.23 Students Stick Papers Directly Proportional” and “Inversely Proportional” Part on the Blackboard

Figure 3.24 Students Take in the Role of Jitney Driver and Passengers in the Jitney

Lesson 6

The aim of the sixth lesson was to make students to explain directly and inversely proportional situations, writing a game about direct proportion with combining and synthesizing the learning from drama based instruction and daily life experiences and summarize the acquisitions about direct and inverse proportion. The first warm up activity was running race game. Students were grouped of five. Students were wanted be in role of racers in an Olympic camp and doing exercising for race. But the key point for being the first in trainings was doing everything that coach of the exercises said. Coach wanted to reach the finish point when said 27 for the first day. Coach started to count in a same rhythm. The racer reached the finishing point was the winner of first day. For the second day, time decreased to 9, for the third day, number decreased to 3 and for the last day number decreased to 1.

Discussion was made about the speed of races and time counting and relationship of these quantities.

Secondly, guessing the crow game was played. Students were wanted to arrange as a circle, turn their back to the center of the circle and close their eyes. Student touched on shoulder by teacher was a crow and others were products. Crow could kill the products with eye wink while walking intricately. Products could guess about the identification of the crowd by whispering to teacher. Wrong guess caused products to die. Dying products were paralysed. Products that made true guess about the identity of the crowd shared the award.24 chocolate was the prize and shared by six students. Discussion was made about the relationship between the number of the chocolate and number of person who predicted truly the identity of the crowd. Students agreed about the type of proportion between quantities in these games. Inverse proportion between quantities was handled.

In the improvisation phase, students were grouped of six. They were wanted to write a short game about direct proportion with combining and synthesizing the learning from drama based instruction and daily life experiences. Fifteen minutes were given to write a short game on the papers. Then, the game papers were distributed intricately to the groups. The group took the game paper, decided about its appropriateness to direct proportion. Necessary modifications were made. Introduction of game was animated by the groups in a speed motion.

In evaluation-discussion part, writing a letter about their learning of ratio and proportion topic to students which have no regular mathematics instruction.

The following figures consist of photographs taken in the classroom during sixth lesson of CDBI.

Figure 3.25 Students Play "Running Race" Game

Figure 3.26 Students Play the Game of "Estimating the Crowd"

Figure 3.27 Students Play "Turn Your Head" Game Written by Their Own

Figure 3.28 Students Write Letter

3.7. Data Analysis

In this study, both quantitative and qualitative data analysis techniques were used. In order to answer the first and second research question, quantitative data analysis and to answer the third research question qualitative data analysis methods were utilized.

Quantitative data of the present study were analyzed by descriptive and inferential statistics. Hypotheses of the study were analyzed by Analysis of Covariance (ANCOVA) and independent sample t-tests with the statistical package program Predictive Analytics Software (PASW) Statistics 18.

Data received in the interviews were transcribed and read carefully to identify common responses of the students. More specifically, qualitative data obtained from students' interviews were transcribed by two coders and then categories were formulated according to the responses.

3.8. Internal and External Validity of the Study

Both internal validity threats and external validity for this study were discussed in the last part of the methodology chapter.

3.8.1. Internal Validity

Internal validity means effects on dependent variable are due to independent variables, not some other unintended variables. Threats to internal validity are possible alternative explanations of the results that are not related to the treatment (Fraenkel & Wallen, 2006). This present study represents a weak experimental study. Hence, the validity threats and ways to minimize the possible effects of threats to internal validity seemed necessary to address in this section.

Fraenkel and Wallen (2006) states threats to internal validity in experimental designs. The possible threats to internal validity in the present study were subject characteristics, location, history, maturation, mortality, instrument decay, data collector characteristics, data collector bias, testing, regression, implementation of the treatment and Hawthorne effect.

The current study was nonrandomized pretest posttest control group design. Already existing intact groups were used as EG and CG. This might result in subject characteristics threat to internal validity that is individuals differing from one another in unintended ways that are related to the variables to be studied. In order to control effects of this threat, some characteristic that could have unintentional effects on the differences were determined. Subjects were at the same age. Moreover, all students were living at the same district and subjects' socio economic backgrounds were almost the same. Hence, those characteristics assumed that have no unintentional effect on research results. Also, PRT was administered to both CG and EG with the purpose of determining the pre-requisite knowledge related to ratio and proportion topic and level of proportional reasoning skills of both group at the beginning. Additionally, first and second mathematics exam scores (MES1 and MES2) were determined as possible unintentional variable to posttest. Then equivalency of these groups was tested by MES1, MES2 in terms of mathematics achievement and PRT in terms of level of proportional reasoning at the beginning by using independent samples t-tests. There were no significant mean differences between the treatment groups with respect to MES1, MES2 and PRT ($p > 0.05$) at the beginning of the

treatment. Therefore, study continued with these two treatment groups. Besides, their differences on pretreatment measures were taken by using ANCOVA. Therefore, their educational backgrounds could not be a threat. As a consequence, the subject characteristics threat was controlled.

History threat was removed with administration of pretests and posttests to both groups at the same time. Beside these, there was no an unexpected event during the testing period that could affect the subjects' responses. Classrooms were at the same floor in the same school. So, physical conditions were same for both CG and EG. Hence, location threat was controlled. Maturation was not an issue because all the subjects were at the same age and duration of the study was limited to three weeks.

Mortality is another threat to internal validity means loss of subjects (Fraenkel & Wallen, 2006). In the present study, only one student in EG was absent in the implementation of PreRPAT. Since this variable was the dependent variable of the analysis, this subject was deleted as listwise for the analysis. The loss of one subject did not cause a viable threat.

If the scoring of an instrument is changing according to scorers or time to time, it could be a threat for instrument decay (Fraenkel & Wallen, 2006). A detailed rubric was prepared by the researcher in order to score students' responses in the pretest and posttest. While scoring instruments, the researcher scored an item for all students then passed to next item. Also, two elementary mathematics teachers scored photocopied answers of the items at the same time according to rubric to prevent instrument decay threat to internal validity. Researcher calculated inter-rater reliability in terms of providing subjective decisions by using Interclass correlation (ICC). Interclass correlation (ICC) was 0.99 indicate quite high reliability for three scorers.

Data collector characteristics and data collector bias threats were controlled following the same procedure in both groups. During the implementation of pretest and posttest, besides researcher classroom teacher was in the classroom. This situation was helpful to observe that students were not directed toward a certain response by the researcher during the implementation of tests. In addition, the interviews were conducted with the teacher and randomly selected ten students. The

researcher did not give a biased direction to the answers of the students and teacher. Instead, at the beginning of the interviews the actual responses are important for the results of the study. Although, all data collection procedure was implemented by the researcher, she made every effort to behave unbiased and non-directive way.

According to Fraenkel and Wallen (2006), performance of subjects in related posttest which includes similar content with pretest can be influenced by responses to the first instrument as pretest. This is called testing threat. In the study, equivalent forms of achievement tests were used to eliminate the testing threat. Also, there was four weeks break from pre-intervention through post-intervention. This time interval was long enough to prevent students to memorize the questions and remember the results.

Regression threat is due to difference between the subjects related to their low or high pre-intervention performances (Fraenkel & Wallen, 2006). The regression threat was mostly eliminated for this study, since the information that students were heterogeneous in their achievement levels was given from the school administrator.

Fraenkel and Wallen (2006) experimental group may be treated in an unintended way that supplies advantages to this group in the experimental studies. This is called implementation threat that might occur if different people implement different treatments. Also, preference of the implementer results personal bias for one of the treatments. In the present study, the researcher was the implementer of the CDBI since she had some training about creative drama and also a mathematics teacher. It is also difficult to find a person who is also a mathematics teacher and have training about creative drama. Also, education of classroom mathematics teacher about creative drama and creative drama based instruction needs a long time and a special education. Therefore, CDBI was implemented by the researcher. But classroom teacher was also in the classroom during the implementation and an observer for the data collector bias and consistency of the lessons with lesson plans. Implementer of CDBI tried to implement lessons consistent with lesson plans and there were no clues about questions in achievement test during the CDBI.

Finally, Hawthorne effect can be a threat for the internal validity. Experimental group can increase their interest since they are selected for a study.

Hawthorne effect was not eliminated in this study. Any Hawthorne effects could be a threat due to implementation of an unfamiliar method for the students.

3.8.2. External Validity

External validity of the study is "the extent to which the results of a study can be generalized from a sample to a population" (Fraenkel & Wallen, 2006, p.108). Generalizing is constructed on two dimensions: population generalizability and ecological generalizability. Population generalizability is related to a sample's degree of representativeness of the intended population. Ecological generalizability is related to extent the results of a study to settings and conditions (Fraenkel & Wallen, 2006).Target population of this study was determined as all 7^{th} grade students in Kocaeli. The accessible population of this study was a public elementary school in this region. The participants in this study were selected from one of public elementary in Körfez district by using convenience sampling. Thus, the selected sample size did not provide population generalizability. However, this study was implemented in a public elementary school in Körfez district of Kocaeli. The students in this school have low level of socio-economic status; most of their parents are illiterate or graduated from elementary school. For this reason the results of the study could be generalized to the schools have similar conditions with the school that data were collected. This supplies the ecological generalizability.

CHAPTER 4

RESULTS

The main purpose of the study was to investigate the effect of creative drama based instruction (CDBI) on seventh grade students' achievement in ratio and proportion concepts and attitude towards mathematics. Another purpose was to examine students' self-reported views related to CDBI. This chapter aims to present the results in three main sections. The first section includes the descriptive statistics of pretest, posttest of Ratio and Proportion Achievement test (RPAT), Mathematics Attitude Scale (MAS) and gained scores of Mathematics Attitude Scale (gMAS). The second section contains the inferential statistics of the quantitative analysis and final section deals with the qualitative analyses.

4.1. The Results of Descriptive Statistics

In this section the descriptive statistics of the data are given. First of all, the results of descriptive statistics of Proportional Reasoning Test (PRT) scores are given. The aim of PRT use in this study was to determine the achievement levels in proportional reasoning of both control and experimental groups at the beginning. Secondly, the results of Ratio and Proportion Achievement Test (RPAT), Mathematics Attitude Scale (MAS) and gained scores on MAS scores (gMAS) are given.

4.1.1. The Results of Descriptive Statistics of PRT Scores

In this part, students' scores on Proportional Reasoning Test (see Appendix A) were examined. Descriptive statistics related with the PRT for the EG and the CG appear in Table 4.1.

Table 4.1 Descriptive Statistics Related with PRT for the EG and the CG

	CG	EG
	PRT (out of 56)	PRT (out of 56)
N	28	30
Mean	10.21	10.60
Median	7.00	7.00
Std. Deviation	9.43	10.78
Maximum	37.00	34.00
Minimum	1.00	1.00

The answers of students in this study were evaluated according to rubric developed by Akkuş and Duatepe (2006) (see Appendix B). The maximum possible score of PRT was 56 according to this rubric. As it can be seen in this table, the EG mean scores on the PRT were approximately equivalent with the CG mean scores. Table 4.1 indicates that while CG had a mean score of 10.21 (*SD*=9. 43) on PRT, EG had a mean score of 10. 60 (*SD*=10.78). PRT was used as one of the pre-treatment measurements showed that the two groups were equivalent at the beginning. Therefore, it was decided to continue study with these two groups.

4.1.2. The Results of Descriptive Statistics of RPAT

Descriptive statistics related with the preRPAT and the postRPAT for the CG and EG appear in Table 4.2.

Table 4.2 Descriptive Statistics Related with preRPAT and postRPAT for the CG and EG

	CG		EG	
	preRPAT (out of 44)	postRPAT (out of 44)	preRPAT (out of 44)	postRPAT (out of 44)
N	28	28	30	30
Mean	5.50	15.39	6.20	29.07
Median	3.50	13.00	3.00	29.00
Std. Deviation	5.32	9.55	5.93	11.99
Skewness	1.648	1.219	1.209	-0.281
Kurtosis	2.960	1.230	0.821	-0.931
Maximum	23.00	40.00	23.00	44.00
Minimum	1.00	2.00	1.00	3.00

Table 4.2 indicates that while CG had a mean score of 5.50 (*SD*=5.32) and EG had a mean score of 6.20 (*SD*= 5.93) on the pretest of RPAT, and their mean scores in the posttest of RPAT were 15.39 (*SD*= 9.55) for CG and 29.07 (*SD*= 11.99) for EG out of 44. As it is seen from the Table, the EG mean scores' on both the preRPAT and the postRPAT were higher than the mean scores of the CG. Mean scores of both groups demonstrated an increase from pre to posttest. Namely, while the mean score of the CG increased from 5.50 (*SD*=5.32) to 15.39 (*SD*= 9.55), the mean score of the EG increased from 6.20 (*SD*= 5.93) to 29.07 (*SD*= 11.99) from pretest to posttest.

4.1.3. Descriptive Statistics of Mathematics Attitude Scale

The descriptive statics related with the preMAS, the postMAS and the gained scores on MAS (gMAS) for the EG and the CG is shown in Table 4.3. Gain scores were obtained by the difference between the preMAS and postMAS scores. As the table shows, both the preMAS and postMAS mean scores of the EG were higher than those of CG. The CG and the EG increased their mean scores from 34.64 (*SD*= 7.04) to 37.86 (*SD*= 7.13) and from 38.10 (*SD*= 6.65) to 47.83 (*SD*= 5.04), respectively.

Table 4.3 Descriptive Statistics related with the preMAS, the postMAS and the gMAS for the EG and the CG

	CG			EG		
	preMAS	postMAS	gMAS	preMAS	postMAS	gMAS
N	28	28	28	30	30	30
Mean	34.64	37.86	3.21	38.10	47.83	9.73
Median	34.00	36.50	4.00	38.00	48.00	9.00
Std.Deviation	7.04	7.13	3.38	6.65	5.04	4.25
Skewness	0.227	0.400	0.080	-0.056	-0.857	1.116
Kurtosis	0.406	1.534	0.858	-0.982	0.572	0.842
Maximum	52.00	56.00	11.00	50.00	54.00	20.00
Minimum	19.00	20.00	-5.00	27.00	34.00	4.00

The mean of gain score on MAS for CG was 3.21 (*SD*= 3.38) and the mean of gain score on MAS for EG was 9.73 (*SD*= 4.25) which show that there is an increase in both MAS scores of CG and EG after TI and CDBI. The gain score on MAS for CG constituted 6.17 % of 52, which was the highest possible score in MAS and the gain score on MAS for EG constituted 18.71 % of 52, which was the highest possible score in MAS.

In addition to total scores obtained from MAS, Table 4.4 presents the descriptive statistics for preMAS and postMAS of each sub dimension of MAS.

Table 4.4 Descriptive Statistics for preMAS and postMAS for Each Categories of MAS

		CG		EG	
		preMAS	postMAS	preMAS	postMAS
Interest in and enjoyment of mathematics (IEMAT)	N	28	28	30	30
	Mean	10.71	11.21	12.20	14.00
	Median	12.00	12.00	13.00	14.00
	Std. Deviation	3.13	2.99	2.46	1.66
	Skewness	-0.490	-0.385	-0.607	-1.161
	Kurtosis	-0.334	-0.396	0.833	0.833
	Maximum	16.00	16.00	16.00	16.00
	Minimum	4.00	4.00	8.00	9.00
		CG		EG	
		preMAS	postMAS	preMAS	postMAS
Instrumental motivation to learn mathematics (IMMAT)	N	28	28	30	30
	Mean	12.79	13.11	13.40	14.63
	Median	13.00	13.50	13.50	15.00
	Std. Deviation	2.36	2.40	2.08	1.38
	Skewness	-0.432	-0.632	-0.478	-1.318
	Kurtosis	-0.157	-0.082	-0.490	2.869
	Maximum	16.00	16.00	16.00	16.00
	Minimum	7.00	7.00	9.00	10.00
		CG		EG	
		preMAS	postMAS	preMAS	postMAS
Mathematics anxiety (AMAT)	N	28	28	30	30
	Mean	11.14	11.36	12.50	15.80
	Median	10.50	11.00	11.00	16.50
	Std.Deviation	4.03	3.18	4.36	3.01
	Skewness	0.774	0.932	0.449	-0.379
	Kurtosis	0.355	1.470	-1.275	-0.857
	Maximum	20.00	20.00	20.00	20.00
	Minimum	5.00	5.00	6.00	10.00

Note. Negatively worded items were reversed. High mathematics anxiety score indicates low mathematics anxiety.

As shown in Table 4.4, while preMAS mean scores of CG in the IEMAT which was 10.71 (*SD*= 3.13) increased to 11.21 (*SD*= 2.99) in postMAS, preMAS mean scores of EG in the IEMAT which was 12.20 (*SD*= 2.46) increased to 14.00 (*SD*= 1.66) in postMAS. Besides, while preMAS mean scores of CG in the IMMAT increased from 12.79 (*SD*= 2.36) to 13.11 (*SD*= 2.40), preMAS mean scores of EG in the IMMAT increased from 13.40 (*SD*=2.08) to 14.63 (*SD*= 1.38). Similarly, while preMAS mean scores of CG in the AMAT which was 11.14 (*SD*= 4.03) increased to 11.36 (*SD*= 3.18) in postMAS, preMAS mean scores of EG in the AMAT which was 12.50 (*SD*= 4.36) increased to 15.80 (*SD*= 3.01) in postMAS.

4.2. Inferential Statistics

In the previous section, descriptive statistics on PRT, RPAT, MAS and categories of MAS were mentioned. In this section inferential statistics will be given.

4.2.1. The Results of Pre-Treatment Measures

At the beginning of the treatment, Proportional Reasoning Test (PRT) was administered to determine the achievement levels of students related to ratio and proportion topic and achievement levels in proportional reasoning of both control and experimental groups at the beginning. Moreover, Ratio and Proportion Achievement Test (RPAT) and Mathematics Attitude Scale (MAS) were administered as pretests. Besides, 2010-2011 first and second mathematics exam scores (MES1, MES2) were taken from the school administrations in the elementary school to determine equivalency of EG and CG in terms of mathematics achievement at the beginning. Equivalency of the treatment groups were intended to test in terms of pre-treatment measures by using independent samples t-tests. Normality assumption was checked.

Table 4.5 Values of Skewness and Kurtosis of Each Variable for Each Group

Groups	N	Skewness/Kurtosis	PRT	MES1	MES2	preRPAT	preMAS
CG	28	Skewness	1.708	0.369	0.273	1.648	0.227
		Kurtosis	2.353	1.109	-0.921	2.960	0.406
EG	30	Skewness	1.142	-0.359	-0.250	1.209	-0.056
		Kurtosis	-0.187	-1.703	-0.692	0.821	-0.982

As seen in Table 4.5, the value of skewness and kurtosis is approximately between -2 and 2 for MES1, MES2 and preMAS. Unfortunately, skewness and kurtosis values showed non-normal distribution for PRT and preRPAT scores. Therefore, equivalencies of the treatment groups were tested in terms of pre-treatment measures by using independent sample t-tests for MES1, MES2 and preMAS scores. Besides, non-parametric alternative to t-test: Mann-Whitney U test was used to test equivalency of the treatment groups in terms of pre-treatment measures for PRT and preRPAT. The results of independent sample t-test were given in Table 4.6 and the results of Mann-Whitney U test were given in Table 4.7.

