A COMPARISION OF DRAMA-BASED LEARNING AND COOPERATIVE LEARNING WITH RESPECT TO SEVENTH GRADE STUDENTS' ACHIEVEMENT, ATTITUDES AND THINKING LEVELS IN GEOMETRY

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ABSTRACT

A COMPARISION OF DRAMA-BASED LEARNING AND COOPERATIVE LEARNING WITH RESPECT TO SEVENTH GRADE STUDENTS' ACHIEVEMENT, ATTITUDES AND THINKING LEVELS IN GEOMETRY

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This study aimed to determine the effects of drama based learning on seventh grade students' achievement (angles and polygons, circle and cylinder), attitudes and thinking levels in geometry compared to the cooperative learning. The study was conducted on four seventh grade classes from two public elementary schools in the same district in the 2006-2007 academic year, lasting seven and a half week (30 lesson hours).

The data were collected through angles and polygons (APA); and circle and cylinder achievement (CCA) tests, the van Hiele geometric thinking level test (POSTVHL), geometry attitude scale (PRE-POSTGAS).

The quantitative analyses were carried out by using Multivariate Analysis of Variance (MANOVA). The results showed that drama based learning had a significant effect on students' angles and polygons achievement, circle and cylinder

achievement, van Hiele geometric thinking level compared to the cooperative learning. However, attitude findings regarding the attitudes revealed that there is not a significant difference according to the geometry attitudes of drama group and cooperative group after treatment.

Both the two instructional methods supported active participation, created cooperative working environment, included daily life examples and gave the chance to classroom communication. On the other hand, drama group students' significantly better performance was attributable to the make belief plays and improvisations of daily life examples included in drama activities.

Keywords: Mathematics education, drama-based learning, cooperative learning, geometry achievement, van Hiele geometric thinking levels, and attitude toward geometry.

ÖZ

DRAMA TEMELLİ ÖĞRENME İLE İŞBİRLİKLİ ÖĞRENMENİN YEDİNCİ SINIF ÖĞRENCİLERİNİN GEOMETRİ BAŞARILARI, GEOMETRİYE YÖNELİK TUTUMLARI VE VAN HIELE GEOMETRİK DÜŞÜNME DÜZEYLERİNE GÖRE KARŞILAŞTIRILMASI

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Bu çalışma drama temelli öğrenmenin, işbirlikli öğrenme ile karşılaştırıldığında yedinci sınıf öğrencilerinin geometri başarılarına (açılar ve çokgenler; daire ve silindir), van Hiele geometrik düşünme düzeylerine, geometriye yönelik tutumlarına etkisini araştırmayı amaçlamıştır.

Çalışma iki devlet okulundan seçilen 4 yedinci sınıf üzerinde(her okuldan 2 sınıf) 2006-2007 öğretim yılında gerçekleştirilmiş ve yedi buçuk hafta (30 ders saati) sürmüştür.

Veri toplamak amacıyla, açılar ve çokgenler (APA); ve çember ve silindir başarı testleri (CCA), van Hiele geometrik düşünme düzeyi testi (POSTVHL) ve geometriye yönelik tutum ölçeği (PRE-POSTGAS) kullanılmıştır.

Elde edilen niceliksel veriler, yapılan Çok Değişkenli Anova (MANOVA) ile incelenmiştir. Analiz sonuçlarına göre gruplar arasında açılar ve çokgenler; çember ve daire başarı testleri, van Hiele geometrik düşünme düzeyleri testinden alınan puanlara göre drama grubu lehine istatistiksel olarak anlamlı bir fark bulunmuştur. Yapılan analizlerde drama ve işbirliği gruplarının geometriye yönelik tutumlarında anlamlı bir değişiklik gözlenememiştir.

İki öğretim yönteminin de aktif katılımı gerektirdiği, işbirlikli çalışma ortamı yarattığı, günlük yaşam örnekleri içerdiği ve sınıf içi iletişim şansı yarattığı belirtilmiştir. Buna karşılık drama grubundaki öğrencilerin başarısındaki anlamlı fark drama aktivitelerinin günlük yaşantıya yönelik canlandırmalar ve rol oynama durumları içermesiyle açıklanabilir.

Anahtar Kelimeler: Matematik eğitimi, drama temelli öğrenme, işbirlikli öğrenme, geometri başarısı, van Hiele geometrik düşünme düzeyleri, ve geometriye yönelik tutum

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ABBREVIATION

DramG:	Drama based learning group
CoopG:	Cooperative learning group
APA:	Students' scores on Angles and polygons achievement test
CCA:	Students' scores on Circle and cylinder achievement test
VHL:	Van Hiele geometric thinking level test
GAS:	Geometry attitude scale
PREVHL:	Students' pretest scores on van Hiele geometric thinking level test
PREGAS:	Students' pretest scores on geometry attitude scale
POSTGAS:	Students' posttest scores on geometry attitude scale
POSTVHL:	Students' posttest scores on van Hiele geometric thinking level test
MANOVA:	Multivariate analysis of variance
ANOVA:	Analysis of variance
Sig:	Significance
Df:	Degree of freedom
N:	Sample size
α:	Significance level

CHAPTER 1

INTRODUCTION

According to Vygotsky's sociacultural theory, cognition is a profoundly social phenomenon. Social experiences shape the ways of thinking and interpretation of the world. He indicated that through cooperative dialogues between age mates, children learn to think and behave in ways that reflect their community's culture (Vygotsky, 1978). Numerous research findings suggest that elementary students are no actively involving in their learning process in traditional learning atmospheres. Cooperative learning, discussion, dialogues, hands-on activities and drama emphasizes students' active participation to the learning process. While a variety of instructional practices have been shown to engage students in learning, the remainder of this research will focus on cooperative learning and drama based learning.

For the last century, cooperation has been a subject of interest to researchers, therefore cooperation and collaborative learning techniques became popular. The research findings indicated the students' apathy and low participation as the serious constraints to learning (Chilcoat, & Ligon, 1998). Lindquist (1989) proposed that cooperation in mathematics could encourage verbalization and working together; make students responsible for their own learning. Much of the literature supports that working together in groups result in higher student achievement especially in mathematics (Davidson, 1990; NCTM, 1989; NCTM, 2000). Nichols and Hall (1995) recommended cooperative learning as an effective teaching method in geometry lessons. Johnson and Johnson (1985) showed that cooperative groups used more advanced thought processes than did individual students. As the evidence for effectiveness of cooperative learning is accumulating, researchers tried to compare different methods of cooperation. Mulryan (1995) reported that students in small-

groups engage in activities more than did the students in large-groups. The results of such study reflect how the different instructional settings affect the students' participation and learning. In addition, Peterson & Miller (2004) investigated the quality of students' experiences during cooperative learning and large group instruction. The research findings addressed that the instructional context has an important effect in the quality of students' experience.

On the other hand, researchers hoped that drama would be one of many progressive methods that challenge students to take active part in community involvement (San, 1996; Adıgüzel, 2002). Drama-based learning has a large potential for group work. Drama, as a teaching tool, creates a mini community in which the students' direct involvement to the learning process is necessary. It provides the opportunity for learning to cooperate and collaborate (Sternberg, 1998). As stated by Berghammer (1991), "through the language of drama, individuals interact with each other, share thoughts, feelings and experiences" (p.1). However, it has different characteristics compared to cooperative learning; especially with respect to the social communication situations, cognitive load and participation of the learner. Charlesworth and Hartup (1967) reported, "When children are engaged in pretend play they are likely to be more cooperative, more communicative, and are willing to accept reinforcement from their peers" (p.993).

According to Annarella (1992), students can be empathetic to the needs of others. In addition, Vygotsky's general genetic law of cultural development indicates the importance of collaboration with peers instead of being internalized when developing new capacities for children (Vygotsky, 1978). Vygotsky (1978) emphasizes that much learning occurs when children play. From his point of view, during this play, students use language; determine the conditions for make-believe play; discuss on roles, objects and directions that they learn about situations and ideas, which are not tried. Children's play encourages the children to behave beyond their average age, above their daily behavior. This indicates the creation of "zone of proximal development" for the child, which was defined by Vygotsky (1978) as "the distance between the actual developmental level and the level of potential development…" Drama based learning environment involves children's play. During

this play, they try to present their potential developmental abilities.

The examination of the literature on drama and geometry indicated that only one study; Duatepe & Ubuz (in press) investigated the effects of drama-based instruction compared to traditional teaching in promoting geometry achievement, attitudes and van Hiele thinking levels. The results of such study point to the greater effectiveness of the drama based instruction because of contextualization of geometry concepts and problems, role playing, working in groups, and communicating each other.

Ministry of Education in Turkey started to implement new elementary mathematics curriculum through grades 1 to 8 by 2005-2006 academic year. New mathematics curricula indicate the importance of cooperative learning because of its strengths in student participation and communication. Student and teacher books include many examples for cooperative learning activities. Moreover, new mathematics curricula suggest the use of drama for cooperative learning activities. Both the cooperative and drama activities encourage students' active participation to the lesson and involve students' communication toward achieving the goals. However, drama based learning and cooperative learning has similarities, review of the literature indicates the differences of drama based learning with respect to the students' participation and communication situations (Annarella, 2000; Roland, 2001). When students join to the role-playing situations in drama, they use their cogitive and physical abilities at the same time. Moreover, these role-playing situations include the whole class participation. On the other hand, while students work on cooperative learning activities they use only their cognitive abilities by sitting in small groups and students communication is mostly limited to the small groups.

Considering these facts, there is a need to design an experimental study including the comparison of the drama-based learning and the cooperative learning method in promoting students' achievement, thinking levels and attitudes. In this study, drama based learning and cooperative learning were recommended for their strengths in encouraging expression, exposing feelings, permitting the participation

of students on various levels and the sharing of strengths and weaknesses of individual group members, and developing group responsibility. This study aimed to compare the students' participation and communication situations in drama based learning and cooperative learning.

1.1 The research question

What are the differences of the drama based learning compared to the cooperative learning on seventh grade students' van Hiele geometric thinking level, attitudes toward geometry, and achievement on angles and polygons; and circle and cylinder?

1.2 Assumptions

1. All tests were administered to the cooperative group and drama group under the same standard conditions.
2. The subjects of the study were sincere while responding to the test items.

1.3 Limitations

1. The study was not a true experimental study since subjects were not randomly assigned to the cooperative and the drama group.
2. The results of the study are limited to the population with similar characteristics.
3. The students' prior achievement was not taken into consideration. Instead, the prior van Hiele thinking level and mathematics grade in previous year were assessed. Researches (Senk, 1989; Usiskin, 1982) have revealed that students' van Hiele level is a good predictor of the students' achievement on geometry.

1.4 Definition of the Important Terms

The terms used in this study can be defined as follows;

Attitude toward Geometry: Students' attitudes toward geometry were defined

by their scores on the Geometry Attitude Scale developed by Duatepe & Ubuz (in press).

Geometry Achievement: Students' levels of geometry achievement were defined by their scores on the Angles and Polygons; Circle and Cylinder achievement tests developed by Duatepe & Ubuz (in press)

Mathematics grade in previous year: Students' mathematics grades at their sixth grade report cards. This information was obtained from school administration.

Drama based learning: Drama based learning is an exploratory and experiential approach to learning that involves the interaction of mind and knowledge; sensory and kinesthetic experiences; evaluation and decision making; understanding of the how, the why and why not of complex issues (Martin-Smith, 1993). It creates an imaginary world in which the students can explore the situations, places, feelings that they did not experienced before (Roland, 2001). In this imaginary world, students construct their own knowledge by actively participating to the activities rather than passively absorbing the given knowledge. It encourages children to speak and gives them the chance to communicate, using non-verbal communication, such as body movements and facial expressions (Philips, 2001).

Cooperative Learning: Cooperative learning involves a small group of learners, who work together as a team to solve a problem, complete a task, and accomplish a common goal. It requires teacher guidance that help students understand group dynamics, develop the cooperative learning skills they need, and learn the content by working together in groups. Cooperative learning encourages student-to-student interaction, establishes symbiotic relationships among team members (Artzt, & Newman, 1990).

1.5 Significance of the Study

The purposes of this study were to examine the effects of cooperative learning and drama based learning on seventh grade students' geometry

achievement; van Hiele geometric thinking level; and attitudes towards geometry. Also describing the classroom atmospheres in terms of student participation, social communication situations, and cognitive load is in the scope of this study.

Many publications indicate that cooperative learning is an effective instructional method in teaching mathematics. However, they focused on comparison of cooperative learning with traditional teaching methods or implementation of cooperative learning itself. Review of the related literature indicates that drama is a cooperative group art form in which the students are the instruments of the learning process. However, there exist slight differences between drama and cooperative learning according to the cooperation and social communication situations.

Considering these facts, there is a need to design an experimental study to compare the effects of drama-based learning and cooperative learning in mathematics classrooms. In addition, if there is a significant difference between these two instructional techniques, it is necessary to clarify what causes the differences that affect the learning.

Although, lack of the research on the effects of drama in mathematics will offer a question of "why this study is necessary?" Findings will be significant in validating the use of drama-based learning in geometry. New mathematics curriculum, K-8 grades, encourages the use of drama activities. Results of this study can contribute to the use of drama in classrooms. Moreover, teacher education might be affected with the result of the study. Drama training will be offered for the preservice and the in-service teachers.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

2.1 Drama Based Learning

Taylor (2000) defined drama as a cooperative group art form in which people are the instruments of the inquiry. According to him, people transform, act, and reflect upon the human condition. Drama was seen as representation of human construction processes where the suggestions for exploration and experiment were the predictors of boundaries rather than the predetermined knowledge and authority (Chilcoat & Ligon, 1998). There exists a fictitious world where the participants find themselves in a world that they momentarily step into imagined roles, characters and situations (Taylor, 2000). Creating real life situations by means of improvisation is the main idea (Chilcoat & Ligon, 1998).

Each people's own interpretation of the world, lays out the content (Taylor, 2000). According to Chilcoat and Ligon (1998), students learn and understand academic knowledge easier by doing drama in a way, which is less abstract, since students had to translate information into meaningful acts and scenes. However, they have to use academic content to design plays, information became more interesting, pleasurable and enjoyable and students were motivated to better understand and memorize. According to Annarella (1992), the ability to be creative is present within every individual and it begins to work in an experiment climate in which students feel comfortable for taking risks. She emphasized that the use of creative drama helps the student to process the existing internal ability into an external form.

In drama, the classroom teacher sets up the classroom atmosphere for the drama in non-scripted dialogue situations (Roland, 2001). The students participate in an active exploration of ideas, not in a subordinate teacher-student situation. The climate is in a free and accepting atmosphere where they feel secure enough to express ideas and emotions freely (Chilcoat & Ligon, 1998). Through role-playing, students begin to explore places, times, and situations that they may not have directly experienced (Roland, 2001).

Drama, when used as a teaching strategy, takes the individual student in a community atmosphere where the student can share individual thoughts and actions with the other participants. For valid outcomes, individuals are being encouraged by the process for combining the emotional strengths with external facts (Annarella, 1992.). As reported by Philips (2001), children often work in groups or pairs when dramatizing. They have to make decisions as a group, listen to each other, and value each other's suggestions. Cooperation is necessary for achieving the aims, finding the ways of settling their differences, and using the strengths of each member of the group.

With respect to the (Chilcoat & Ligon, 1998) the play - making process can provide teachers with a conceptual framework. It helps students to take responsibility for their own learning through collective social interaction. By the way, they negotiate meanings, practice reasoning and critical thinking, and present their points of view; they question, plan, speculate, describe, disagree, express commitment, negotiate and interpret with talk. According to Philips (2001), drama activities encourage children to speak and give them the chance to communicate, using non-verbal communication, such as body movements and facial expressions.

According to Annarella (1992), the idea of group participation in drama lends itself particularly well with the practice of cooperative learning. She emphasized the implementation of the creative drama activities within the cooperative structure by involving the students in a task-oriented project associated with the content material. Planning, acting, observing, reflecting, replanning, observing-participating, and re-

reflecting activities builds up the collaborative nature of drama(Richards, 1996).

During most of the drama activities, the children stand up, and usually there exists enough space at the front of the classroom. If the children stand in a circle or work in groups, more space is necessary and this can be created by pushing the tables and chairs to the edge of the classroom. While the children are doing the activity, teacher should watch and listen to them, try not to interfere, and take notes on what is being observed. However, the process is the main aim; students will see the performance as most valuable thing. Classroom teacher need to value their performances (Philips, 2001). The student must feel trust from the instructor. The teacher becomes a mentor for the students, guiding them through activities and creating a non-threatening atmosphere for the class.

The classroom teacher should not acknowledge that some one has performed well. Creative drama is non- judgemental (Annarella, 1992). In addition, the teacher can use roles to encourage children who would otherwise hold back, and control children who dominate the weaker ones (Heinig, 1988).

According to the theory of multiple intelligences of Gardner (1985), individuals receive and process information in different ways such as sight, hearing, and our physical bodies. One of these channels tends to be dominant in each individual. If the new information is being received through this dominant channel, it is easier to understand and use this information. However, children use all the channels while they are dramatizing, each child will draw on the most appropriate channel that suits them best (Philips, 2001).

With respect to the findings of Chilcoat & Ligon (1998), they reported that drama activities provide students five types of experiences as follows:

1. Opportunities for active group participation within a context of community improvement;
2. Opportunities for creative expression of personal experiences, building both self-confidence and collective confidence

3. Contexts promoting greater understanding of subject matter,
4. Practice in applying basic principles of effective and efficient critical thinking,
5. Challenges to link experience with social responsibility in fostering social change

2. 1.1 Phases of Drama Based Learning

Heinig (1988) explained the three phases of drama based lessons as follows: introduction, development and quieting parts. During the introduction part, the warm up material is used and it should not be too difficult for the children to do. These activities aim to put everyone in a relaxed mood and ready to work together. In addition, the warm up material includes some hidden clues about the rest of the lesson (Heinig, 1988).

In the development part, make-believe play exists and an experiment climate is created (Annarella, 1992). Then the students use their knowledge and experience to develop their characters' response.

During the make-believe play, students carry out their internal abilities, feelings and experiences to the real life situations by "as if" play. Some of the drama techniques are used in this phase to achieve the objectives. According to Neelands (1991), to reach the aims of the drama activities, these techniques are chosen with respect to the experience of the group, content, appropriateness to the needs, available time and space. Dramatic moment, that was defined by (Andersen, 2000) as a "tension" during the process is a key point for the rest of the lesson. Until the conflict that is formed by dramatic moment is being solved, students strongly get interested in the problem.

A review of the lesson exists in the quieting part. This review can be such as explanations, short improvisations or answers to the questions that requires the use of knowledge learned. As an evaluation part, quieting activities are necessary to check out if the objectives are reached or not.

2.1.2 Drama Techniques

However, there exist many drama techniques for drama activities; teachers use the most appropriate ones for their lessons. Some of the drama techniques are as follows:

Role-Play: Students pretend to be a character by putting themselves in a similar position and imagining what that character might say, think and feel (Neelands, 1991).

Meetings: Students get together to hear news, plan action, make decision together and propose strategies to solve problems that have emerged. (Neelands, 1991).

Games: Traditional games or suitable variations of them are used to establish trust, confidence or rules. They are selected to simplify a complex experience (Neelands, 1991).

Interviews: Interviews are challenging, and demanding situations designed to reveal information, attitudes, motives, aptitudes and capabilities. Interviewer has the charge of eliciting reaction through suitable questions (Neelands, 1991).

Reportage: This provides an interpretation of events, situations and concepts through a journalist perspective and presents in the form of TV news or documentaries. The students may be in media roles to reveal what has happened from a distance, within emphasis on how events can be interpreted by outsiders (Neelands, 1991).

Teacher-in-Role: The teacher manages the learning opportunities provided by the dramatic context within the context by adopting a suitable role in order to; excite interest, control the action, and invite participation provoke tension, challenge superficial thinking, create choices and ambiguity, develop narrative, and create possibilities for the group to interact in role. The teacher is not acting spontaneously

but is trying to mediate her/his teaching purpose through her/his involvement in the drama (Neelands, 1991).

Role-Reversal: Students exchange their roles in some part of the activity. As play-within play, and one group display to each other how they think and behave (Neelands, 1991).

Writing in Role: Students are asked to write a letter, a report, etc. while pretending that they are the character in the story like reporter (Neelands, 1991).

Mimed Activity: Students act without speaking. This activity emphasizes movement, actions and physical responses rather than dialogue or thoughts. Speech can be included as an aid to enactment, encouraging a demonstration or behavior rather than a description of it (Neelands, 1991).

Small-group play making: Small groups plan, arrange and present improvisations as a means of representing an idea, a hypothesis, or show different perspective of action. The improvisations express existing perspective of a condition or experience (Neelands, 1991).

Flashbacks: Events from the past are blended with the presentation of current events. This technique is frequently used in order to illustrate a character's memories or to explain the outcome of certain actions. To recall what happened in the past, to show the audience, what had happened in the past.

Hot Seating: Students, performing as themselves, have the opportunity to question or interview a role-player who remains in a character. The individual student sits in the "hot seat" and has questions fired at them that they have to answer from the point of view of the role they are enacting. Improvisation may be frozen and role player answers questions (Neelands, 1991)

Diaries, Letters, Journals and Messages: Diaries, letters, journals and messages are written in or out of role to reflect on experience; to review work; or to

build up a cumulative account of a long sequence of work (Neelands, 1991).

Mantle of Expert: Students are given the role of experts in a particular area, and the teacher-in-role asks for their suggestions to solve some conflicts raised in the drama (Neelands, 1991).

Still- Image: In order to make clear and emphasize a moment, an idea, a concept or a theme, students construct an image using their own bodies (Neelands, 1991).

Whole Group Role Play: The entire class (teacher as well) behaves, as they were an imagined group facing a situation as it actually happening around them (Neelands, 1991).

Telephone Conversation: This occurs as two-way conversation between pairs or one-way conversation where the group only hears one side of the conversation (Neelands, 1991).

Noises Off: The conflict and motivation result from a sense of threat or danger, that is coming up but not actually present. Students work with/against an imagined presence (Neelands, 1991).

Forum-Theatre: A small group of students is engaged a situation or a concept while the others observe. Both the actors and the observers have the right to stop the action whenever they feel it is losing direction, or if they need help. Observers may step in and add a role or take over an existing one (Neelands, 1991)

Analogy: A problem is revealed through working on a similar situation that reflects the real problem (Neelands, 1991).

Re-enactment: An event that is known, or has previously occurred, is reenacted in detail to show what might have happened, or in order to find out its details (Neelands, 1991).

2.1.3. Research on Drama Based Learning

Most of the previous research on drama-based learning was done in social sciences investigating the social skills such as communication abilities, language usage, socialization and self-confidence.

Ömeroğlu (1990) implemented a study by measuring 80 five-six year old children's verbal creativity with Torrance Creative Thinking Test. He reported that drama is an effective method that contributes to the verbal creativity of five-six year old children.

Ballou (2000) examined the effects of drama on communication skills and attitudes toward school and learning. Twelve pairs of at risk six graders were randomly selected to participate in a 20-week in-school drama experience. Findings showed that drama made a significantly positive effect on experimental students' communication skills and on their attitudes towards school and learning.

Selvi and Öztürk (2000) investigated the effects of drama-based instruction on fifth grade student's achievement on "body recognition" and attitude toward science compared to traditional teaching. The treatment lasted four weeks totally 24 lesson hours. Participants were 40 students for drama group and 40 students for control group. Pre-post test control group design was used for this study. However one of the groups were taught by the researcher with drama-based instruction the other was taught by the classroom teacher by traditional teaching. Findings have shown that creative drama had a significant effect on science teaching in accordance to the student achievement. On the other hand, according to the attitudes of students, no significant difference was found. Researchers have emphasized that a 4 weeks period is too short for changing students' attitudes.

Kamen (1992) examined the effects of drama-based instruction in enhancing the elementary students' understanding of the science concepts. Activities included the use of movement, pantomime, improvisation, role-playing and characterization. Data were collected by interviews with students and teachers; direct observations;

and written tests for the students. Analysis of the collected data revealed that student achievement improved on the content tests. Both the students and the teachers reported the positive effects of drama such as better understanding of the concepts, an improved motivation and interest in learning science, students' enjoyment of using drama based instruction. The students indicated that they learned more when this method was included.

2.1.4. Research on Drama Based Learning in Mathematics Education

On the contrary of the research that investigates the effects of drama and drama-based learning in other sciences such as language and science teaching, there are few studies indicating the effects of drama based instruction on mathematics teaching. Lack of the mathematics educators who were qualified on drama-based instruction can be one of the reasons for this.