Table 4.6 Results of Independent Samples t-test for Pre-Treatment Measures for MES1, MES2 and preMAS scores

Variables				Levene's Test				
	Group	Mean	SD	F	Sig.	t	df	p
MES1	CG	53.39	15.34	0.840	0.363	-0.025	56	0.980
	EG	53.50	17.43					
MES2	CG	54.82	19.03	1.680	0.200	-0.056	56	0.960
	EG	55.13	22.88					
preMAS	CG	34.64	7.04	0.056	0.815	-1.924	56	0.059
	EG	38.10	6.65					

As seen in Table 4.6, there were no significant mean differences between CG taught by traditional instruction (TI) with EG taught by creative drama based instruction (CDBI) with respect to MES1, MES2 and preMAS scores ($p > 0.05$).

Table 4.7 Results of Mann- Whitney U Test for Pre-Treatment Measures for PRT and preRPAT scores

Variables	Group	Mean	Median	Mean Rank	Z	Mann Whitney U	Asymp.Sig. (2 tailed)
PRT	CG	10.21	7.00	29.95	-0.680	376.500	0.497
	EG	10.60	7.00	30.95			
preRPAT	CG	5.50	3.50	29.04	-0.205	407.000	0.838
	EG	6.20	3.00	29.93			

As seen in Table 4.7, Mann-Whitney U test revealed no significant difference in the PRT scores of CG (*Md*= 7.00, *n*=28) and EG (*Md*= 7.00, *n*=30), *U*=377, *z* = -0.68, *p* = 0.50, *r* = 0.09 . Besides, there was no significant difference in preRPAT scores of CG (*Md*= 3.50, n= 28) and EG (*Md*= 3.00, *n*=30), *U*= 407, *z*= -0.205, *p*= 0.84, *r* = 0.03. The two groups of this study were determined randomly among five 7^{th} grade classes as EG and CG. Since there were no significant mean differences between the treatment groups with respect to pre-treatment measurements at the beginnig, it was decided to continue to study with these two groups.

4.2.2. Testing the First Hypothesis

In this part the findings of the analyses to answer the first research question will be presented. The first research question was "Is there a significant effect of the creative drama based instruction compared to traditional instruction on seventh grade students' achievement in ratio and proportion concepts in general when students' prior achievement in ratio and proportion concepts is controlled?" The first hypothesis (H_0) was **"**There is no significant mean difference between the students received creative drama based instruction and those received traditional instruction in terms of achievement in ratio and proportion concepts". This hypothesis was tested by the ANCOVA that provides examination of differences between groups when the effects of additional one or more variables called covariates are controlled (Pallant, 2007). Tabachnick and Fidell (2000) indicated that the covariates are controlled

because of their influence on the scores on the dependent variable. ANCOVA is used to explore differences among groups when random assignment of the groups is impossible (Green, Salkind, & Akey, 2000). Stevens (2002) suggested that the use of two or three carefully chosen covariates provides reduction of the error variance and extension of chances of detecting a significant difference between groups. On the other hand, these covariates need to be chosen carefully (Tabachnick & Fidell, 2000). The covariates need to be correlated not too strongly when more than one covariate are used (Pallant, 2007). First, Proportional Reasoning Test (PRT) and pre Ratio and Proportion Achievement Test (preRPAT) were intended to be used as covariates for the ANCOVA of the first hypothesis. However, there was a strong positive relationship between the two variables, $r = .85$, $n=58$, $p < .05$. In the case that covariates intended to use correlate strongly, one of them should be removed (Stevens, 2002). Therefore, only pre Ratio and Proportion Achievement Test (preRPAT) was used as covariate in ANCOVA of the first hypothesis.

4.2.2.1. Assumptions of ANCOVA

The variables were tested for the assumption of ANCOVA. These assumptions are normality of dependent variables, measurement of covariate, reliability of covariate, correlations among covariate, linearity, homog eneity of regression, equality of variances and independency of observations.

For the normality of dependent variables assumption, Kolmogorov-Smirnov and Shapira-Wilk tests were examined; and the significant results were the indicators of non-normal distribution of data. Since these strict tests were not only tools to check for normality, the researcher focused on finding some other evidences to meet this assumption. The histograms for dependent variable with normal curves were checked and it was seen that distribution was almost normal with a slightly skewed direction. In Normal Q-Q plots, the observed value for dependent variable was plotted against expected value form normal distribution. Reasonable straight line was obtained. Also, skewness and kurtosis values were checked for the normality of dependent variables assumption, (Pallant, 2007). The values between -2 and +2 can be assumed as approximately normal for skewness and kurtosis (Green, Salkind, & Akey, 2000). The value of skewness and kurtosis was approximately between -2 and

+2. Consequently, assumption of normal distribution was satisfied. Skewness and Kurtosis values were given below for each group in Table 4.8.

Table 4.8 Values of Skewness and Kurtosis of the Dependent Variables for Each Group

Group	N	Skewness/Kurtosis	postRPAT
CG	28	Skewness	1.219
		Kurtosis	1.230
EG	30	Skewness	-0.281
		Kurtosis	-0.931

Measurement of covariate assumption was not a statistical assumption, simply means that the covariate should be measured before the treatment. This assumption was supplied by the implementation of preRPAT as covariate before the treatment.

Reliability of preRPAT as covariate was checked by calculating Cronbach alpha. The Cronbach alpha reliability coefficient was found .83 that should be at least .70 and preferably .80 (Pallant, 2007). So, reliability of the covariate assumption was satisfied.

Scatter plots were generated between dependent variable and covariate for each group. It was found that there was a reasonable linear relationship between dependent variable–postRPAT- and the covariate for the treatment groups. The assumption was also tested statistically. R squared values gave an indication of the strength of the relationship between dependent variable and covariate for the treatment groups. In the CG, value was found as $R^2_{\text{postRPAT}-\text{preRPAT}} = 0.81$ and in the EG group, R squared value was found as $R^2_{\text{postRPAT}-\text{preRPAT}} = 0.63$. Consequently, linearity assumption was approximately satisfied.

Interaction between group and covariate was checked for the homogeneity of regression slope assumption. As seen in Table 4.9 interaction between group and covariate was not statistically significant at the level of significance 0.05 ($F_{\text{group}*\text{preRPAT}}=0.03$, $p_{\text{group}*\text{preRPAT}}= 0.96$).

Table 4.9 The Results of ANCOVA for Testing Assumption on Homogeneity of Regression Slopes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7287.392[a]	3	2429.131	63.830	.000
Intercept	4515.981	1	4515.981	118.666	.000
group	1092.291	1	1092.291	28.702	.000
preRPAT	4492.878	1	4492.878	118.059	.000
group * preRPAT	.105	1	.105	.003	.958
Error	2055.039	54	38.056		
Total	38615.000	58			
Corrected Total	9342.431	57			

a. R Squared = .780 (Adjusted R Squared = .768)

Levene's test for homogeneity of variance showed that error variance of the postRPAT scores is not equal across groups, F (1,56)= 7.80, $p < .05$. Therefore, homogeneity of variance assumption was violated. If Levene's test violated the assumption, it is recommended to look at the sample size. If $\frac{\text{largest sample size}}{\text{smallest sample size}} \leq 1{,}5$, analysis can be continued (Stevens, 2002). In this case, largest sample size was 30 and smallest sample size was 28 for this study. $\frac{30}{28} = 1{,}07 \leq 1{,}5$ that equality of error variance of the postRPAT scores was assumed.

Independency of observations was not a statistical assumption, simply means that each participant responded independently from other participants. This assumption was supplied by the observations of the researcher during the administration of the all tests.There was no interaction among students.

4.2.2.2. Investigation of the First Hypothesis

After testing the assumptions of ANCOVA, the hypothesis was tested by ANCOVA with covariate preRPAT. Group (experimental or control) served as the independent variable and posttest score of Ratio and Proportion achievement test (postRPAT) served as dependent variable at the significance level 0.05. The results were given in Table 4.10.

Table 4.10 The Results of ANCOVA for postRPAT Scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7287.287[a]	2	3643,643	97.512	.000	.780
Intercept	4535.113	1	4535.113	121.369	.000	.688
preRPAT	4579.401	1	4579.401	122.554	.000	.690
group	2272.840	1	2272.840	60.826	.000	.525
Error	2055.144	55	37.366			
Total	38615.000	58				
Corrected Total	9342.431	57				

a. R Squared = .780 (Adjusted R Squared = .772)

As seen in Table 4.10 preRPAT scores was taken as covariate for postRPAT scores. preRPAT was statistically significant covariate for the postRPAT, F (1,55)= 122.55, $p < .05$.

Results revealed that there was a statistically significant difference between the mean scores of EG received creative drama based instruction (CDBI) and CG those received traditional instruction (TI) in terms of achievement in ratio and proportion concepts in the favor of EG, F (1,55)= 60.83, $p < .05$. The effect size was 0.53. This meant that it was large effect size because it was greater than 0.14 (Cohen, 1988). It also indicated that 53 % of variance in postRPAT score was explained by independent variable-group. The calculated effect size referred to a large effect size indicating practical significant in addition to statistical significance (Cohens, 1988).

4.2.3. Testing the Second Hypothesis

In this part the findings of the analysis to answer the second research question will be presented. The second research question was "Is there a significant effect of creative drama based instruction compared to traditional instruction on seventh grade students' gain score of attitudes toward mathematics?" The second hypothesis of the problem (H_0) was "There is no significant mean difference between the students received creative drama based instruction and those received traditional instruction in terms of gain scores of attitudes toward mathematics". This hypothesis was intended to be tested by ANCOVA to control the effects of preMAS scores as covariate and explore differences among groups by controlling their prior attitudes towards

mathematics. Thus, assumptions of ANCOVA began to be checked. But, homogeneity of regression slopes that is one of the assumptions associated with ANCOVA was violated. Interactions between groups and covariate was statistically significant at the level of 0.05 ($F_{\text{group}*\text{preRPAT}}$= 6.070 $p_{\text{group}*\text{preRPAT}}$= 0.17). A violation of homogeneity regression slopes can bring about the false results if covariance is used. Furthermore, when comparing two groups with pretest and posttest design, comparing means on gain scores (posttest-pretest) is possible (Stevens, 2002). Thus, since the design of the present study was pretest-posttest control group design, running independent-samples t-test for dependent variable as gain score was seen appropriate. Hence, in order to investigate second hypothesis, independent samples t-test was performed on gain scores of MAS.

4.2.3.1. Assumptions of Independent-samples t-test

Before conducting the analysis, three assumptions of independent-samples t-test stated by Green, Salkind, & Akey (2000) were checked. To check the normal distribution of the gain scores, Kolmogorov-Simirnov statistics was run. Table 4.11 presents the test of normality results of gain scores for CG received TI and EG received DBI.

Table 4.11 Results of Kolmogorov-Simirnov Test

Groups (CG received TI and EG received CDBI)			Statistic	df	Sig.
	CG	gMAS	0.158	28	0.071
	EG	gMAS	0.208	30	0.002

As shown in Table 4.11, significance value of gain scores of MAS for CG was 0.07 indicating the normality. On the other hand, significance value of gain scores of MAS for EG was 0.00 which indicates the violation of normality assumption. However, Central Limit Theorem stated that the distribution can be accepted as normal if the sample size is larger or equal to 30 (Gravetter & Wallnau, 2007). Hence, the distribution can be accepted as normal according to central limit

theorem. Besides, skewness and kurtosis values were checked for the normality assumption that was given below for each group.

Table 4.12 Skewness and Kurtosis Values of pre-post and gain MAS scores

Group (CG received TI and EG received DBI)	N	Skewness/Kurtosis	preMAS	postMAS	gMAS (postMAS-preMAS)
CG	28	Skewness	0.227	0.400	0.080
		Kurtosis	0.406	1.534	0.858
EG	30	Skewness	-0.056	-0.857	1.116
		Kurtosis	-0.952	0.572	0.842

Table 4.12 illustrates that skewness and kurtosis the value for pretest, posttest and gain scores for MAS scores. These values are between -2 and +2 that indicate the distribution of preMAS, postMAS and gMAS scores were normally distributed (Bryman & Cramer, 2009). Moreover, when Normal Q-Q Plots of gain scores for both groups were inspected, almost straight lines were observed suggesting a normal distribution.

The second assumption for independent-samples t-test was the homogeneity of variances. Levene's Test for the equality of variances is output of independent-samples t-test was used in order to check this assumption (Pallant, 2007). Levene's test showed that error variance of the gain scores of MAS is equal across groups, $p > 0.05$. The assumption of homogeneity of variances has been met.

Another assumption for independent-samples t-test indicates that "The cases represent a random sample from the population and the scores on the test variable are independent of each other" (Green, Salkino, & Akey, 2000, p.150). In this study it was assumed that difference scores were independent of each other.

4.2.3.2. Investigation of the Second Hypothesis

After testing the assumptions of independent-samples t-test, the second hypothesis was tested at the significance level 0.05. An independent-sample t-test was conducted to compare gain score of MAS for CG received TI and EG received CDBI. Gain scores of MAS were computed as postMAS-preMAS. The results were presented in Table 4.13.

Table 4.13 The Results of Independent Samples t-test for gain scores of MAS (gMAS)

Variable	Group	N	Gain Scores Mean	SD	Levene's Test F	Levene's Test Sig.	t	df	p
gMAS	CG	28	3.21	3.38	0.748	0.391	-6.434	56	0.000
	EG	30	9.73	4.25					

Results revealed that there was a statistically significant difference in gain scores of MAS for CG received TI (M= 3.21, SD= 3.38) and EG received DBI (M= 9.73, SD= 4.25), t (56) = -6.43, $p < .05$ (two-tailed).

The effect size is evaluated by eta squared statistic computed by following formula (Pallant, 2007, p. 236)

$$\text{Effect size (eta squared)} = \frac{t^2}{t^2 + (N1+N2-2)} \quad (4.1)$$

The effect size was computed as 0.43 by replacing the appropriate values to the formula. Thus, 43% of the variance in gain score of MAS was explained by independent variable-group. The calculated effect size referred to a large effect size indicating practical significant in addition to statistical significance (Cohens, 1988).

The results indicated that students received CDBI had significantly greater achievement in ratio and proportion concepts than students received TI. The statistically calculated large effect size (0.53 for the postRPAT scores) claims the practical significance of this result. Furthermore, findings of the study also indicated positive effect of the drama based instruction on gained scores of attitude towards mathematics (gMAS) compared to traditional instruction. The statistically calculated large effect size (0.43 for the gMAS scores) claims the practical significance of this result.

One of the purposes of this study was to investigate the effect of creative drama based instruction (CDBI) on seventh grade students' achievement in ratio and

proportion concepts and attitude toward mathematics. In this section, to investigate the effect of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts and attitude toward mathematics, first two research questions were answered by using quantitative methods. As a result, there is a significant difference between the students who received creative drama based instruction and traditional instruction in terms of achievement in ratio and proportion concepts and gain scores of attitude toward mathematics in favor of creative drama based instruction. Another purpose of this study was to examine students' self-reported views related to creative drama based instruction. In the next section of analysis, the qualitative analysis results of the third research question will be given.

4.3. Qualitative Analysis

One of the aims of the study was to investigate the seventh grade students' views related to creative drama based instruction. Ten students were interviewed from the experimental group to address the third problem at the end of the treatment. The responses of students were divided into four main categories: "Views about active participation", "Group Work/Working with friends", "Views expressing negative aspects of CDBI" and "Self-awareness". In this section, analysis based on the topics mentioned above will be presented. The following excerpts from the interview responses can be seen Turkish in Appendix I. They can be followed with codes, involving numbers, given in the parentheses at the end of the each excerpt. For example, in the code (Student7-4), 4 was used to indicate the fourth excerpt.

4.3.1. Students' Views about Active Participation

Analysis of students' views related to creative drama based instruction showed that the interview participants had common views about creative drama based instruction, in the sense that it provided them to learn easily and understand better through active participation. Generally, students emphasized that they were more active by physically and cognitively in these lessons. They stated that all had chance to participate. When we looked at the students' responses, they particularly noticed that, everyone in the classroom participated to the lessons. For instance; a student stated that "Friends who are shy and do not usually talk or participate in other lessons were included to the activities" (Student 10-1).

Similarly, following student mentioned about even students who are bored easily on the same subject or in the same lesson attended the course as followed;

> The students who are get spoiled in other lessons actively involved to creative drama based activities. Although, they spoke in activities, their speech was about the subject of the lesson. All of us participated to the lesson to learn something about the ratio and proportion concepts and to share our ideas about these concepts (Student 5-2).

Experiences in creative drama based activities provided students express themselves physically and linguistically with whole participation of all students. Another point noted about the students' participation is related to the feature of participation. Seven students indicated that class participation was directly related to the subject. An example explanation of a student is as followed;

> I was involved in the subject and games. While solving problems on the blackboards, I am not involved in the concepts and I do not understand the meanings of the concepts. On the other hand, I was in the activities, concepts and subjects and all of doings so I understood better with drama activities (Student 5-3).

Creative drama based activities provided students the incorporation of an affective element within the content as stated:

> I felt that I was doing better than regular mathematics lessons. I became involved in the examples. We found the examples by ourselves and improvise them. Being involvement in the activities was different from only writing the examples on the blackboard (Student 7-4).

All experiences created by activities involved students into the process and serve to a natural learning. Moreover, another point of attention related to students' participation is different ways of participation. Seven students stated that they participated to subject in variety of ways. They generally stated that only writing rules or questions from the blackboard was meaningless for them and also hard to understand the written things. Creative drama based instruction provided them to understand through actively involvement in different ways such as discussion within groups and between groups, thinking, improvisation, communication, writing their own ideas, etc. Creative drama based activities involved active participation rather

than a mere reliance upon knowledge transfer. Students were aware of what they were studying on with actively involvement in different ways. For instance:

> We were different characters and things in the improvisations. For example; being taps, a part of a machine, seller in a bazaar, jitney driver…We were not only students who were writing. We were role players, students and also sometimes a teacher. We were doing all of these different things related to subject. So, the subject was meaningful for me (Student 2-5).

Being included in the learning process and internalize knowledge fostered understanding. By this way the learning of concepts were facilitated. Active involvement through different ways altered lesson format from boring to meaningful as stated:

> In other lessons; only teachers talk about the subject of the lesson. We only answer the questions if teachers ask something and we write in most part of the lesson. It was boring for me since I could not understand. But in drama lessons, we all shared our ideas about the concepts or other group improvisations. We played games, talked about activities and also wrote letter or our ideas in only one lesson hour. Writing my own ideas to subject was meaningful for me (Student 8-6).

Being active in the learning process provided students asking questions to discover in an investigation way to learning ratio and proportion concepts. Student centered activities of creative drama in the classroom fostered experiential learning. In this section, students' views about active participation through creative drama based activities were mentioned. More specifically, active participation categorized into three sub-categories as (i) "everyone participated" (ii) "participation was directly related to the subject" and (iii) "active participation to subject in variable ways". In general, creative drama based activities provided students communicate and reflect their ideas related to the subject. Also, engaging in quieting activities within and between groups in all phases of the lesson provided being aware of what they were studying on. In the next section, students' views related to group work/ working with friends will be given.

4.3.2. Students' Views about Group Work and Working with Friends

Analysis of students' views showed that working as groups with their friends affected their learning. Generally, they stated that doing the activities with their friends was good and affected their friendship relation in a positive way. When we looked at the students' responses, five students stated that working as groups provided them to share ideas with friends about the subject and understanding the concepts better through working with friends. They stated that they enjoyed participating in the activities with their friends and also, the creative drama based activities helped them to better understand the concepts. They mentioned that if they did not know the answer, their friends helped them to understand the problem context and they felt very comfortable being supported by their friends. For instance; a student mentioned about understanding the concepts better through working with friends as following: "We shared our ideas with our friends to find examples related to ratio and proportion concepts and we thought deeply about that. We listened different ideas and also corrected mistakes. All of these made us understand the concepts better" (Student 7-7).