Saab (1987) investigated the effects of drama based mathematics instruction compared to textbook-oriented mathematics instruction. A pre-posttest experimental design was used for the study. Participants were 87 sixth graders. Once the pretests for the three dependent variables (mathematics achievement, attitudes toward mathematics, and creativity) were given, the experimental groups received eight weeks of drama based mathematics activities during their regular mathematics classes. The control groups received textbook oriented mathematics instruction without any of the drama methods integrated into their classes. All students were then post-tested with the mathematics achievement test; mathematics attitude scale; and a creativity test. The collected data were analyzed by means of Analysis of Covariance. Results showed that drama based activities had a significant positive effect in levels of mathematics achievement related to mathematics computation. According to this study, attitudes toward mathematics and levels of creativity were not affected by the use of drama-based activities.

Southwell (1999), in his research, gave only examples of using dramatic moments to explore mathematical ideas, to challenge students and to develop conceptual understanding at the beginning, at the middle or at the end of the lesson.

Duatepe and Ubuz (in press) investigated the effects of drama-based instruction on seventh grade students' achievement, attitudes and van Hiele Geometric Thinking levels on mathematics and geometry compared to the traditional instruction method. A quasi-experimental research design was used and data were collected through achievement tests, attitude scales, geometric thinking level test and both student and teacher interviews. There were 102 participants of the study. With respect to the analysis results, they reported that, drama-based instruction had a positive effect on student achievement and van Hiele Geometric Thinking Levels on angles and polygons, circle and cylinder units. Results indicated that both the traditional and drama based methods was not significantly effective on students' attitudes toward mathematics and geometry.

2.1.5 Effects of Drama Based Learning

Review of the related literature on the effects of drama-based learning has indicated that, drama activities,

1. develop active group participation (Chilcoat & Ligon,1998; Kelner, 1993)
2. foster creative expression of personal experiences for building self-confidence and collective confidence (Ballou, 2000; Kelner, 1993)
3. improve academic achievement (Chilcoat,&Ligon,1998, Saab, 1987; Üstündağ, 1997)
4. promote direct community action and cooperative work (Chilcoat,&Ligon,1998; Kelner, 1993; Southwell, 1997)
5. develop critical thinking skills (Kelner, 1993; San, 1996)
6. improve problem-solving skills (Freeman, 2000)

2.2 Cooperative Learning

Cohen (1994) defined cooperative learning as the students working together in groups, which are small enough so that each individual can contribute to a task that has been clearly defined and is intended to be dealt with collectively. Cooperative learning usually supplements the teacher's instruction by giving students

an opportunity to discuss information or practice skills originally presented by the teacher (Slavin, 1994).

There are many different cooperative learning techniques; however, all of them have certain elements in common. These elements are necessary to insure that when students do work in groups, they work cooperatively. In this study, Learning Together technique was used. It is not sufficient to direct a group of students to separate into small groups and study on a problem or set of problems. First, the members of a group must perceive that they are part of a team and they have a common purpose. It is not cooperative learning if the students sit together and work on problems individually. Second, group members must realize that the problem they are studying on is a group problem and that the success or failure of the group will be shared by all of the members of the group. Third, to complete the group's goal, all students must talk with one another for engaging in discussion of all problems. At last step, each member's individual work should have a direct effect on the group's success (Askew & William, 1998). These elements of the cooperative learning methods sometimes require students to find or discover information on their own.

Many cooperative learning methods recommend heterogeneous group composition rather than homogeneous in order to reflect varying student abilities and backgrounds in the class. To maximize the benefits of cooperative learning groups, the membership should be heterogeneous in ability and personal characteristics. The group must stay together long enough for cohesiveness to develop. A successful group will be small enough for everyone to be needed but large enough to permit a diversity of ideas and skills (Artzt & Newman, 1990).

Kramarski (2004) indicated the implementation of cooperative learning with heterogeneous teams of four pupils: One high, two middle, and one low achieving student. Kramarski (2004) reported with respect to the Johnson & Johnson (1999)'s suggestions that teacher-selected groups often result in the best mix because teachers are better able to form optimal combinations than did students.

When students of different abilities are grouped together, more frequent

giving and receiving of explanations take place. Contrary to what one might expect, the high-ability student derives as much benefit from group interaction as do the low- and average-ability students. The verbal communication of mathematics is a means for students to become actively involved in learning mathematics. To give a mathematical explanation to one's peers, a student must understand the material with far more depth than is required merely to produce an answer on a worksheet. Cooperative learning strategies have been credited with the promotion of critical thinking, higher-level thinking, and improved problem-solving ability of students (Artzt & Newman, 1990).

The classroom teacher plays a vital role in the implementation of effective cooperative learning. It has already been pointed out that the teacher is responsible for the formation of groups. In addition, explaining the assignment, the academic expectations for the group, the expected collaborative behaviors, the procedures to follow, and the definition of group success is teacher's responsibility, too. The materials and the instructions for their use should be structured in such a way that each student in the group does something to contribute to the group's work. Each person is expected to learn the material and to help others learn the material. Teachers must monitor the groups while they are in progress and provide assistance as it is needed. The teacher should provide feedback so that students know how well they are doing. In addition, the instructor should organize the physical class environment for cooperative learning by arranging the desks. (Artzt & Newman, 1990).

2.2.1 Cooperative Learning Schemes

There are many different cooperative learning schemes have been developed and studied; however, all of them have certain elements in common.

Some practical cooperative learning models are stated as follows by Slavin (1994):

- Student Team Learning Techniques
- Learning Together
- Group Investigation

2.2.1.1 Student Team Learning (STL) Techniques

All cooperative learning methods share the idea that students work together to learn and are responsible for one another's learning as well as their own. STL methods, in addition to this idea, emphasize the use of team goals and team success, which can only be achieved if all members of the team learn the objectives being taught. That is, in Student Team Learning the students' tasks are not to do something as a team but to learn something as a team.

Team rewards, individual accountability and equal opportunities concepts are central to all Student Team Learning methods. The following Student Team Learning methods are general cooperative learning methods adaptable to most subjects and grade levels:

a. Student Teams-Achievement Divisions (STAD)
b. Teams-Games-Tournament (TGT)

2.2.1.1.a Student Teams-Achievement Divisions (STAD)

In STAD, students are assigned to four-member learning teams mixed in performance level and gender. The teacher presents a lesson, and then students work within their teams to make sure that all team members have mastered the lesson. Finally, all students take individual quizzes on the material, at which time they may not help one another. The whole cycle of activities, from teacher presentation to team practice to quiz, usually takes three to five class periods.

STAD have been used in a wide variety of subjects, from mathematics to language arts and social studies. They have been used from grade two through college. STAD are most appropriate for teaching well-defined objectives with single right answers, such as mathematical computations and applications, language usage and mechanics, geography and map skills, and science facts and concepts (Artzt & Newman, 1990).

2.2.1.1. b Teams-Games-Tournament(TGT)

Teams-Games-Tournament uses the same teacher presentations and teamwork as in STAD, but replaces the quizzes with weekly tournaments. In these students compete with members of other teams to contribute points to their team scores.

2.2.1.2 Learning Together

David Johnson and Roger Johnson at the University of Minnesota developed the Learning Together models of cooperative learning (Johnson & Johnson, 1987). The methods they have researched involve students working on assignment sheets in four-or five-member heterogeneous groups. The groups hand in a single sheet and receive praise and rewards based on the group product. Their methods emphasize team-building activities before students begin working together and regular discussions within groups about how well they are working together.

2.2.1.3 Group Investigation

Group Investigation, developed by Shlomo Sharan and Yael Sharan at the University of Tel-Aviv. In this method, students form their own two-to six-member groups. After choosing subtopics from a unit being studied by the entire class, the groups further break their subtopics into individual tasks and carry out the activities necessary to prepare group reports. Each group then makes a presentation or display to communicate its findings to the entire class.

2.2.3. Phases of Cooperative Learning

Cooperative learning environment is proposed by Toumasis (2004) as follows:

(a)Teacher introduces the unit to class including a general discussion about the unit objectives or interesting film, media about topic.

(b)The whole class is divided into study teams for providing a forum in which students ask questions ,discuss ideas, make mistakes, learn to listen to others' ideas, offer constructive criticism and summarize their discoveries in writing.

(c)Teacher distributes study team worksheets.

(d)Students learn concepts identified on the worksheet cooperatively. While the groups are at work, the teacher has the opportunity to be an active listener to six or more different discussions. In this session, students feel secure in the study team; because once the group has started its work then each member knows that the group will assist if he or she gets stuck or has been absent and needs information or did not understand something. During this session the instructor feels he or she is working with students instead of 'on' them by moving among groups, answering their questions and encouraging them for their work.

(e) Class discussion session helps the class to explain key ideas and difficult points eliminating the possibility that an incorrect response has been given in them.

(f) Teacher distributes summary cards to students for writing important points according to them.

(g) Students take individual tests. These are used to assess student mastery of the concepts.

2.2.4 Research on Cooperative Learning

Cooperative learning, a topic studied by many researchers from different research traditions, is certainly no exception. However, after nearly two decades of research and scores of studies, a considerable degree of consensus has emerged. There is agreement that-at least in elementary and middle/junior high schools and with basic skills objectives-cooperative methods that incorporate group goals and individual accountability accelerate student learning considerably. Further, there is agreement that these methods have positive effects on a wide array of affective

outcomes, such as intergroup relations, acceptance of mainstreamed students, and self-esteem (Slavin, 1994). Research has shown that collaborative learning encourages the use of high-level cognitive strategies, critical thinking, and positive attitudes toward learning (Garrison, Anderson & Archer, 2000; Johnson & Johnson, 1999).

In Slavin' s(1994) review research of more than 70 high-quality studies have evaluated various cooperative learning methods over periods of at least four weeks in regular elementary and secondary schools; 67 of these have measured effects on student achievement. Overall of 67 studies of the achievement effects of cooperative learning, 41 (61 percent) found significantly greater achievement in cooperative than in control classes. Twenty-five (37 percent) found no differences, and in only one study did the control group outperform the experimental group.

All these studies compared the effects of cooperative learning to those of traditionally taught control groups on measures of the same objectives pursued in all classes. Some of these research projects have compared cooperative learning methods with whole-class learning methods. Others have examined the individual and group processes that occur within cooperating teams. There is strong evidence to indicate that cooperative learning is beneficial for students across many dimensions. Cooperative learning capitalizes on the powerful influence of peer relationships. By promoting interaction within the group, cooperative learning teaches students to be supportive and accepting of students who are different. When placed in a working group, students of different abilities, cultural backgrounds, and physical make ups have a common ground for discourse (Artzt & Newman, 1990). Other outcomes seen in many studies of cooperative learning consist of gains in self-esteem, liking of school and of the subject being studied, time-on-task, and attendance (Slavin, 1990).

2.2.5 Research on Cooperative Learning in Mathematics Classrooms

Many research findings emphasize the effects of cooperative learning in mathematics classrooms. However, these researches generally focus on the comparison of cooperative learning and traditional instructional methods or

investigate the implementation of cooperative learning itself.

Fourth graders in a study by Swing and Peterson (1982) worked in small groups of heterogeneous ability during the seatwork phase of lessons that had been patterned on active mathematics teaching (AMT). Students who had received training in working cooperatively engaged in more task-related interactions than did controls. They provided and answered more high-order questions than did controls; in contrast, controls sought and provided more answers to questions than did trained students. The effects of training on small group interactions were within chance levels on tests of fractions, division, and two-week retention.

Watson, Chick (2001) investigated the factors that influence the effectiveness of collaboration on open-ended mathematical tasks. They studied with the students in grades 3, 6 and 9 in groups of 3. The group outcomes and the types of collaboration observed are investigated. They have reported the benefits of cooperative learning. They reported the factors that influence the collaborative tasks such as academic disagreement, misunderstanding, doubt, and tenacity of ideas.

Whicker et all. (2001), studied the effects of cooperative learning on student achievement and attitudes in secondary mathematics classrooms. Participants were the 31 students in a rural high school. According to the survey results, most students indicated that they liked working in groups and appreciated getting help from other students. Research indicated that students in cooperative learning group had increasingly high test scores than students in control group.

Toumasis (2004), reported on an experimental study. The study took place for three years in grade levels 8-10. With respect to the results, students' attitude, attendance, completion of assignments and willings to participate in class has improved.

2.3 Geometry Teaching

Since prehistory, people arranged their lives by stylized drawings, decorated

their artifacts by adding ornamental motifs formed by simple geometric shapes endowed with symmetries and shaped their first constructions in regular geometric forms. The word "geometry" derives from the Greek word "geometria" that means measurement of land. As a science, geometry was found around 600 B.C. in the Greek culture by Thales (Mammana & Villiani, 1998).

Freudenthal (1973) defines geometry as a "…grasping space… that space in which the child lives, breathes and moves. The space that the child must learn to know, to explore, to conquer in order to live, to breathe and to move better in it." School geometry encourages students to develop insight for understanding other mathematical concepts and connect ideas across different areas of mathematics (Mammana & Villiani, 1998; NCTM, 2000). NCTM (2000) also reported that nature and the beauty of mathematics could be understood by the concepts of geometry such as symmetry and generalization.

Mammana & Villiani (1998) indicated that in general mathematics and geometry in particular interact with the real world. In their report they described the relation between physical world in which we live and the geometry. How the other sciences, such as physics and economics use geometry was discussed. For example, economics will use the coordinates and graphs for interpreting money supply and mathematical physics require the usage of three-dimensional figures for the higher dimensional space experiments. In addition to the place of geometry in real world, Kahane (1994) stated, "geometry is everywhere… The most classical geometrical objects (circle, triangle) are rich in marvelous properties. Soap bubbles, polymers, the natural fissures in rocks- are a mine of new geometries".

2.3.1 Development of the Geometry Concepts

Van Hiele (1986) defined a model for geometrical thinking that explains the development of human geometric reasoning. According to his modeling, all human beings progresses through five stages of geometrical reasoning as follows; (level 0) visual level, (level 1) descriptive level, (level 2) theoretical level, (level 3) formal logic and (level 4) the nature of logical laws.

With respect to the characteristics of these stages as stated by van Hiele (1986), outputs of one level are the inputs for the following level. A person cannot pass through a higher level before achieving the previous one. If this situation appears, it reflects that the child stimulate a level by performing algorithmically. This was named as "reduction of levels". In this case, the student is often applying rules without understanding the meaning and may consider arbitrary. Progress from one level to the next level depends more on the content and methods of instruction than on age or biological maturation. Students need a treatment to move from one level to the next. Each level has its own linguistic symbols and its own structure connecting those symbols. While talking on geometry, two people at different levels of geometric reasoning cannot understand each other.

2.3.1.a Level 0 (The Visual Level):

Students first learn to recognize a shape by its appearance as a whole or through some physically qualities such as "tightness", "wideness", etc. They are not able to notice the properties of components. Without giving explanations, concerning properties of the shape, students can name a shape only by memorizing. They may estimate a given figure is a rectangle because it looks like window. Fuys, Geddes and Tischler (1988; p. 58-59), identified the descriptors for this level as follows;
Students at this level;

1. identifies instances of a shape by its appearance as a whole
   a. in a simple drawing, diagram or set of cut-outs,
   b. in a different positions,
   c. in a shape or other more complex configurations,
2. constructs, draws, or copies a shape,
3. names or labels shapes and other geometric configurations and uses standard and/or nonstandard names and labels appropriately,
4. compares and sorts shapes on the basis of their appearance as a whole,
5. verbally describes shapes by their appearance as a whole,
6. solves routine problems by operating on shapes rather than by using properties,

which apply in general,

7. identifies parts of a figure but

a. does not analyze a figure in terms of its components.

b. does not think of properties as characterizing a class of figures.

c. does not make generalizations about shapes or use related language.

2.3.1.b Level 1 (The Descriptive Level)

At descriptive level, students reason about geometric concepts by means of an informal analysis of their parts and properties. These properties could be realized by a variety of activities such as observation, measuring, cutting, and folding. At this level, necessary properties of the figure could be understood. For example, the student knows the properties of a square such as; a square has four congruent sides; a square has congruent diagonals; a square has four right angles; the diagonals of a square bisect each other; the diagonals of a square are perpendicular; opposite sides of a square are parallel. Therefore, relations between properties and definitions are not understood. According to Fuys et al., (1988; p. 60-63), the descriptors for this level are as follows;

Students at this level;

1. identifies and tests relationships among components of figures,

2. recalls and uses appropriate vocabulary for components and relationships,

3 a. compares two shapes according to relationships among their components,

b. sorts shapes in different ways according to certain properties, including a sort of all instances of a class from non-instances,

4. a. interprets and uses verbal description of a figure in terms of its properties and uses this description to draw/construct the figure,

b. interprets verbal or symbolic statements of rules and applies them,

5. discovers properties of specific figures empirically and generalizes properties for that class of figures,

6 a. describes a class of figures (e.g., rectangles) in terms of its properties,

b. tells what shape a figure is, given certain properties,

7. identifies which properties used to characterize one class of figures also apply to

another class of figures according to their properties,

8. discovers properties of an unfamiliar class of figures,

9. solves geometric problems by using known properties of figures of figures or by insightful approaches,

10. formulates and uses generalizations about properties of figures (guided by teacher/ material or spontaneously on own) and uses related language (e.g., all, every, none) but,

a. does not explain how certain properties of a certain figure are interrelated.

b. does not formulate and use formal definitions.

c. does not explain subclass relationships beyond checking specific instances against given list of properties.

d. does not see a need for proof or logical explanations of generalizations discovered empirically and does not use related language (e.g., if-then, because) correctly.

2.3.1.c Level 2 (The Theoretical Level)

Students logically order the properties of concepts, form abstract definitions, and distinguish between the necessity and sufficiency of a set of properties in determining a concept. The relationship between properties can be seen, hierarchies can be built and the definitions can be understood, properties of geometric figures are deduced one from others. For example, the student can see that a square is a rectangle; but a rectangle may not be a square. However, the importance of deduction cannot be understood at this level. According to Fuys et al., (1988; p. 64-68), the descriptors for this level are as follows;

Students at this level;

1. identifies different sets of properties that characterize a class of figures and test that these are sufficient,

a. identifies minimum sets of properties that can characterize a figure,

b. formulates and uses a definition for a class of figures,

2. gives informal arguments (using diagrams, cutout shapes that are folded, or other materials),

a. justifies the conclusion using logical relationships, having drawn a conclusion from given information.

b. orders classes of shapes.

c. orders two properties.

2.3.1.d Level 3 (Formal Logic)

Van Hiele (1986) treats this level as the essence of mathematics since thought on this level is concerned with deduction. Students at this level reason and organize proofs logically. They can construct proofs of theorems, understand the role of axioms and definitions, and the meaning of necessary and sufficient conditions. As the proof is constructed rather than memorized, it is not forgotten thereby can be reconstructed. Students understand the fact that the definition of "quadrilaterals in which all sides and angles are equal" and the definition of "quadrilaterals in which all angles are perpendicular and adjacent sides are equal" could be proved to be equal and both can define a square. According to Fuys et al., (1988; p. 69-70), the descriptors for this level are as follows;

Students at this level;

1. recognizes the need for undefined terms, definitions, and basic assumptions (e.g., postulates),
2. recognizes characteristics of a formal definition (e.g., necessary and sufficient conditions) and equivalence of definitions,
3. proves in axiomatic setting relationships that were explained informally on level 2,
4. proves relationships between a theorem and related statements (e.g., converse, inverse),
5. establishes interrelationships among networks of theorems,
6. compares and contrasts different proofs of theorems,
7. examines effects of changing an initial definition or postulate in a logical sequence,
8. establishes a general principle that unifies several different theorems,
9. creates proofs from simple sets of axioms frequently using a model to support arguments,

10. gives formal deductive arguments but does not investigate the axiomatic themselves or compare axiomatic systems,

2.3.1.e Level 4 (The Nature of Logical Laws)

Students compare different geometries based on different axioms and study them without concrete models. They can establish consistency of a set of axiom, and equivalence of different sets of axioms, create an axiomatic system for geometry. Theorems in different axiomatic systems could be established. According to Fuys et al., (1988; p. 71), the descriptors for this level are as follows;
Students at this level;

1. rigorously establishes theorems in different axiomatic systems (e.g., Hilbert's approach to foundations of geometry),
2. compares axiomatic systems (e.g., Euclidean and non-Euclidean geometries); spontaneously explores how changes in axioms affect the resulting geometry,
3. establishes consistency of a set of axioms, independence of axiom, and equivalency of different sets of axioms; creates an axiomatic system for a geometry,
4. invents generalized methods for solving classes of problems,
5. searches for the broadest context in which a mathematical theorem/principle will apply,
6. does in-dept study of the subject logic to develop new insights and approaches to logical inference.

CHAPTER 3

METHODOLOGY

This chapter explains participants, variables, measuring tools, treatments, treatment verification, methods for analyzing data, internal validity of the study.

3.1 Participants

Since it was difficult to select a random sample of individuals, convenience sampling was used in this study. Participants were 77 seventh grade students (38 boys and 39 girls) in the range of 12-13 years of age attending to two different public elementary schools in a middle socio-economic neighborhood in Yenimahalle district, Ankara. As two different instructional methods were used in the study, to avoid the students' perceptions that they are in competition with the other treatment group and perform beyond their usual level, each school was assigned for one treatment: drama based learning group (DramG) and cooperative learning group (CoopG).

Schools were similar in terms of size, average level of socioeconomic status, technical and educational opportunities, and academic achievement. Drama Group had 38 students and similarly Cooperative Group had 39 students. Demographic information about participants are shown in Table 3.1.

Table 3.1 Demographic information about the participants

Group	Boys (N)	Girls (N)	Total (N)
CoopG	19	20	39
DramG	19	19	38
Total (N)	38	39	77

The number of the students in the classes ranged from 18 to 20. There were three 7^{th} grade classrooms in each school. As students need more free space for movements in drama, one of the two schools having larger classrooms was assigned for the drama groups. As the researcher, who had a degree in mathematics education and one and a half years of experience in teaching mathematics in a public elementary school, taught the courses, one of the three classes from each school having coinciding mathematics lessons were eliminated from the study. Two classes for drama based learning and two classes for cooperative learning took part in the study. Four of the classes took part in the study during their normally scheduled mathematics periods.

3.2 Variables

Four dependent and five independent variables were considered in this study.

3.2.1 Dependent Variables

Dependent variables of the study are; students' posttest achievement scores on angles-polygons and circle-cylinder, post test score of van Hiele geometric thinking level, and post test score of geometry attitude scale.

3.2.2 Independent Variables

Independent variables of the study are; instructional methods, students' gender,

mathematics grade in previous year, students' pretest scores on van Hiele geometric thinking level test and on geometry attitude scale .

3.3 Measuring Tools

3.3.1 Achievement Tests:

Angles and polygons achievement test (APA) and circle and cylinder achievement test (CCA) developed by Duatepe and Ubuz (in press) were used in this study to determine students' achievement on angles and polygons.

The APA consists of 17 open-ended questions, most of which having subtasks. Totally, it includes 326 tasks, 72 of which are covering the topics on angles (identifying adjacent, vertical, corresponding, congruent, interior, and exterior alternate angles; finding the angles in triangles; identifying angle bisectors, altitudes, and medians of a triangle) and 254 of which are on polygons (ordering the side lengths of a triangle according to its angles; drawing the triangles with given side lengths if possible; identifying polygons, square, rectangle, diamond, parallelogram, trapezoid and rhombus; finding the perimeter and area of these quadrilaterals).

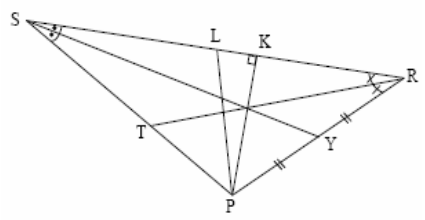
The CCA involves 15 open-ended questions, each containing subtasks. In total, it contains 42 tasks, 36 of which are related with circle (explaining the difference between a ring and a circle by giving examples; explaining how many radius can be drawn in a circle; stating the positions of the points in a given circle; drawing the points at the outside and inside, and on the circle; drawing tangents and chord to the circle; finding the perimeter and area of a circle) and six tasks are related with cylinder (drawing and explaining of open form of cylinder; finding area and volume of a cylinder). Two specimen questions are shown in Figure 3.1.