Similarly,

> I could understand inverse proportion when my friend helped to me. A friend in our group corrected something in our problem and I asked the reason while we were writing problems. We transferred knowledge to each other. I taught my friend something and they taught something to me, too. And I learned the concepts better than teacher directed lecture (Student 1-8).

Parallel to this view another student mentioned that:

> Different groups' improvisations about ratio and proportion concepts presented different daily life examples of these concepts. We saw different aspects of these concepts from different perspectives of our friends. We learned something new from different friends and I understood easier (Student 4-9).

By using the physical and oral representations as a reflection of their past experiences and share these experiences with whole group gave opportunity to incorporate students in a group atmosphere and see other points of view. Another point related to working with friends was mentioned by five students. They stated

that creative drama based instruction provided working in groups with different friends those they usually do not talk or sit by them. Sharing ideas with these different friends affected their friendship relationship positively. All had a chance to know their friends. For instance:

> We had no intimacy with our boyfriends in our classroom. There was a gender grouping in our class. At the first times, we had difficulty while forming the drama circle for holding their hands. But after achieving of forming drama circle and working as a group with our boyfriends, our friendship became more intimate (Student 2-10).

Besides working with different friends, working with friends provided them opportunities for asking help, discussing and sharing ideas with different students. These opportunities made them to be closer with different friends as mentioned in the following student's response:

> We could be in the same groups with friends that I usually do not talk or sit by them. We could work in groups. I could help to them and also they could help to me. I could hold their hands as a friend. I could felt that different friends can also be my close friend (Student 8-11).

Working with friends also enabled them to see their friends in different roles and to understand other points of view. Four students stated they can see the good characteristics of other students by working as a group in activities. For instance; a student stated "Some of our friends were not active in other lessons when our teachers asked a question. In drama activities, we could see that they are smart and funny people" (Student 1-12). Similarly another student stated that "Although, one of our friends is very spoiled person, he improvised the characters very well. He was more relaxed and he was talented for acting. He gave us very valuable ideas when we are in the same group" (Student 5-13).

Moreover, some students' responses revealed that working collaboratively in creative drama based activities require togetherness and respecting to opinions of others while taking decisions. Another point related to working with friends was forgetting about past arguments with their friends. Four students stated that producing something as a group and sharing ideas with friends made them forget

about their past arguments with these friends. For instance; a student stated “I saw that I could work with friends that I do not like much while working with them in the same group” (Student 3-14). Another student stated “Firstly, I did not want to be in the same group with some friends since I had a prior problem with them. On the other hand, in drama activities we could be in the same groups and forgot about our problem” (Student 6-15).

Creative drama not only provided an opportunity for individual development but also created a group dynamic for students. Group dynamic made individuals feel as participant of the process individually and socially. Furthermore, four students realized the positive interdependence and solidarity within groups that was taken as another point related to working with friends. As they said, they had a chance to work collaboratively and feel a member of a group. They stated that they took responsibility for their own studies and shared responsibility of being a group member. The positive interdependence within the groups affected their friendship positively. For instance; a student stated “Nobody scoffed with each other within groups. We decided about ideas as a group” (Student 4-16). Parallel to this view another student mentioned that “We should work together since we were doing improvisations as a group. I could feel that we were group and I was a member of a group” (Student 6-17).

In this section, students’ views related to group work and working with friends were mentioned. More specifically, this relation was categorized into five general categories as (i) understanding the concepts better through working friends (ii) work in groups with different friends (iii) see the good characteristics of other students (iv) forget about their past arguments with their friends (v) positive interdependence. They generally mentioned that discussing the knowledge with friends and then using it to move towards an agreed way of interaction in their performance provided them to learn better. Creative drama based activities consists of activities worked with different friends. They stated that these collaborative activities provided them to be closer with different students. In the next section, students’ views expressing negative aspects of CDBI will be given.

4.3.3. Students' Views Expressing Negative Aspects of CDBI

Analysis of students' views showed that three students stated that there is no negative point of creative drama based activities for them. On the contrary, five students complained about the difficulties related with learning environment. All desks and chairs were moved aside since applying creative drama based instruction in a narrow class is difficult. However, there were some problems related to learning environment. One of the students' sample explanation about difficulties related with learning environment was stated as "One of the negative aspects of drama based instruction is the necessity of a wider place. Our classrooms are not appropriate for these activities since we are a crowded class" (Student 1-18). Similarly, another student mentioned that "Our classroom area was narrow. Therefore, we could not play games for a long time. Regular classroom environment and desks obstructs applying these activities" (Student 6-19).

Moreover, six of the students complained about higher noise levels than in a regular class. Although, all students mentioned about this higher noise levels, the reasons of this noisy environment are consistent with the context and structure of drama based instruction that are mentioned by students. They stated that they were excited in games and talking about the subject. One of the students' response related to higher noise levels than in a regular class was stated as following; "There are lower noise level in other lessons since everyone sits down. In drama based lessons, people were talking within groups to decide about the content of their performance. Also playing games were another reason for higher noise level" (Student 7-20). Parallel to this view another student mentioned that "We get excited while playing games. For instance, we get excited while match playing in physical education lessons. We could make noise since we got excited while playing games. There was higher noise level than regular class" (Student 8-21).

In this section, students' views expressing negative aspects of CDBI were mentioned. Five students complained about the difficulties related with learning environment and six of them complained about higher noise levels than in a regular class. The events in creative drama based instructional classroom were very unusual and even chaotic for them. They stated that moving around in the classroom,

discussing, dancing and exciting in a game are not usual for regular class activities. In the next section, students' views about self-awareness will be mentioned.

4.3.4. Students' Views about Self-awareness

Finally, analysis of students' views showed that creative drama based activities provided self-awareness to students that all, they learned about themselves during the process. Students indicated that they realized their ability to design any creative performance. Eight students mentioned about gaining an awareness of their ability to succeed in mathematics, create or produce something and act. Opportunities to communicate and reflect their own understanding about mathematical concepts enabled them being aware of their potentials of being successful in mathematics. For instance, a student mentioned about this realization process as follows: "I realized that I can solve mathematics problems and I can understand the concepts about mathematics. Therefore, I started to love mathematics" (Student 4-22).

Creative drama experiences provided a wide variety of learning situations for learners by enacting naturally. Also, the following student felt his/her capability of doing mathematics.

> I realized that I can succeed in mathematics. I love mathematics but I was skipping the questions that I could not solve. Also, I was looking at the answer key before I understood the question context. On the other hand, we get our answers by ourselves in drama activities and I realized that we could get our own answers without looking anywhere. Moreover, we investigated the meanings and reasons of the concepts. I realized my potential of being successful in solving mathematics problems (Student 1-23).

Creative drama based activities encourage students to share and listen to experiences in verbal, visual and written ways. Some students mentioned that they realized their ability to create or produce something while they are sharing their experiences in the process. For instance; a student stated that "I realized that I have the ability to create new and different games and improvisations" (Student 3-24).

The students reflected on their experiences by active involvement to activities that provided development of creativity and being aware of their own ideas. Another student mentioned that:

> At first, I thought I could not write anything for the activities or to express my ideas. On the other hand, I thought about our activities also after school. I prepared alternative improvisations in my mind. I realized that I have ability to write and produce some statements for drama. Also, I realized I can write to express my feelings and ideas (Student 7-25).

Moreover, some students noticed their ability to act. For instance; a student stated that "I thought that I could not speak, do improvisations in front of a community and I was not talented about that. Now, I realized I have ability to act" (Student 2-26). Also another student mentioned that "Initially, I could not improvise anything without laughing. Then I get used to take roles in different characters and interpret different situations. As a consequence, I noticed awareness that I am talented to act" (Student 10-27).

Furthermore, another point related to students' views about awareness of themselves was gaining confidence. Nine students mentioned about their feelings during the process and they felt confidence in themselves. They generally stated that learning about themselves provided them to gain confidence about themselves. For instance; a student stated that "I felt confidence in myself since my friends ignored my mistakes and I could correct them without flustered. I felt happy" (Student 4-28).

In creative drama activities everyone was encouraged to be him/herself. Another student mentioned that:

> Initially, it was difficult for me to talk in front of the community. Before that, I could not talk since I had a fear of doing or saying wrong things. But in drama activities, I did not feel any fear to do wrong since we had a chance correction for anything. I can tell my opinions without fear of doing wrong whether my opinions are true or wrong. Now, I feel confidence in myself (Student 1-29).

Working in a nonthreatening environment provided less anxiety about doing wrong. Similarly, another student stated that:

> I am a shy person. On the other, I felt taking role in a theatre scene. For instance, I was a part of a machine and also my friends were part of a machine. We were similar characters in activities. Then, all of us shared ideas. We were equal about that. There was nothing to do wrong or right. Therefore, I could say anything that I thought without hesitation. Consequently, I felt happy myself and confidence in myself about saying my ideas (Student 6-30).

Creative drama based activities encouraged students to express and share their own ideas and feelings. Students gained confidence in communication with others through these encouragement activities as they stated. For instance, one student stated that "I could say my own ideas while preparing our performances. I gained confidence in communication with others" (Student 1-31).

Similarly, the following student mentioned about feeling of confidence to communicate:

> Before that, I was embarrassed while I am speaking with others and I did not like speaking. As I was speaking during the activities in this lesson, I felt that I can communicate with others if I have anything to say (Student 8-32).

In this section, self-awareness provided through creative drama based activities was mentioned. Self awareness was categorized into two categories as (i) gaining awareness of the ability, (ii) feeling confidence. Eight students mentioned about gaining an awareness of their ability to succeed in mathematics, create or produce something and act. Moreover, nine students mentioned that they felt confidence in themselves and communication with others. They generally stated that learning about themselves provided them to gain confidence about themselves. Also, students gained confidence in communication with others through communication opportunities as they generally stated.

In the qualitative part of the analyses students' self-reported views related to creative drama based instruction were examined. More specifically, "Views about

active participation", "Group Work/Working with friends", "Views expressing negative aspects of CDBI" and "Self-awareness were investigated.

Qualitative data analyses showed that students who received creative drama based instruction on ratio and proportion concepts preferred learning mathematical concepts through creative drama. Interviewed students stated that they enjoyed participating in the activities with their friends and creative drama created a positive classroom environment for them. They indicated that all students enjoyed from participating creative drama activities since creative drama improved their social interactions and self-awareness. Also, they stated that creative drama activities increased their curiosity and comprehension toward mathematics with everyday context mathematics and active involvement. Student-student communications provided a non-threatening environment that enabled students an immediate feedback about their understanding. This learning environment made students feel responsible for their studies.

CHAPTER 5

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

The main purpose of the study was to investigate the effect of creative drama based instruction on seventh grade students' achievement in ratio and proportion concepts and attitudes toward mathematics. Another purpose was to investigate students' self reported views related to creative drama based instruction.

In this chapter findings will be summarized and will be discussed in line with the previous research studies. In addition, implications and recommendations for the future research studies will be presented.

5.1. The Effect of Creative Drama Based Instruction on Achievement in Ratio and Proportion Concepts and Attitudes toward Mathematics

In general, mathematics teaching in most classrooms is teacher- centered in Turkey despite constructivist reform movements in Turkish education system in 2003. Traditional instruction does not provide an active learning environment for students, and does not develop necessary skills (Doğan, 2006). In this study, student-centered instruction requiring concretization, participation, co-operation, interaction and communication was used to teach ratio and proportion concepts. The ratio and proportion concepts were taught through creative drama based instruction in the experimental group and with traditional instruction in the control group. The pre-treatment measurements were used to check whether the mean achievement scores of both groups whether statistically significant or different at the beginning of the treatment or not. Pre-treatment measurements were consisting of proportional reasoning test scores developed by Akkuş and Duatepe (2006), achievement in ratio and proportion concepts test scores as pre-test and first and second mathematics exam scores taken from school administration. The pre-treatment measurements showed that the two groups were equivalent at the beginning. Therefore, it was continued to implement the study with these existing groups. Also, students' preRPAT score was used as covariate to control its influence on the dependent

variable in the main analysis. ANCOVA results indicated that students received CDBI had significantly greater achievement in ratio and proportion concepts than students received TI. The statistically calculated large effect size (0.53 for the postRPAT scores) claims the practical significance of this result.

In the literature, there are a number of studies indicating similar results about the effectiveness of creative drama based instruction in the literature (Cantürk-Günhan & Özen, 2010; Duatepe, 2004; Erdoğan, & Baran, 2009; Kariuki & Humphrey, 2006; Omnievski, 1999; Özsoy, 2003; Saab, 1987; Sözer, 2006). These studies showed the effectiveness of creative drama based instruction on understanding of different mathematics concepts. These findings can be interpreted as creative drama based instruction has an impact on students' mathematics achievement. This can be resulted from student centered approach of creative drama based instruction and active involvement into the process rather than passive knowledge transfer (Annarella, 1992; Arieli, 2007; Randall, 1967). Creative drama activities provide actively involvement that let students searching for explanations of abstract concepts and processes, while constructing their own knowledge (Duveen & Solomon, 1994; Steinert, 1993). In this study, analysis of students' views related to creative drama based instruction showed that the interview participants had common views about creative drama based instruction, in the sense that it provided them to learn easily and understand better through active participation. Thus, it could be deduced that active involvement into the process and student centered activities provided by creative drama based instruction related to the subject could be important factors for efficiency of creative drama based instruction in students' achievement in this study. More specifically, creative drama based instruction could be regarded as one of the appropriate instructional approach to improve students' mathematics achievement.

Several reasons may account for the positive effects of creative drama based instruction on achievement. Previous researchers stated that collaborative reasoning and discussion on the proportional everyday situations engage participants in a dialogic process and they can reach more advance levels of understanding about the proportional reasoning strategies (Ben–Chaim et al.,1998; Koellner–Clark & Lesh, 2003; Post et al. 1988b). By this way students mentally gather information with

tasks, discuss about tasks, make reflection and communication to generalize the patterns and relationship (Ellen et al., 2009; Post et al., 1998; Spinillo, 1999). The cognitive potential of collaborative work in creative drama based instruction could be the reason to promote and support reasoning processes by social cognitive interaction.

Creative drama based instruction let students observe relationships with cooperative group working and share, extend and revise their ideas in real-life context (Farris & Parke, 1993; Kelner, 1993; Yeh, 2008). Also, this aproach to instruction provides participants a chance not only share what they know, but an opportunity to demonstrate their ability to think, feel, and imagine about what they know through active participation and collaborative activities (Adıgüzel, 2006; Mason, 2001). Peer discussions that took place in games, in development part while brainstorming and making decisions regarding the content of their performance and in evaluation part, confronted the students with different ideas. Students valued their peers' viewpoints. Thus, it could be deduced that significant difference in achievement in this study was partly attributable to the opportunities for working together provided with creative drama based activities. Findings of the interviews also appear to suggest that working together had a positive effect on their performance. Working in groups provided motivation to learn, sharing ideas with friends about the subject and understanding the concepts better. Also, creative drama based activities helped them to better understand the concepts by helping each other and learning from each other. In other words, the social interaction between the students provided a comfortable learning environment supported by their friends' points of view and help. The construction of knowledge by this social interaction was the result of the atmosphere of acceptance created by creative drama based instruction.

Feedback is crucial a factor in influencing learning in all settings that help students take control of their learning (Nicol & Macfarlane-Dick, 2006).Also, sharing ideas with classroom friends, discuss about the content of the games, improvisations and concepts in the whole process enabled students to receive feedback immediately. External feedback is influential on students' positive or negative feelings about themselves and also on their learning (Dweck, 1999).

Creative drama based activities provided students receive immediate feedback in a non-threatening and authentic environment during the whole process that influenced their learning in a positive way.

Recognizing additive and multiplicative relationships and use them appropriately are the key points to get ratio and proportion concepts (Lo et al. 2004; Verschaffel et al., 1999). Recommendations about these key points focused on providing acquisition of proportional reasoning skills and improving students' conceptual understanding of ratios and proportions (Siegler et al., 2010). Also, classroom tasks should provide opportunities to connect these intuitive origins of ratio and proportion concepts to experiences in the classroom (Lamon, 1993). Ignorance of students' informal strategies and exposing some formulas priority result in superficial understanding of algorithms (Lamon, 1999). Creative drama based instruction provided students with the opportunity to communicate with each other. Communication in the classroom provided students share their implicit ideas explicitly and clarify their intuitive ideas for themselves and for their friends. Having time to communicate the mathematical ideas related to the subject could be an important factor in positive effects of creative drama based instruction on achievement.

Findings of the study also indicated positive effect of the drama based instruction on gained scores of mathematics attitude compared to traditional instruction. The statistically calculated large effect size (0.43 for the gMAS scores) claims the practical significance of this result. Generally, attitudes toward mathematics include level of ability, understanding, liking or disliking mathematics, and interest in mathematics, as well as classroom factors such as the amount of fun in classes, level of difficulty, and the teacher (Clinton-Sullivan, 2008). Most of the students in traditional instruction, listen passively their teachers. Therefore their interest to subject declines in traditional settings. On the other hand, drama based instruction provides active involvement, creating a collaborative study environment, and giving opportunity to students to enjoy from the process. The finding of this study is consistent with the results of other drama based studies (Cantürk-Günhan & Özen, 2010; Kamen, 1992; Özdemir and Üstündağ, 2007; Özsoy, 2003; Sağırlı and Gürdal, 2002; Üstündağ, 1997; Yeh, 2008).

Increase in attitude can be explained by alleviation of threatening situations. In the interviews, some students mentioned that they could say what they wanted and felt very comfortable in the class atmosphere. They implied that all of them had to chance to participate while sharing their ideas. Also, they stated that afraid of making mistakes and to talk was out of the question in this process. Drama based instruction gave students the opportunity to express themselves. Some students interviewed for the aspects of drama based instruction, also mentioned that seeing shy friends while talking in a relaxed mood was amazing. Besides advantages for shy children, more outgoing students became aware of the need to work cooperatively. They mentioned that helping and teaching each other provided them to show a greater degree of responsibility for their own learning. Each member has responsibility for the whole team (Duveen & Solomon, 1994; Kentish, 1995).They mentioned about feeling positive interdependence between the group members. When students are given the opportunity to communicate their own conceptions and understanding, they are not only motivated but also take charge of their own process of learning (Hiebert et al., 1997). Besides opportunity to communicate, tasks in drama based instruction attracted students' understanding toward concepts of lesson through actively involvement to process and lead to open-minded attitude. Also, creative drama based instructional activities provided students to internalize of concepts through an increasing interest and engagement to lesson.

Exciting, enjoyable and interesting classroom environment could be another reason for the positive effect on attitude towards mathematics. Students indicated that they get excited while playing games and showing their performance. This excitement for the process provided them actively involvement to the activities and so to the subject. Students stated that they enjoyed participating in creative drama based activities. Also, enjoyment and excitement from the activities could be observed during the process. All students showed enthusiasm while doing activities. All students were eager to participate in creative drama based activities and expressed that they were having fun while learning and working together. This result was supported by Freeman (2000) and Kamen (1992) where in their studies; students indicated their ideas about drama based instruction by positive statements like fun, interesting and enjoyable. During the drama based instruction, students work with

their friends while dealing with mathematical concepts. Opportunity to explain their own ideas without teacher inhibition could be the reason of influence on their attitude toward mathematics. Benefits gained from group work and working with friends was another indicated idea by interviewed students. Students had a chance to communicate with their classmates in a relaxed, positive and friendly atmosphere during the process. Being included and accepted by different friends with no peer pressure make students close to each other and created a positive classroom environment. Moreover, students did not use classical methods to learn ratio and proportion concepts; they learned these concepts by drama activities which was new for them. This new method could draw their attention to the mathematical concepts. Everyday context of drama based activities created a new way of looking and learning the mathematical concepts that students studied before. All of these were likely to facilitate experimental group students' relatively better understanding of the concepts taught than their control group counterparts.