Giving one for each correct answer and zero for each incorrect answer each task in the APA and the CCA was scored. The possible scores for the APA ranged from 0 to 326 and for the CCA ranged from 0 to 42. For example, question 6 in the APA and question 12 in the CCA (see Figure 3.1) included 26 and 2 tasks, respectively. Eight

tasks of question 6 are related to identifying the medians of the given triangle, one task on explaining why the given segments are medians or not, nine tasks are related to identifying the angle bisectors of the given triangle, one task on explaining why the given segments are angle bisectors or not, seven tasks are related to identifying the altitudes of the given triangle, one task on explaining why the given segments are altitudes or not. For question 12 one task is related to finding the radius of a circle given the perimeter of it, and one task is related to finding the diameter of a circle using the radius of it. For the main study, the KR-20 internal consistency reliabilities obtained for APA and CCA were, 0.98 and 0.95, respectively.

APA - Question 6

The SRP triangle was given in the figure. In this triangle, s(RSY)=s(YSP), s(SRT)=s(TRP), s(SKP)=90°, $|SR| \perp |PK|$, $|SL| = |RL|$, $|RY| = |YP|$.



According to this triangle,

a) Circle which of the given line segments are medians of this triangle. Explain why these segments are medians or not.

[PL], [PK], [SY], [RT], [PY], [YR], [SL], [RL]

Explanation:

b) Circle which of the given line segments are angle bisectors of this triangle. Explain why these segments are angle bisectors or not.

[PL], [PK], [ST], [RT], [PY], [YR], [SL], [TP],[SY]

Explanation:

c) Circle which of the given line segments are altitudes of this triangle. Explain why these segments are altitudes or not.

[PL], [PK], [ST], [RT], [RK], [LK], [KS]Explanation:

Figure 3.1 Question samples for APA and CCA

CCA - Question 12

After a full turn a bicycle wheel takes 180cm way. What is the diameter of this bicycle wheel?(π=3)

Figure 3.1(continued)

3.3.2 Van Hiele Geometric Thinking Level Test

In order to determine students' geometric thinking levels of van Hiele geometric thinking model, the van Hiele Geometric Thinking Level Test (VHL) developed by Usiskin (1982) was used. This test was adopted into Turkish by Duatepe (2000) during a master thesis study. According to this model, all human beings progress through five stages of the geometric thinking (van Hiele, 1986).

The first level geometric thinking begins with nonverbal thinking. The student at this level perceives a figure as a whole shape and does not perceive their parts. He/she might say, "It is a rectangle because it looks like a door". At the second level, properties can be recognized but properties are not yet logically ordered. At the third level, properties are logically ordered; one property precedes or follows from another property. However, at this level, the intrinsic meaning of deduction, that is, the role of axioms, definitions, theorems, and their converses are not understood.

At forth level, deduction and construction of proof can be understood. Different axiomatic systems can be understood at the last level. In the test, the first five items represent level 1, second five items represent level 2, the third five items represent level 3, the fourth five items represent level 4, and the last five items represent level 5. As the elementary school mathematics leads students only reach to the third level (van Hiele, 1986) and elementary school mathematics curriculum in Turkey does not require deduction and construction of proof, only the first 15 items of the 25 multiple choice items were considered in the present study.

The items in the first level are related to identifying polygons. The items in the second level are about the properties of square, rectangle, diamond,

rhombus, isosceles triangles, and radius and tangent of circle. The items in the third level are on ordering properties of triangle, simple deduction, comprehending hierarchy among square, rectangle and parallelogram, and comparing rectangle and parallelogram.

Student responses to VHL were scored as 1 for each correct answer and 0 for each incorrect answer. The possible scores of the VHL range from 0 to 15. As the VHL consists of questions with different difficulty levels, KR-20 reliability coefficients of the pre and post implementation of the VHL were found as 0.56 and 0.42, respectively. These low reliability values are of concern. It is well known that reliability coefficients are greatly influenced by the difficulty of a test, the small differences among the scores and the number of items.

In the pre and post implementation of the test the scores were clustered together mostly around the mean, with small differences among students. The mean scores of the pre and post implementation of the test were calculated as 6.82 and 7.31 out of 15, with the standard deviation of 2.23 and 2.02, respectively. Particularly, 71.6 and 83.5 percent of the students lied in the first standard deviation for the pre and post implementation, respectively. Furthermore, when the number of items was tripled by the Spearman-Brown prophecy formula, the new reliabilities were calculated as .66 and .43. Therefore, the small differences among the scores and the number of items on the test might have lowered the reliability.

3.3.3 Geometry Attitude Scale

To determine students' attitudes toward geometry, geometry attitude scale (GAS), developed by Duatepe and Ubuz (in press), covering the components of motivation and self-confidence was used. Items representing motivation reflected students' pleasure when dealing with geometry and their eager to continue to think about puzzling ideas outside class. Items standing for self-confidence involved the behavior of nervousness and tension felt in geometry topics and the students' confidence in their ability to learn and to perform well on examination on geometry.

Examples of items related to each component – motivation and self-confidence - include respectively: (a) I do not realize how the time passes when I am studying geometry, (b) I do not feel tension in geometry lessons. This scale consists of 12 Likert type items with five possible alternatives as strongly disagree, disagree, uncertain, agree, and strongly agree. Negative statements (1, 3, 4, 6, 8, 9) were scored as 5, 4, 3, 2, and 1 and positive statements (2, 5, 7, 10, 11, 12) were scored as 1, 2, 3, 4 and 5 according to the order of alternatives. The possible scores on this scale range from 12 to 60. Pre and post implementation of the GAS results yielded Cronbach alpha reliability coefficient of .90 and .89, respectively.

3.4 Treatments

All classes studied the Angles and Polygons, Cylinder and Circle unit. In all classes, mathematics was taught four times a week according to the mathematics curriculum adopted by the Turkish Ministry of Education. The Angles and Polygons unit was taught for three and half weeks (14 lessons), Circle and Cylinder unit was taught for three weeks (12 lessons). All students in both methods of instruction practiced the same content with the same problems/tasks, and used the same textbook (İlköğretim Matematik Ders Kitabı 7, 2003). The sessions under both methods included three parts: introduction (about 10 min), development (about 20 min) and quieting/review (about 10 min).

While the drama groups (DramG) learned geometry with drama based learning, the cooperative learning groups (CoopG) learned by working in cooperative groups. During the experiment, the DramG and the CoopG received instruction from the researcher in their regular classrooms.

The DramG was treated identically to the CoopG except that the students instructed to complete the same tasks by improvisations, role-playings, and make-belief plays during the study phase. Photographs from some classroom situations are presented below within the DramG and the CoopG (Figure 3.2, 3.3, 3.4 and 3.5).

Figure 3.2 Working Students in CoopG

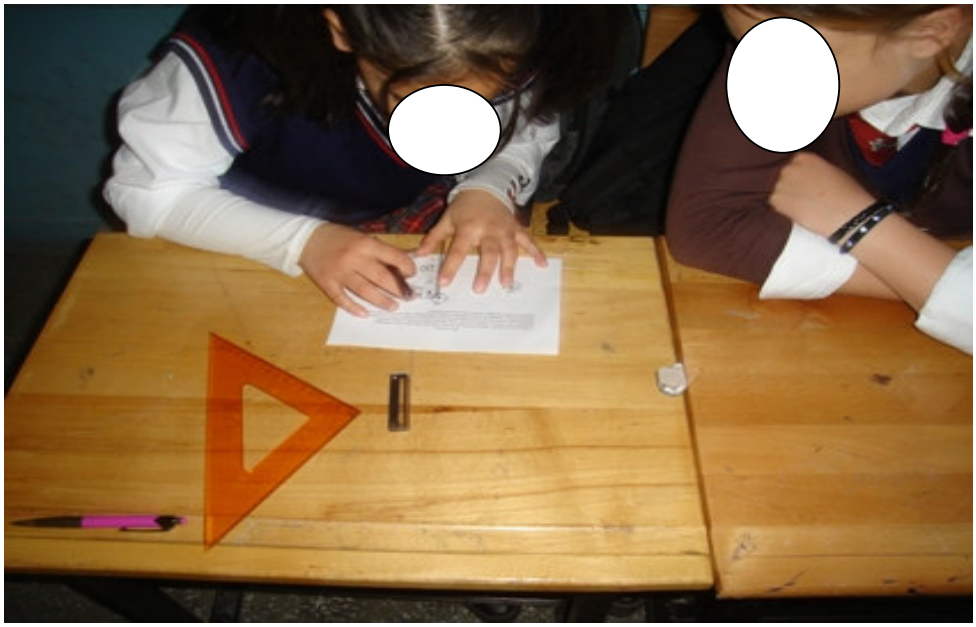


Figure 3.3. Sample of one activity in CoopG

Figure 3.4 Working Students in DramG

Figure 3.5 Sample of one activity in DramG

Figure 3.2 and 3.4, shows how the students participate to the drama and cooperative learning activities, respectively. As it is clear, while the CoopG students are only sitting on desks and talking to each other to agree on solutions, DramG students are both physically acting and orally talking to achieve the same tasks.

Figure 3.3 and 3.5 are the examples for cognitive experiences during lessons in DramG and CoopG, respectively. According to Figure 2.2, CoopG students are trying to form a circle on a work sheet, by pointing the equal distances from a central point. They use a ruler to find the equal distances. Figure 2.4 shows DramG students who are the points that form a circle. They are trying to sit around a centre, with equal distances. To find their places they are using a rope. The same content was covered in two of the treatment groups. All the groups solved the same questions to reach exactly the same objectives, and at the end of each lesson, homework was assigned to students from the same textbook. The comparison of example lesson flows in the DramG and the CoopG is illustrated in Figure3.6

Objective(s): Understanding polygons 1) Explaining the polygons with examples 2) Naming a given polygon 3) Writing the sides and corners of a given polygon by using symbols 4) Explaining the regular polygons by giving examples		
Category	Drama Group	Cooperative Group
Introduction	Students worked in groups of two while painting pictures involving polygons in the form of houses and used colored pencils to paint them.	Each group was asked to make a list of the real life examples of polygons which were assigned at the end of the previous lesson, and then read their list to the whole class.

Figure 3.6 Sample lesson flows for DramG and CoopG

Development	Two groups constituted in the classroom and each group were given a 3m long elastic band with two ends tied to each other. Each group was asked to form a triangle by using this elastic band. Firstly, they discussed how to form a triangle. Three students from each group entered in the elastic band and formed a triangle by stretching from 3 corners. After each group formed a triangle with one student on each corner, teacher asked the following questions: 1) How many sides does this shape have? 2) How are the sides located? 3) How many corners does this shape have? 4) Who are standing on the corners? Students' responses to these questions were discussed in order to specify the characteristics Figure 3.6(continued)	Each group was given a geometry board and a piece of tire. Students asked to form a triangle on the geometry board by using the tire. Firstly, they discussed how to form a triangle and agreed on stretching the tire to the three non-linear nails of the board. After each group formed a triangle teacher asked the following questions: 1) How many sides does this shape have? 2) How are the sides located? 3) How many corners does this shape have? Students' responses to these questions were discussed. Each group was asked to form a quadrilateral by using the tire. After each group formed a quadrilateral with, they asked to answer the following questions: 1) How many sides does this shape have? 2) How are the sides located? (expected answers: parallel to each other, equal length, all sides have different length…vs.) 3) How many corners does this shape have? 4) Who are standing on the corners?

	of a polygon. Later, each group was asked to form a quadrilateral by using their elastic band. After each group formed a quadrilateral with one student on each corner, they asked to answer the following questions: 1) How many sides does this shape have? 2) How are the sides located? (expected answers: parallel to each other, equal length, all sides have different length…vs.) 3) How many corners does this shape have? 4) Who are standing on the corners? 5) How many angles does this shape have? 6) What type of angles are they? 7) Can a person inside this shape, move outside? (Is the shape closed or open?) 8) Does your shape looks like any of the shapes that you know? Figure 3.6(continued)	5) How many angles does this shape have? 6) What type of angles are they? 7) Is the shape closed or open? 8) Does your shape looks like any of the shapes that you know? The same questions were asked for a different quadrilateral, for a pentagon, for a different pentagon before the previous one, for a hexagon, for a different hexagon, for an octagon, for a different octagon, and so on. Through the way students formed new polygons, in accordance with the formed shapes' familiarity to students from the previous years, some questions directed to students for classifying the polygons. For example; when the students formed a rectangle, they were asked the following questions: 1) Can we name this shape except rectangle? 2) Is it possible to call this shape as a parallelogram? What were the identifiers of a parallelogram? 3) Can we name this shape as a square? What are the similarities and differences? *Teacher drew all the formed polygons to the board and asked students about naming the sides and

	The same questions were asked for a different quadrilateral, for a pentagon, for a different pentagon before the previous one, for a hexagon, for a different hexagon, for an octagon, for a different octagon, and so on. Through the way students formed new polygons, in accordance with the formed shapes' familiarity to students from the previous years, some questions directed to students for classifying the polygons. For example; when the students formed a rectangle, they were asked the following questions: 1) Can we name this shape except rectangle? 2) Is it possible to call this shape as a parallelogram? What were the identifiers of a parallelogram? 3) Can we name this shape as a square? What Figure 3.6(continued)	corners of the polygons. *Students were encouraged to name the regular and irregular forms of the same polygons. *Teacher drew some figures on the board and wanted students discuss if the figures are polygons or not? * Students were asked to identify the properties of a polygon.

	are the similarities and differences? *Teacher drew all the formed polygons to the board and asked students about naming the sides and corners of the polygons. *Students were encouraged to name the regular and irregular forms of the same polygons. *Teacher drew some figures to the board and wanted students discuss if the figures are polygons or not? *Students were asked to identify the properties of a polygon.	
Quieting / Evaluation	Students asked to prepare a telephone conversation. For this quieting activity, each student worked with a partner. Each partner named as A or B. As the A was ill, he/she was absent for this mathematics lesson. Student A called student Figure 3.6(continued)	Students were asked to summarize the definition of the polygon and the lesson finished by writing the definition of polygon on the board.

	B after school and asked what was done and processed during the lesson. Student B summarized the lesson, explained the properties of polygons by giving examples. Then A and B changed the roles and the conversation repeated. While a group was presenting the conversation, other students listened carefully and they added the missing or forgotten parts to their conversation. At the end of the lesson, the definition of polygon was written on the board.	

Figure 3.6(continued)

3.4.1 Treatment in Drama Based Learning Group

In most of the treatment periods, the desks were moved to the edges for creating an empty space in the center of the classroom. For some tasks students worked in groups of two or four by mutually putting their desks. DramG was instructed based on the lesson plans developed by Duatepe (2004). There exists three phases in each lesson; introduction, development and quieting.

Introduction part consisted of warm up activities, which takes 3-5 minutes to put students in a relaxed mood and ready to work together. The warm up material was

not too difficult for the students. These warm up activities included some hidden clues about the objectives of the lesson.

During development part, make-belief environment is created in which students take roles, experience and live ideas embellished with geometry. In this part of the lesson, students mostly worked in groups of 4-10; sometimes worked individually, or as a whole. They made decisions as a group, listened to each other, and valued each other's suggestions; co-operated to achieve their aims, found ways of settling their differences, and used the strengths of each member of the group. Through role-playing, students used non-verbal communication, such as body movements, facial expressions to explore places, times, and situations that they may not have directly experienced. The dialogue was not scripted, and the teacher set up the situation for the drama by helping students to explore, develop, express, discuss and criticize the ideas. The students then use their knowledge and experience from daily life to develop their characters' response to circumstances presented to foster meaningful understanding. This encouraged their creativity and developed their imagination.

In the quieting phase, main points of the lessons were emphasized and then the key points of the concept covered were summarized either by the teacher or by the students. Students reviewed what they have learned by either answering or solving the questions posed by the teacher, or presenting what they have learned as an improvisation that requires the use of knowledge learned. The analogy created between the real life conditions and the geometry facts by the help of make believe play and dramatic moments were emphasized by the teacher.

3.4.2 Treatment in Cooperative Learning Group

Within the CoopG, students previous semester mathematics grades served as the basis for formal cooperative learning group membership. Each group included four students, one from the top fourth of the class, one from the bottom fourth of the class and two from the middle half of the class. The classroom environment was arranged by mutually putting two student desks together to encourage interaction between members.

The drama based lesson plans developed by Duatepe (2004) were adapted for cooperative learning by the researchers. However, the same content was covered, in accordance with the five basic elements of cooperative learning as defined by Johnson and Johnson (1999). These five characteristics and their reflections to the lesson plans are as follows:

1) Positive interdependence necessitated mutual support and encouragement, sharing resources. Group members encouraged to believe that all group members were essential for the success of the group. This was accomplished by assigning each group clear and measurable tasks, structuring and routinely reinforcing goal interdependence within the groups. The students provided explanations, elaboration and guidance to help their peer understand the key points.

2) Individual accountability was promoted by keeping the group size small, assessing each students' achievement by individual tests, calling on group members randomly and asking them to present the group's work to the whole class, requiring each student to teach something that he or she had learned to someone else and appraising each student's performance by observing the small group works and giving feed backs to the individuals and groups.

3) Face-to-face interaction necessitated group members' encouragement and facilitation to each other's effort to achieve group goals in order to build academic and personal support systems for every group member. Face-to face interaction promoted by scheduling enough time for the group to meet, making group members work together in small groups to achieve group goals, arranging the classroom by mutually putting two student desks together, encouraging instances of promotive interaction between members.

4) Collaborative skills such as reaching consensus, involving every student in group-work, giving constructive feedback and making others believe that they were contributing to each other were constantly reinforced. The teacher was responsible for making each student communicate effectively with each other, solve conflicts,

reconcile their differences and trust in one another.

5) Group processing aims to clarify and improve the contributions of each group member with respect to the collaborative efforts to achieve the goals of the group. Factor that contributed to group processing was students' reflections on group sessions to determine which actions to continue, change, or modify. The teacher also monitored group processing regularly.

In this study cooperative learning environment consisted of three phases: introduction, development and evaluation.

In the introduction part, groups either gave daily life examples related to the concepts or answered the questions of the teacher with respect to the previous year's knowledge. Some hidden clues about the objectives of the lesson exist in this phase. The introduction activities enhanced communication skills (such as listening someone, expressing an idea…vs.) by creating opportunity for intergroup and intragroup discussions, creativity and imagination that make students trust each other, ready to work collaboratively, and enjoy the lesson.

In the development part of the lesson, teacher distributed the work sheets related to the content; students worked in groups, implemented the steps for the given tasks, shared ideas, measured and calculated, commented on each other's opinions, and made conjectures. They spent most of the lesson hour studying on the tasks distributed. After intergroup discussions, intragroup discussions were included during the treatment phase. Teacher observed the group works and directed questions to the individuals, groups or the entire class. She was the facilitator of the classroom activity by helping students to explore, develop, express, explain, discuss and criticize ideas.

Evaluation part consisted of the summary of the key points of the activities. Students reviewed what they have learned. As in the DramG, they shared ideas about the content of the lesson. They answered or solved the questions posed by the teacher.

3.5 Data Collection and Analysis

Design of the study was quasi-experimental. At the beginning of the study, both the DramG and the CoopG were asked to respond to the van Hiele geometric thinking level test, and the geometry attitudes scale to measure their thinking level and attitudes respectively prior to the treatment. At the end of the treatment, achievement tests as well as van Hiele geometric thinking level test, and geometry attitude scale were administered to students in both groups. All these tests were administered to the students within a scheduled one or two 40-minutes mathematics class session allowing each time 60, 40, 40 and 15 minutes for the APA, CCA, VHL and GAS respectively.

The data collected were analyzed through descriptive and inferential statistic multivariate analyses of variance (MANOVA). To aid in the interpretation of the MANOVA results test scores for each group at each time were used to conduct univariate follow-up tests.

At the beginning of the study, the effect size was set to high. In the analyses, the probability of making Type-1 error (probability of the rejecting true null hypothesis) was set to .01. For the MANOVA based on the posttest measures as dependent variables, there were 77 subjects in the sample. The statistical power of the study for these values was calculated as between .81.

3.6 Treatment Verification

The classroom teachers acted as an observer during the lessons. The observer teachers were asked to grade each lesson from 0 to 5 in terms of the degree to which the researcher implemented the lessons according to the lessons plans. The grade “0” means, “The implemented lesson is totally different than the lesson plans” and grade “5” means, “The lesson is implemented as exactly in the lesson plans”. The observer teachers graded all lessons by giving them grade 5 for both instructional methods.

3.7 Internal Validity

Internal validity is the extent to which detected differences on the dependent variables are associated with the independent variables and not some uncontrolled variables. Threats to internal validity are alternative explanations of the results that are not related to the treatment. A list of possible threats to the internal validity of the study and how they were minimized or controlled were discussed in this section.

This study was carried on intact groups in which individual students were not randomly assigned to the groups. This might bring the subject characteristics threat to the study. Some characteristics, which could potentially affect the outcomes of the study, were determined. With this respect, students' gender, mathematics grade in previous year, previous van Hiele geometric level, and geometry attitude were determined as potential extraneous variables to posttests. These variables were checked to see whether they had a relation with the dependent variables of the study. There were no statistically associated variables. Both the drama groups and the cooperative groups were equal with respect to the number of students, PREGAS and PREVHL scores. Therefore the subject characteristics threat was removed.

In order to control the history effect, groups were administered all tests approximately at the same time. By this way, similar situations were tried to be provided. The results of the treatment may be associated with specific events occurred between pretest and posttest. This was not an issue because the length of the study was limited to a semester.

The location of this study was four similar classrooms at two different schools (two classes per school). Schools were in the same neighborhood. Technical, physical and educational opportunities were very similar. These similar situations and administration of all tests at the mathematics lesson were a remedy for the possible location threats. Beside these, no outside events were observed during the testing period that could influence the subjects' responses.

Another likelihood of threat might be pretesting effect. Both groups were

administered pretest to equalize the pretesting effect. Moreover, there were eight weeks for the implementation of posttest. This period was assumed to be sufficient for desensitization. In addition, achievement tests were not implemented as pretest to minimize pretesting effect.

Mortality refers to loss of students during the treatment. There were no missing data in all pretests and posttests.

To avoid the maturation threat both the DramG and CoopG spent the same amount of time on the units. Although, the length of the study was limited to one semester.

An instrumentation threat can be in the form of instrument decay, data collector bias, or inadequate demonstration of reliability and validity of the assessment. In this study although open-ended questions were used in the achievement tests, each questions were divided into subtasks according to the objectives covered and each tasks were scored as 0 or 1. Therefore, instrument decay was not a viable threat. Data collectors were both the classroom teachers and the researcher. This was helpful to control data collector characteristics and data collector bias.

It is possible that the person administering a treatment may be the cause of the results or any observed outcomes. To avoid this kind of threat two instructional techniques were administered by the researcher with respect to the previously prepared lesson plans and classroom teachers filled out a Treatment Verification form at the end of each lesson.

Since instructional period lasted more than six weeks, any Hawthorne effect that may be caused by the use of novel instruction method washes out. Moreover, two different schools were assigned to the study to avoid the conceptions of students that they are in competition with the other treatment group.

CHAPTER 4

RESULTS

This chapter contains descriptive statistics of the data, quantitative results of data and summary of research findings divided into four sections. Several statistical procedures were employed, including correlational analyses, analysis of variance, and multiple analyses of variance. Besides, summary of research findings are shown in last part of this chapter.

4.1 Descriptive Statistics

By using quantitative research techniques, PREVHL, POSTVHL, APA, CCA, PREGAS and POSTGAS calculated and interpreted. Pretest scores and Posttest scores described by using tables.

4.1.1 Descriptive Statistics of the Geometry Attitude Scale

The descriptive statistics related with the PREGAS and the POSTGAS for the DramG and the CoopG are shown in Table 4.1. According to the table, both the PREGAS and the POSTGAS mean scores of the DramG were higher than those of the CoopG. On the other hand, while the mean score of the DramG increased from 43.79 to 44.87, similarly the mean score of the CoopG increased from 40.05 to 40.26 from pretest to posttest.

Table 4.1 Descriptive statistics related with the PREGAS and the POSTGAS for the CoopG and the DramG.

	PREGAS		POSTGAS	
	CoopG	DramG	CoopG	DramG
N	39	38	39	38
Mean	40.05	43.79	40.26	44.87
Standard deviation	11.52	8.74	11.01	8.37
Skewness	.22	-.30	.38	.10
Kurtosis	-1.06	.47	-.67	-.63
Minimum	20	19	20	20
Maximum	60	60	60	60

4.1.2 Descriptive Statistics of the Van Hiele Geometric Thinking Level Test

Table 4.2 shows the descriptive statistics related with the PREVHL and the POSTVHL for the DramG and the CoopG. According to the table, both the PREVHL and the POSTVHL mean score of the DramG were higher than those of the CoopG. On the other hand, while the mean score of the DramG increased from 6.84 to 8.13, the mean score of the CoopG decreased from 6.82 to 6.69 from pretest to posttest.