Creative drama has the potential to change how the child thinks about themselves that brings children self confidence (Farris & Parke, 1993; Yassa, 1999). The aim is to allow students see themselves in a different way by enabling to express ideas without fear of making mistakes (Yassa, 1999). Non-threatening and authentic environment of drama based instruction provide students feeling confidence in themselves and in communication with others (Yeh, 2008). Most of the interviewed students indicated that they realized their potentials of being successful in mathematics, ability to act and produce or create something new. Also, they mentioned that they felt confidence in themselves and in communication with others. Thus, it can be inferred that feelings and efficacy beliefs about themselves could influence students' attitudes toward mathematics.

All of these results revealed that creative drama based instruction could be regarded as one of the appropriate instructional approaches to affect students' mathematics achievement in ratio and proportion concepts and attitude toward mathematics in a positive way. Also, students' self reported views related to the creative drama based instruction were positive. Therefore, as mentioned above students' positive attitudes toward mathematics and positive self reported views related to creative drama based instruction could also have an effect on difference in

achievement in ratio and proportion concepts between experimental and control group.

5.2. Implications and Recommendations

This study mainly focused on the effects of creative drama based instruction compared to traditional instruction on seventh grade students' achievement in ratio and proportion concepts and gain score of attitudes toward mathematics. In addition, it emphasized students' self-reported views related to creative drama based instruction. Based on the analysis of the data, some recommendation for further research studies can be proposed.

This study analyzed the only data collected from 7^{th} grade students in a public school. A similar study might be conducted with different grade levels and school types. Also, it is recommended that the study can be replicated with other samples selected randomly to generalize the results over a wider population.

Further researches can be conducted in longer period including more lesson plans about different wider concepts affecting the reliability and validity of the study. Moreover, achievement in ratio and proportion test can be applied to examine the retention effect in further studies. In addition, this study might be conducted with classroom teachers instructing not with researcher to determine whether creative drama based instruction has an effect on students' achievement regardless of the implementer.

It is also recommended that replication of this study can be conducted with class that has smaller number of students or by separating the experimental group into two groups to provide easiness to control the students. Besides, considering the difficulty of applying creative drama based instruction in a narrow class although all desks and chairs were moved aside, it would be better to arrange drama based instruction in a wider place with carpet. Although this study was applied with an initial period for introduction creative drama activities to provide an environment for thrust and cooperation, this initial time was only two lesson hour that is not enough. Therefore, a longer initial period for introduction creative drama activities should be arranged in the replication of the study.

Finally, there are some implications for mathematics teachers, mathematics teacher educators, and curriculum developers. The results revealed that ratio and

proportion topics can be taught effectively and efficiently by carefully developed creative drama based lesson plans. Therefore, mathematics teachers and mathematics teacher educator should be informed and instructed about the creative drama based instruction. In other words, in-service training related with creative drama based instruction should be provided for mathematics teachers and also for other teachers. Also, pre-service teachers should be informed about advantages of creative drama based instruction in order to make mathematics teachers more sufficient in this context. In addition, courses related with creative drama based instruction in mathematics for pre-service teachers should be offered to gain them knowledge and skills for preparing appropriate creative drama based lesson plans and implementation of creative drama based lessons. Besides, school administrators and parents should be informed about the benefits of the creative drama based instruction and multiple dimensions of the drama based instruction. In this manner, school administrators and parents can be helpful to implement creative drama based lessons without fear of examinations and solving too much questions.

Based on the findings of this study and based on the dimensions of the creative drama based instruction, it can be suggested that the teachers should provide a meaningful learning environment for their students in which they would provide connections between mathematical concepts and everyday context. The teachers should emphasize every student's communication and participation in each lesson and they should encourage students to explain their ideas, discuss, and work collaboratively. In addition, the teachers should give meaningful tasks that give opportunity to actively participate to concept. Also, teacher should be facilitator or guide for the lesson process instead of exposing students to a passive knowledge transfer.

Moreover, this study revealed that drama based activities could be used as an instructional activities in mathematics classes to improve students' achievement and learning more meaningfully. Therefore, the use of creative drama based instruction activities can be in variety of lessons although creative drama based activities are included in the new curricula.

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APPENDICES

APPENDIX A

Orantısal Akıl Yürütme Beceri Testi

Bu test öğrencilerin orantısal- akıl yürütme becerileri hakkında bilgi edinmek için hazırlanmıştır. Testin sonuçları sadece bilimsel bilgi edinmek amacıyla kullanılacaktır. Herhangi bir şekilde not ile değerlendirme amacıyla kullanılmayacaktır.
Katkılarınız için teşekkür ederim.

I. Kişisel bilgiler
1) Adı Soyadı:
2) Cinsiyetiniz: ( ) E ( ) K

3) Sınıfınız:

3) Matematik başarınız hangi seviyededir?
(Matematik dersinden aldığınız notları düşünerek aşağıda size en uygun olan sayıyı yuvarlak içine alınız.)
0…5…10…15…20…25…30…35…40…45…50…55…60…65…70…75…80…85…90…95…100

II. Lütfen aşağıdaki problemlerde çözümlerinizi boş bırakılan yerlere ayrıntılı bir şekilde yazınız.

1) Burak ile Türker aynı hızda araba kullanmaktadır. Burak 3 dakikada 6 km yol alırsa, Türker 18 km'lik yolu kaç dakikada alır?

2) Kısa Bey'in Uzun Bey adında bir arkadaşı vardır. Kısa Bey'in ataç ile uzunluğu ölçüldüğünde 6 ataç boyunda olduğu görülmüştür. Uzun Bey ve Kısa Bey'in boyları düğme ile ölçüldüğünde, Uzun Bey'in 6, Kısa Bey'in 4 düğme uzunluğunda olduğu bulunmuştur. Buna göre Uzun Bey'in boyu kaç ataç uzunluğundadır?

Bir hayvanat bahçesinin havuzunda boy uzunlukları 10 (A), 15 (B) ve 25 (C) cm olan üç tane yılanbalığı bulunmaktadır. Bu yılanbalıkları boy uzunlukları ile doğru orantılı olarak beslenmektedirler. Buna göre;

3) Eğer A yılanbalığı 2 adet yem ile beslenirse, C yılanbalığına kaç adet yem verilmelidir?

4) Eğer B yılanbalığı 9 adet yem ile beslenirse, C yılanbalığına kaç adet yem verilmelidir?

5) Eğer C yılanbalığı 10 adet yem ile beslenirse;

- A yılanbalığına kaç adet yem verilmelidir?

- B yılanbalığına kaç adet yem verilmelidir?

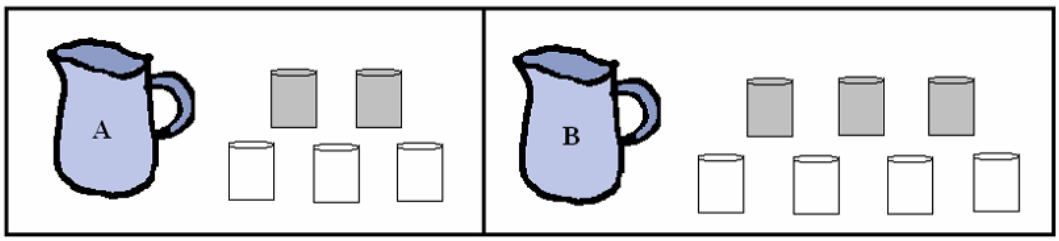
6) 300 km yolu 4 saatte alan bir otomobil, aynı hızla giderse 750 km' lik yolu kaç saatte alır?

7) Mert ile Mine aynı hızla çalışarak bir duvarı 10 günde boyamaktadırlar. Aralarına aynı hızda çalışan 3 kişi daha katıldığında, aynı duvar kaç günde boyanır?

8) Nesrin ile Başak bir koşu parkurunda koşmaktadırlar. Nesrin 8 turu 32 dakikada koşarken, Başak 2 turu 10 dakikada koşmaktadır. Buna göre hangisi daha hızlı koşmaktadır? Açıklayınız.

9) Bir lokantada aynı boyda pideler üretilmektedir. Bu lokantada yemek yiyen 7 kız 3 pideyi paylaşırken, 3 erkek ise 1 pideyi paylaşmaktadırlar. Bu lokantada 1 kız başına düşen pide miktarı mı, 1 erkek başına düşen pide miktarı mı daha fazladır? Açıklayınız.

10)



Yukarıdaki şekilde görülen A ve B sürahilerinde portakal suyu yapılmaktadır. Koyu renkli bardaklarda portakal suyu konsantresi, açık renkli bardaklarda ise su vardır. Şekilde görüldüğü gibi A sürahisine 2 bardak portakal suyu konsantresi ve 3 bardak su, B sürahisine ise 3 bardak portakal suyu konsantresi ve 4 bardak su konulmuştur. Buna göre hangi sürahideki portakal suyu daha tatlıdır? Açıklayınız.

11) Umut bugün, dün koştuğundan daha çok zamanda daha az tur koşmuştur. Buna göre,

Umut'un bugünkü koşusu dünküne göre;

a) Hızlıdır b) Yavaştır c) Aynıdır d) Verilen bilgiler yetersizdir.

Hangi seçeneğin doğru olduğunu açıklayarak yazınız.

12) Tufan sabah kahvaltısındaki çayını, dünküne göre daha büyük bardakta, daha az sayıda şeker atarak içmiştir. Bu çayın tadı dünkü çayın tadına göre;

a) Daha tatlıdır b) Daha tatsızdır c) Aynıdır d) Verilen bilgiler yetersizdir

Hangi seçeneğin doğru olduğunu açıklayarak yazınız.

13) Bir koşu parkurunda Elif, Emel'den daha kısa zamanda daha çok tur koşmuştur. Hangisi daha hızlı koşucudur? Açıklayarak yazınız.

14) Sena ile Gökalp farklı arazilere belli aralıklarla ağaç dikmektedirler. Sena, Gökalp'e göre daha küçük bir araziye, daha çok ağaç dikmektedir. Buna göre kimin arazisindekiNağaçlar birbirine daha yakındır?

a) Sena b) Gökalp c) Yakınlıkları eşittir d) Verilen bilgiler yetersizdir

Hangi seçeneğin doğru olduğunu açıklayarak yazınız.

15) Nevzatcan ile Nergis'in bir parkurdaki yürüme hızları aynıdır. Yürümeye önce Nevzatcan başlamıştır. Nevzatcan 9 turu tamamladığında, Nergis 3 turu tamamlamışsa; Nergis 15 turu tamamladığında Nevzatcan kaç turu tamamlamış olur? Açıklayarak yazınız.

APPENDIX B

RUBRIC for PRT

Orantısal Akıl Yürütme Beceri Testi Dereceli Puanlama Anahtarı

BİRİNCİ KISIM (1, 2, 3, 4, 5, 6 ve 7 numaralı sorular için)

(Testteki verilmeyen değeri bulma ve ters orantı ile ilgili maddeler ve bu maddelere ilişkin kullanılan dereceli puanlama anahtarı)

0 PUAN

- Boş
- Orantısal akıl yürümenin var olduğuna ilişkin ipucu yok
- Verilerin toplamsal karşılaştırılması var
- Verilerin sayıların ve işlemlerin rastgele kullanımı var

1 PUAN

- Sadece sonuç belirtilmiş
- Orantısal akıl yürütmenin var olduğuna ilişkin ipuçları var (Yanlış değişkenler arasında orantı kurma, görsel verileri kullanarak orantı kurma gibi)
- Orantı çeşidi fark edilmemiş

2 PUAN

- Beklenen değişkenler arasında orantısal akıl yürütme var, ancak sonuca ulaşılamamış
- Beklenen değişkenler arasında orantısal akıl yürütme var, ancak işlem hataları yapılmış

3 PUAN

- Soruyu tam ve doğru çözebilmek için gereken orantısal akıl yürütme var ve sonuca ulaşılmış

İKİNCİ KISIM (8, 9 ve 10 numaralı sorular için)

(Testteki niceliksel karşılaştırma ile ilgili maddeler ve bu maddelere ilişkin kullanılan dereceli puanlama anahtarı)

0 PUAN

- Boş
- Sadece sonuç belirtilmiş
- Yanlış değişkenler arasında orantı kurulmuş
- Orantısal akıl yürütmenin var olduğuna ilişkin ipucu yok
- Verilerin toplamsal karşılaştırılması var
- Verilerin sayıların ve işlemlerin rastgele kullanımı var

1 PUAN

- Beklenen değişkenler arasında orantısal akıl yürütme becerisini kullanarak ya da kullanmayarak, doğru sonuca ulaşılmış, ancak yanlış yorumlanmış
- Doğru yanıt verilmiş ancak açıklama yetersiz

2 PUAN

- Beklenen değişkenler arasında orantısal akıl yürütme becerisine sahip olunduğu gösterilmiş, doğru sonuca ulaşılmış, ancak yapılan açıklama yetersiz

3 PUAN

- Beklenen değişkenler arasında orantısal akıl yürütme becerisi var, ancak işlem hatası nedeniyle doğru sonuca ulaşılamamış
- Doğru sonuca ulaşmamış olsa de bulunan sonuca göre yapılan doğru yorumlanmış

4 PUAN

- Doğru sonuca ulaşmak için gerekli orantısal akıl yürütme becerisi iyi düzeyde gösterilmiş ve doğru açıklama yapılmış

ÜÇÜNCÜ KISIM (11, 12, 13, 14 ve 15 numaralı sorular için)

(Testteki niteliksel karşılaştırma ile ilgili maddeler ve bu maddelere ilişkin kullaılan dereceli puanlama anahtarı)

0 PUAN

- Boş
- Orantısal akıl yürütmenin var olduğuna ilişkin ipucu yok
- Sadece doğru yanıt işaretlenmiş, açıklama yok

1 PUAN

- Soruda bulunan verilerden sadece biri kullanılarak sonuca ulaşılmış ve doğru yanıt işaretlenmiş

2 PUAN

- Doğru yanıt işaretlenmiş, soruda bulunan verilerden ikisi de kullanılarak yanlış ya da eksik açıklama yapılmış

3 PUAN

- Beklenen doğru yanıt bulunmuş, açıklama soru kökündeki ifadeler kullanılarak yapılmış

4 PUAN

- Beklenen doğru yanıt bulunmuş, açıklama soru kökündeki ifadeler kullanılarak değil, özgün tümcelerler yapılmış, açıklamalar şekil oluşturma, çizim yapma, örnek verme gibi yöntemlerle zenginleştirilmiş

APPENDIX C

THE ORINIGAL FORMS OF ACHIEVEMENT TESTS

Oran Orantı Başarı Testi

Bu test öğrencilerin oran orantı başarıları hakkında bilgi edinmek için hazırlanmıştır. Test 16 sorudan oluşmaktadır. Bazı sorular bir ya da birkaç alt soru içermektedir. Bazıları ise açıklama yapmanızı istemektedir. Sorulardaki alt sorulara verilecek cevaplara ve yapacağınız açıklamalara karşılık gelen puan değerleri bulunmaktadır. Testin sonuçları sadece bilimsel bilgi edinmek amacıyla kullanılacaktır. Herhangi bir şekilde not ile değerlendirme amacıyla kullanılmayacaktır.

I. Kişisel bilgiler

1) Adı Soyadı:

2) Cinsiyetiniz: ( ) E ( ) K

3) Sınıfınız:

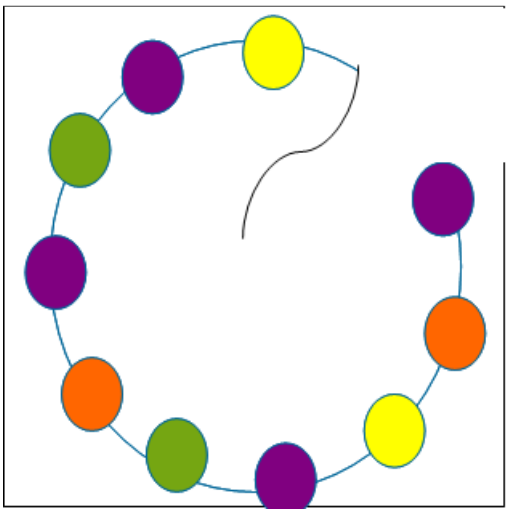
3) Matematik başarınız hangi seviyededir?

(Matematik dersinden aldığınız notları düşünerek aşağıda size en uygun olan sayıyı yuvarlak içine alınız.)

0…5…10…15…20…25…30…35…40…45…50…55…60…65…70…75…80…85…90…95…100

SORULAR (ÖN TEST)

1) Aşağıda verilen boşlukları cümlede istenileni sağlayacak şekilde doldurunuz.



Şekilde gördüğünüz kolyede **turuncu boncukların yeşil boncuklara oranının 4:3** olmasını istiyorsunuz. Buna göre kolyeye ……turuncu……yeşil boncuk daha eklemelisiniz.

2) Futbolda bir takımın maçı kazanabilmesi için, atılan golün yenilen golden fazla olması gerekir. Bu ifadede yer alan atılan gol ile yenilen gol arasındaki ilişki orantı belirtir mi? Açıklayınız.

3)

MİNİK PEDALLAR YARIŞIYOR !!

23 NİSAN MİNİKLER BİSİKLET YARIŞMASI

Başvuru formu

Adı: Mustafa

Soyadı: Deniz

(Bisikletinizin fotoğrafını boşluk kalmayacak ve yer artmayacak şekilde aşağıdaki yere yapıştırınız.

6 cm

9 cm

Mustafa yarışmaya katılmak için başvuru formunu doldurmuştur.

Mustafa'nın bisikletinin fotoğrafını küçültmek için kullandığı ölçeği yazınız.

12 cm

18cm

4) Bahçenizi aşağıdaki gibi bölümlere ayırdınız. Her bir bölümde 1.sıradaki tohum sayılarıyla 2.sıradaki tohum sayılarını oranlı bir şekilde düzenlediniz.

	A	B	C	D
1.sıra				
2.sıra				

A bölümünde 1. sıraya 2 çiçek tohumu

2. sıraya 3 çiçek tohumu

B bölümünde 1.sıraya 4 çiçek tohumu

C bölümünde 2.sıraya 9 çiçek tohumu

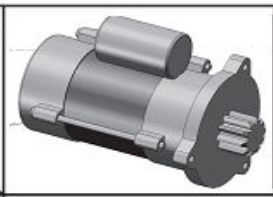
D bölümünde ilk sıraya 10 çiçek tohumu ektiniz.

a- Boş kalan sıralardaki tohum sayılarını A bölümündeki 1. sıradaki tohum sayılarıyla 2. sıradaki tohum sayıları arasındaki oranı dikkate alarak bulunuz.

b- Bahçenizi düzenlerken bölümler arasında dikkate aldığınız 1. sıradaki tohum sayılarıyla 2. sıradaki tohum sayıları arasındaki ilişkiyi açıklayınız.

5)

Tablo: Bir Makinenin Farklı Modellerinin Özellikleri

MODELLER / ÖZELLİKLER			
Boy (cm)	60	30	20
Maliyet (bin TL)	1	2	3
Kütle (kg)	6	3	2
Dayanıklılık (yıl)	2	4	6

Bir fabrikada üretilen bir makinenin farklı modellerine ait veriler yukarıda tabloda gösterilmektedir.