Table 4.2 Descriptive statistics related with the PREVHL and the POSTVHL for the CoopG and the DramG.

	PREVHL		POSTVHL	
	CoopG	DramG	CoopG	DramG
N	39	38	39	38
Mean	6.82	6.84	6.69	8.13
Standard dev.	2.05	2.37	1.91	2.15
Skewness	.24	.21	-.28	.31
Kurtosis	.48	-.11	1.02	-.05
Minimum	2	2	1	4
Maximum	12	12	11	13

4.1.3 Descriptive Statistics of the Angles and Polygons Achievement Test

The descriptive statistics related with the APA for the DramG and the CoopG are shown in the Table 4.3. According to the table, APA mean-score of the DramG were higher than the mean score of the CoopG. In addition, while the mean score of the DramG is 196.53, the mean score of the CoopG is 147.51.

Table 4.3 Descriptive statistics related with APA for the CoopG and the DramG.

	APA	
	CoopG	DramG
N	39	38
Mean	147.51	196.53
Standard deviation	52.88	71.36
Skewness	.10	-.42
Kurtosis	-.48	-1.16
Minimum	47	42
Maximum	254	289

4.1.4 Descriptive Statistics of the Circle and Cylinder Achievement Test

Table 4.4 shows the descriptive statistics related with the CCA for the DramG and the CoopG. According to the table, CCA mean score of the DramG were higher than the mean score of the CoopG. In addition, while the mean score of the DramG is 27.42, the mean score of the CoopG is 17.18.

Table 4.4 Descriptive statistics related with CCA for the CoopG and the DramG.

	CCA	
	CoopG	DramG
N	39	38
Mean	17.18	27.42
Standard deviation	11.59	10.93
Skewness	.68	-.62
Kurtosis	-.60	-.78
Minimum	2	3
Maximum	42	42

4.1.5 Correlation among Dependent Variables

Leech, Barrett, and Morgan (2005) mentioned that if the correlations of dependent variables were .60 or above, either making a composite variable would be considered (in which the highly correlated variables were summed or averaged) or eliminating one of the variables.

Table 4.5 Correlations between dependent variables

Correlations				
	POSVHL	CCA	APA	POSGAS
POSVHL	1	.449	.456	.312
CCA	.449	1	.857	.354
APA	.456	.857	1	.218
POSGAS	.312	.354	.218	1

Correlation between APA and CCA was found as .857. With respect to this finding APA and CCA scores of each student were summed and a new variable (performance) was constituted.

Table 4.6 Descriptive statistics related with Performance for the CoopG and the DramG

	Performance	
	CoopG	DramG
N	39	38
Mean	164.69	223.95
Standard deviation	62.77	80.98
Skewness	.258	-.407
Kurtosis	-.528	-1.253
Minimum	54	53
Maximum	294	331

Table 4.6 shows the descriptive statistics related with the Performance for the DramG and the CoopG. According to the table, Performance mean score of the DramG was higher than the mean score of the CoopG. In addition, while the mean score of the DramG is 223.95, the mean score of the CoopG is 164.69.

4.2 Inferential Statistics

In order to answer research question:" What are the differences between the drama based learning compared to the cooperative learning on seventh grade students' van Hiele geometric thinking level, attitudes toward geometry, and achievement on angles and polygons; and circle and cylinder?" data were analyzed by using a multivariate analysis of variance (MANOVA). According to table 4.7 and 4.8, there were no significant differences between groups' pretest scores before treatment therefore MANOVA was used (Buyukozturk, 2007).

Table 4.7 Independent Samples T-Test for Equality of Means of PREVHL

Groups	N	Mean	Std. Deviation	df	t	p
CoopG	39	6.82	2.05	75	.04	.966
DramG	38	6.84	2.37			

This independent-samples t test analysis indicates that participants in cooperative group had a mean of 6.82 and the students in drama group had a mean of 6.84 and the means did not differ significantly at the $p < .01$ level ($p=.966$).

Table 4.8 Independent Samples T-Test for Equality of Means of PREGAS

Groups	N	Mean	Std. Deviation	df	t	p
CoopG	39	40.05	11.52	75	1.60	.114
DramG	38	43.79	8.74			

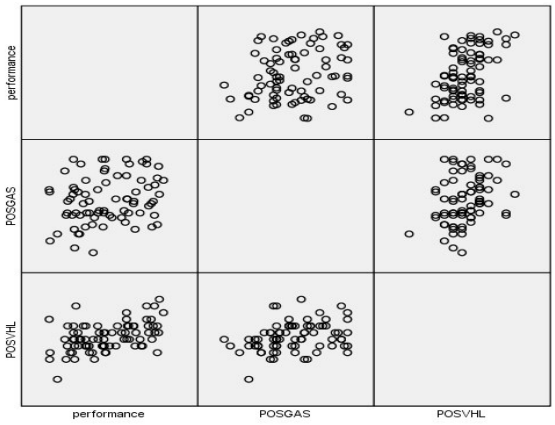
This independent-samples t test analysis indicates that participants in cooperative group had a mean of 40.05 and the students in drama group had a mean of 43.79 and the means did not differ significantly at the $p < .01$ level ($p=.114$).

4.2.1 Assumptions of the MANOVA

The assumptions of MANOVA include; independent observations (each person's scores are independent of every other person's scores), multivariate normality, and homogeneity of variance/covariance matrices (variances for each dependent variable are approximately equal in all groups and covariances between pairs of dependent variables are approximately equal for all groups). First assumption is independence of observations and it was controlled by researcher during administration of the all tests. All participants did all tests by themselves.

Second assumption is multivariate normality. However, it is not possible to check the multivariate normality assumption we interpret this assumption by checking univeriate normality assumption. Statistical approaches that assess univariate normality requires measures of skewness and kurtosis (Meyer, Gamst, and Guarino, 2006). Skewness and kurtosis values of the scores should be checked and the values between –2 and +2 can be assumed as approximately normal for skewness and kurtosis (George and Mallery, 2003). According to Tables 4.1, 4.2 and 4.6, skewness and kurtosis values of dependent variables were in the acceptable range for a normal distribution. However, satisfying the univariate normality assumption may not always satisfy the multivariate normality. Therefore, bivariate scatterplot examination recommended (Meyer, Gamst, and Guarino, 2006).

Figure 4.1 Scatterplots for dependent variables



According to Meyer, Gamst, and Guarino (2006), linearly related and normally distibuted variables produce oval shaped or elliptical scatterplots.With respect to Figure 4.1 and kurtosis-skewness values, all dependent variables satisfy the multivariate normality assumption.As it is seen, Table 4.9 displays the Box's test of equality of covariance matrices for the MANOVA used for comparing posttests, respectively. According to these tables, observed covariance matrices of the dependent variables were equal across groups. This indicates that the multivariate normality assumption for analyze was satisfied. Last assumption is homogeneity of variance/covariance matrices and was satisfied by Table 4.10.

Table 4.9 Box's test of equality of covariance matrices for the MANOVA comparing posttests scores

Box's M	13.383
F	2.133
df1	6
df2	40677.194
Sig.	.046

Significance level of .046 indicates that there are no significant differences between the covariance matrices at significance level .01. Therefore, the assumption is not violated and Wilk's Lambda is an appropriate test to use (Leech, Barrett, and Morgan; 2005)

Table 4.10 Levene's test of equality of error variances for the MANOVA comparing posttest scores

	F	df1	df2	Sig.
POSTGAS	3.579	1	75	.062
POSTVHL	.425	1	75	.516
Performance	5.939	1	75	.017

According to Table 4.10 POSTGAS, POSTVHL and Performance

satisfied assumption at significance level .01

4.2.2 The results of MANOVA

Table 4.11 Multivariate tests results for the MANOVA comparing posttest scores

Effect	Wilks' Lambda	F	Hypothesis df	Error df	Sig.	Eta Squared	Observed Power
Treatment	.810	5.725	3	73	.001	.19	.81

A multivariate analysis of variance was conducted to assess if there were differences between the treatment groups on a linear combination of POSTVHL, POSTGAS, APA and CCA. A significant difference was found in the favor of the drama-based learning, according to Table 4.10 MANOVA results of DramG and CoopG students' posttest scores (Wilks Lambda=0.810, F(3, 73)=5.725, p<0.01).

According to Table 4.11, a statistically significant difference was found for the POSTVHL, the Performance between groups in the favor of the drama based learning, [F (1,75) =9.688, p = .003; F (1,75) =12.917, p = .00; respectively]. On the other hand, for the POSTGAS scores the differences was not significant between DramG and CoopG [F (1,75) =4.262, p = 042]. This means that students taught by drama-based learning got higher scores on each posttest except POSTGAS than the students instructed by cooperative learning method.

Table 4.12 Tests of between-subjects effects

Source	Dependent Variable	Sum of Squares	df	F	Sig.	Eta Squared	Mean Square	Observed Power
Corrected Model	POSTVHL	39.870	1	9.688	.003	.114	39.870	.680
	Performance	67578.473	1	12.917	.001	.147	67578.473	.782
	POSTGAS	409.391	1	4.262	.042	.054	409.391	.289
Intercept	POSTVHL	4229.428	1	1027.72	.000	.932	4229.428	1.000
	Performance	2907044.96	1	555.659	.000	.881	2907044.96	1.000
	POSTGAS	139466.534	1	1452.01	.000	.951	139466.534	1.000
Treatm	POSTVHL	39.870	1	9.688	.003	.114	39.870	.680

	Performance	67578.473	1	12.917	.001	.147	67578.473	.782
	POSTGAS	409.391	1	4.262	.042	.054	409.391	.289

Table 4.12(Continued)

Error	POSTVHL	308.650	75				4.115	
	Performance	392378.202	75				5231.709	
	POSTGAS	7203.778	75				96.050	
Total	POSTVHL	4568.000	77					
	Performance	3355989.00	77					
	POSTGAS	146907.000	77					
Corrected Total	POSTVHL	348.519	76					
	Performance	459956.675	76					
	POSTGAS	7613.169	76					

For determining the exact importance of the dependent variables that were found to be significantly affected by the treatment, within this analysis, by considering number of dependent variables, significance level was selected as p=.0025.

In terms of the new p value in Table 4.12 there was a significant difference between DramG and CoopG with respect to the results of Performance scores in the favor of the drama-based learning [F (1, 75) =12.917, p<0.0025].

There was not a significant difference between DramG and CoopG with respect to the results of POSTVHL scores [F (1, 75) =9.688, p>0.0025].

On the other hand, there was not a significant difference between DramG and CoopG with respect to the results of POSTGAS scores [F (1, 75) =4.262, p>0.0025].

4.3 Summary of Results

With respect to the MANOVA results, drama-based learning had a significant positive effect on students' Performance scores and van Hiele geometric thinking level at p= .01 significance level, compared to the cooperative learning.

In addition, drama-based learning was not significantly effective on students' geometry attitude scores compared to the cooperative learning (p=.01).

By considering p = .0025 [.01/4(number of dependent variables)] for determining the unique importance of dependent variables drama-based learning had a significant positive effect on students' angles and polygons achievement, and circle and cylinder achievement. On the other hand, drama-based learning was not significantly differ from the cooperative learning on students' van Hiele Geometric thinking level scores. Moreover, for geometry attitude scores of students' there was not a significant difference between the drama-based learning group and cooperative learning group.

CHAPTER 5

DISCUSSION, CONCLUSIONS AND IMPLICATIONS

This chapter consists of four sections. First section presents the discussion of the results. The conclusions are given in the second section. Implications and recommendations for further studies are given in the third and fourth sections respectively.

5.1 Discussion

The aim of this study was to investigate the effects of drama based learning and cooperative learning on seventh grade students' geometry achievement; van Hiele geometric thinking level; and attitudes towards geometry.

Results of the study indicated that drama-based learning has a positive significant effect on students' angles and polygons, and circle and cylinder achievement compared to the cooperative learning.

Findings of this study with respect to the achievement scores, supports the findings of previous research on drama that indicates the differences on achievement (Kamen, 1992; Selvi & Öztürk, 2000). Similar results was reported by Saab (1987) on sixth grade students' mathematics achievement and by Duatepe & Ubuz (in press)

on seventh grade students' geometry achievement. However, these studies compared the drama based learning with traditional teaching method. This study revealed that drama based learning is effective on students' achievement compared to the cooperative learning.

Drama and the cooperative learning have similar strengths in teaching process. With respect to the observations of the researcher who was the instructor of the treatments, these strengths are consistent with the literature. Both the drama group and cooperative group students were able to make decisions as a group, listen to each other, value each other's suggestions, cooperate to achieve the goals, and communicate to solve problems (Chilcoat & Ligon, 1998; Slavin, 1994; Johnson & Johnson, 1999). Workings in groups made students develop communication skills, understand the others' feelings, share the thoughts; plan, question, describe, interpret and disagree between peers. As students worked in groups, they improved each others learning by helping the friends.

In this study, the success of drama-based learning on student achievement can be attributable to its strengths in role-playing and make-believe situations (Roland, 2001; Heinig 1988; Vygotsky, 1978). Drama group students were using non-verbal communication, such as body movements and facial expressions as stated by Philips (2001) in the literature. These non-verbal communications provided them a more free and enjoyable classroom environment. They were able to live in real life situations connected to the content. As they lived mathematical situations, it became easier to learn. In contrast with the Vygotsky (1978)'s theories, much learning occur when children play. It was easy for them to create tensions and solutions during real life situations. They enjoy the activities with their whole being by using feelings and bodies. Gardner's (1985) theory of multiple intelligences supports that the people receive information in different ways. Drama activities provided a class atmosphere that all kind of receivers can obtain the knowledge. This is why children use all the channels while they are dramatizing.

Make believe play situations made students' friendship relations stronger. Before the treatments, some students in both drama group and cooperative group were not

talking to each other. In DramG, those students became more close to each other after treatments. However, in CoopG there was not a difference with respect to friendship relations. This could be why the CoopG students worked in the same groups during the whole process and developed their communication skills limited to the student groups of four. Contrary to this, each lesson, DramG students were communicating with every member of the class. By this way atmosphere of acceptance was created in a short time between the entire class members.

In addition, analysis results indicated a more significant difference with respect to the CCA score of DramG and CoopG compared to the APA scores. This could be attributable to the social communication opportunities. When the lesson plans were checked out, it is clear that more drama activities included in CCA topics that require entire class communication rather than small group plays compared to the APA topics.

Although the DramG students performed significantly better on the VHL than the CoopG students, the mean score difference from pretest to posttest was not significant. Previous research (Johnson, 2002) reported that it takes time for students to raise their van Hiele levels. The short period of treatment will be the reason for this result. A longer period is necessary for students to make significant gains in geometric thinking. Although, students' explanations for the POSTVHL responses of DramG include more logical relations than did the CoopG students.

As the literature supported, it is difficult to change the students' attitudes in a short period, both the drama based-learning and cooperative learning did not have a significant effect on students' POSTGAS scores (Saab, 1987).

5.2 Conclusions

Internal and external validity threats of the study were sufficiently controlled by the settings of the study. Treatment and the administration of the instruments were carried out in regular classrooms during the regular lesson hours. As the study carried out in two different public primary schools in the same neighborhood,

physical and educational settings were more or less the same. The threats related to the ecological validity were controlled. The accessible population of the study was the seventh grade students in Yenimahalle district, Ankara. The subjects were the seventh grade students of two schools from this area. Since the sample of the study was chosen by the nonrandom sample of convenience, generalizability of the research was limited. This study can be applied to a broader population of similar sample.

The quantitative analyses and the observations of the instructor revealed that the drama based learning had a significant effect on students' angles and polygons achievement, circle and cylinder achievement compared to the cooperative learning.

Significantly better performance of the DramG students with respect to the all dependent variables was attributable to the potential of the drama based learning to make learning easy and understanding better by; (a) involving plays in make-believe situations (b) giving chance to improvise daily life examples c) including activities that require bodily kinesthetic, musical, oral, written expressions of thoughts.

5.3 Implications

This study holds the following implications for educational practice:

• With respect to the related literature, drama based learning has differences from cooperative learning. In drama, students take roles in make believe situations. They construct their knowledge by cooperatively playing in games. Students mostly interact with the whole class members during the activities. On the other hand, students who were working in cooperative learning groups try to achieve the goals in small groups by talking to each other. Students' interaction is mostly limited to these small group works. In this study, the better performance of drama-based learning can be attributable to the role-playing situations. The findings suggest that drama based lesson plans should be developed and used in other topics of geometry and mathematics to increase student achievement.

•Curriculum developers should take the effectiveness of drama-based learning

compared to cooperative learning into consideration during curriculum development process. They could carry drama-based learning practices into reality and should encourage the teachers for using drama in their classrooms within the cooperative works.

•New curricula emphasize the effects of cooperative learning. Both the preservice and inservice teacher-training programs focus on cooperative learning settings. Teachers and novice teachers take courses on cooperative learning. On the other hand, drama courses can be helpful for teachers. Inservice and preservice teachers should be trained about the benefits of drama-based learning. Courses should assist them to gain knowledge and skills about the implementation of drama based lessons.

5.4 Recommendations for Further Researchers

Based on the results of this study, the following recommendations are made for further researchers.

• Drama based learning and cooperative learning should be compared by considering students individual differences.

• Drama based learning and cooperative learning should be compared for different mathematics topics.

• This study revealed that some aspects of drama-based learning, such as role playing situations, have an effect on students' achievement, attitude and van Hiele levels compared to cooperative work. More qualitative studies to provide a deep understanding about how drama based learning differ from cooperative learning can be fruitful in mathematics education research.

• Replication of this study on different grades sample and other mathematics topics are recommended to provide more in-depth results.

• Although, for drama group and cooperative group implementer was the same,

replication of this study with different teachers instructing with different methods would be helpful to determine whether drama based instruction is an effective teaching method regardless of the implementer.

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APPENDICES

APPENDIX A

COOPERATIVE LEARNING
LESSON PLANS

Ders Planı 1: Süre: 1 ders saati

Hedef 1: Eş açıları kavrayabilme
Davranışlar:

1. Bir noktada kesişen iki doğrunun oluşturduğu açılardan, komşu bütünler ve ters açıları gösterip yazma.
2. Ters iki açının kenarları arasındaki ilişkiyi söyleyip yazma.
3. Verilen bir açıya ters olan açıyı çizme.
4. Ters açıların ölçüleri arasındaki ilişkiyi söyleyip yazma.
5. Kesişen iki doğrunun oluşturduğu açılardan birinin ölçüsü verildiğinde, diğerlerinin ölçülerini bulup yazma.

İŞLENİŞ

- Sınıf öğretmeninin yardımıyla cinsiyet ve başarı yönünden 4 kişilik heterojen gruplar oluşturulur. Gruplar içinde heterojen olmasına karşın gruplar arası bu oluşum homojen olacaktır. Belirlenen bu gruplarda öğrenciler 7 hafta boyunca çalışmalarını birlikte yürüteceklerdir.

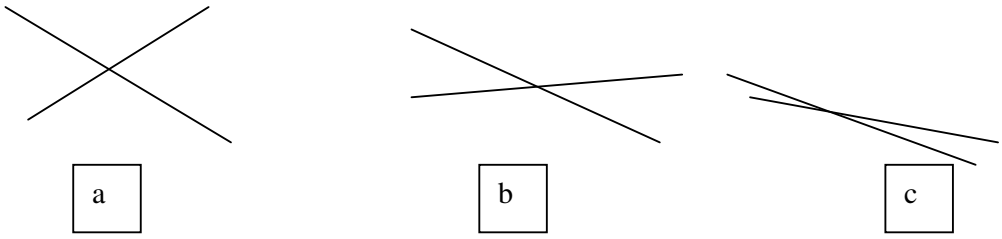
- Öğrenciler her dersten sonra, o derste yaptıkları çalışmaları grup çalışma dosyalarında saklarlar.

- Her grubu 1er tane beyaz dosya kağıdı verilir.

- Grupların günlük hayatımızda açıları nerelerde ne şekilde kullandığımızla ilgili birer paragraf yazmaları için süre verilir.

- Gruplardaki öğrencilerin tartışarak, beyaz çizgisiz kâğıda bir makasın 3 farklı durumunu çizmeleri istenir. Öğrencilerin çizdikleri makas modellerindeki açıları göstermeleri istenir. (a),(b) ve (c) şekillerindeki açıların nasıl

değiştiğiyle ilgili grup içi tartışmalar yapılır.



Şekil 1

- Grupların bir önceki etkinlikte çizimini yaptıkları 3 makas modelinden birini seçerek açıları adlandırmaları, açıların birbirlerine göre durumları ile ilgili önce grup içinde daha sonra gruplar arasında tartışmaları sağlanır. Amaç öğrencilerin; bazı açıların ters bazılarının ise yan yana olduğunu keşfetmeleridir.

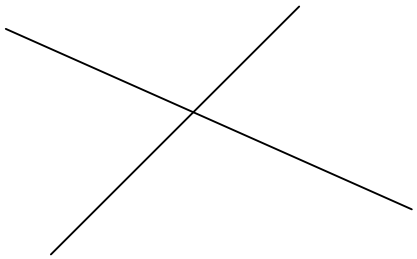
- Alınan cevaplardan "komşu açılar" ve "ters açılar" ın tespit edilmesi sağlanır. Her bir grubun komşu açılarda ve ters açılarda açıların kenarları arasında nasıl bir ilişki olduğunu görerek, komşu açı ve ters açı tanımını yaparak çalışma kâğıtlarına yazmaları istenir.

- Öğrencilerin defterlerine makas modelini çizerek açıları göstermeleri istenir.

- Öğrencilerin komşu açı ve ters açı tanımlarında eksiklikler varsa giderilerek,

***"**Komşu açı:** Köşesi ve bir kenarı ortak, diğer kenarları ortak kenarın farklı taraflarında olan iki açıya komşu açılar denir."
***"**Ters açı:** Köşeleri ortak ve kenarları aynı doğrultuda birbirlerinin ters ışınları olan açılara ters açılar denir." tanımları yazdırılır.

- Öğrencilerin, makasta bulunan komşu açıların bütünler olduklarını keşfetmeleri sağlanır. Bunun için her grubun açıölçer yardımıyla komşu açıların ölçülerini hesaplayıp toplamaları sağlanır.



Şekil 2

Şekil–2 tahtaya çizdirilir. t ile v, z ile y' nin ters açılar oldukları buldurulur. z ile y, y ile v,
v ile z, z ile t'nin konumları üzerinde tartışılır.

Öğrencilerin ters açıların ölçülerinin birbirine eşit olduğunu görmeleri beklenir. Grupların ters açıların ölçülerini açıölçer ile ölçerek karşılaştırmaları ve bunu çalışma kâğıtlarında yazılı olarak ifade etmeleri istenir.

*** Öğretmen tahtaya, "Ters açıların ölçüleri birbirine eşittir. Komşu bütünler açıların ölçüleri birbirini 180° 'ye tamamlar;

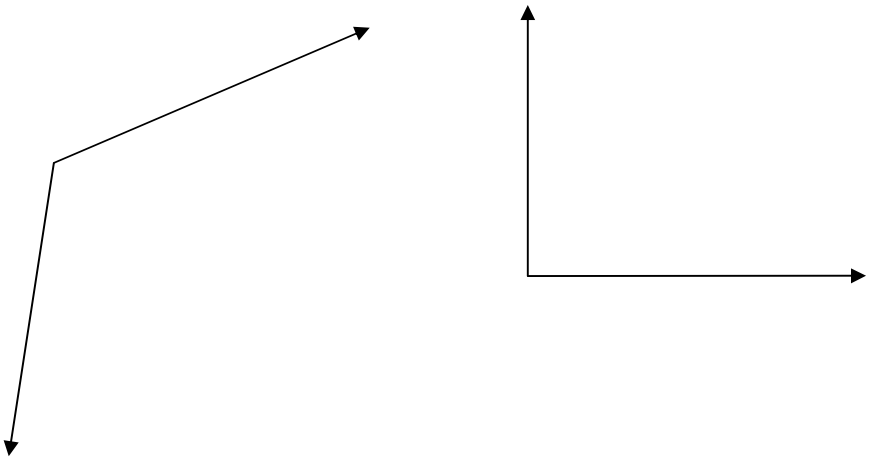
s(t)=s(v)	s(t)+s(y)=180°	s(v)+s(z)=180°
s(z)=s(y)	s(v)+s(y)=180°	s(z)+s(t)=180°"

yazar. Öğrencilerin de defterlerine yazmaları sağlanır.

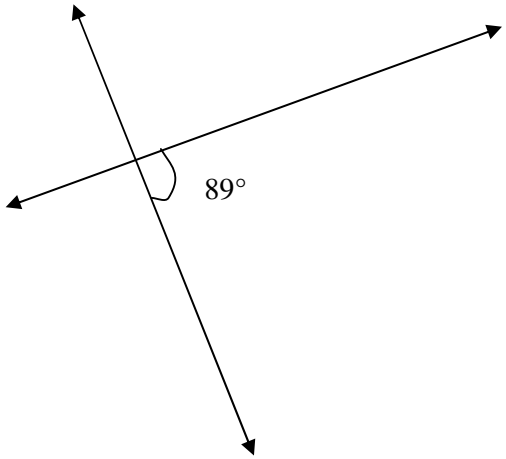
❖ Gruplara aşağıdaki çalışma yaprağı verilir. Ve sorularda belirtilenleri gruplar içerisinde tartışarak yapmaları istenir.

<u>AÇILAR ÇALIŞMA YAPRAĞI – I</u>

1. Aşağıda verilen açılara ters olan birer açı çiziniz.



2. Aşağıdaki şekilde kaç açı bulunduğunu tartışınız. Ölçüsü verilen açıdan yola çıkarak, verilmeyen açıların ölçülerini hesaplayınız ve hesaplama sırasında açılara ait ne gibi özelliklere dikkat ettiğinizi belirtiniz.



3. Komşu bütünler iki açıdan biri diğerinin 2 katıdır. Bu açılara ait şekli çiziniz, şekil üzerinde açılar ait ilişkiyi gösteriniz. Bu açılardan küçük olan açının ters açısını çizerek ölçüsünü hesaplayınız. Kullandığınız çözüm yolunu arkadaşlarınızla tartışınız.

❖ Öğrenci gruplarına 10cmx10cm boyutlarında renkli kartonlar verilir. Derste öğrenilenleri kartın bir tarafına özetlemeleri, diğer tarafına ise dersle ilgili 1'er soru yazmaları istenir. Soru kartları karşılaştırılarak gruplara dağıtılır. Grupların aldıkları bu kartlardaki ifadeleri okuyup yanlışlıkları düzeltmeleri, soruyu da çözmeleri istenir. En kısa sürede cevapları tamamlayan 3 gruba sorular tahtada çözdürülür ve diğer öğrencilerin de defterlerine yazmaları sağlanır.

❖ Derste yapılan çalışmaları grup dosyalarına eklemeleri istenir.

Ders Planı 2: Süre: 1 ders saati

Davranışlar:

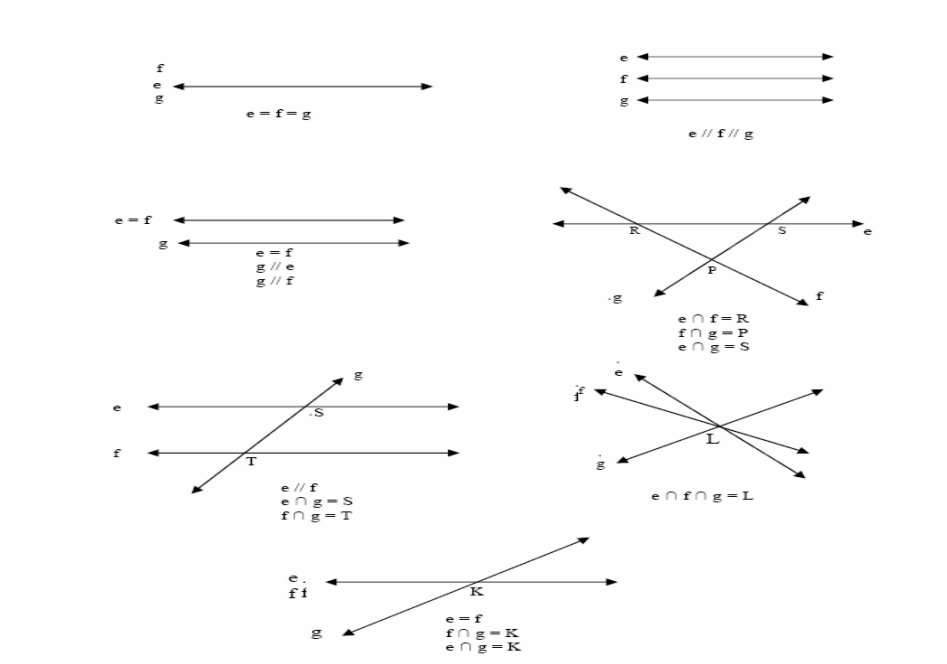
6. Bir düzlemde, üç doğrunun birbirine göre durumlarını söyleyip yazma.
7. Paralel iki doğrunun bir kesenle yaptığı açılardan, yöndeş, iç ters, dış ters açıları gösterip işaretleme.
8. Yöndeş; iç ters ve dış ters açıların özelliklerini söyleme.
9. Paralel iki doğrunun üçüncü bir doğru ile oluşturduğu açılardan, belirtilen bir açıya göre yöndeş, iç ters ya da dış ters olan açıları gösterme.
10. Ters, iç ters, dış ters ve yöndeş açıların özelliklerinden faydalanarak çeşitli açı hesaplamaları yapma.

İŞLENİŞ

❖ Öğrenciler daha önce oluşturulan 4 kişilik grupları ile çalışacaklardır. Dersin başında her gruba çalışmalarını yapmaları için 1er tane dosya kağıdı verilir.

❖ Öğrencilerin 3 doğrunun düzlemde birbirlerine göre konumlarının neler olabileceğini tartışarak ve bu konumları beyaz dosya kâğıdı üzerinde, isimlendirdikleri doğrular yardımıyla çizmeleri istenir.

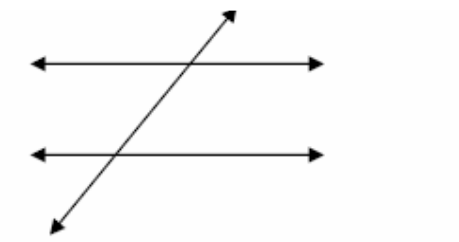
❖ Öğrencilerin aşağıdaki 7 durumu keşfetmeleri sağlanır.



- Bu 7 farklı durum hakkında grup içi ve gruplar arası tartışmalar yapılır.

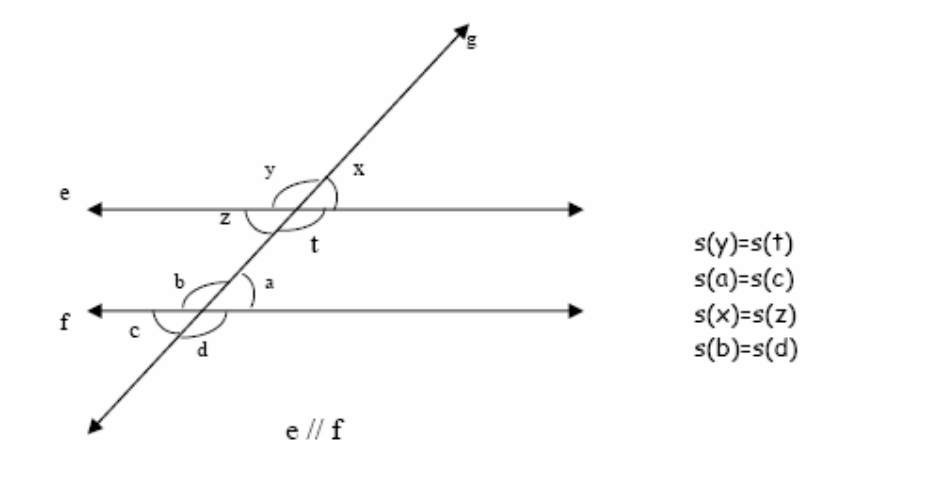
- Öğrencilerin bu durumları defterlerine çizmeleri sağlanır.

- Keman tellerinin ve keman yayının birbirlerine göre konumları üzerine grupların fikirleri alınır.



- İkisinin birbirine paralel, diğerinin bunları kestiği durum olduğunu keşfetmeleri beklenir.

- Tahtaya aşağıdaki şekil çizilir. Bu şekil üzerindeki ters açılar, ters açıların ölçüleri konuşulur. Bu şekilde ters açılar belirtilir ve açılarının ölçülerinin eşitliği sembolle gösterilir.

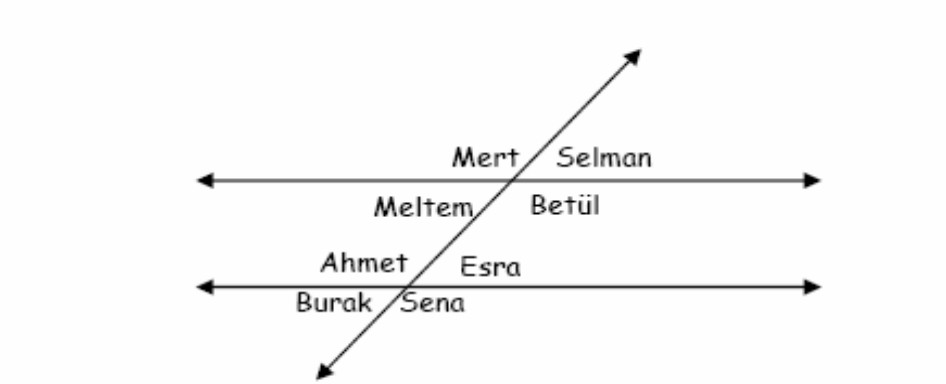


❖ Öğrencilerin bunları defterlerine yazmaları sağlanır.

❖ Aşağıdaki çalışma yaprağı gruplara dağıtılır.

AÇILAR ÇALIŞMA YAPRAĞI - II

Aşağıda verilen iki paralel doğrunun bir kesenle yaptığı açıların her birinde tam karşılarını görecek şekilde bazı öğrenciler durmaktadır. Buna göre bu öğrencilerden aynı yöne bakanları belirtiniz. Bunlara ne isim verilebileceğini tartışınız.

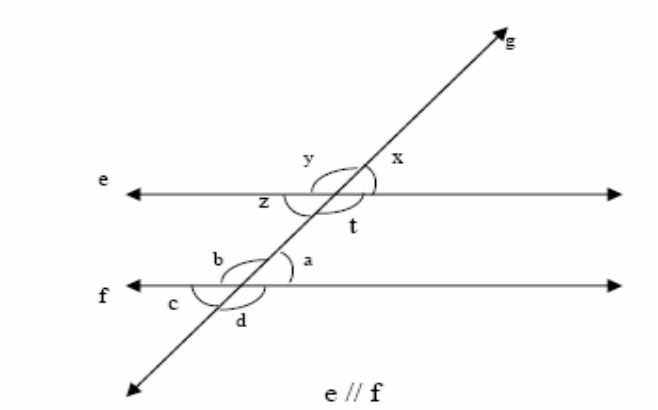


Aynı yöne baktığını belirlediğiniz açıların ölçülerini açıölçeriniz yardımıyla ölçerek karşılaştırınız.

Öğrenci çalışmalarının ardından bu açılara yöndeş açı denildiği hatırlatılır ve ölçülerinin eşit olduğunu görmeleri sağlanır.

***"Paralel iki doğruyu bu doğrulara paralel olmayan üçüncü bir doğru kestiğinde oluşan açılardan aynı yöne bakanlarına yöndeş açılar denir. Yöndeş açıların ölçüleri eşittir." Tanımı öğrencilerin defterlerine yazdırılır.

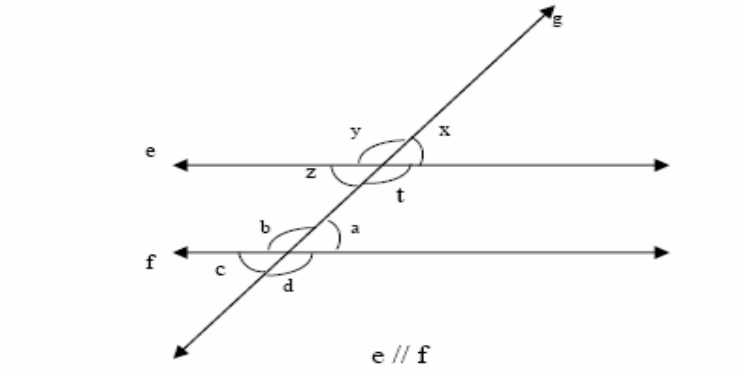
ÖRN:



Verilen şekilde e//f 'dir. g ise e ve f 'yi keser.
s(b)=110 ise a,c,d,x,y,z ve t açılarının ölçülerini bulmaları için gruplara süre verilir. Çözüm tahtada yapılır. Çözüm yolu üzerinde tartışılır.

- Öğrencilerin grupları ile birlikte, çalışma kâğıtlarına iki paralel doğru ve bunları kesen üçüncü bir doğru çizmeleri istenir.

- İç tarafta kalan açıları sarı renk ile dış tarafta kalan açıları mavi renk ile boyamaları istenir. Dışta kalan açılara DIŞ AÇILAR, içte kalan açılara İÇ AÇILAR denileceğini bulmaları sağlanır.



- y ile h, x ile c ve z ile a, t ile b açılarının birbirlerine göre konumları hakkında konuşulur. Bunlara ne isim verileceği tartışılır.

- Öğrencilerin bu açılardan; dışarıda olup ters yöne bakanlarına **DIŞ TERS**, içerde olup ters yöne bakanlarına ise **İÇ TERS** açılar denildiğini keşfetmeleri istenir.

- Öğrencilerin açıölçer yardımıyla bu açıların ölçülerini bularak iç ters açıların ölçülerinin eşit olduğunu, dış ters açıların ölçülerinin eşit olduğunu bulmaları sağlanır.

Dış ters açılar	İç ters açılar
s(y)=s(d)	s(z)=s(a)
s(x)=s(c)	s(t)=s(e)

- Paralel iki doğrunun bir kesenle yaptığı açılarla ilgili alıştırmalar çözülür.

❖ Öğrencilerin ders sırasında hazırladıkları materyalleri dosyalarında saklamaları hatırlatılır.

❖ Ders kitabındaki alıştırmalar ödev olarak verilir.

Ders Planı 3: Süre: 1 ders saati

Hedef 3: Üçgenin yardımcı elemanlarını kavrayabilme.

D.1)Verilen bir üçgenin kenarlarını ve açılarını sembol kullanarak yazma.
D.2)Verilen bir üçgenin yüksekliklerini gösterip özelliğini söyleme.
D.3)Verilen bir üçgenin açıortaylarını gösterip özelliğini söyleme.
D.4)Verilen bir üçgenin kenarortaylarını gösterip özelliğini söyleme.

Hedef 4: Üçgenin yardımcı elemanlarını çizebilme.

D.1)Verilen bir üçgenin, belirtilen kenarına ait yüksekliğini çizme.
D.2)Verilen bir üçgenin, belirtilen kenarına ait kenarortayını çizme.
D.3)Verilen bir üçgenin, belirtilen kenarına ait açıortayını çizme.

İŞLENİŞ

❖ Öğrenciler daha önceden belirlenen 4 kişilik gruplarla çalışacaklardır. Her grubun 3'er tane metal parayı kullanarak, bunların kaç değişik şekilde durabileceğini modelleyip, defterlerine çizmeleri istenir. Bu üç paranın birbirlerine göre doğrusal olan ve olmayan konumları üzerine konuşulur.

❖ Öğretmen gruplara bu paraların bulunduğu yere birer ağaç dikilip bu ağaçların çevrelerini bir lastik ile bu çevrelediklerinde nasıl bir şekil oluşacağını sorar. Öğrenciler grupları ile bu konuda tartışır. Üçgenin kenarları ve köşeleri üzerine konuşulur. Bu şekil tahtaya çizilir.

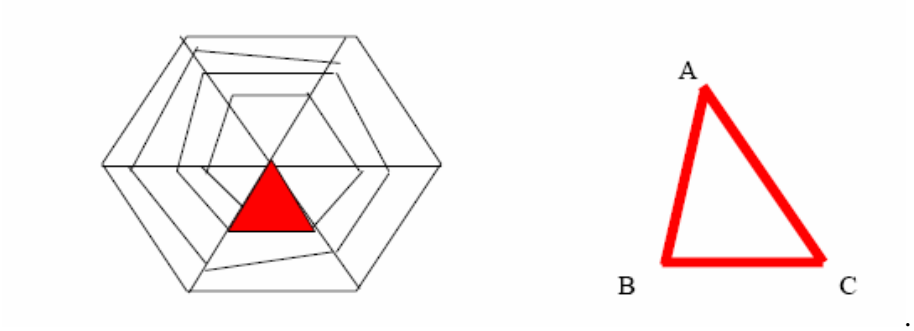
❖ Öğrencilerin, oluşan bu üçgenlerde seçtikleri bir "köşeden", bu köşenin karşısındaki "kenara" giden en kısa yolu (yükseklik-dik) bulmaları istenir. Yüksekliğin 90° açı ile karşı kenarı kestiğini ve en kısa uzaklık olduğunu keşfetmeleri sağlanır.

❖ "Örümcek Adam"ın mektubu gruplara dağıtılır.

ÖRÜMCEK ADAMDAN GELEN MEKTUP

Merhaba Sevgili 7/… Öğrencileri;
Sizin üçgenler konusunda oldukça bilgili olduğunuzu öğrendim. Ördüğüm

ağın ve bu ağın üçgen şeklindeki parçasının resmini sizlere gönderiyorum.



Ağın üçgen şeklindeki kısmı ile ilgili bir sorunum var. Benim evim üçgenin A köşesinde, sevgilim Mary Jane'nin evi bu üçgenin a kenarında. Benim evimden Mary Jane'nin evine giden yol A köşesindeki açının tam ortasından geçiyor. Fakat benim evimden Mary Jane'in evine giden yolu kaybettim. A köşesindeyken Mary Jane'in evine gitmek için izlemem gereken yolu çizerseniz, çok çok çok mutlu olacağım. Size üçgenin kopyalarını gönderiyorum. Şimdiden teşekkürler…
Örümcek Adam

- Gruplara örümcek adamın istediği çizimin yapılması için yeterli süre verilir.
  Gruplar çizimlerini bitirdikten sonra "siz çizimlerinizi yaparken örümcek adam bir zarf daha gönderdi" denir. Öğretmen zarfı açarak mektubu okur:
  "*Eğer evim A köşesinde değil de B köşesinde, Mary Jane'nin evi B kenarında olsaydı ve benim evimden Mary Jane'nin evine giden yol B köşesindeki açının tam ortasından geçiyor olsaydı, bu durumda benim evimden Mary Jane'nin evine giden yolu çizer misiniz?"* Bu çizim için de yeterli süre verilir.
  Bu çizim bitince mektubun 2. kısmı okunur:
  "*Eğer evim C köşesinde olsaydı ve Mary Jane'nin evi C kenarında olsaydı ve benim evimden Mary Jane'nin evine giden yol C köşesindeki açının tam ortasından geçiyor olsaydı, benim evimden Mary Jane'in evine giden yolu çizer misiniz?"* Bu çizim için de yeterli süre verilir.

- Öğretmen öğrencilere bu 3 çizim sonucunda nasıl bir şekil elde ettiklerini sorarak, bu üç çizginin bir noktada kesiştiği cevabını bulmalarını sağlar. Bu doğru parçasına **AÇIORTAY** denildiğini söyleyen öğretmen öğrencilerin açıortayın özellikleri ile ilgili olarak fikirlerini söylemelerini sağlar.

- Öğretmen gruplara "Örümcek Adam A köşesinde durmaktadır ve karşı kenarın tam ortasına gitmek istemektedir. Örümcek adamın gideceği yolu bulun" der. B ve C köşeleri için de öğrencilerin aynı çizimleri yapmaları sağlanır. Bu üç çizim yapıldığında ne bulunduğu öğrencilere sorulur. Kenarortay ve özellikleri üzerinde tartışılır.

- Öğrencilerden Örümcek Adamın üçgenlerinden 3 tanesini defterlerine çizmeleri istenir. 1.üçgen üzerinde tüm yükseklikleri, 2.üçgen

üzerinde tüm açıortayları, 3.üçgen üzerinde tüm kenarortayları göstermeleri istenir. Üçgenlerin yanına yapılan çizimlerin özelliklerinin yazılması istenir.

Ders Planı 4: Süre: 1 ders saati

Hedef 5: Üçgenin kenarları ve açıları arasındaki bağıntıları kavrayabilme.

D.1)Bir üçgenin iki kenarının toplamı veya farkı ile üçüncü kenarının uzunluğu arasındaki ilişkiyi söyleyip yazma.
D.5)Bir dik üçgenin hipotenüsünün uzunluğu ile bir dik kenarının uzunluğu arasındaki ilişkiyi söyleyip yazma.

Araç-Gereçler: Pipet, makas, ip, asetat kalemi, sarı ve mavi renkli fosforlu kalem

İŞLENİŞ

- Daha önceden belirlenen 4 kişilik gruplarla çalışma yapılacaktır.
- Öğrencilere yeterli miktarda pipet ve ip ile birer makas, fosforlu kalemler ve birer asetat kalemi verilir.
- Aşağıdaki çalışma yaprağı gruplara dağıtılır.

NASA'NIN YENİ GEZEGENİ
NASA, yeni bir gezegen bulmuştur. Sizler de NASA'nın araştırma laboratuarlarında görevli bilim adamlarısınız. Bulunan yeni gezegende sadece üçgen şeklindeki evlerde yaşanabiliyor. Siz bilim adamlarının yapması gereken, orada içinde yaşamak için üçgenler üretmek. Bu iş kolay gibi görünse de bu üçgenleri oluşturmak biraz zor olacağa benziyor. Bir takım bilim adamları kenarları; 2cm,3cm ve 13cm olan üçgenin çizilemeyeceğini söylediler ancak nedenini açıklayamadılar. Biz de bu işi size bırakmaya karar verdik.
Bu işi başarmak için, size verilen pipetlerden belirtilen uzunluklarda kenarlar keserek içinden ip geçirin. Bakalım üçgen oluşturulabiliyor mu?
Aşağıdaki tabloyu doldurunuz ve bulgularınızdan yararlanarak NASA'ya bir rapor hazırlayınız. Oluşturulamayan üçgenler var ise nedenlerini tartışınız.

Kenar Uzunlukları	*Üçgen Oluşturulup Oluşturamayacağı*
2,3,13	
4,5,7	
6,1,9	
4,3,10	
8,5,4	
6,2,1	
14,9,4	
7,7,8	
4,4,10	
3,4,5	
1,2,3	

- Öğrencilerin belli uzunluklarda kesilip üzerine asetat kalemi ile uzunluklarını yazdıkları 3 pipetin içinden ip geçirerek kenar uzunlukları o sayı olan, bir üçgen oluşturulup oluşturulamayacağını tespit edip tabloyu doldurmaları sağlanır.
- Tablo doldurulduktan sonra üçgen oluşacak durumları sarı fosforlu kalemle, üçgen oluşturmayacak durumları ise mavi fosforlu kalemle boyayarak bunlar arasındaki ilişkiyi bulmaları beklenir.(Oluşan dik üçgenlerin ise yanına yıldız konulması istenir.)
- Öğrencilerin raporları dinlenir. Üçgenin kenar uzunlukları arasındaki "İki kenarın uzunluğunun toplamı, üçüncü kenarın uzunluğundan büyük; iki kenarın uzunluğu farkı ise üçüncü kenarın uzunluğundan küçüktür." ilişkisinin bulunması sağlanır.
- Dik üçgenlerde ise hipotenüs ile dik kenarlar arasındaki ilişkiyi görmeleri istenir. Hipotenüsün uzunluğunun, bir dik üçgenin kenarlarından en büyüğü olduğunu görmeleri beklenir.

Ders Planı 5: Süre: 1 ders saati

Hedef 5: Üçgenin kenarları ve açıları arasındaki bağıntıları kavrayabilme.

D.2)Bir üçgende, bir köşedeki iç ve dış açılar arasındaki ilişkiyi söyleyip yazma.
D.3)Bir üçgende, bir köşedeki dış açı ile kendisine komşu olmayan iki iç açı arasındaki ilişkiyi söyleyip yazma.
D.4)Bir üçgenin kenar uzunlukları ile bu kenarlar karşısındaki açıların ölçüleri arasındaki ilişkiyi söyleyip yazma.