Buna göre aşağıda verilen özellikler arasındaki ilişkiyi belirlemek için doğru ya da ters orantı seçeneklerinden birini işaretleyiniz. Nedenini belirtiniz.

	Doğru orantı	**Ters Orantı**	**Neden?**
Kütle ve Boy			
Dayanıklılık ve Maliyet			

6)

a) Canan ve Göksu gazete ilanlarından, bilgisayarın dolar ile satıldığını öğrenirler. Canan dolar kurunun düşmesi durumunda bilgisayar fiyatının da düşeceğini söyler. Göksu ise bu fikre katılmaz. Sizce kim haklıdır? Nedenini açıklayınız.

b) Işıl hafta sonu bisiklet ile dedesini ziyarete gider. Normal süratle gittiği zaman yol 20 dakika, süratli gittiği zaman 10 dakika sürmektedir. Hız ve zaman arasındaki ilişkiyi açıklayınız.

c) Dağcılar tırmanışlarında oksijen tüpüne ihtiyaç duyarlar. Bunun sebebi, yeryüzünde yükseklere çıkıldıkça havadaki oksijen miktarının azalmasıdır. Yükseklik ile oksijen miktarı arasındaki ilişki, orantı çeşitlerinden hangisi ile açıklanabilir?

7)

a) Aşağıdaki izci gruplarından birine katılan izcilerden biri sizsiniz. Tercihinizi daha çok pizza yiyebileceğiniz grubu dikkate alarak yaptığınıza göre hangi izci grubunda yer almaktasınızdır? Cevabınızı ve nedenini açıklayınız?

Turuncu İzci Grubu

5 izci için 3 pizza ısmarladılar. (Herkese eşit büyüklükte paylaştırılmıştır)

Yeşil İzci Grubu

3 izci için 2 pizza ısmarladılar. (Herkese eşit büyüklükte paylaştırılmıştır)

b) Yolda kalan Emrah'ın motosikletinin deposundaki yağ-benzin karışımı bitmiştir.

Bu motosikletin hareket edebilmesi için deposunda yağ ile benzinin 1:7 oranında karıştırılması gerekmektedir.

Emrah 'ın yolda kalan motosikletinin hareket edebilmesi için getirdiği 24' lik karışımın ..... L'si benzin, ... L'si yağ olmalıdır. (Boşlukları doldurunuz. Yaptığınız hesaplamaları aşağıda belirtiniz)

8)

Dağcılar, yanlarına tırmanış sırasında kullanacakları araçları ve yiyeceklerini alırlar.
Siz de ilk dağcılık deneyiminizi yaşamak için fotoğrafta verilen bilgiye göre çantanızı hazırlanıyorsunuz. Çantanızda 20 kg'lık araç bulunuyor ve yanınıza 5 kg'lık yiyecek aldınız.
Belirtilen orana göre bu yiyecek miktarı yeterli midir? Cevabınızı ve nedenini açıklayınız.

9) Bir bilgi yarışmasında, sorulan bir soruya belirli bir süre içinde doğru cevap veren izleyicilere toplam 24 000 TL ödül verilecektir.

i) Birden fazla izleyicinin doğru cevap vermesi durumunda ise ödül paylaştırılacaktır. Buna göre aşağıdaki tabloyu tamamlayınız.

Doğru cevap veren izleyici sayısı	Bir kişinin alacağı ödül
1	12 000
2	6 000
....	
....	
....	
....	

ii) Doğru cevap veren izleyici sayısı ile bir kişinin alacağı ödül arasında nasıl bir ilişki vardır? Açıklayınız.

iii)

Deniz'in hayalindeki Carbon Profesyonel Yarış Bisikleti

Deniz hayalindeki bisikleti alabilmek için gerekli olan parayı kazanabileceğini düşünerek yukarıda bahsedilen bilgi yarışmasına katılır.

Belirli süre içerisinde onunla birlikte toplam 5 kişi sorulan soruya doğru cevap vermiştir.

Deniz'in kazandığı ödül bisikleti satın almaya yetecek midir? Cevabınızı ve cevabınızın nedenini açıklayınız.

10)

a) Aşağıdaki sayıları kullanarak doğru orantı ile ilişkilendirebileceğiniz bir problem kurunuz.

3 90 450

b) Aşağıdaki sayıları kullanarak ters orantı ile ilişkilendirebileceğiniz bir problem kurunuz.

4 9 36

11) Şeker kavanozunda 12 kırmızı, 18 sarı, 16 mavi, 20 yeşil şekerleme vardır. Kavanozdaki kırmızı şekerlerin yeşil şekerlerin sayısına oranının 2: 3 olmasını isteyen Ali kavanozdan en az kaç yeşil şeker yemelidir?

12) Bir evin maketinin ölçeği 1:35 tir. Maket evin kapısının uzunluğu 5 cm olduğuna göre gerçek evin kapı uzunluğu kaç cm'dir ?

13)

$\frac{a}{6} = \frac{6}{9}$ orantısında a kaçtır?

14)

a- Şenay'ın arabası 240 km'de 20 L yakıt, Erkan'ın arabası ise 180 km'de 12 L yakıt tüketmektedir. İkisi birlikte bir geziye gitmeye karar verirler. Tek bir araba ile gideceklerdir. Hangi araba daha ekonomiktir? Cevabınızı nedenini açıklayarak yazınız.

b- Elif hazırlayacağı limonatanın tarifinde karışımdaki suyun limon suyuna oranının 4:1 olması gerektiğini okudu. Okul balosu için hazırlayacakları 25 litre limonatanın kaç litresi limon suyudur?

15) Bir sınıfta satranç oynamayı bilenlerin sayısının bilmeyenlerin sayısına oranı 1 : 4 tür. Bu sınıfta 8 öğrenci satranç bildiğine göre satranç oynamasını bilmeyenlerin sayısını bulunuz.

16) Eş güçteki 3 arkadaş bir duvarı aynı hızla çalışarak 8 saatte boyamaktadırlar. Aralarına aynı hızda çalışan 1 kişi daha katıldığında aynı duvar kaç saatte boyanır?

Sorular bitmiştir, katılımınız için teşekkürler.

Post Test:

Oran Orantı Başarı Testi

Bu test öğrencilerin oran orantı başarıları hakkında bilgi edinmek için hazırlanmıştır. Test 16 sorudan oluşmaktadır. Bazı sorular bir ya da birkaç alt soru içermektedir. Bazıları ise açıklama yapmanızı istemektedir. Sorulardaki alt sorulara verilecek cevaplara ve yapacağınız açıklamalara karşılık gelen puan değerleri bulunmaktadır. Testin sonuçları sadece bilimsel bilgi edinmek amacıyla kullanılacaktır. Herhangi bir şekilde not ile değerlendirme amacıyla kullanılmayacaktır.

I. Kişisel bilgiler

1) Adı Soyadı:

2) Cinsiyetiniz: ( ) E ( ) K

3) Sınıfınız:

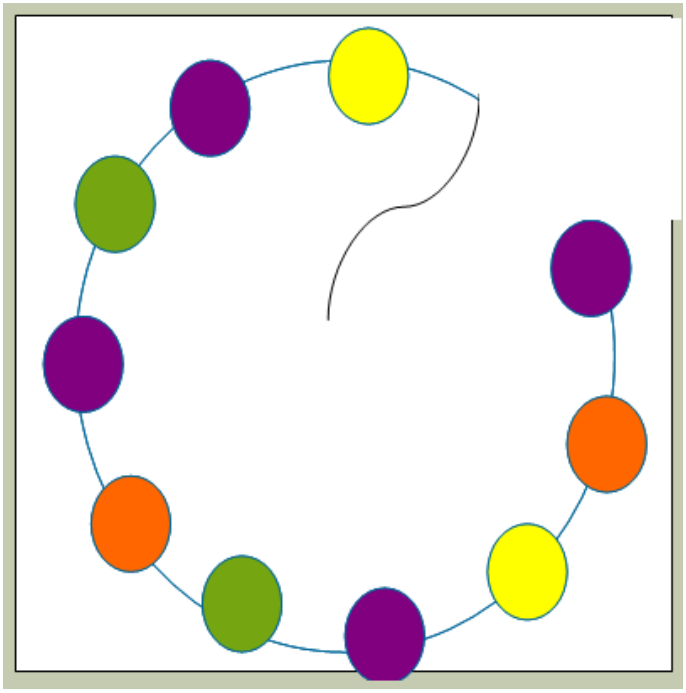
3) Matematik başarınız hangi seviyededir?

(Matematik dersinden aldığınız notları düşünerek aşağıda size en uygun olan sayıyı yuvarlak içine alınız.)

0…5…10…15…20…25…30…35…40…45…50…55…60…65…70…75…80…85…90…95…100

SORULAR (SON TEST)

1) Aşağıda verilen boşlukları cümlede istenileni sağlayacak şekilde doldurunuz.



Şekilde gördüğünüz kolyede **mor boncukların sarı boncuklara oranının 5:3** olmasını istiyorsunuz. Buna göre kolyeye ……mor……sarı boncuk daha eklemelisiniz.

2) Futbolda bir takımın maçı kazanabilmesi için, atılan golün yenilen golden fazla olması gerekir. Bu ifadede yer alan atılan gol ile yenilen gol arasındaki ilişki orantı belirtir mi? Açıklayınız.

3)

MİNİK PEDALLAR YARIŞIYOR !!

23 NİSAN MİNİKLER BİSİKLET YARIŞMASI

Başvuru formu

Adı: Mustafa

Soyadı: Deniz

(Bisikletinizin fotoğrafını boşluk kalmayacak ve yer artmayacak şekilde aşağıdaki yere yapıştırınız.

4 cm

6 cm

Mustafa yarışmaya katılmak için başvuru formunu doldurmuştur.

Mustafa'nın bisikletinin fotoğrafını küçültmek için kullandığı ölçeği yazınız.

12

18cm

4) Bahçenizi aşağıdaki gibi bölümlere ayırdınız. Her bir bölümde 1.sıradaki tohum sayılarıyla 2.sıradaki tohum sayılarını oranlı bir şekilde düzenlediniz.

	A	B	C	D
1.sıra	3			
2.sıra	4			

A bölümünde 1. sıraya 3 çiçek tohumu

2. sıraya 4 çiçek tohumu

B bölümünde 1.sıraya 6 çiçek tohumu

C bölümünde 2.sıraya 12 çiçek tohumu

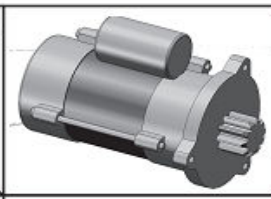
D bölümünde ilk sıraya 15 çiçek tohumu ektiniz.

a- Boş kalan sıralardaki tohum sayılarını A bölümündeki 1.sıradaki tohum sayılarıyla 2. Sıradaki tohum sayıları arasındaki oranı dikkate alarak bulunuz.

b- Bahçenizi düzenlerken bölümler arasında dikkate aldığınız 1. sıradaki tohum sayılarıyla 2. sıradaki tohum sayıları arasındaki ilişkiyi açıklayınız.

5)

Tablo: Bir Makinenin Farklı Modellerinin Özellikleri

MODELLER / ÖZELLİKLER			
Boy (cm)	60	30	20
Maliyet (bin TL)	1	2	3
Kütle (kg)	6	3	2
Dayanıklılık (yıl)	2	4	6

Bir fabrikada üretilen bir makinenin farklı modellerine ait veriler yukarıda tabloda gösterilmektedir.

Buna göre aşağıda verilen özellikler arasındaki ilişkiyi belirlemek için doğru ya da ters orantı seçeneklerinden birini işaretleyiniz. Nedenini belirtiniz.

	Doğru orantı	**Ters Orantı**	**Neden?**
Boy ve kütle			
Maliyet ve dayanıklık			

6)

a) Canan ve Göksu gazete ilanlarından, bilgisayarın dolar ile satıldığını öğrenirler. Canan dolar kurunun düşmesi durumunda bilgisayar fiyatının da düşeceğini söyler. Göksu ise bu fikre katılmaz. Sizce kim haklıdır? Nedenini açıklayınız.

b) Işıl hafta sonu bisiklet ile dedesini ziyarete gider. Normal süratle gittiği zaman yol 20 dakika, süratli gittiği zaman 10 dakika sürmektedir. Hız ve zaman arasındaki ilişkiyi açıklayınız.

c) Dağcılar tırmanışlarında oksijen tüpüne ihtiyaç duyarlar. Bunun sebebi, yeryüzünde yükseklere çıkıldıkça havadaki oksijen miktarının azalmasıdır. Yükseklik ile oksijen miktarı arasındaki ilişki, orantı çeşitlerinden hangisi ile açıklanabilir?

7)

a) Aşağıdaki izci gruplarından birine katılan bir izcisiniz. Tercihinizi daha çok pizza yiyebileceğiniz grubu dikkate alarak yaptığınıza göre hangi izci grubunda yer almaktasınızdır? Cevabınızı ve nedenini açıklayınız?

Mor İzci Grubu
7 izci için 3 pizza ısmarladılar. (Herkese eşit büyüklükte paylaştırılmıştır)

Sarı İzci Grubu
3 izci için 1 pizza ısmarladılar. (Herkese eşit büyüklükte paylaştırılmıştır)

b) Yolda kalan Emrah'ın motosikletinin deposundaki yağ-benzin karışımı bitmiştir.

Bu motosikletin hareket edebilmesi için deposunda yağ ile benzinin 1:8 oranında karıştırılması gerekmektedir.

Emrah 'ın yolda kalan motosikletinin hareket edebilmesi için getirdiği 27' lik karışımın ..... L'si benzin, ... L'si yağ olmalıdır. (Boşlukları doldurunuz. Yaptığınız hesaplamaları aşağıda belirtiniz).

8)

Dağcılar, yanlarına tırmanış sırasında kullanacakları araçları ve yiyeceklerini alırlar.
Siz de ilk dağcılık deneyiminizi yaşamak için fotoğrafta verilen bilgiye göre çantanızı hazırlanıyorsunuz.
Çantanızda 30 kg'lık araç bulunuyor ve yanınıza 7 kg'lık yiyecek aldınız.
Belirtilen orana göre bu yiyecek miktarı yeterli midir? Cevabınızı ve nedenini açıklayınız.

9) Bir bilgi yarışmasında, sorulan bir soruya belirli bir süre içinde doğru cevap veren izleyicilere toplam 24 000 TL ödül verilecektir.

iii) Birden fazla izleyicinin doğru cevap vermesi durumunda ise ödül paylaştırılacaktır. Buna göre aşağıdaki tabloyu tamamlayınız.

Doğru cevap veren izleyici sayısı	Bir kişinin alacağı ödül
1	24 000
2	12 000
....	
....	
....	
....	

iv) Doğru cevap veren izleyici sayısı ile bir kişinin alacağı ödül arasında nasıl bir ilişki vardır? Açıklayınız.

iii)

Deniz'in hayalindeki Carbon Profesyonel Yarış Bisikleti

Deniz hayalindeki bisikleti alabilmek için gerekli olan parayı kazanabileceğini düşünerek yukarıda bahsedilen bilgi yarışmasına katılır. Belirli süre içerisinde onunla birlikte toplam 5 kişi sorulan soruya doğru cevap vermiştir. Deniz'in kazandığı ödül bisikleti satın almaya yetecek midir? Cevabınızı ve cevabınızın nedenini açıklayınız.

10)

a) Aşağıdaki sayıları kullanarak doğru orantı ile ilişkilendirebileceğiniz bir problem kurunuz.

3 90 450

b) Aşağıdaki sayıları kullanarak ters orantı ile ilişkilendirebileceğiniz bir problem kurunuz.

4 9 36

11) Şeker kavanozunda 12 kırmızı, 18 sarı, 16 mavi, 20 yeşil şekerleme vardır. Kavanozdaki sarı şekerlerin yeşil şekerlerin sayısına oranının 3: 5 olmasını isteyen Ali kavanoza en az kaç yeşil şeker koymalıdır?

12) Bir evin maketinin ölçeği 1:45 tir. Maket evin kapısının uzunluğu 4 cm olduğuna göre gerçek evin kapı uzunluğu kaç cm'dir?

13)

$\frac{a}{6} = \frac{3}{2}$ orantısında a kaçtır?

14)

a- Şenay'ın arabası 280 km'de 20 L yakıt, Erkan'ın arabası ise 180 km'de 12 L yakıt tüketmektedir. İkisi birlikte bir geziye gitmeye karar verirler. Tek bir araba ile gideceklerdir. Hangi araba daha ekonomiktir? Cevabınızı nedenini açıklayarak yazınız.

b- Elif hazırlayacağı limonatanın tarifinde karışımdaki suyun limon suyuna oranının 4:1 olması gerektiğini okudu. Okul balosu için hazırlayacakları 25 litre limonatanın kaç litresi limon suyudur?

15) Bir sınıfta satranç oynamayı bilenlerin sayısının bilmeyenlerin sayısına oranı 1:5 tir. Bu sınıfta 5 öğrenci satranç bildiğine göre satranç oynamasını bilmeyenlerin sayısını bulunuz.

16) Eş güçteki 4 arkadaş bir duvarı aynı hızla çalışarak 5 saatte boyamaktadırlar. Aralarına aynı hızda çalışan 1 kişi daha katıldığında aynı duvar kaç saatte boyanır?

Sorular bitmiştir, katılımınız için teşekkürler.