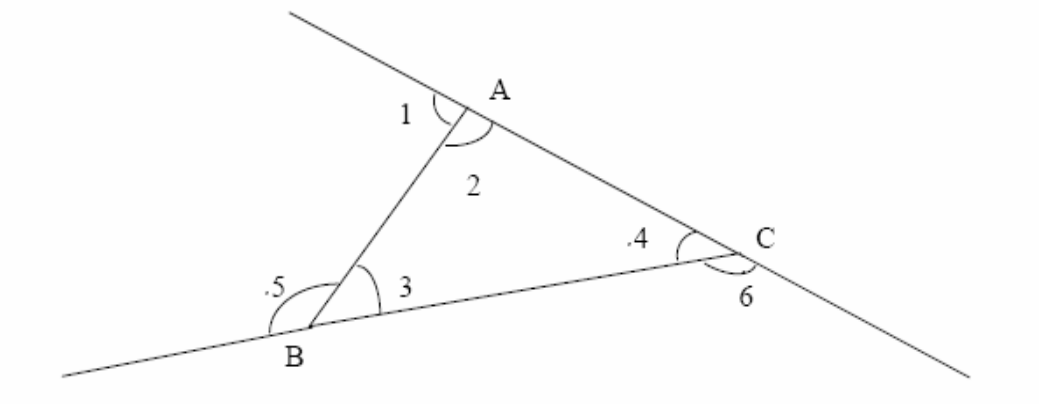
Hedef 6: Üçgenlerde açı hesaplayabilme.

D.1)Bir üçgenin iç açılarının ölçüleri toplamını bulup yazma.
D.2)Bir üçgenin dış açılarının ölçüleri toplamını bulup yazma.
D.3)Bir üçgenin bir köşesindeki iç veya dış açılardan birinin ölçüsü verildiğinde, diğer açının ölçüsünü bulup yazma.
D.4)Bir üçgenin iki iç açısının ölçüsü verildiğinde üçüncü iç açısının ölçüsünü bulup yazma.
D.5)Bir üçgenin bir dış açısının ölçüsü ile farklı köşesindeki bir iç açısının ölçüsü verildiğinde, diğer iç açılarının ölçülerini bulup yazma.
D.6)Bir üçgenin herhangi iki açısının ölçüsü verildiğinde, diğer iç veya dış açıların ölçülerini bulup yazma.
D.7)Tepe açısı veya taban açılarından birisinin ölçüsü verilen ikizkenar üçgenin diğer açılarının ölçülerini bulup yazma.
D.8)Dar açılardan birinin ölçüsü verilen bir dik üçgenin diğer dar açısının ölçüsünü bulup yazma.
D.9)Üçgenin açıları arasında verilen bağıntılardan yararlanarak, istenilen açıların ölçülerini bulup yazma.

İŞLENİŞ

- Öğrenciler 4 kişilik gruplarla çalışacaklardır. Aşağıdaki şeklin çizili

olduğu çalışma yaprağı gruplara dağıtılır.



Elinizdeki şekil, bir bahçenin kuşbakışı görüntüsüdür. Bu bahçede üçgen şeklinde bir parça çevrelenmiştir. Arazinin iç ve dış köşelerindeki açıları sulayan fıskiyeler numaralandırılmıştır.
Aşağıdaki soruları grup arkadaşınızla tartışarak cevaplayınız. Cevaplarınızı diğer gruplarla paylaşınız.

- 1 numaralı fıskiye üçgenin hangi tarafını sulamaktadır?
- 2 numaralı fıskiye üçgenin hangi tarafını sulamaktadır?
- 3 numaralı fıskiye üçgenin hangi tarafını sulamaktadır?
- 4 numaralı fıskiye üçgenin hangi tarafını sulamaktadır?
- 5 numaralı fıskiye üçgenin hangi tarafını sulamaktadır?
- 6 numaralı fıskiye üçgenin hangi tarafını sulamaktadır?

Bu fıskiyelerin suladığı açılara hangi isimler verilebileceğini sorar.(İç ve dış açı kavramına dikkat çekilmeli.) Öğretmen "Burada 1,5 ve 6 numaralı fıskiyelerin suladığı açılara üçgenin dış açıları; 2,3 ve 4 numaralı fıskiyelerin suladıkları açılara üçgenin iç açıları adı verilmektedir" açıklamasını yapar.

Öğrencilerin 1, 5 ve 6 numaralı açıların ölçüsü toplamını bulmak için grup halinde çalışmaları istenir. Açıölçerler yardımıyla hesaplayarak 180° cevabını bulmaları beklenir, açıklamalar üzerinde tartışılır.

Her köşede 2 tane fıskiye olduğuna dikkat çekilir. Bu iki fıskiyenin ölçüleri toplamı sorulur.(Komşu bütünler açılar dikkate alınmalıdır.)

ÖRN:
1 numaralı fıskiye 60 derece'lik açı ile sulama yapıyor ise 2 numaralı fıskiye kaç derecelik açı ile sulama yapar?

- Öğretmen öğrencilere 1 numaralı fıskiyenin sulama açısı mı 3 numaralı fıskiyenin sulama açısı mı daha büyük diye sorar.
- Aynı şekilde 1 numaralı fıskiyenin sulama açısı ile 4 numaralı fıskiyenin sulama açısını karşılaştırmalarını ister.
- 2, 3, 4 numaralı fıskiyelerin sulama açıları toplamını sorar.

- Bir dış açının ölçüsünün, kendisine komşu olmayan iç açıların ölçülerinden büyük olduğunun fark edilmesi sağlanır.
- Öğrencilerin 2, 3, 4 numaralı açıları, açıölçer ile ölçerek büyüklüklerini

karşılaştırmaları istenir. Cetvelleri ile üçgende bu açılar karşısındaki kenar uzunluklarını ölçmeleri istenir.(Açıların ölçülerini sırala, kenar uzunluklarını sırala) ve kenar uzunluğu ile açı ölçüsünün ne gibi bir ilişkisi olduğunu tespit edip bunu 1 paragraflık bir rapor halinde sınıfa sunmaları istenir. Sonuçlar tartışılır.

- ❖ Öğrencilerin, kısa kenar karşısında en küçük; uzun kenar karşısında en büyük açının olduğunu keşfetmeleri sağlanır.
- ❖ Grupların, büyük bir pergelin farklı açılardaki açıklıkları için 3.kenarını tamamlamak üzere ne kadar uzunlukta bir kenara ihtiyaç duyulacağı tartışılabilir.

Ders Planı 6: Süre: 2 ders saati

Hedef 7: Çokgenleri kavrayabilme

D.1)Çokgeni örneklerle açıklama
D.2)Verilen bir çokgeni adlandırarak söyleme
D.3)Verilen bir çokgenin kenarlarını ve köşelerini sembol kullanarak yazma.
D.6)Düzgün çokgeni örneklerle açıklama.

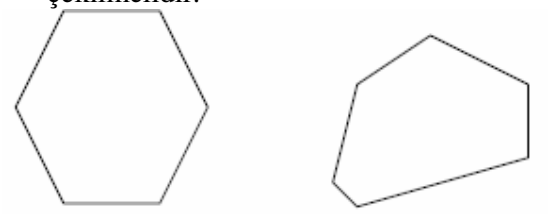
Araştıralım:
Öğrencilerin derse gelirken çevrelerindeki çokgenleri not etmeleri istenir.

İŞLENİŞ

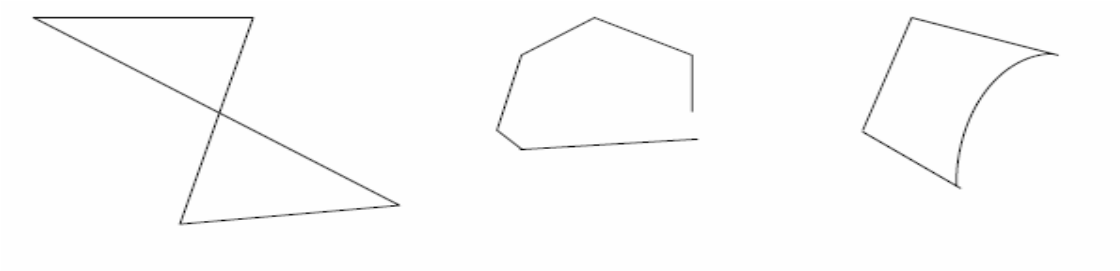
- ❖ 4 kişilik gruplarla çalışma yapılacaktır. Her gruba çivili geometri tahtalarından veriniz. Birer tane de lastik ve çalışmalarını not etmek için beyaz dosya kâğıdı veriniz. Bu lastiği kullanarak her grubun bir üçgen oluşturmasını isteyiniz. Beyaz dosya kâğıdına oluşan şekli çizmelerini isteyiniz. Şeklin yanına; kaç kenarı olduğunu, kaç köşesi olduğunu, kenarlarının birbirlerine göre konumlarını belirten notlar yazmalarını isteyiniz.
- ❖ Dörtkenarlı bir şekil oluşturmalarını isteyiniz. Bunun da şeklini çizdirerek kenarların sayısı, konumu(paralellik), uzunluğu, köşelerin sayısı, kapalı olup olmadığı, açı sayısı, açıların çeşitlerini not etmelerini sağlayınız. Bilinen bir şekle benzeyip benzemediği sorulur.
- ❖ Dörtkenarlı farklı bir şekil oluşturulur. Aynı sorular sorulur.
- ❖ Beş kenarlı bir şekil oluşturulur.
- ❖ Beş kenarlı farklı bir şekil oluşturulur.
- ❖ Altı kenarlı bir şekil oluşturulur.
- ❖ Altı kenarlı farklı bir şekil oluşturulur.
- ❖ Yedi kenarlı bir şekil oluşturulur.
- ❖ Yedi kenarlı farklı bir şekil oluşturulur.
- ❖ Sekiz kenarlı bir şekil oluşturulur.
- ❖ Sekiz kenarlı farklı bir şekil oluşturulur.
- ❖ Bu sırada her şekle çevreden örnekler verilmesi istenir. Öğrencilere çokgenlerin adlandırılmaları ile ilgili sorular sorulur. Grup içi tartışmalar tamamlandıktan sonra gruplar arası fikir alışverişi yapılır.
- ❖ Öğretmen grupları dolaşarak çalışmaları değerlendirir ve gerek

duyulursa yönlendirir.

- Örneğin kare için ; "Bu şekle kareden başka isim verilebilir mi? Bunun dikdörtgen olması mümkün mü? Dikdörtgenin özellikleri nelerdir? Aynı zamanda buna paralel kenar da diyebilir miyiz?" gibi sorularla tartışma yapılır.
- Aşağıdaki şekiller tahtaya çizilir, kenar ve köşelerin nasıl isimlendirileceği tartışılır. Aynı tür çokgenin düzgün ve düzgün olmayan hallerine dikkat çekilmelidir.



- Bu şekillere ne isim verileceği buldurulmaya çalışılır." Çokgen" cevabına ulaşmaları istenir.
- Aşağıdaki şekiller tahtaya çizilerek çokgen olarak adlandırılıp adlandırılamayacağı sınıfça tartışılır.



***"En az üçü doğrusal olmayan noktaları birleştiren doğru parçalarının meydana getirdiği kapalı düzlemsel şekillere **çokgen** denir." kavramı verilir. Öğrencilerin bunu defterlerine not etmeleri sağlanır.

Ders Planı 7: Süre:1 ders saati

Hedef 7: Çokgenleri kavrayabilme

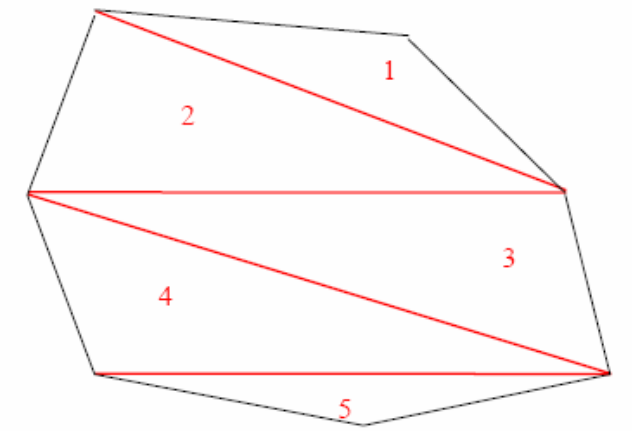
D.4)Bir çokgenin bir köşesinin diğer köşelere birleştirilmesinden elde edilecek üçgen sayısı ile çokgenin kenar sayısı arasındaki ilişkiyi söyleyip yazma.
D.5)köşe ve kenar sayısı verilen bir çokgenin iç açılarının ölçümleri toplamını veren bağıntıyı söyleyip yazma.
D.7)Düzgün çokgenlerden; üçgenin, dörtgenin, beşgenin ve altıgenin iç açılarından her birinin ölçülerini veren bağıntıyı söyleyip yazma.

İŞLENİŞ

- 4 kişilik gruplara, daha önceden hazırladığınız üçgen, dörtgen, beşgen, altıgen, yedigen, sekizgen modellerini veriniz.
- Aşağıdaki tabloyu tahtada oluşturunuz.
-

A	B	C	D	E
Çokgenin kenar sayısı	Çokgenin adı	Köşe sayısı	İçinde kaç üçgen var	İç açılarının ölçüsü kaç derecedir
3				
4				
5				
6				
7				
8				

- ❖ Gruplardan verdiğiniz çokgenlerin içine üçgenler çizmesini isteyiniz. Ancak üçgen çizerken, üçgenin kenarlarından en az birinin çokgenin kenarı olması şartını hatırlatınız.



- ❖ Üçgenlerin birbirini kesmemesini belirtiniz.
- ❖ Her grubun elindeki çokgene göre tablodaki uygun yeri tahtaya kalkıp doldurmasını isteyiniz.
- ❖ Tablo doldurulduktan sonra A ile D, D ile E, A ile E kolonları arasındaki ilişkinin ne olabileceğini grup arkadaşlarıyla tartışarak bulmalarını isteyiniz. Bunlara ilişkin bağıntıları tahtaya yazınız.
- ❖ Ders kitabında konu ile ilgili alıştırmalar çözülür.

Ders Planı 8: Süre: 2 ders saati

Hedef 8: Dörtgen, paralelkenar, dikdörtgen, eşkenar dörtgen, kare, yamuk, deltoid ile bunların arasındaki ilişkileri kavrayabilme.

D.1)Verilen bir dörtgenin, kenarlarını ve köşelerini adlarıyla söyleyip yazma.
D.2)Verilen bir dörtgenin kenar özelliklerini söyleyip yazma.
D.3)Verilen bir dörtgenin açı özelliklerini söyleyip yazma.
D.4)Verilen bir dörtgenin köşegen özelliklerini söyleyip yazma.
D.5)Yamuk çeşitlerini söyleyip yazma.

❖ 4 kişilik gruplardan her birinin elinizdeki kapalı zarflardan birisini seçmesini sağlayın. Zarflarda paralelkenar, dikdörtgen, eşkenar dörtgen ve kare yazılıdır. Her gruba seçtikleri dörtgenle ilgili bir paket verilir. Paketlerde; o dörtgenin değişik

kenar uzunlukları ve (uygunsa)değişik açı ölçülerine sahip çeşitli örnekleri, dörtgenle ilgili çalışma yaprağı, açıölçer ve cetvel vardır. Her grup çalışma yaprağının yönergelerini yerine getirir.

ÇALIŞMA YAPRAĞI:

1. Bütün şekillerinizin köşelerine isim verin.
2. Bütün şekillerinizin kenarlarına isim verin.
3. Şekillerin kenar uzunluklarını ölçüp aşağıdaki tabloya yazın.
4. Şeklinizin kenar uzunlukları hakkında ne söylersiniz?

.....
.....
.....
.....

Şekil no:	1. kenarının uzunluğu	2. kenarının uzunluğu	3. kenarının uzunluğu	4. kenarının uzunluğu
1				
2				
3				
4				
5				
6				
7				
8				

5. Şekillerinizin açılarını ölçüp aşağıdaki tabloya yazınız.
6. Şeklinizin açıları hakkında ne söylersiniz?

.....
.....
.....
.....

Şekil no:	1. açısının ölçüsü	2. açısının ölçüsü	3. açısının ölçüsü	4. açısının ölçüsü
1				
2				
3				
4				
5				
6				
7				
8				

7. Şeklinizin köşegenlerini çizin.
8. Köşegenlerinin uzunluklarını aşağıdaki tabloya yazın.
9. Şeklin köşegenleri hakkında ne söylersiniz?

.....
.....
.....
.....

Şekil no:	Köşegenlerinin uzunlukları
1	
2	
3	
4	
5	
6	
7	
8	

Şimdi bu etkinlikte şeklinize ait bulduğunuz özellikleri kısaca özetleyin (Kenarlar, açılar, köşegenler ile ilgili)

.....
.....
.....
.....
.

- Çalışma yaprakları tamamlandıktan sonra gruplar dörtgenler ve özellikleri ile ilgili tartışırlar. Grupların hazırladıkları çalışma kâğıtlarını değiştirmeleri sağlanır.
- Ders arasında her gruba diğer grupların çalışma yapraklarından birer tane çoğaltılır.
- Dersin diğer yarısında öğrenciler bu 4 çokgenle ilgili çalışma yapraklarını gruplar halinde inceleyerek ortak özelliklerini bir yere not ederler.
- Yamuk çeşitleri ve deltoid verilerek öğrencilerin gruplar halinde tabloyu doldurarak bir rapor hazırlamaları istenir.

ÇALIŞMA YAPRAĞI:

1. Şekillerin köşelerine isim verin.
2. Şekillerin kenarlarına isim verin.
3. Şekillerin kenar uzunluklarını ölçüp aşağıdaki tabloya yazın.
4. Şekillerin kenar uzunlukları hakkında ne söylersiniz?
5. .....
6. .....
7. .....
8. .....

Şekil no:	1. kenarının uzunluğu	2. kenarının uzunluğu	3. kenarının uzunluğu	4. kenarının uzunluğu
1				
2				
3				
4				
5				
6				
7				
8				

Ders Planı 9: Süre: 1 ders saati

Hedef 9: Paralelkenarın, eşkenar dörtgenin, karenin, yamuğun ve deltoidin çevrelerini hesaplayabilme.

D.1)Kenar uzunlukları verilen bir paralelkenarın çevresin hesaplayıp yazma.
D.2)Bir kenar uzunluğu verilen bir eşkenar dörtgenin çevresini hesaplayıp yazma.
D.3)Bir kenar uzunluğu verilen bir karenin çevresini hesaplayıp yazma.
D.4)Kenar uzunlukları verilen bir yamuğun çevresini hesaplayıp yazma.
D.5)Kenar uzunlukları verilen bir deltoidin çevresini hesaplayıp yazma.

İŞLENİŞ

- Sınıfı 4'erli gruplara ayırınız. Her gruba farklı uzunluklarda hazırlanmış paralelkenar, eşkenar dörtgen, kare, yamuk ve deltoid şeklinde kartonlardan yapılmış arazi maketleri dağıtılır. Çalışmaları not etmek için 1er tane de dosya kağıdı verilir.
- "Bu bahçelerin çevrelerini tel ile çevirmek isteyen bir çiftçi, kaç metre tele ihtiyacı olduğunu hesaplamak için neleri bilmelidir?" sorusu sınıfa yöneltilir ve öğrencilerin bir dosya kâğıdına sorunun çözümü için bilinmesi gerekenleri yazmaları istenir. Bundan sonra kartonların arkasında yapıştırılmış olan zarfları açarak verileri kullanarak bu şekillerin çevrelerini hesaplamalarını istenir.
- Cevaplamayı tamamlayan gruplardan birer öğrencinin soruları tahtada çözmesini sağlanır. Çözüm stratejisini açıklaması istenir.
- Ders kitabındaki konu ile ilgili alıştırmalar çözülür.

Ders Planı 10: Süre: 1 ders saati

Hedef 10: Paralelkenarın, üçgenin, eşkenar dörtgenin, yamuğun ve deltoidin alanlarını hesaplayabilme.

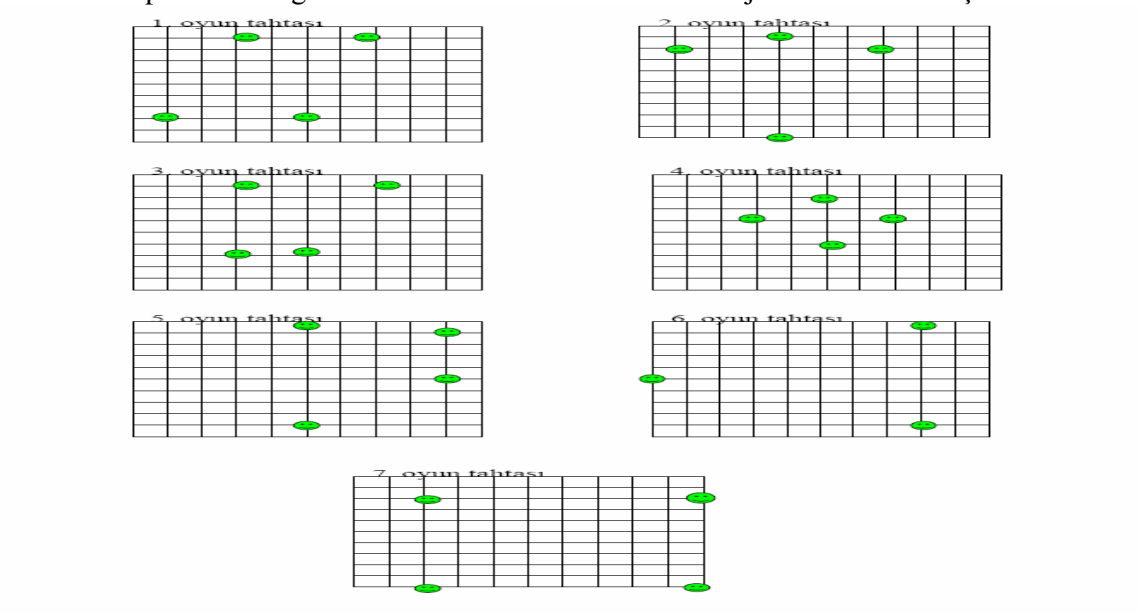
D.1)Bir paralelkenarı kendi alanına eşit alanlı bir dikdörtgene dönüştürerek, meydana gelen dikdörtgenin alanı ile paralelkenarın alanı arasındaki bağıntıyı söyleyip yazma.
D.2)Bir kenar ile bu kenara ait yüksekliği verilen paralelkenarın alanını hesaplayıp yazma.
D.3)Bir paralelkenarın bir köşegeni yardımıyla ayrılan üçgenlerden birinin alanı ile paralelkenarın alanı arasındaki bağıntıyı söyleyip yazma.
D.4)Bir kenarı ve bu kenara ait yüksekliği verilen bir üçgenin alanını hesaplayıp yazma.
D.5)Dik üçgenin alanını hesaplayıp yazma.
D.6)Eşkenar dörtgenin ve deltoidin alanı ile köşegenlerinin uzunlukları arasındaki bağıntıyı söyleyip yazma.
D.7)Köşegenlerinin uzunlukları verilen eşkenar dörtgenin alanını hesaplayıp yazma.
D.8)Köşegenlerinin uzunlukları verilen deltoidin alanını hesaplayıp yazma.
D.9)Bir yamuğun alanını, bilinen çokgen alanları yardımıyla hesaplayıp yazma.
D.10)Tabanları ve yüksekliği verilen bir yamuğun alanını hesaplayıp yazma.
D.11)Bir dik yamuğun alanını veren bağıntıyı söyleyip yazma.

İŞLENİŞ

- Sınıf 4'erli gruplara ayrılır. Her gruba 7'şer tane oyun kartı dağıtılır. Oyunun amacı en güçlü kartı bulmaktır. Ancak bunun için kartta verilen gülen yüzler arasındaki alanlara bakılır. Hangi alan daha büyükse, o kart daha

güçlüdür.

- Gruplara 20'şer dakika vererek en güçlü kartı bulmak için aradaki alanları hesaplamaları sağlanır. Daha sonra kullandıkları stratejiler üzerinde tartışılır.



- Paralel kenar, üçgen, deltoid, eşkenar dörtgen, yamuk için alan bağıntıları verilir. Bunlarla ilgili sorular çözülür.

Öğrencilerin dosyaları toplanarak grup olarak değerlendirileceklerdir.

ÇEMBER – DAİRE – SİLİNDİR

Ders Planı 11: Süre: 1 ders saati
Ünite 6: Çember, daire ve silindir.

Hedef 1: Çember ve daire ile ilgili kavramlar bilgisi.