APPENDIX D

RUBRIC for RPAT

Oran Orantı Başarı Testi Dereceli Puanlama Anahtarı

Soru	Puan	
	0	1
1 4a 6c 13	• Boş • Soruya yanlış cevap verilmiş • Verilerin toplamsal karşılaştırılması var • Verilerin, sayıların rastgele kullanımı var ve rastgele bir açıklama yapılmış • Oran-orantı kavramının anlaşıldığına dair ipucu yok • Yanlış değişkenlerin karşılaştırılması oran olarak ifade edilmiş • Orantı çeşidinin anlaşıldığına dair ipucu yok • Açıklama olarak sadece sorudaki ifade tekrarlanmış	• Çarpımsal ilişkiye dayalı olarak sonuç bulunmuş • Oran doğru bir şekilde ifade edilmiş • Orantı doğru bir şekilde ifade edilmiş • Sonuç oran-orantı kavramına uygun bir şekilde ifade edilmiş • Soru tam ve doğru olarak çözülmüş

Soru	Puan		
	0	**1**	**2**
5 7b 9b 9c 11 12 14b 15 16	• Boş • Verilerin toplamsal karşılaştırılması var • Verilerin, sayıların rastgele kullanımı var • Oran kavramının anlaşıldığına dair ipucu yok • Orantı çeşidinin anlaşıldığına dair ipucu yok	• Sadece doğru sonuç belirtilmiş • Oran kavramının anlaşıldığına dair ipucu var • Orantı çeşidinin anlaşıldığına dair ipucu var • Beklenen değişkenler arasında çarpımsal ilişkiye dayalı karşılaştırma yapılmış ancak sonuca ulaşılamamış/ işlem hatası yapılmış	• Çarpımsal ilişkiye dayalı karşılaştırma var • Beklenen değişkenler arasında oran belirtilmiş • Beklenen değişkenler arasında orantı çeşidine uygun ilişki kurulmuş • Doğru sonuca ulaşılmış

Soru	Puan		
	0	1	2
2 3 4b 6a 6b 7a 8 14a	• Boş • Sadece sonuç belirtilmiş • Sonuç belirtilmiş fakat yapılan açıklamada toplamsal karşılaştırmalar yapılmış/ verilerin, sayıların rastgele kullanımı var • Verilerin toplamsal karşılaştırılması var • Orantı çeşidinin anlaşıldığına dair ipucu yok • Açıklamada sadece soruda verilen ifade tekrarlanmış	• Orantı kavramının anlaşıldığına dair ipucu var fakat yapılan açıklama yetersiz • Orantı çeşidinin anlaşıldığına dair ipucu var • Çarpımsal ilişki olduğu ifade edilmiş • Oran kavramıyla ilişkili olduğu ifade edilmiş • Beklenen değişkenler arasında çarpımsal ilişkiye dayalı karşılaştırma yapılmış ancak sonuca ulaşılamamış/ işlem hatası yapılmış • Beklenen doğru yanıt bulunmuş ancak açıklama sadece soru köküندeki ifadeler kullanarak yapılmış • Birim oran düşünülmüş fakat yapılan açıklama yetersiz	• Çarpımsal ilişkiye dayalı karşılaştırma var • Beklenen değişkenler arasında oran belirtilmiş • Orantı çeşidi doğru olarak fark edilmiş ve ifade edilmiş • Açıklamada orantı kavramına ve orantı çeşidine uygun özgün ifadeler kullanılmış • Beklenen değişkenler arasında orantı çeşidine uygun ilişki kurulmuş • Doğru sonuca ulaşılmış

Soru	Puan		
	0	1	2
9a	• Boş • Orantı çeşidinin anlaşıldığına dair ipucu yok • Verilerin toplamsal karşılaştırılması var • Verilerin sayıların rastgele kullanımı var • Orantı çeşidine uygun ilişki kurulmamış • Sadece bir verinin karşılaştırılması dikkate alınmış	• Orantı çeşidinin anlaşıldığına dair ipucu var • Beklenen değişkenler arasında orantı çeşidine uygun ilişki kurulmuş ancak işlem hataları yapılmış/ yapılan açıklama yetersiz	• Orantı çeşidi doğru olarak fark edilmiş • Beklenen değişkenler arasında orantı çeşidine uygun ilişki kurulmuş ve doğru sonuca ulaşılmış

Soru	Puan		
	0	1	2
10a 10b	• Boş • İfade • Orantı problemi değil • Orantı çeşidi yanlış ve çözülemez	• Orantı problemi • Orantı çeşidi doğru soru çözülemezse • Orantı çeşidi yanlış fakat soru çözülebilir	• Orantı problemi • Orantı çeşidi doğru ve soru çözülebilir

APPENDIX E

MATHEMATICS ATTITUDE SCALE

Matematik Dersi Tutum Ölçeği

Genel Açıklama: Aşağıda matematiğe ilişkin tutum cümleleri ile her cümlenin karşısında "Hiç katılmıyorum", "Katılmıyorum", "Katılıyorum", "Tamamen Katılıyorum" olmak üzere dört seçenek verilmiştir.

Lütfen cümleleri dikkatli okuduktan sonra her cümle için kendinize uygun olan seçeneklerden birini işaretleyiniz.

	Hiç Katılmıyorum	**Katılmıyorum**	**Katılıyorum**	**Tamamen Katılıyorum**
1. Matematik ile ilgili bir şeyler okumaktan hoşlanıyorum				
2. Matematik derslerinin gelmesini dört gözle bekliyorum.				
3. Matematik çalışıyorum, çünkü matematiği seviyorum.				
4. Matematikte öğrendiğim konular ilgimi çekiyor.				
5. Daha sonra yapacağım işte bana yardımı olacağından dolayı matematik için çaba harcamaya değer.				
6. Meslekte ilerlememi sağlayacağı için matematik öğrenmek önemlidir.				
7. Daha sonraki öğrenimimde matematiğe gereksinim duyacağımdan matematik benim için önemlidir.				
8. Matematik dersinde iş bulmama yardımcı olacak çok şey öğreneceğim.				
9. Matematik derslerinde genellikle zorluk çekerim diye kaygılanırım.				
10. Matematik ödevlerini yaparken çok gergin				

olurum.
11. Matematik problemlerini çözerken çok sinirlenirim.
12. Matematik sorularını çözerken çaresiz kaldığım duygusuna kapılırım.
13. Matematikte kötü not alacağım diye endişelenirim.

APPENDIX F

STUDENT INTERVIEW QUESTIONS

1-“Does drama affect your learning? How? ”

2-“Are there any negative effects of drama on your learning?”

3-“Do you think, what was done during these units have affected friendship relations in class? If yes, in what way? (Think about your relation with your friends or relation between others based on your observations)”

4-“During these lessons, have you learned something new about yourself?”

5-“Do you realize any feature of yourself, you have never recognized before?”

6-“Do you think, in these lessons have the role of the students changed? Can you compare the role of the students in these lessons with the role of the students in the other lessons?” (Duatepe, 2004, p.56).

APPENDIX G

LESSON PLANS

DERS PLANI 1

Sınıf düzeyi: 7. sınıf

Öğrenme Alanı: Sayılar

Alt Öğrenme Alanı: Oran

Süre: 2 ders saati (80 dakika)

Araç/ gereç: Binanın yapısına göre hazırlanmış farklı ölçekte krokiler, Miniatürk eserlerinin fotoğrafları, farklı renkte tebeşirler, mor ve yeşil renkte kartlar, mavi ve kırmızı renklerde kâğıt, süreölçer, CD çalar, müzik (Gevende-Okyanus Düğünü)

Yaratıcı Drama Yöntem-Teknikleri: Rol Oynama, Doğaçlama, Öğretmenin role girmesi, Donuk imge

Kazanımlar

- İki nicelik arasındaki ilişkiyi oran olarak ifade eder.
- Nicelikleri karşılaştırmada oran kullanır.

ISINMA-HAZIRLIK

Etkinlik 1

Koridorun farklı ölçeklerde küçültülmüş krokileri lider tarafından hazırlanır. Koridorun farklı yerlerine (sütunların, kapıların, kaloriferin üzeri vb.) farklı sayıda oran ile ilgili o gün içerisinde bahsedilecek ve 3 hafta boyunca bahsedilecek orantı, doğru orantı, ters orantı ile ilgili kavramlardan yerleştirilir (nicelik, miniatürk, maket, harita, ölçek, karşılaştırma, hız, artış, azalış, eşitlik, parça, bütün, değer, miktar, çarpım, kat, oran, orantı, ters, doğru).

Öğrenciler 6 gruba ayrılır. Her grubun eline farklı ölçeklerde koridor planı verilir. Grupların planlarında hangi noktalardaki kavramlara ulaşacakları işaretlenerek belirtilmiştir. Haritalarında belirtilmiş hedeflere (kavram noktalarına) sırasıyla ve en kısa sürede ulaşmaya çalışırlar. Yarışmacıların birbirini izlememesi için genellikle ayrı zamanlarda çıkış verilir. Her grup için ayrı süre tutulur. Yarışmacılar parkur

boyunca karşılaşsalar dahi birbirlerini izlemeleri yasaktır. Aynı zamanda yarışmacılara sadece kendi grubunun rengindeki kağıtları getirmeleri hatırlatılır.

Planlarındaki tüm kavramları toplayıp (her grup için 20 kavram) getiren gruplar için getirdikleri zaman kaydedilir. En kısa sürede getiren grup kazanır.

Ara değerlendirme: Her grup kendi haritasını ölçeği bakımından sınıfa tanıtır. Bu ölçeğin ne ifade ettiği sorulur. Farklı grupların farklı ölçekteki haritaları karşılaştırılır. Bu büyüklük farkının ve şekil farkının neden kaynaklandığı konusundaki fikirleri alınır. Hangi ölçekli haritaya sahip öğrencilerin kavramların yerini daha kolay bulduğu konusundaki fikirleri grupça paylaşılır.

Etkinlik 2

Sınıfın zeminine farklı renkte tebeşirlerle farklı büyüklükte çemberler çizilir. Öğrencilere farklı renklerde kartlar dağıtılır. Müziğin ritmine uyarak yürümeleri söylenir. Müzik çalmakta iken müziğin arada durdurulacağı ve durduğu anda herkesin donması istenir. Müzik durduğunda yönergeler verileceği, herkesin bu yönergelere uyması gerektiği anlatılır. Müzik açılır öğrenciler müzik eşliğinde sınıfta dolaşırlar. Müzik durdurulur. Pembe çemberde, yeşil çemberde, sarı çemberde, beyaz çemberde ve mavi çemberde kalan kişilerin içinde kaldıkları çemberin elemanı olacakları belirtilir. Farklı renkteki iki çemberin içerisindeki öğrenci sayılarının birbirleriyle ve tüm grupla karşılaştırılması yapılır. Bu karşılaştırmayı yaparken matematikte oran kavramını kullandıkları soru cevap yöntemiyle öğrencilere hatırlatılır.

Verilen oranların hangilerinin parça parça oranı hangilerinin parça bütün oranı olduğu sorulur.

CANLANDIRMA

Lider tarafından sınıfın çeşitli yerlerine Minyatürk' te bulunan eserlerin fotoğrafları asılır (Fotoğraflar eserlerin yanlarında insanların bulunduğu fotoğraflardır. Dolayısıyla fotoğraflardaki eserlerin gerçek eserlerin maketleri olduğu öğrenciler tarafından anlaşılması düşünülmektedir).

Öğrencilerin müzik eşliğinde serbestçe dolaşmaları ve eserleri incelemeleri istenir.

Kendileri için tanıdık gelen eserleri akıllarında tutmaları ve çembere gelmeleri istenir.

Çemberde öğrencilerin fotoğraflar hakkında ne düşündükleri ve kendilerine ilginç gelen bir yanın olup olmadığı sorulur? Bu eserlerin gerçek eserlerin maketleri olduğu vurgulanır. Fotoğraflar arasında tanıdıkları ve daha önceden gördükleri eserler olup olmadığı sorulur ve görüşleri alınır.

Öğrenciler 4 gruba ayrılırlar. Gruplara Miniatürk' teki maketlerin boyutlarının gerçek eserlere boyutlara oranının 1/25 olduğu hatırlatılır.

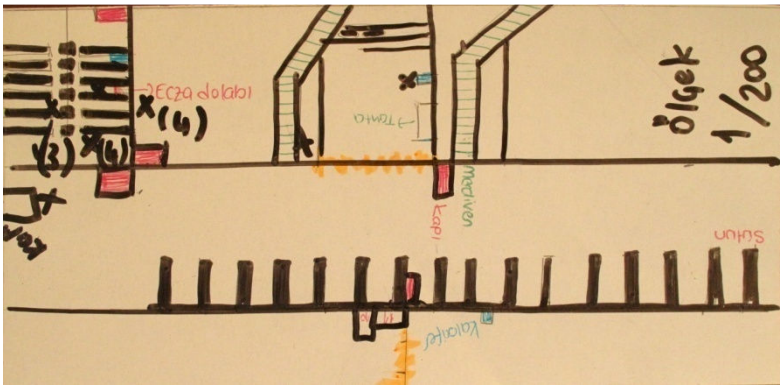
Öğretmen, kendisinin Kültür İşleri Bakanı olduğunu belirtir. Şu anda Miniatürk parkının işletmesinin kendilerine ait olduğunu ve belirledikleri bir amaç için belli eserleri büyültüp küçültebileceklerini söyler. Aynı zamanda Türkiye'yi eni iyi temsil edeceğini düşündükleri bir eseri seçmelerini ister. Gruplara kendi aralarında bu eseri belirlemeleri için süre verilir. Eser belirlendikten sonra kendi bedenleriyle bu eseri oluşturmaları ve neden bu eseri seçtiklerini belirten bir sloganla ya da tanıtım filmi ile bize bu eserin maketini tanıtmaları istenir. Bu eserin daha büyük maketini oluşturabilmek için ölçeğin nasıl değiştiğini düşünmeleri ve tanıtım filminde maketin özelliklerini belirtirken bunu vurgulamaları istenir.

DEĞERLENDİRME-TARTIŞMA

Öğrencilerden çember olmaları istenir. İlk yön bulma etkinliğinde birlikte hareket ettikleri gruplardaki kişilerle yan yana oturmaları istenir. İlk etkinlikte topladıkları kavram kâğıtları gruplara dağıtılır ve her gruba bir kırmızı ve bir mavi kâğıt verilir. Bu günkü etkinliklerde hangi kavramlarla karşılaştıysak o kavramları kırmızı kâğıdın üzerine, karşılaşmadığımız kavramları ise mavi kâğıdın üzerine koymaları istenir. Matematikte kullandığımız oran kavramının onlar için ne ifade ettiğini bu kavramlardan yola çıkarak önlerinde ki kâğıtlara yazmaları istenir. Grupla paylaşılır. Her grup için bahsettiğimizi düşündükleri kavramların bahsetmediğimiz kavramlara oranı sorulur.

DERS PLANI 1 – Kullanılan Malzemeler

Farklı ölçekteki koridor planlarından örnek



Yön bulma etkinliği kavram kâğıtlarından örnek

Miniatürk parkı eser fotoğraflarından örnekler

DERS PLANI 2

Sınıf düzeyi: 7. sınıf

Öğrenme Alanı: Sayılar

Alt Öğrenme Alanı: Orantı

Süre: 2 ders saati (80 dakika)

Araç/ gereç: Yumak ip, farklı renkte kartlar, oran kartları, doğaçlama kartları

Yaratıcı Drama Yöntem- Teknik: Doğaçlama, Rol oynama, Öğretmenin role girmesi

Kazanımlar

- Orantıyı açıklar.
- Orantılı nicelikler arasındaki ilişkiyi açıklar.

ISINMA-HAZIRLIK

Etkinlik 1

Öğrenciler dört gruba ayrılır. Her grup tek sıra halinde dizilir. Her gruba bir yumak ip verilir. İlk kişiden başlayarak ipin yumağı bir önden bir arkadan geçirilerek en son kişiye kadar iletilir. İpin ucu ilk geçiren kişi de olmak üzere ip en sona kadar açılır. En son kişiye ip ulaştıktan sonra ip çekilerek ve sarılarak tekrar yumak haline getirilir. İlk bitiren grup kazanır.

Lider bu esnada süre tutar ve ilk bitiren gruba göre yaklaşık bir süre söyler.

Gruplar 2 grup oluşturacak şekilde birleştirilir. Aynı oyun tekrar oynanır. İlk bitiren grup kazanır. Lider bu esnada süre tutar ve ilk bitiren gruba göre yaklaşık bir süre söyler.

Tüm öğrenciler birleşir ve tek sıra oluşturur. Aynı oyun tekrar oynanır. Lider bu esnada süre tutar ve oyunun bitiminde ortalama bir süre söyler.

Ara Değerlendirme: Öğrencilerden çember oluşturmaları istenir. Oyundaki gruplardaki kişi sayıları ve süreler arasındaki ilişkiyi düşünmeleri ve düşündüklerini paylaşmaları istenir.

Etkinlik 2

Öğrencilerden 2'li eşler olarak A ve B adını almaları istenir ve karşılıklı sırayla dizilirler. Önce A'lardan arkalarını dönmelerini istenir. Lider B'lere bir sayı verir (2, 4, 8, 16, 32, …). Bu sayıları eşlerinin arkasına yazmalarını ister. Yazdıkları sayılar eşleri tarafından doğrulandıktan sonra B'ler arkasını döner. Lider A'lara bir sayı

verir (3, 9, 27, 81, …). Bu sayıları eşlerinin arkasına yazmalarını ister. Yazdıkları sayılar eşleri tarafından doğrulandıktan sonra yüz yüze dönerler. Liderin vereceği yönerge ile eşler sıra ile ilk A sonra B olacak şekilde arkalarına yazılan sayıyı söylerler.

Ara Değerlendirme: Bu sayılar arasında nasıl bir ilişki olduğu tartışılır.

CANLANDIRMA

Öğrenciler 1. grup 2 kişi, 2. grup 4 kişi, 3. grup 6 kişi, 4. grup 8 kişi ve 5. grup 10 kişi olacak şekilde gruplara ayrılır.

Her gruba dramatik an verilip, canlandırmaların esnasında oran oluşturacak nicelikleri karşılaştırmaları istenir.

Öğretmen 1. grubun doğaçlamasında otobüs firması sorumlusu, 2. grubun doğaçlamasında ev sahibi 3. ve 4. grubun doğaçlamasında işletme müdürü ve 5. grubun doğaçlamasında mekan sahibi olarak farlı rollere girerek doğaçlamaları yönlendirir.

1.gruba

Doğaçlama: Bayram sonrası memleketinden yaşadığı şehre Ankara'ya dönen iki kişi. Otobüse bindiklerinde otobüsün dolu ve tek bir koltuğun boş olduğunu görürler. Bu koltuğun bileti de ikisine de kesilmiş. Bayram sonrası olduğu için diğer tüm otobüsler dolu.

1.kişinin amacı: Boş koltuğun kendisine verilmesi.

2.kişinin amacı: Boş koltuğun kendisine verilmesi gerektiğini savunuyor.

3.kişi bilet satış elemanı.

2.gruba

Doğaçlama: 4 arkadaş eve çıkmaya karar verirler. İnternetten görüp özelliklerini beğendikleri bir evi kiralarlar. Fakat anahtarı teslim alıp eve girdiklerinde evin yalnızca 2 odasının olduğunu görürler.

Grubun amacı: Sözleşmeyi iptal ettirmek

Ev sahibinin amacı: Bir odada 2 kişi kalabilecekleri konusunda gençleri ikna etmek ve aldığı parayı geri vermemek.

3.gruba

Doğaçlama: 6 arkadaş sinemaya giderler. Önceden bilet almamışlardır. Kapıda bilet bulabileceklerini düşünürler. Fakat film gösterimi için sadece 3 boş yer vardır ve gösterimin başlamasına 5 dakika vardır. 5 dakika sonra kapılar kapanacaktır.

Grubun amacı: 6 kişi içeri girmek isterler.

Bilet satış elemanın amacı: Sadece 3 kişiyi alabilecekleri konusunda ısrarcıdır.

4.gruba

Doğaçlama: 8 arkadaş tiyatroya giderler. Önceden bilet almamışlardır. Kapıda bilet bulabileceklerini düşünürler. Fakat oyun için sadece 4 boş yer vardır ve oyunun başlamasına 5 dakika vardır. 5 dakika sonra kapılar kapanacaktır.

Grubun amacı: 8 kişi içeri girmek isterler.

Bilet satış elemanın amacı: Sadece 4 kişiyi alabilecekleri konusunda ısrarcıdır.

5.gruba

Doğaçlama: 10 arkadaş aralarından birinin doğum gününü kutlamak için canlı müzik yapan bir mekanda yer ayırtırlar. Aynı zamanda o gece sahnede olan grup hepsinin hayranı oldukları gruptur. Oraya vardıklarında mekan doludur ve onlar için yanlış anlaşılmadan dolayı yalnızca 5 kişilik yer ayrılmıştır.

Grubun amacı: Kendilerine 5 kişilik daha yer açılmasını sağlamak.

Garsonun amacı: Yer bulma konusundaki ısrarları geri çevirmek.

Ara Değerlendirme: Her grubun canlandırmaları izlenir. Her grubun canlandırmasında oran olarak ifade edilebilecek nicelikleri karşılaştırmaları istenir. Her grubun doğaçlamasında kişi sayısı ve yer sayısı arasındaki oranlar arasında nasıl bir ilişki olduğu tartışılır.

DEĞERLENDİRME-TARTIŞMA

Etkinlik 1

Sınıfın farklı yerlerine farklı sayılarda farklı renklerde kartlar dağıtılır. Öğrenciler 6 gruba ayrılır.