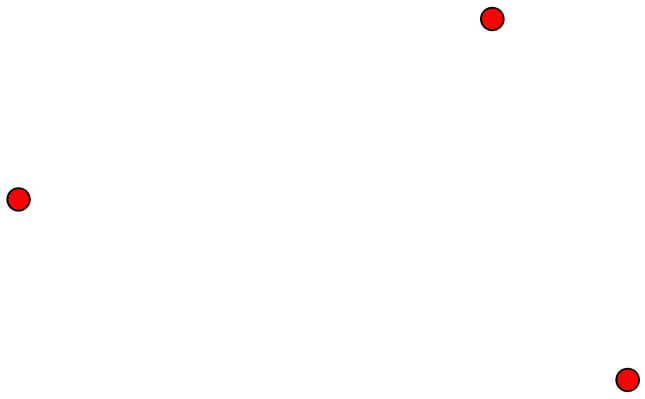
D.1)Düzlemde bir noktadan eşit uzaklıktaki noktaları işaretleyip bu noktaların oluşturduğu şeklin adını söyleme.
D.2)Çemberin tanımını söyleme
D.3)Verilen çemberin çapını, yarıçapını ve merkezini gösterme.
D.4)Bir çemberin belirtilmesi için gerekli olan elemanları söyleme
D.5)Çemberin düzlemde ayırdığı bölgeleri gösterme.
D.6)Bir çemberin merkezinin iç ve dış bölgedeki noktalara olan uzaklığı ile yarıçapını karşılaştırıp sonucu yazma.
D.7)Çember ile iç bölgesinin birleşim kümesini söyleyip yazma.
D.8)Çember ile daire arasındaki farkı söyleyip yazma.

İŞLENİŞ

- Sınıf 4 kişilik gruplar halinde çalışmayı yürütecektir. Uygulamanın başında oluşturulan heterojen gruplar aynı şekilde çalışmaya devam edeceklerdir.
- Aşağıdaki çalışma yaprağını gruplara dağıtın.

İZCİ KAMPI

24 kişilik bir izci grubu, kamp kurmak için araziye ulaştıklarında, hava iyice soğumaya başlamıştı. İzci obaları ısınmak için birer ateş yakmaya karar verdiler. Ancak obadaki kişilerin ateşin çevresine öyle bir şekilde yerleşmeleri gerekiyor ki herkes ısıdan eşit şekilde faydalanabilsin. Aşağıda üç obanın yaktıkları ateşler gösterilmiştir. Her obadaki 8 kişiyi bu ateşlerin etrafına en uygun şekilde nasıl yerleştirebilirsiniz.



- Burada öğrencilerin; herkesin eşit şekilde ısınabilmesi için ateşin etrafında çember şeklinde durulması gerektiğini görmeleri istenir.

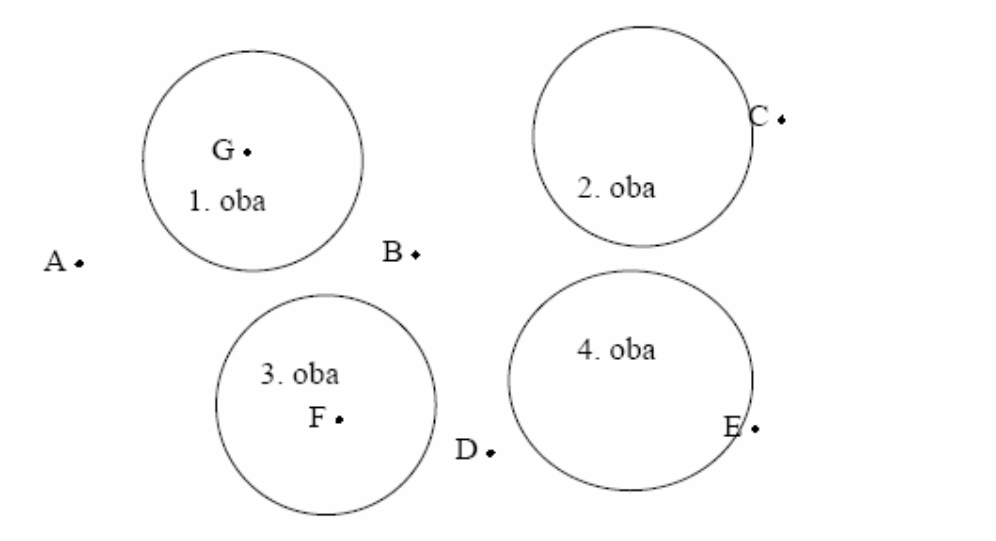
- Öğrencilerin, yerleştirdikleri her bir izcinin ateşe uzaklığını cetvel yardımıyla ölçmeleri istenir. Böylece hepsinin eşit uzaklıkta olduğunu görmeleri sağlanır.

- Tahtaya çember çizilir. Öğretmen " düzlemde bir noktadan eşit uzaklıkta bulunan noktalar kümesine "**çember**" denildiğini, çalışma yaprağındaki ateşin ise " **çemberin merkezi**" olduğunu, her izcinin ateşe uzaklığının da "**yarıçap**" olarak adlandırıldığını anlatır. M merkezli ve r yarıçaplı bir çemberin **Ç(M,r)** ile gösterildiğini belirtir."

- Aşağıdaki etkinlik kâğıdı gruplara dağıtılır.

ISINABİLİR Mİ?

Aşağıda 4 farklı izci obasının yaktığı ateşler gösterilmiştir.

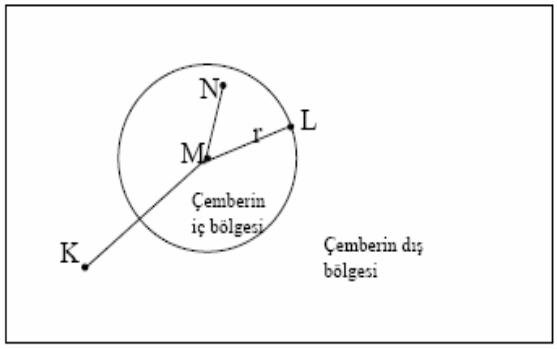


- İzci kampının lideri A,B,C,G ve F noktalarında durduğunda ısınabilir mi? Hangisinde daha çok, hangisinde daha az ısınır?

- Grup içi tartışmalar desteklenir. Öğretmen grupları dolaşarak çalışmalarını izler, yönlendirmelerde bulunur sorular sorar.

- Öğrencilerin çemberin iç ve dış bölgeleri kavramını oluşturmaları sağlanır.

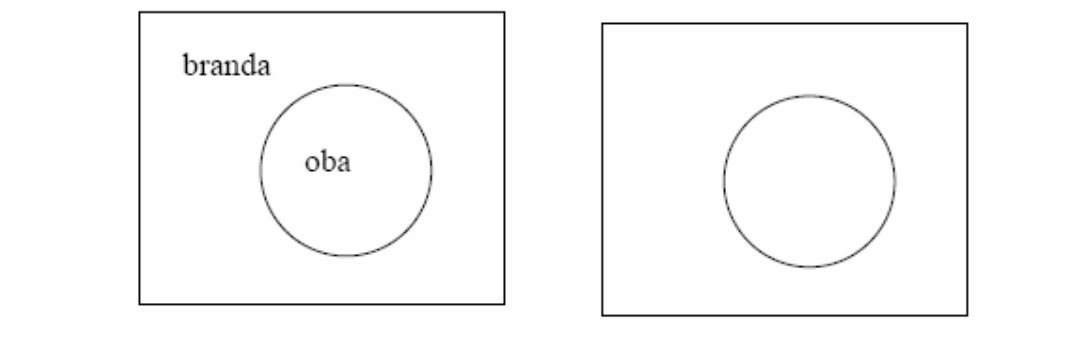
- Aşağıdaki şekil tahtaya çizilir ve açıklamalar yazılır.



a. Eğer bir noktanın çemberin merkezine uzaklığı çemberin yarıçapından büyük ise nokta çemberin dış bölgesindedir. Sembollerle gösterirsek, |KM| > r ise, K noktası çemberin dış bölgesindedir. Dış bölge; {K / |KM| > r} dir.

b. Eğer bir noktanın çemberin merkezine uzaklığı çemberin yarıçapından küçük ise nokta çemberin iç bölgesindedir. Sembollerle gösterirsek, |NM| < r ise, N noktası çemberin iç bölgesindedir. İç bölge; {N / |NM| < r} dir.

YA YAĞMUR BAŞLARSA!
İzci obaları ateş etrafında oturmuşlarken, birden yağmur başladı. Ateşin sönmemesi ve hiç kimsenin ıslanmaması için ne gibi bir çözüm yolu öneririsiniz?sorusu gruplara yöneltilir.



Grup olarak tartışınız.

- Öğrencilere yağmurda şemsiye, yağmurluk vb. kullanıldığı hatırlatılarak bir branda kullanılabileceği fikri oluşması sağlanır. Bu obaların yağmurdan korunmak için ne gibi bir brandaya ihtiyaçları olduğunu grupların çizmeleri istenir. Yukarıdaki gibi daireler çizmeleri gerekmektedir.

- Oluşan şekil çember mi? Çemberden farkı ne? Öğretmen bu şeklin daire olduğunu söyler. Çember ve iç bölgesinin birleşimine **daire** denildiğini ve "**M**" merkezli , "**r**" yarıçaplı bir dairenin **D(M,r)** ile gösterileceğini söyleyip tahtaya yazar.

- Öğrencilerin grupları içerisinde bir rapor hazırlayarak bu raporda çember şeklinde olan 5 nesne yazmaları istenir.

- Daire şeklinde 5 nesne bularak not etmeleri istenir.

- Öğrencilere çember ve daire şeklinde bisküviler dağıtılarak aradaki fark ve benzerlikler üzerinde konuşulur.

Ders Planı 12: Süre: 2 ders saati

Ünite 6: Çember, daire ve silindir.

Hedef 2: Bir doğrunun çembere göre durumlarını kavrayabilme.

D1. Bir doğrunun, verilen bir çembere göre durumlarını söyleyip yazma
D2. Bir çemberde, teğet ile değme noktasını merkeze birleştiren doğrunun birbirine göre durumunu söyleyip yazma
D3. Bir çemberin merkezine olan uzaklığı verilen bir doğrunun, o çembere göre durumunu söyleyip yazma
D4. Çemberde, bir kirişin orta noktası ile merkezden geçen doğrunun kirişe göre durumunu söyleyip yazma
D5. Bir çemberde, birbirine eşit kirişlerin merkeze olan uzaklıklarını karşılaştırarak sonucu söyleyip yazma
D6. Bir çemberde, biri diğerinden büyük kirişlerin merkeze olan uzaklıklarını karşılaştırarak sonucu söyleyip yazma
D7. Bir çemberde, en büyük kirişin çap olduğunu söyleyip yazma
D8. Merkezi belli olmayan çizilmiş bir çemberin merkezini ve yarıçapının ölçüsünü çizim yardımıyla bulma
D9. Bir çemberde, birbirine eşit kirişlere ait yayların ölçülerini karşılaştırarak sonucu söyleyip yazma
D10. Bir çemberde, biri diğerinden büyük olan kirişlere ait yayların ölçülerini karşılaştırarak sonucu söyleyip yazma

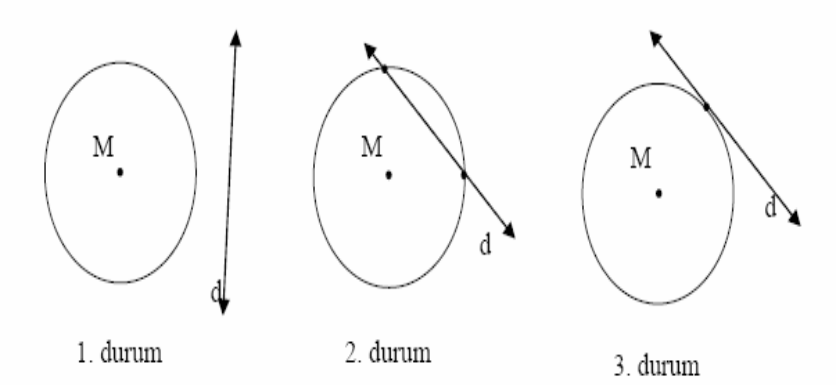
İŞLENİŞ

- Ormanda kurumuş ağaçların bazı görevliler tarafından işaretlendiği ve bir sonra başka görevliler tarafından bu işaretli ağaçların kesildiği sınıfta konuşulur. Eğer işaretli kuru bir ağaç izcilerin ateş çemberi etrafında kesilirse ateş çemberi üzerine düşebilir. Bu durumda izcilere neler olacağı sınıfça tartışılır.(Öğrencilerin bazı izcilerin yaralanabileceğini bulmaları beklenir.)
- 4 kişilik gruplar oluşturulur.
- Aşağıdaki çalışma yaprağı gruplara dağıtılır.

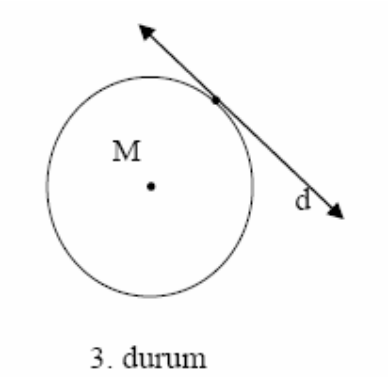
İZCİLERİ KORUMA PROJESİ

Orman Bakanlığı "izcileri koruma projesi" adı altında bir proje başlatmıştır. Sizler bu projede çalışmak üzere görevlendirildiniz. Bu yıl bakanlığa 18 izci kuru ağaç kesimlerinde yaralandıkları için şikâyet dilekçesi vermiştir. İzcilerin kuru ağaç kesimlerinde yaralanmalarını önlemek için bir proje geliştirmeniz gerekmektedir. İlk olarak siz proje sorumlularının, ateş çevresinde kesilen ağaçların hangi değişik durumlarda düşebileceğini tespit etmeniz isteniyor. Çalışma gruplarınızla birlikte düşünerek, ateş çemberi yakında kesilen bir ağacın ne gibi durumlarda yere düşebileceğini çiziniz.

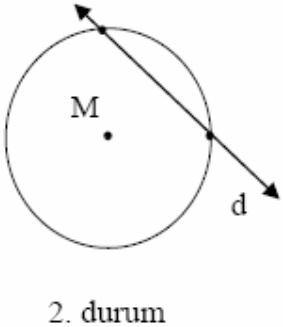
- Öğrencilerin çizimleri üzerinde tartışılır. Aşağıdaki şekilde verilen 3 durumun anlaşılması önemlidir.



❖ Her gruba 3.durumun çizili olduğu bir kâğıt verilir. Öğretmen;"Eğer yere düşen ağaç bu şekildeki gibi düşmüş olsaydı, burada bu ağacın ateş çemberine TEĞET olduğunu söyleyecektik" der. Doğrunun çembere teğet olduğu bu durum incelenir.



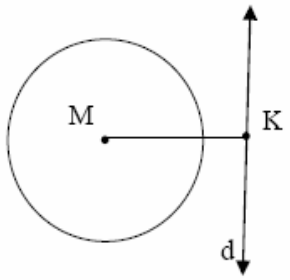
❖ Değme noktasını merkeze birleştirmeleri istenir.
❖ Değme noktası ile merkez arası uzaklığı ölçmeleri istenir.
❖ Değme noktası ile merkez arasındaki doğru parçası ile teğet arasındaki açıyı açıölçer yardımıyla ölçmeleri istenir.
❖ Böylece öğrencilerin teğetin özelliklerini bulmaları sağlanır.
❖ Her gruba 2.durumun çizili olduğu bir kâğıt verilir. Öğretmen;"Eğer yere düşen ağaç bu şekildeki gibi düşmüş olsaydı, burada doğrunun çemberi kestiği iki nokta arasında kalan doğru parçasına kiriş adı verecektik" der. Öğrencilerin bu durumu incelemelerini ister.



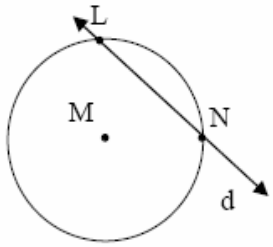
❖ Kirişin orta noktasını bulmaları ve bir isim vermeleri istenir. Kirişin orta noktası ile merkezi birleştirmeleri istenir.

❖ Kirişin orta noktası ile merkez arasındaki uzaklığı ölçmeleri istenir.
❖ Kirişin orta noktası ile merkez arasındaki doğru parçası ve kiriş arasında kalan açıyı ölçmeleri istenir.
❖ Öğretmen öğrencilerin bulmuş oldukları sonuçlar doğrultusunda teğet ve kirişin özelliklerini tekrarlayarak tahtaya yazar.

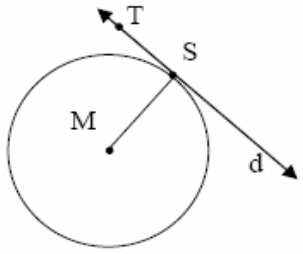
1. Durum: d doğrusu ile Ç (M, r) çemberinin hiç ortak noktaları yoktur. Yani kesişmezler. d doğrusu üzerindeki herhangi bir K noktası alırsak |MK| > r ve d ∩ Ç = { } dir.



2. Durum: d doğrusu ile Ç (M, r) çemberinin iki ortak noktaları vardır. Yani doğru çemberi iki noktada keser. d doğrusu üzerindeki herhangi bir K noktası alırsak |MK| < r ve d ∩ Ç = {L, N } dir. Çemberi iki noktada kesen doğrulara, 'kesen' denir. Bir çemberin iki noktasını birleştiren doğru parçalarına bu 'çemberin kirişi' denir.

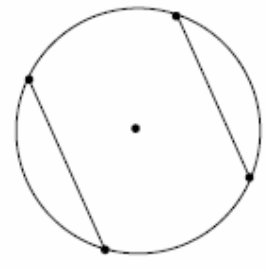


3. Durum: d doğrusu ile Ç (M, r) çemberinin bir ortak noktası vardır. Yani doğru çemberi bir noktada keser. Şekildeki |MS| = r ve d ∩ Ç = {S } dir. Çemberle bir ortak noktası olan doğrulara, 'çemberin teğeti' denir. Ortak noktaya 'teğetin değme noktası' denir. Aşağıdaki şekilde teğetin değme noktası S'dir. Teğetin değme noktası olan S ile merkezi birleştiren doğru parçası, teğete diktir. [MS] ⊥ d dir. Şekilde s(MST) = 90°. Kısaca, bir çembere teğet alınan doğru, değme noktasında yarıçapa diktir.



❖ Aşağıdaki çalışma yaprağı gruplara dağıtılır.

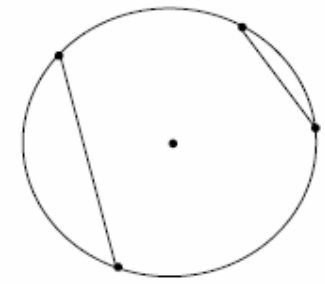
Aşağıda, devrilen eşit uzunluktaki iki kütüğün şekli verilmiştir. Bu şekle göre devrilen **eşit** uzunluktaki kütüklerin ateşe uzaklıkları hakkında ne söylersiniz?



İpuçları:
- Kirişleri isimlendirin.
- Kirişlerin uzunluklarını ölçüp karşılaştırın.
- Kirişlerin merkeze uzaklıklarını ölçüp karşılaştırın.
- Kirişlerin uzunlukları ve merkeze uzaklıkları hakkında ne söylersiniz.

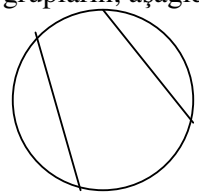
❖ Öğrencilerin, cevaplarını diğer gruplarla karşılaştırmaları istenir.
❖ ***Aynı uzunluktaki kirişlerin, çemberin merkezine uzaklıklarının eşit olduğunu bulmaları beklenir.
❖ Aşağıdaki çalışma yaprağı gruplara dağıtılır.

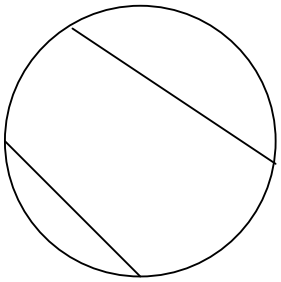
Bu şekil ateşin çevresine düşmüş farklı uzunluklardaki iki kütüğü göstermektedir. Bu kütüklerin ateşe olan uzaklıklarını inceleyiniz.



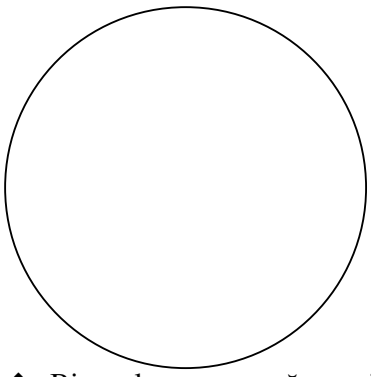
İpuçları:
- Kirişleri isimlendirin.
- Kirişlerin uzunluklarını ölçüp karşılaştırın.
- Kirişlerin merkeze uzaklıklarını ölçüp karşılaştırın.
- Kirişlerin uzunlukları ve merkeze uzaklıkları hakkında ne söylersiniz.

❖ Öğrencilerin, cevaplarını diğer gruplarla karşılaştırmaları istenir.
❖ ***Farklı uzunluktaki kirişlerden uzun olanının çemberin merkezine daha yakın olduğunu bulmaları beklenir.
❖ İki farklı kirişi verilen bir çemberin merkezini bulmak için "kirişlerin orta noktalarının yarıçapa dik olduğu" bilgisini hatırlamaları istenir. Bu bilgi ışığında grupların; aşağıda verilen iki çemberin merkezini bulmaları istenir.





❖ Bu çalışma için öğrencilerin, aynı çembere ait farklı kirişlerin orta noktalarından çıkılan dikmelerin kesim noktalarının, merkez olduğunu bulmaları beklenir.

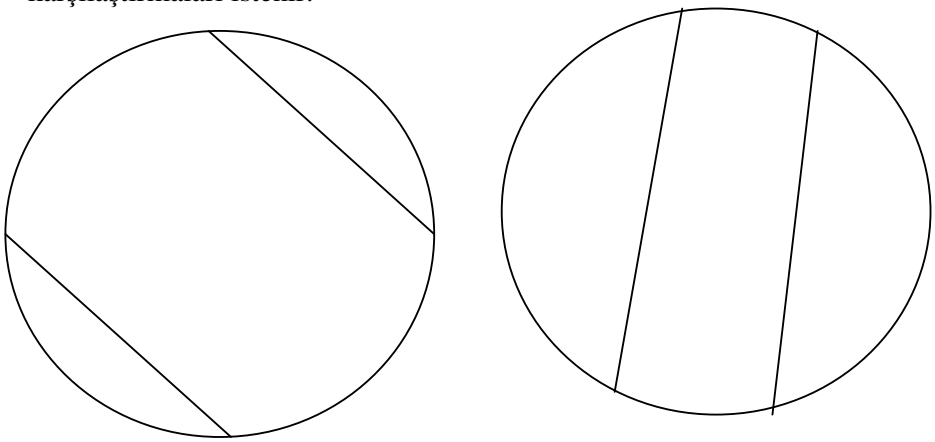


İzci obalarının oluşturduğu ateş çemberi üzerinde bir noktadan karşı tarafa geçmek isteyen bir izcinin, çember üzerinde yürümeden karşıya geçmek için kullanabileceği <u>en uzun</u> yolu çiziniz.

❖ Bir çalışma yaprağına çizilmiş yukarıdaki şekil gruplara dağıtılır. Bu etkinlik ile öğrencilerin en uzun kirişi bulmaları hedeflenmiştir.

❖ **"Bir çember üzerinde çizilen bir kiriş, çemberi iki parçaya ayırır. Bu parçalardan her birine yay adı verilir."tanımı öğretmen tarafından yapıldıktan sonra aşağıdaki çalışma yaprağı ile yeterli miktarda ip ile birer cetvel gruplara verilir.

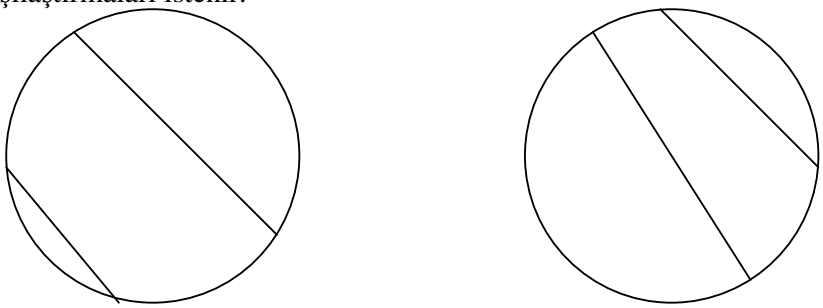
❖ Grupların bir miktar ip ile kirişlerin uzunluğunu ölçerek kaydetmeleri ve daha sonra da kirişlerin ayırdığı yay uzunluklarını yine ip yardımıyla ölçerek karşılaştırmaları istenir.



❖ Bu çalışmanın amacı, öğrencilerin eşit uzunluktaki kirişlere ait yayların uzunluklarının da eşit olduğunu keşfetmeleridir.