Her öğrenciye farklı oranlar verilir. $\frac{1}{5}$, $\frac{2}{7}$, $\frac{3}{8}$, $\frac{3}{27}$, $\frac{10}{35}$, $\frac{21}{56}$, $\frac{4}{20}$ … gibi. Bu oranları topladıkları kartlarla oluşturmaları istenir.

Belirtilen oranlarda verilen miktar kadar kart bulamayan kişilerin kartları farklı şekilde nasıl toplayabileceği sorgulatılır.

Gruplar topladıkları kartları ve oranlarını tüm gruba sunarlar.

DERS PLANI 3

Sınıf düzeyi: 7. sınıf

Öğrenme Alanı: Sayılar

Alt Öğrenme Alanı: Doğru Orantı

Süre: 2 ders saati (80 dakika)

Araç/ gereç: Gazete kağıtları, karton, tarım ürünü resmi

Yaratıcı Drama Yöntem-Teknikleri: Doğaçlama, Rol oynama, Donuk imge, Öğretmenin role girmesi

Kazanımlar

- Doğru orantılı nicelikler arasındaki ilişkiyi açıklar.

ISINMA-HAZIRLIK

Etkinlik 1

Öğrencilerden çember oluşturmaları istenir.

Öğrenciler iki gruba ayrılır. Her grup ayrı şekilde oynatılır. Yere serilecek gazete kâğıtlarının onların yaşam alanı olduğu söylenir. Sekiz gazete kâğıdı yere serilir. Öğrencilerden gazete kâğıtlarına basmadan karışık bir şekilde yürümeleri istenir. Öğretmen el çırptığında bu yaşam alanlarının üzerinde kendilerine bir yer bulmaları söylenir. Öğretmen el çırptığında gazete kağıtlarının üzerinde kendilerine bir yer bulamayan öğrencilerin oyundan çıkarak yaşam alanının kenarında donarak bir ağaç olmaları istenir. Oyun esnasında kağıtları her seferinde öğrencilere söylemeden ½ oranında azaltılır.

Ara Değerlendirme: Zaman geçtikçe kendimize yaşam alanı bulmada zorlandınız mı? Bunun nedeni nedir? Yaşam alanının büyüklüğü ve gazete kağıtları üzerinde yer bulabilme kolaylığı arasında ki ilişki soru cevap yöntemiyle öğrencilere fark ettirilir.

Etkinlik 2

Öğrencilere öğretmenin her el çırpışının bir para birimi olduğu ve öğrencilerin ellerinin bir torba havuç olduğu ve her parmağın aynı boyda bir havuç olduğu belirtilir. Öğretmen alıcıdır ve öğrenciler sebze satıcısıdır. 1 para birimi ile 3 havuç alınabileceği ve öğretmen ellerini bir defa çırparsa öğrencilerin üç havucu torbaya atacağı yani üç parmağı havaya kalkacağı öğrencilere söylenir. 1 defa el çırpılır. 3 parmak havaya kalkar. Öğrencilerin kendi sıralarında sebze satıcısı pozu alıp donmaları istenir. 2 defa çırpılır ve 6 parmak havaya kalkar. Bir önceki basamaktaki

gibi herkesin alışveriş yaparken ya pozlarını almaları ve donmaları istenir. Öğrenciler pozlarını oluşturunca 3 kez el vurarak 9 parmağın kalkması istenir. Bu kez hiçbir yönerge vermeden elin kaç defa çırpıldığına göre tekrar parmak kaldırmaları istenir. Karışık olarak el 2 kez, 3 kez ve 1 kez vurularak öğrencilerin orana dikkat ederek parmak kaldırmaları istenir.

Ara Değerlendirme: Daha fazla parmağımız olsaydı 4 defa vurulduğunda, 5 defa vurulduğunda, 6 defa vurulduğunda ve 80 defa vurulduğunda kaç parmak kaldırmamız gerektiğini tartışmaları istenir.

CANLANDIRMA

Etkinlik 1

Eşit sayıda iki grup oluşturulur. Kartonlardan 1. grup için dar bir alan 2. grup için ise geniş bir alan oluşturulur. Her gruptan gönüllü bir kişi seçilir. Bu kişi çiftçidir. Diğerleri ise tarlaya ekilecek tarım ürünüdür. Bu alanlara ürünlerin dikim ve yetişme aşamasını yalnızca beden dilini kullanarak dans ve devinim ile canlandırmaları istenir.

Ara Değerlendirme: Öğrencilerin süreçte neler hissettikleri paylaşılır. Gruplarda hangi tarım ürünleri olduğunun ve ekim alanı ve ürünlerin arasındaki mesafe hakkındaki yorumları alınır.

Etkinlik 2

Gruptan çember olması istenir. Para olmadığı zamanlarda insanların geçimlerini ne ile sağladıkları ve alışverişlerini ne şekilde yaptıkları tartışılır.

Para olmadan önce feodal dönemde takas usulü ile alışveriş yapıldığını, alınan her şeyin oranlı bir şekilde karşılığının verildiği öğrencilere anlatılır. Herkesin gözlerini kapamasını ve her şeyin takas usulü ile alındığı bir dönemde olduklarını hayal etmelerini, kendi ihtiyaçlarını karşılamak için onların başkalarına ne verebileceğini düşünmelerini ister.

Öğrencilerin gözleri kapalı iken sınıfın farklı yerlerine satış köşeleri olarak patates tezgahı, şeker tezgahı, pirinç tezgahı gibi kartonlar yerleştirilir. Öğrencilerin ellerine farklı tarım ürünleri resmi verilir. Aynı resimlerin bir grup oluşturmaları istenir.

Grupların tezgahları incelemeleri istenir.

Her gruba aşağıdaki doğaçlama kartı dağıtılır.

Doğaçlama kartı: Sizin uğraştığınız mesleği ve ihtiyaçlarınızı belirleyin. Böyle bir dönemde alışveriş yapıldığında nasıl alışveriş yapılacağını, insanlar arasında nasıl ilişkiler ve konuşmalar geçeceğini düşünmeleri, tartışmaları istenir. Belirlenen bu özellikleri kullanarak o dönemdeki bir pazar ortamını canlandırmaları istenir. Aynı zamanda öğretmen pazarlık yaparak bu oranı bozmaya çalışan kişi olarak canlandırmaya katılır.

Canlandırmada belli bir yerde dondurarak aynı üründen daha fazla almak istediğinizde kullanacağınız yöntemi belirleyin (Bu yöntemi belirlemeleri için 1 dakika süre verilir).

Tüm canlandırmalar izlenir. Tablolar dağıtılır öğrenciler tarafından doldurmaları istenir.

Örnek:

Verilen	**Alınan**
1 torba pirinç	2 torba şeker
2 torba pirinç	4 torba şeker
3 torba pirinç	6 torba şeker
…	…

Canlandırmada takas usulündeki oran kartlarını gruplar paylaşır.

DEĞERLENDİRME-TARTIŞMA

Süreç gözden geçirilir, neler yapıldı, neler hissedildi konuşulur. Tüm süreçte ısınma çalışmaları ve canlandırmalardaki durumlarda nicelikler arasında nasıl bir ilişki olduğu sorulur? Bilişsel düzeyde bilgilenmeyi amaçlayan sorular sorulur.

Bu çoklukların oluşturduğu oranların doğru orantılı olduğu “Pirinç torba sayısı ile şeker torba sayısı arasındaki ilişkiyi “ biri artarken diğeri de artıyor” veya “biri azalırken diğeri de azalıyor” şeklinde açıklayabilmeleri beklenir.

Gruplar ellerindeki tabloları kullanarak

-İki tarım ürününün oranında yararlanarak pirinç torba sayısı vb. 20 kat attırıldığında şeker torba sayısı vb. nasıl bulunabilir? Tartışılır.

DERS PLANI 4

Sınıf düzeyi: 7.sınıf

Öğrenme Alanı: Sayılar

Alt Öğrenme Alanı: Ters Orantı

Süre: 2 ders saati (80 dakika)

Ön koşul bilgileri:

Araç/ gereç: Tablo kağıtları, doğru ve ters orantılı durumların yazılı olduğu kağıtlar, torba

Yaratıcı Drama Yöntem-Teknikleri: Doğaçlama, Rol oynama, Öğretmenin role girmesi

Kazanımlar

- Ters orantılı nicelikler arasındaki ilişkiyi açıklar.

ISINMA-HAZIRLIK

Etkinlik 1

Uzun ağaç, kısa ağaç oyunu oynatılır. Fakat bu oyunun kuralının ters işlediği uzun ağaç dendiğinde öğrencilerden oturmaları, kısa ağaç dendiğinde öğrencilerden ayağa kalkmaları istenir. Oyunun kuralını bozan ya da şaşıran kişi yanar.

Etkinlik 2

Öğrencilerden eşit aralıklardan oluşan biri 4 kişilik biri 20 kişilik çember oluşturmaları istenir (Aralıklar önceden lider tarafından belirlenir). Bu iki çemberde bir başlangıç noktası belirlenir. Lider ellerini her vurduğunda öğrencilerin bir adım alarak önlerindeki yere geçmeleri ve yer değiştirmeleri istenir. Liderin verdiği tempoya göre ritim değişebilir.

Ara değerlendirme: Büyük çember bir turu tamamladığında küçük çemberin kaç tur attığı öğrencilere sorulur.

CANLANDIRMA

Doğaçlama Kartı 1- Tarımda verimi arttırmak için (ses ve devinimi kullanarak) bir tarım makinesi üretin. Bu makinenin parçaları sizsiniz. Parçaların arasında bir oran olmasına dikkat edin.

Doğaçlama kartı 2- Tarlalarınız uzakta olduğu için sulama sıkıntısı çekiyorsunuz. Tarlalarınıza su taşıyabilmek için (ses ve devinimi kullanarak) bir makine üretin makine parçalarının hareketleri arasında bir oran olmasına dikkat edin.

Öğretmen makineleri üreten fabrikanın sahibi olarak bu makineleri halka tanıtan bir film yapılmasını ister. Müdürün filmde olmasını istedikleri parçaları arasındaki oranlara dikkat çekmeleri ve bu makineyi aldıklarında işi kaç günde bitireceklerini tanıtımlarında yer vermeleridir.

Makine tabloları gruplara dağıtılır.

Makine Sayısı	**İşin biteceği gün sayısı**
1	12
2	6
3	4
…	…

Şeklinde tahtaya çizilir.

Canlandırmadaki tabloları grupların sunmaları beklenir. Makine sayısı artarken işin biteceği gün sayısının arasındaki ilişkiyi açıklamaları istenir. " Bir çokluktan biri artarken diğerinin azalması veya biri azalırken diğerinin artması şeklinde açıklayabilmeleri beklenmektedir.

DEĞERLENDİRME-TARTIŞMA

Gruptan çember olması istenir. Torba içinde kağıt üzerine yazılmış doğru orantı ters orantı cümleleri vardır. Herkesin sırayla bir cümle çekmesi istenir. Bu cümleyi ve bu cümlenin doğru orantı mı ters orantı mı olduğu hakkındaki düşüncesini grupla paylaşması sağlanır.

DERS PLANI 5

Sınıf düzeyi: 7.sınıf

Öğrenme Alanı: Sayılar

Alt Öğrenme Alanı: Doğru ve Ters Orantı

Süre: 2 ders saati (80 dakika)

Araç/ gereç: Limonata tarif kartonu, küçük yapışkanlı kağıtlar,

Yöntem- Teknik: Öğretmenin role girmesi, Rol oynama, Doğaçlama

Kazanımlar

- Doğru orantıyla ilgili problemleri çözer.
- Ters orantıyla ilgili problemleri çözer.
- Oran problemlerini çözer.
- Doğru orantı ve ters orantıyla ilgili problemleri kurar.

ISINMA-HAZIRLIK

Etkinlik 1

Öğrenciler bardak su, limon suyu, şeker diye sayarlar. Bardak su olanlar 2 adım şeker olanlar 4 adım öne gelerek arka arkaya dizilirler.

Öğretmen kıvamında lezzetli bir limonata hazırladığını bunun için 2 bardak limon suyu, 4 bardak su ve 1 bardak şeker koyduğunu söyler. En dıştaki limon suyunun söylediği miktarın oranına göre iç çemberdeki limon suyu ve şeker sırasıyla miktar belirtirler. Oranın yanlış kurulduğu limonata tadı bozulduğu için dökülür. O sıradaki öğrenciler yere çöker ve oyundan çıkar. En son kalan limon suyu, bardak su ve şeker üçlüsü alkışlanır ve yılın limonatasını yapan ödülünü alır.

Etkinlik 2

Öğrenciler 2 gruba ayrılır. Her grup kendi arasında arka arkaya dizilerek tren oluştururlar. Her sıranın en başındaki öğrencinin tırtıl olduğu arkadakilerin ise onun halkaları olduğu söylenir. Tırtılın başının görevi karşı gruptan kendine halka kapmak aynı zamanda kendi halkalarını korumaktır. Fakat tırtılın başı sadece grubun en zayıf halkasının bulunduğu yerden dokunarak diğer halkaları kendi grubuna katabilir. Bu zayıf halkanın yeri de liderin söylediği orantıya göre belirlenir

İlk olarak lider, grupların 1 ve 3 ile orantılı olarak 2 parçaya ayrıldığı noktanın grupların kopma noktası olduğunu söyler. Gruplara bu parçalardaki kişi sayılarını hesaplamalarını ve zayıf halkanın yerini belirlemeleri için süre verilir. Bir grup

öğrenci de hesaplamanın doğru olup olmadığını kontrol etmek ve oyun esnasında zayıf halkadan sonra halka kapma kuralının ihlal edilip edilmediğini kontrol eden hakem heyetidir. Zayıf halkanın yeri belirlendikten sonra oyun başlar.

Lider öğrenci sayısına göre aynı gruplarla, grupları ikiye bölerek ya da birleştirip ebe seçerek farklı oranlarda bu oyunu oynatır.

CANLANDIRMA

Ekinlik 1

Öğretmen "Gez Gör Kanalı" sunucusu olarak Orantı ülkesini tanıtır. Orantı ülkesinin içinde "Doğru Orantılı" ve "Ters Orantılı" vatandaşların beraber dostça yaşadıklarını belirtir.

Tahta "Doğru Orantılı" ve " Ters Orantılı" olarak ikiye ayrılır. Öğrencilere yapışkanlı kağıtlar dağıtılır. Her öğrencinin ilk olarak doğru orantılı dendiğinde akıllarına gelen fikirleri, doğru orantıyı günlük hayatta kullanabilecekleri zamanları ellerindeki kağıda yazmaları istenir. Daha sonra aynı durum ters orantılı için de tekrarlanır.

Öğrenciler gruplara ayrılır. İsteyen grupların Ters Orantılı vatandaşlar isteyen gruplarında Doğru Orantılı vatandaşlar olabilecekleri söylenir. Her gruba tahtadaki kağıtlardan dağıtılır. Grupların bu kağıtlarda yazılanlar üzerine konuşmaları ve ellerindeki kağıtlardaki fikirlerden de yaralanarak günlük hayatla ilişkili orantı çeşitlerine uygun olan bir durum sergilemeleri istenir.

DEĞERLENDİRME-TARTIŞMA

Canlandırmalardaki orantı çeşitleri üzerine konuşulur. Bu durumların orantılı, doğru orantılı ve ters orantılı olarak değerlendirilebilmesi ve doğru orantılı, ters orantılı problemlerin çözülebilir olması için gerekli olan bilgiler tartışılır.

Grupların ellerindeki kağıtlardan ve canlandırmalardan aldıkları fikirlerden de yaralanarak günlük hayatla ilişkili 1 ters orantı ve 1 doğru orantı problemi yazmaları istenir. Problemler lider tarafından toplanır ve karışık bir şekilde diğer gruplara paylaştırılıp çözümleri üzerinde düşünmeleri ve problemleri beraberce çözmeleri istenir.

DERS PLANI 6

Sınıf düzeyi: 7.sınıf

Öğrenme Alanı: Sayılar

Alt Öğrenme Alanı: Doğru ve Ters Orantı

Süre: 2 ders saati (80 dakika)

Araç/ gereç: 24 şeker, kağıt, kalem ve zarf

Yaratıcı Drama Yöntem-Teknikleri: Öğretmenin rol alması, Doğaçlama, Rol oynama, Rol içinde yazma

Kazanımlar

- Doğru orantı ve ters orantılı nicelikler arasındaki ilişkiyi açıklar.
- Drama temelli öğretimden edindiği deneyimlerle doğru orantı ile ilgili oyun tasarlar.
- Oran, Orantı, Doğru ve Ters Orantı ile ilgili edindiği bilgileri özetler.

ISINMA-HAZIRLIK

Etkinlik 1

Bir olimpiyat kampında koşucular olarak antrenman yapıyorsunuz. Fakat antrenmanlarınızın şöyle bir kuralı var "önemli olan önce bitirmek değil çalıştırıcının vereceği sayıda bitiş noktasında olmak". Lider çalıştırıcı olarak role girer.

1.gün için koşucular koşmaya başlar. Liderin belirgin bir ritimde 27' ye kadar sayacağı ve koşucuların 27 dendiğinde bitiş noktasında olmaları gerektiği söylenir. Bu gün için koşucuların hızlarının varış noktasına kadar sabit olacağı bu nedenle varışa kadar hızlarını iyi ayarlamaları gerektiği belirtilir.

2.gün için lider koşucuların yine antrenmanda olduğunu söyler. Fakat bu kez 9 a kadar sayılacağı ve 9 da bitiş noktasında olmaları gerektiği belirtilir. Bu gün için koşucuların hızlarının varış noktasına kadar sabit olacağı bu nedenle varışa kadar hızlarını iyi ayarlamaları gerektiği belirtilir.

3.gün için 3'e kadar sayılacağı belirtilir.

4.gün için 1'e kadar sayılacağı belirtilir.

Ara değerlendirme: 4 günde olan koşular hakkında koşucuların ne düşündükleri, nelerin değiştiği neyin aynı kaldığı sorulur. Verilen süre ve kendi hızları hakkındaki yorumları dinlenir.

Etkinlik 2

Lider öğrencilerden çember olmalarını ve herkesin arkasını dönüp gözünü kapamasını ister. Gözler kapalı iken lider bir kişinin eline dokunur. Eline dokunduğu kişi kargadır. Diğerleri mahsul. Karganın görevi diğerlerine belli etmeden onların gözlerine bakıp göz kırparak öldürmektir. Ölen mahsuller donar. Karga dışındaki diğer öğrencilerin karganın kim olduğunu tahmin etmek için bir hakları vardır. Tahminlerini gelip liderin kulağına söyleyebilirler. Yanlış tahmin edenler oyundan çıkar.

Lider oyun sonuna kadar kargayı doğru tahmin eden kişilere toplam 24 şekerin ödül olarak verileceğini söyler. Birden fazla kişinin doğru tahmin etmesi durumunda ise ödül paylaştırılacaktır.

Ara değerlendirme: Öğrencilere doğru tahmin eden kişi sayısı ve bir kişinin aldığı şeker sayısı arasında nasıl bir ilişki olduğu sorulur.

CANLANDIRMA

Öğrencilerden çember olmaları istenir. Öğrencilere giriş kısmında oynanan oyunların hangi orantı çeşidi ile ilişkili olduğu sorulur. Öğrenciler gruplara ayrılır. Her gruba doğru orantı ile ilişkili bir oyun düşünmeleri ve bunu önlerindeki kağıda yazmaları istenir.

Yazılan oyun kağıtları gruplara karışık olarak dağıtılır. Yazılan oyunun doğru orantı çeşidi için uygun olup olmadığı grupça incelenir ve karara varılır. Yazılan oyun doğru orantıya uygun değilse gerekli düzenlemeler yapılır, uygun ise grubun oyuna eklemek istedikleri bir şey var ise orantı çeşidini bozmadan ekleyebilecekleri söylenir. Her grubun ellerindeki oyunu hızlandırılmış çekimle oynayarak tanıtmaları istenir.

DEĞERLENDİRME-TARTIŞMA

Öğrencilerden çember olmaları istenir. Öğrencilere, şu anda matematik öğretmeni olmayan bir okuldaki öğrencilere Oran-Orantı- Doğru ve Ters Orantı hakkında edindiğiniz bilgileri paylaşmak için beraber geçirdiğimiz deneyimleri de düşünerek bir mektup yazmanızı istiyorum. Öğrenciler gruplara ayrılır ve ortak deneyimler paylaşılarak mektup yazılır.

APPENDIX H

DIRECT ACTIVITIES of CREATIVE DRAMA BASED INSTRUCTION LESSON PLANS in terms of PHASES and SUB-CRITERIA

Lesson Plan 1	
Introduction	
Warm-up Activities	• Orienteering game • Colored Circle game
Development	
Social Metaphor	• Forming different scaled models of some Miniaturk artifacts with their bodies and introducing these models to other members
Make-Believe Play	• The role of exploiter of Miniaturk park and the role of introduction film producer
Dramatic Moments	• Tension of time in choosing the artifact that is the most suitable for representing the culture of Turkey with an individual reason and explaining this reason
Drama Techniques	• Role playing, teacher in role, still image
Evaluation	• Discussion about the concepts of the first warming up activity, particularly about the difference between the plans, the reasons of these differences • Separating the concepts related to the first lesson and unrelated ones, • Make comparison between related and unrelated concepts or between related and all of the concepts.
In this process	
(Group work)	• Groups of six in finding all of the concepts related with ratio and proportion in orienteering and in the

	evaluation • Groups of five in forming different scaled models of some Miniaturk artifacts with their bodies and in introducing these models to other members of the class
(Role of teacher)	• Timer • Facilitator for developing, expressing ideas within and between the groups, • Minister of Culture role as participant • Encourage for communicating in the evaluation part or call attention to the group presentations

Lesson Plan 2	
Introduction	
Warm-up Activities	• String skein game • Numbers on the back game
Development	
Social Metaphor	• Buying bus ticket, renting a house, buying cinema and theatre ticket and customer in a café
Make Believe Play	• The role of customer for buying bus ticket, householder and tenant, customer for buying cinema and theatre ticket and customer in a cafe

Dramatic Moments	• Two people tried to persuade the responsible officer for buying bus ticket for only one person. 4 person tried to persuade householder to cancel house contract since house has only two room, 6 person tried to persuade ticket salesman for entering the cinema with 3 empty space, 8 person tried to persuade ticket salesman for entering the theatre with 4 empty space and 10 person tried to persuade waiter to find place for 10 person with only 5 empty space.
Drama Techniques	• Improvisation, role playing, teacher in role
Evaluation	• Comparison of number of people and number of empty place in each improvisation and relationship between equal ratios. • Collecting cards to construct given ratio • Discussing about constructing ratios with large numbers and about different ways to construct these ratios, equal forms of these ratios
In this process (Group work)	• Groups of four, groups of eight, groups of sixteen and groups of thirty-two in opening a skein of string game • Groups of two in writing a number back of your couple game • Group of two in the role of customer for buying bus ticket, group of four in the role of tenant, group of six in the role of customer for buying cinema, group of eight in the role of customer for buying theatre ticket and group of ten in the role of customer in a café

(Role of teacher)	• Timer • Facilitator for developing, expressing ideas within and between the groups, • Role of responsible officer for the bus ticket improvisation, role of householder in the tenant improvisation, role of management manager in the cinema and theatre ticket improvisation and role of owner of café in the customer in a café improvisation as participant, • Encourage for communicating in discussion session at the end of the warm up activities

Lesson Plan 3	
Introduction	
Warm-up Activity	• Newspaper game • Carrot seller game
Development	
Social Metaphor	• Plant seed of products in a field • Setting the environment for shopping in feudal period that money was not used for shopping
Make Believe Play	• The role of farmer and agricultural products • The role of customer and seller shopping in a bazaar with barter of products.
Dramatic Moments	• Providing ratio for price of products sell in the bazaar • Be consistent about the price of products to a bargainer
Drama Techniques	• Improvisation, role playing, still image, teacher in role

Evaluation	• Discussing about the relationship between the quantities used in the whole process. • Filling the tables for barter of products with larger numbers
In this process	
(Group work)	• Groups of fifteen in newspaper game • Groups of fourteen in plant seed of products in a field • Group of five in the role of customer and seller shopping in a bazaar with barter of products
(Role of teacher)	• Timer • Facilitator for developing, expressing ideas within and between the groups, • Role of bargainer as participant, • Encourage for communicating in evaluation part

Lesson Plan 4	
Introduction	
Warm-up Activity	• Long tree, short tree game was played • Turning circles game was played..
Development	
Social Metaphor	• Forming machines to provide yield increase and solve thirst problem of the fields
Make Believe Play	• The dance and motion to form a machine part • The role of introduction film producer for introducing the machine to the village members
Dramatic Moments	• Deciding about the appropriate days to finish a work with using machines.

Drama Techniques	• Improvisation, role playing, teacher in role
Evaluation	• Filling the machine tables • Discussing about the type of proportion of a situation written on a piece of paper taken from a bag.
In this process	
(Group work)	• Group of five and group of twenty in circle game • Groups of five in forming machine parts with their bodies
(Role of teacher)	• Facilitator for developing, expressing ideas within and between the groups. • Giving some clues for forming machines and producing introduction films about machines • Role of manager of machine factory in animation of forming machine. • Encourage for communicating on talking about ratio between machine parts and in meeting of village members about increasing the numbers of machines or farmers to finish a field work in village.

Lesson Plan 5	
Introduction	
Warm-up Activity	• Lemonade game • Catterpillar game
Development	
Social Metaphor	• Directly and inversely proportional situations in everyday context • Daily life problems related to direct and inverse proportion

Make Believe Play	• The role of taps to fill a pool • The role of wall painter workers • The role of friends in birthday celebration • The role of racers in a running competition • The role of jitney driver and passengers in the jitney • The role of advertisement producer about credit card and gsm operator.
Drama Techniques	• Improvisation, role playing, teacher in role
Evaluation	• Posing a direct and an inverse proportion problem with combining and synthesizing the learning from drama based instruction and daily life experiences • Discussing about the critical points of the problems
In this process	
(Group work)	• Groups of three in lemonade game • Groups of eight and twelve in caterpillar game • Groups of five in improvisation and posing problem
(Role of teacher)	• Facilitator for developing, expressing ideas within and between the groups. • Giving some clues for synthesizing improvisations • Role of a announcer of a TV channel • Role of a friend in birthday celebration, the role referee in the running race, the role of traffic police in the jitney improvisation as participant. • Encourage for communicating on talking about ratios and proportional situations in improvisations and talking about the important points in a directly or inversely proportional situations by asking questions.

Lesson Plan 6	
Introduction	
Warm-up Activities	• Racers of an Olympic Camp game • Game of Estimating the Crow
Development	
Social Metaphor	• Directly and inversely proportional situations in everyday context • Writing a game about direct proportion • Writing a letter about learning of ratio and proportion topic to students which have no regular mathematics instruction
Make Believe Play	• The role of game player and director of game
Drama Techniques	• Improvisation, role playing, teacher in role, writing in role
Evaluation	• Writing a letter about learning of ratio and proportion topic to students which have no regular mathematics instruction
In this process	
(Group work)	• Group of five in running race • Groups of six in writing and improvising the games • Groups of six in writing letter
(Role of teacher)	• Facilitator for developing, expressing ideas within and between the groups. • Giving some clues in writing games • Role of a coach in running race as participant. • Foster communication within group members

APPENDIX I

TURKISH EXCERPTS FROM INTERVIEWS WITH STUDENTS

Bu etkinliklerde çekingen olan ve derse katılmayan arkadaşlarımda derse katılmaya başladılar. Hiç konuştuğunu duymadığım arkadaşlarımda etkinliklerde vardı. Onlar için de iyi oldu (Student 10-1).

Diğer derslerde şımarmak için konuşan arkadaşlarla bu etkinliklerde ne yapacağımızı ve oran orantı konusunda ne öğrendiğimiz hakkında konuşunca onlarda derse öğrenmek için katılmış oldu. Önceden dersleri dinlerken bazı öğrenciler konuşuyordu ama konu ile alakasız konuşuyorlardı. Fakat şimdi öğrenciler birbirleri ile konuştukları halde anladılar. Çünkü konu hakkında konuşuldu hep. Oran orantı konusunda öğrendiklerimiz hakkındaki düşüncelerimizi paylaştık. Böylelikle herkes derse katılmış oldu (Student 5-2).

Oyunun ve konunun içinde ben de vardım. Sadece tahtada soru çözünce ne demek olduğunu çok anlayamamıştım. Ne yapacağımı da bilememiştim. Drama etkinliklerinde konunun, örneklerin, yapılanların için de ben de olduğum için konuyu daha iyi anladım (Student 5-3).

Normal matematik dersindekinden daha iyi olduğumu hissettim. Örneklerin içinde biz de vardık. Örnekleri biz canlandırdık ve biz bulduk. Ders işlenirken yapılanların için de olmak sadece tahtaya yazılanları yazmaktan çok farklı. Normal ders gibi bu örnekleri sadece tahtaya yazsaydık belki anlamayacaktım ama drama etkinlikleri ile anladım. Çünkü örnekleri bulan bizdik (Student 7- 4).

Canlandırmalar, doğaçlamalar yoluyla farklı kişiler olduk. Ya da farklı şeyleri canlandırdık. Musluk oldular, makine parçası oldular, alışverişte satıcı oldular, otobüs şoförü oldular. Yani sadece yazı yazan öğrenciler değildik. Rol yapıyorduk, bazen öğretmen gibiydik bazen de öğrenci gibiydik. Konu ile ilgili farklı etkinlikler yapınca her şey daha anlamlı geldi (Student 2-5).

Diğer derslerde mesela matematikte de hep öğretmen anlatıyordu ve biz dinliyorduk. Soru sorarsa cevaplıyorduk. Dersin büyük bir kısmında da yazı yazıyorduk. Ama burada yaratıcı drama ile olduğu için tüm etkinliklerden sonra ilk

olarak kendimiz fikirlerimizi söylüyorduk. Arkadaşlarımın canlandırmalarından ya da oyunlardan orantının özelliklerini biz buluyorduk. Sonra onu hep birlikte toparlıyorduk. Bir derste hem oyun oynayıp, hem konu hakkında konuşup bir de mektup yazabildik. Kendi düşüncelerimi yazmak tahtadaki yazmaktan daha anlamlı benim için (Student 8-6).

Bulduğumuz örneklerin oran orantı konusuna uygun olması gerekiyordu. Bu yüzden örnekleri bulabilmek için arkadaşlarımızla oran orantı konusundaki fikirlerimizi paylaştık ve bu konu üzerine çok düşündük. Birbirimizin fikirlerini dinledik ama yanlış varsa düzelttik. Bunlarda daha iyi anlamamı sağlamış olabilir (Student 7-7).

Bir de grup arkadaşlarıma sorunca daha iyi anlayabildim. Mesela bizim grupta bir arkadaşım ters orantı problemi yazarken benim yazdığım bir şeyi düzeltti ve bana niye olduğunu anlatabildi. Ben de onlara farklı örneklerde bir şeyler öğrettim. Benim aklımda kaçırdığım yerler böylelikle daha çok oturdu ve konuları daha iyi anladım (Student 1-8).

Arkadaşlarımızın da canlandırmalarıyla bilgilerimize bilgi kattık. Farklı arkadaşlarımızın canlandırmaları bize oran orantı konusunda günlük hayattan örnekler sundu. Her grup farklı örnekler düşünebilmişti (Student 4-9).

Örnek olarak sınıftaki erkeklerle pek bir yakınlığımız yoktu. Genelde bizim sınıfta kızlar kızlarla erkekler erkeklerle arkadaştır. İlk zamanlarda karışarak çember olurken çok zorlandık. Ama bu çemberi oluşturabildiğimizde iç içe olduk. Grup çalışmalarında fikir alışverişinde erkeklerde aramızda bulundu. Onlarla arkadaşlığımız daha samimi hale geldi (Student 2-10).

Mesela hiç ilgilenmediğim arkadaşımla ya da hiç muhabbetimin olmadığı arkadaşımla aynı grupta olabildik. Birlikte işler yaptık. Ona yardımcı oldum. O bana yardımcı oldu. Onlarla el ele tutuştum. Sınıftaki farklı insanlarında benim yakın arkadaşım olabileceğini gördüm (Student 8-11).

Bazı arkadaşlarımızda diğer derslerde hiç aktif değillerdi. Bazı arkadaşlarımızdan onlara hiç sıra gelmiyordu. Bu derslerde onlarında konuştuklarında eğlenceli ve akıllı insanlar olduklarını gördük (Student 1-12).

Bir arkadaşım mesela çok şımarık normal derslerde ama sanırım rol yapmayı tiyatroyu seviyor. Karakterleri çok iyi canlandırdı. Bizden daha rahattı ve rol yapma

konusunda yeteneği vardı. Onunla aynı grupta olduğumuzda güzel fikirler verdi (Student 5-13) .

Sevmediğim ya da konuşmadığım arkadaşlarımla grup olunca onların da farklı özelliklerinin olduğunu gördüm. Sevmediğim arkadaşlarımla grup olunca onlarla da beraber çalışabileceğimi gördüm (Student 3-14).

İlk olarak bazı kişilerle hiç grup olmak istemedim. Çünkü onlarla normalde hiç konuşmuyorum bir olaydan dolayı ama drama etkinliklerinde aynı grupta olabildik. Sanki o sorunlarımız hiç olmamış gibi bir şeyler paylaşabildik (Student 6-15).

Grup içinde hiç kimse birbiriyle dalga geçmedi. Hangi fikrin güzel olduğuna beraber karar verdik (Student 4-16).

Etkinliklerde sonuçta bizim grubun canlandırmasını ortak yaptığımız için herkesin çalışması gerekiyordu. Grup olduğumuzu hissedebildim (Student 6-17).

Dersin yaratıcı drama yöntemiyle işlenmesinin olumsuz yanlarından biri daha geniş çalışma alanı gerekli olmasıydı. Okulumuzda böyle bir çalışma yapmadığımız için ve böyle bir çalışma için sınıflar müsait olmadığı için biraz sınıfta yer konusunda zorlanabildik (Student 1-18).

Olumsuz yanlarından biri alanımızın dar olmasıydı. Oyunları daha uzun süreler oynayabilirdik ama oynayamadık. Normal ders gördüğümüz sınıflarda yapılabilecek bir yöntem değil (Student 6-19).

Diğer derslerde herkes oturduğu için daha az ses oluyor. Burada oyun oynarken ya da biz grup çalışmasında ne yapacağımızı kararlaştırırken de her grup kendi arasında konuştuğu için daha fazla gürültü olabildi (Student 7-20).

Olumsuz yanları çoğu kişi daha doğrusu bende heyecanlı olduğumuz için derste değilmiş gibi oyunmuş gibi ya da beden eğitimi dersinde maç yaparken heyecanlanırız ya onun gibi. Heyecanlandığımız için bazen derste olduğumuzu unutup oyunmuş gibi gürültü yapabildik. Normal derslerden daha fazla ses çıkabildi (Student 8-21).

Soruları çözebileceğimi ve konuları anlayabileceğimi görünce matematik dersini daha çok sevmeye başladım (Student 4-22).

Bir de matematiği sevdiğimi ve matematik dersini başarabileceğimi fark ettim. Matematiği seviyordum da yapamadığım soruları hemen geçiyordum. Ya da

cevabı varsa hemen sabretmeden cevabına bakıp a bu böyleymiş diyip geçiyordum. O sorunun cevabını kendimin bulamayacağını sanıyordum. Ama bu etkinliklerde çözümlerini birlikte bulunca kendimin de çözüm bulabildiğimizi gördüm. Ya da nedenlerini birlikte biz bulduk. Nedenlerini birlikte görsellerle açıkladığımız için aslında kendimde düşünürsem ya da dikkatli olursam matematik sorularını çözebileceğimi fark ettim (Student 1-23).

Kendimin yeni ve farklı oyunlar, canlandırmalar bulma konusunda yetenekli olduğunu fark ettim (Student 3-24).

Ben hiç kendime güvenmezdim bir şey yazmak için ve yazabileceğime de hiç inanmazdım. Ama bu etkinliklerden çıkınca evde de düşündüm. Başka canlandırmalarda hazırladım kendi kafamda. Drama etkinlikleri için kendi kendime bir şeyler yazabileceğimi ve üretebileceğimi fark ettim. Artık fikirlerimi yazabilirim (Student 7-25).

Önceden bana çıkıp tahtada herkes seni izlerken bir şeyler canlandıracaksın deseler inanmazdım ve kendimin yetenekli olduğunu düşünmüyordum. Simdi canlandırma yapma konusunda yeteneğimin olduğunu fark ettim (Student 2-26).

Bir de ilk başlarda canlandırma yaparken gülmeden yapmayı bilmiyordum. Ama daha sonra gülmeden o rolü yapmayı öğrendim. Farklı anları, kişileri canlandırabildim. Bu konuda yeteneğimin olduğunu anladım (Student 10-27).

Canlandırmalarda bazen hataya düştüm ama arkadaşlarım onu görmezden geldi. Kendimi daha mutlu hissettim. Kendime güvenim geldi (Student 4-28).

Topluluk önünde konuşmak benim için ilk zamanlarda biraz zordu. Çünkü bir soru sorduğumda ya da bir şey söylediğimde yanlış olacak diye fazla konuşmuyordum. Fakat drama etkinliklerinde böyle hissetmedim. Yanlış bir şey yaptığımda düzeltme şansımız vardı. Bir de herkes bir şeyler yaptığı için birbirimizin yanlışlarını düzelttik. Toplum arasında artık konuşurken yanlış yapmaktan korkmadan ve utanmadan cevabımı söyleyebilirim. Yanlış da olsa doğru da olsa cevaplarımı söyleyebildim. Artık kendime daha çok güveniyorum (Student 1-29).

Ben genellikle çekingenim. Burada tiyatro sahnesinde rol yapıyormuşuz gibi oldu. Mesela ben makinenin bir parçası oldum. O yüzden utanmadım. Çünkü diğer arkadaşlarımda makinenin başka bir parçasıydı. Sonra bunu yaparken hissettiklerimizi paylaştık. Bu konuda yanlış bir şey yoktu. Çünkü herkes bir rol

yaptı. O yüzden çekinmeden her hissettiğimi söyleyebildim. Yanlış da olsa doğru da olsa fikirlerimi söyleyince mutlu oldum ve fikirlerimi söylediğim için kendime güvenemeye başladım (Student 6-30).

İletişim yönünden de daha aktif oldum. Beraber canlandırmaları yapmadan önce ne yapacağımıza karar verirken kendi fikirlerimi de söyleyebildim. İletişimim konusunda kendime güvenmeye başladım(Student 1-31).

Tüm bu süreçte tanımadığım kişilerin yanında da rahat bir şekilde konuşabildiğimi gördüm. Normalde kendim böyle durumlarda utanıyordum ve hiç konuşmadığımı biliyorum. İlk başlarda canlandırmalarda yine utandım ama sonradan açıldım. İstediğim zaman söyleyecek bir şeyim varsa konuşabildiğimi gördüm ve fark ettim (Student 8-32).

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