❖ Aşağıdaki çalışma yaprağı ile yeterli miktarda ip ile birer cetvel gruplara verilir.

❖ Grupların bir miktar ip ile kirişlerin uzunluğunu ölçerek kaydetmeleri ve daha sonra da kirişlerin ayırdığı yay uzunluklarını yine ip yardımıyla ölçerek karşılaştırmaları istenir.



❖ Bu çalışmanın amacı öğrencilerin, uzunlukları birbirinden farklı olan kirişlerden, uzun olanına ait olan yayın daha uzun olduğunu bulmalarıdır.

❖ Bu durumlar öğrencilerin defterlerine not ettirilir.

Ders Planı 13: Süre: 3 ders saati

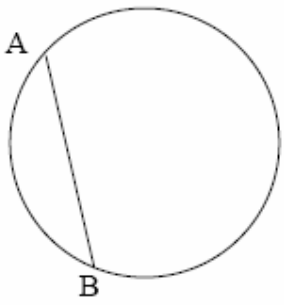
Ünite 6: Çember, daire ve silindir.

Hedef 3: Çemberde yay ve açıları kavrayabilme.

D1. Bir çember üzerinde belirtilen noktaların oluşturduğu yayları gösterip sembol kullanarak yazma
D2. Bir çemberde merkez açıyı gösterip sembol kullanarak yazma
D3. Çemberde, bir merkez açı ile bu açını gördüğü yay arasındaki ilişkiyi söyleyip sembol kullanarak yazma
D4. Çemberde, birbirine eş yayları gören merkez açılar arasındaki ilişkiyi söyleyip yazma
D5. Çemberde, biri diğerinden büyük yayları gören merkez açılar arasındaki ilişkiyi söyleyip yazma
D6. Çemberde, bir çevre açıyı gösterip sembol kullanarak yazma
D7. Çemberde, bir çevre açı ile bu açının gördüğü yay arasındaki ilişkiyi söyleyip yazma
D8 Çemberde, aynı veya eş yayları gören çevre açıların ölçüleri arasındaki ilişkiyi söyleyip yazma
D9. Çemberde, çapı gören çevre açının ölçüsünü söyleyip yazma
D10. Çemberde, aynı yayı gören merkez açıyla çevre açı arasındaki ilişkiyi söyleyip yazma

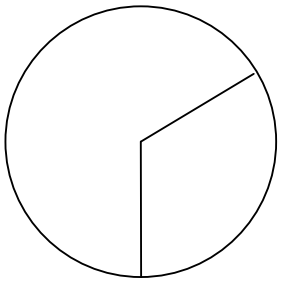
İŞLENİŞ

- Öğretmen "Bir çember üzerinde çizilen bir kiriş, çemberi iki parçaya ayırır. Bu parçalardan her birine yay adı verilir." Tanımını verdikten sonra aşağıdaki şekli tahtaya çizerek bir yayın sembolle gösterimini yazar.

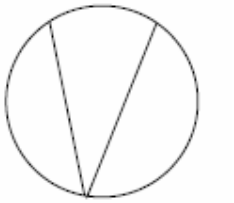


A ve B noktaları arasında kalan yay parçası AB yayı olarak adlandırılır.

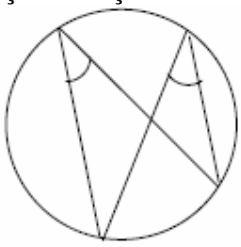
- Öğretmen, "Köşesi çemberin merkezinde olan açıya merkez açı denir." Tanımını verir. Merkez açının kenarları arasında kalan yaya merkez açının gördüğü yay denildiğini belirtir.
- Öğrencilerin 4erli gruplarında birer çember çizmeleri ve çizdikleri çemberde köşesi çemberin merkezinde olan birer açı oluşturmaları söylenir. Öğrencilere oluşan bu açının ölçüsünün, açının gördüğü yayın ölçüsüne eşit olduğu söylenir.



- Öğrencilerin birer çember çizmeleri ve çember üzerinde eşit uzunlukta yay gören iki farklı merkez açı oluşturmaları istenir. Daha sonra bu yayları gören iki merkez açıyı karşılaştırarak aynı uzunlukta yay gören merkez açıların ölçülerinin eşit olduğunu keşfetmeleri beklenir.
- *** Öğretmen tahtaya eşit uzunluktaki yayları gören merkez açıların ölçülerinin eşit olduğunu yazar.
- Aynı şekilde birer çember çizerek bu çemberler üzerinde farklı uzunluktaki yayları gören merkez açıları oluşturmaları istenir. Öğrencilerin merkez açıların ölçülerini karşılaştırarak farklı uzunluktaki yayları gören merkez açıların ölçüleri arasındaki ilişkiyi keşfedip, büyük yayı gören merkez açının ölçüsünün daha büyük olduğunu görmeleridir.
- Öğrencilerden bir çember çizerek, köşesi bu çemberin üzerinde olan bir açı oluşturmaları istenir.
- Öğretmen tahtaya "Köşesi çember üzerinde olan ve kenarları çemberi kesen açılara, çevre açı denildiğini, çevre açının kenarları arasında kalan yaya çevre açının gördüğü yay adı verildiğini yazar.

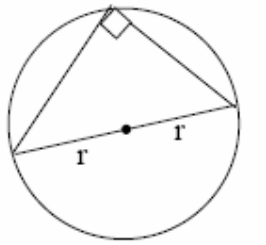


- Çevre açının ölçüsünün gördüğü yayın ölçüsünün yarısına eşit olduğunu görmeleri istenir.
- Öğrencilerin bir çevre açı oluşturmaları, daha sonra da bu çevre açının gördüğü yayı gören başka bir çevre açı daha oluşturmaları istenir. Bu iki çevre açının ölçülerini karşılaştırmalar istenir. Sonuçta aynı yayı gören çevre açıların ölçülerinin eşit olacağını keşfetmeleri beklenir.

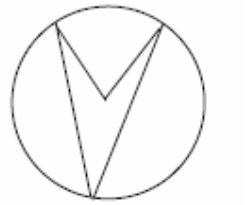


- Grupların bir çember çizerek bu çemberde çap olan doğru parçasını çizmeleri istenir. Çapı görecek şekilde bir çevre açı oluşturmaları söylenir. Grup

içi tartışmalarla çapı gören çevre açının ölçüsünün 90° olduğunu keşfetmeleri sağlanır. Bu sırada öğretmen gruplar arası dolaşarak çapın çemberi ayırdığı yayların ölçülerini göz önünde bulundurabileceklerini belirten ipuçları verir.



- Öğrencilerin gruplar halinde çalışarak bir çember çizmeleri ve bu çemberde köşesi çemberin merkezinde olan bir açı oluşturmaları istenir. Daha sonra bu merkez açı ile aynı yayı gören bir de çevre açı oluşturmaları istenir. Bu iki açının ölçülerini tartışarak karşılaştırmaları istenir.



- Bu çalışma ile öğrencilerin aynı yayı gören merkez açının ölçüsünün çevre açının ölçüsünün iki katı olduğunu bulmaları beklenir.
- Ders kitabındaki konu ile ilgili alıştırmalar çözülür.

Ders Planı 14: Süre: 1 ders saati

Ünite 6: Çember, daire ve silindir.

Hedef 4: Çemberi ve çemberin merkezine farklı uzaklıktaki doğruları çizebilme.

Davranışlar:

D1. Merkezi ve yarıçapı verilen çemberi araç ve gereç kullanarak çizme

D2. Çemberin merkezine olan uzaklığı verilen bir doğruyu çizme

D3. Bir çembere, üzerindeki bir noktadan pergel ve cetvel yardımıyla teğet çizme

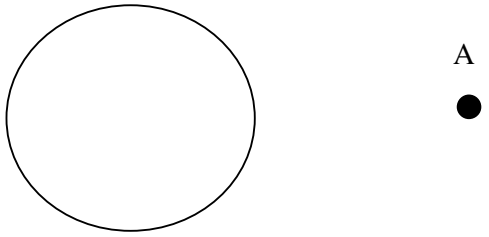
D4. Bir çembere, dışındaki bir noktadan pergel ve cetvel yardımıyla teğet çizme

D5. Bir çembere, üzerinde veya dışında verilen noktadan çizilebilecek teğetlerin sayısını söyleyip yazma

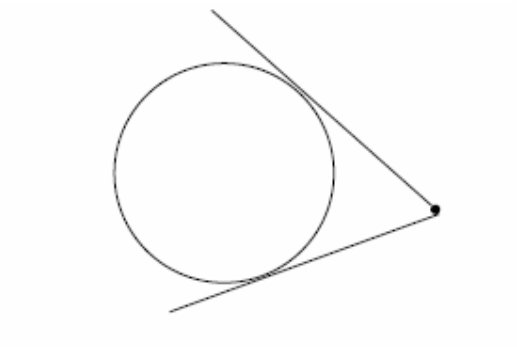
İŞLENİŞ

- Öğrenciler 4 kişilik gruplarla çalışacaklardır.
- Öğrencilere izci kampındaki ateş çemberinin a br kadar uzağına düşmüş bir kütüğün resmini sadece pergel ve cetvel yardımıyla çizmeleri için süre verilir. Gruplar çizimlerini bitirdikten sonra çizimleri yaparken neleri göz önünde bulundurduklarını birbirleriyle paylaşmaları istenir.

- ❖ Öğretmen öğrencilerin teğet kavramını hatırlamalarını ister. Çember üzerinde belirtilen bir noktadan çembere pergel ve cetvel yardımıyla çizilebilecek tüm teğetleri çizmeleri istenir. Çembere üzerindeki bir noktadan sadece 1 teğet çizilebileceğini keşfetmeleri istenir.
- ❖ Gruplara aşağıdaki çalışma yaprağı dağıtılır ve belirtilen A noktasından çembere çizilebilecek bütün teğetleri pergel ve cetvel yardımıyla çizmeleri istenir.



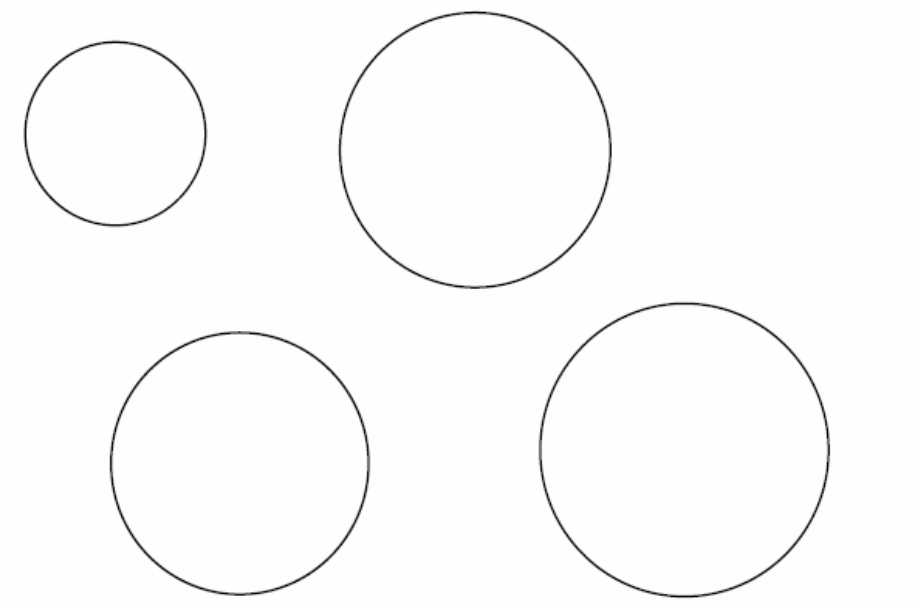
- ❖ Bu çalışma ile öğrencilerin bir çembere dışındaki bir noktadan 2 tane teğet çizilebileceğini keşfetmeleri amaçlanır.



Ders Planı 15: Süre: 3 ders saati
Ünite 6: Çember, daire ve silindir.
Hedef 5: Dairenin çevresini ve alanını hesaplayabilme
Davranışlar:
D1. Bir çemberin uzunluğu ile çapının uzunluğundan faydalanarak, π sayısını bulma
D2. Çemberin çevresi ile yarıçap uzunluğu arasındaki bağıntıyı söyleyip yazma
D3. Yarıçap uzunluğu verilen çemberin, uzunluğunu hesaplayıp yazma
D4. Uzunluğu verilen bir çemberin yarıçap ve çap uzunluğunu bulup yazma
D5. Bir dairenin alanı ile yarıçap uzunluğu arasındaki bağıntıyı söyleyip yazma
D6. Yarıçap uzunluğu verilen bir dairenin alanını bulup yazma
D7. Çevresinin uzunluğu verilen bir dairenin alanını bulup yazma
D8. Yarıçapı ve merkez açısının ölçüsü verilen bir çemberde, merkez açının gördüğü yay uzunluğunu hesaplayıp yazma
D9. Merkez açısının gördüğü yay uzunluğu verilen bir çemberin yarıçapını hesaplayıp yazma
D10. Yarıçapı ve merkez açısının ölçüsü verilen bir daire diliminin alanını hesaplayıp yazma
D11. Merkez açısının ölçüsü verilen daire diliminin alanından yararlanarak, dairenin yarıçapının uzunluğunu hesaplayıp yazma

İŞLENİŞ

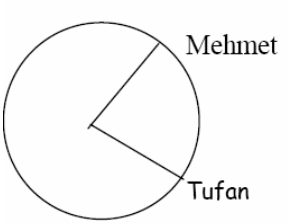
- Öğrencilerden oluşturulan 4 kişilik grupları ile farklı büyüklükte 4 çember çizmeleri istenir. Çizdikleri bu çemberlerin çevrelerini nasıl bulabilecekleri sorulur. İp, tel vb. ile ölçerek bulabilecekleri cevabına ulaşmaları beklenir. Her seferinde her çember için bu hesaplamayı yapmanın günlük hayatımızda zor olduğuna değinerek bunu hesaplamanın kolay bir yolunu bulmaları istenir. Bunun için de çemberlerin sadece yarıçap uzunluğunu kullanarak bu hesaplamayı yapmanın bir yolunu keşfetmeleri istenir.



- Bu sırada öğretmen, öğrencilere aşağıdaki tabloyu kullanarak çevre ile yarıçap arasındaki bağıntıyı bulabileceklerini söyler.
- Gruplar çizdikleri 4 çemberin çevresini ve çapını iple ölçerek aşağıdaki tabloyu doldurur.

	çevre	çap	
1. ateş çemberi			
2. ateş çemberi			
3. ateş çemberi			
4. ateş çemberi			

- Bu sırada öğretmen verilen tablodaki en solda boş olarak bulunan sütuna öğrencilerin çap ile çevre arasındaki ilişkiyi yazmalarını ister. Öğrenciler zorlandıklarında "çevreyle çap arasında bir ilişki görebiliyor musunuz?", "çevreyi çapa bölersek ne olur?" şeklinde ipuçları ile onlara yardımcı olur.
- Burada amaç öğrencilerin bir dairenin çevresin çapına oranının π(pi) sayısı olan 3,14… eşit olduğunu keşfetmeleridir.
- Bu etkinlik ile öğrencilerin bir çemberin çevresinin, o çemberin çapının π katı olduğunu keşfeder.
- Öğretmen bu sefer, izcilerin ateş çemberi etrafında otururken, herhangi iki izci arsındaki uzaklığı nasıl hesaplayacaklarını sorar.



- ❖ Öğrencilerin grup içi tartışmalarla fikir belirtmelerini ister. Grupların birbirine fikirlerini açıklaması için süre verir. Daha sonra öğrencilerin yarıçapı 50cm, merkezdeki ateş açısı 90° olan bu ateş çemberinde Mehmet ile Tufan arasındaki uzaklığı hesaplamaları istenir.
- ❖ Öğretmen, yarıçapı 100cm olan ateş çemberinde Mehmet ile Tufan arasındaki mesafe 314cm olsaydı çemberde bu kısmı aydınlatan ateş açısı kaç derece olurdu diyerek grupların hesaplamayı yapmaları için süre verir.
- ❖ Öğretmen yağmur yağdığında izci obalarının üstünü kapatan naylon brandaların hepsinin alanını alan ölçen bir makineyle hesapladığını, yarıçap uzunluklarını da bildiğini ama yarıçap ile alan arasında bir ilişki olup olmadığını keşfedemediğini söyleyerek tahtaya aşağıdaki tabloyu çizer. Öğrencilerin verilen alan ölçüleri ile yarıçapı karşılaştırarak dairenin alanına ait bağıntıyı bulmaları istenir.

	ALAN	YARIÇAP	BAĞINTI
1.ateş çemberi	3,14	1	
2. ateş çemberi	28,26	3	
3. ateş çemberi	12,56	2	
4. ateş çemberi	314	10	

- ❖ Bu sırada öğretmen "dairenin alanı yarıçapının kaç katı?", "çevre hesaplarken kaç katıyı?" gibi sorular yönelterek öğrencilere ipuçları verir.
- ❖ Öğrencilerden 90° lik merkez açının gördüğü daire diliminin alanını nasıl hesaplayacaklarını tartışmaları istenir. Öğretmen ihtiyaç duyulursa dairenin tamamının 360° olduğunu vurgulayabilir.
- ❖ Öğretmen bir dairenin çevresinin, çapın π katı olduğunu, alanının ise yarıçapın karesinin π katı olduğunu vurgular. Bunu öğrencilerin defterlerine yazdırır.
- ❖ Konuların bitiminde öğrencilerle birlikte ders kitabındaki alıştırmalar çözülür.

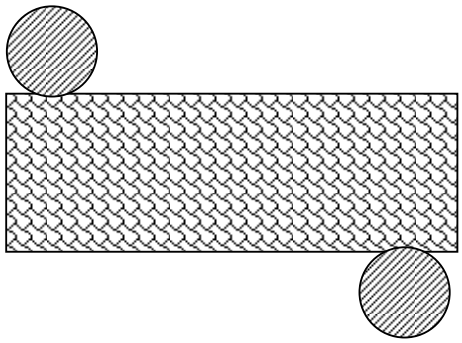
Ders Planı 16: Süre: 1 ders saati
Ünite 6: Çember, daire ve silindir.
Hedef 6: Dik silindirin özelliklerini kavrayabilme
Davranışlar:
D1. Silindirin açık şekline bakarak yan yüzü ile tabanlarının hangi düzlemsel şekiller olduklarını söyleme.
D2. Silindirin yüksekliğini gösterme.
D3. Silindirin tabanı ile yanal yüzü arasındaki ilişkiyi söyleme.

İŞLENİŞ

- ❖ Öğrencilerin grupları ile sınıfa getirilen silindir şeklindeki bir nesneyi

incelemeleri istenir.

- ❖ Çevrede nerelerde bu tür bir cisim gördükleri sorulur. Bütün öğrencilerin silindire çevreden örnekler vermeleri istenir.
- ❖ Öncelikler grup içi tartışarak tabanlarının hangi geometrik şekil olduğunu belirtmeleri istenir. Grupların cevaplarını veya fikirlerini diğer gruplarla paylaşmaları istenir.
- ❖ Daha sonra silindirin yan yüzeyini oluşturan geometrik şekli keşfetmeleri istenir. bu sırada öğrencilerin bir dosya kağıdını inceleyerek silindirin yan yüzeyini oluşturup oluşturamayacağını keşfetmeleri istenir.
- ❖ Bu iki etkinlik ile bir dik silindirin 2 daire(tabanlar) ve bir dikdörtgenden(yan yüz) oluştuğunu belirtmeleri istenir.
- ❖ Dik silindir şeklindeki nesneye bakarak yüksekliğinin nere olabileceğini bulmaları istenir. Öğretmen burada hatırlatma yaparak yüksekliğin tabanlara dik olması gereğini hatırlatabilir.
- ❖ Dik silindirin tabanındaki dairenin çevresi ile yan yüzü oluşturan dikdörtgenin kenarı arasındaki ilişkiyi keşfetmeleri istenir. Silindiri inceleyerek, dairenin çevresinin dikdörtgenin bir kenarına eşit olduğunu görmeleri istenir.
- ❖ Dik silindiri oluşturan düzlemsel şekiller öğrencilere tekrar ettirilir.
- ❖ Bunlar defterlerine yazdırılır.



Ders Planı 17: Süre: 2 ders saati

Hedef 7: Dik silindirin alanını ve hacmini hesaplayabilme

Davranışlar:

D1. Silindirin taban alanını veren bağıntıyı söyleyip yazma

D2. Silindirin yanal alanını veren bağıntıyı söyleyip yazma

D3. Silindirin tüm alanını veren bağıntıyı söyleyip yazma

D4. Taban yarıçapı ve yüksekliği verilen bir silindirin yanal alanını hesaplayıp yazma

D5. Silindirin tüm alanını hesaplayıp yazma

D6. Silindirin hacmini veren bağıntıyı söyleyip yazma

D7. Taban alanı ile yüksekliği verilen silindirin hacmini hesaplayıp yazma

D8. Hacim formülündeki değerlerden herhangi ikisi verildiğinde, üçüncü değeri hesaplayıp yazma

İŞLENİŞ

- ❖ Öğrencilerin 4 kişilik gruplar halinde silindir şeklindeki bir kutunun alt

ve üst kapaklarını yapmak için ne kadar kartona ihtiyaç olduğunu bulmaları istenir. Bunun için tabanları oluşturan düzlemsel şeklin alan bağıntısını hatırlamaları sağlanır. "taban hangi düzlemsel şekilden oluşuyor, bu düzlemsel şekilden bu silindirde başka bir tane daha var mı, bu düzlemsel şekil için gerekli kartonu nasıl hesaplarız?" şeklinde yönlendirmelerle öğretmen öğrencilere yardımcı olabilir.

- Silindirin yan yüzeyini yapmak için ne kadar kartona ihtiyaç duyulacağı sorulur. Bunun için "yan yüz hangi geometrik şekillerden oluşuyor?" "Bu dikdörtgenin alanı için neleri bilmeliyiz?" "Dikdörtgenin kenar uzunluklarını nasıl bulabiliriz?" şeklinde sorular yönelterek öğretmen öğrencilerin yan yüzü oluşturan dikdörtgenin kenar uzunluklarından birisinin silindirin yüksekliğine diğerinin ise tabandaki dairenin çevresine eşit olduğunu bulmalarını bekler. Buradan yan yüzün alan bağıntısına ulaşmaları istenir.
- Silindirin tamamını yapmak için ne kadar kartona ihtiyaç duyulduğu sorulur. Öğrencilerin bu hesaplamayı yapmaları istenir.
- Öğrencilerin bir su varilinin şeklini düşünmeleri istenir. İzcilerin ormanda kamp kurduklarında bu varillerde su sakladıkları üzerinde konuşulur. Varilde kalan su miktarını izcilerin nasıl ölçebilecekleri sorulur.
- Daha sonra öğretmen silindirin hacim bağıntısını verir.
- Öğrencilerin defterlerine bir dik silindirin, taban alan, yan alan, bütün alan ve hacim formülleri yazdırılır.
- Ders kitabındaki konuyla ilgili alıştırmalar öğrencilerle birlikte çözülür.

APPENDIX B

TREATMENT VERIFICATION FORM

ÖĞRETMENE BİLGİ;

7-A ve 7-B sınıflarında araştırmacı Neslihan KALE tarafından işlenen açılar ve çokgenler; çember, daire ve silindir konulu derslerde siz de bulundunuz. Bu derslerde araştırmacının kullandığı ders planları ekte verilmiştir. Bu ders planlarına bakarak, işlenen derslerle ilgili puan vermeniz gerekmektedir. 1 puan "işlenen dersin ekteki ders planıyla ilgisi yok" anlamına gelmektedir. 5 puan ise "dersler aynen ders planında olduğu gibi işlendi" anlamına gelmektedir. Lütfen ders planlarındaki numarayı göz önüne alarak her ders planı için 0 ile 5 arasında bir puan veriniz.

DERS PLANI NO / **VERİLE PUAN**	**0**	**1**	**2**	**3**	**4**	**5**
1						
2						
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6						
7						
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APPENDIX C

ÖĞRENCİ İŞLERİ
DAİRESİ BAŞKANLIĞI

T.C.
MİLLÎ EĞİTİM BAKANLIĞI
Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı

Sayı : B.08.0.EGD.0.33.05.311- 270/970 22/02/2007
Konu : Araştırma İzni

ORTA DOĞU TEKNİK ÜNİVERSİTESİ REKTÖRLÜĞÜNE

İlgi : 07.02.2007 tarih ve B.30.2.ODT.0.70.72.00-400-1005/1943 sayılı yazı.

Üniversiteniz İlköğretim Fen ve Matematik Eğitimi Ana Bilim Dalı Yüksek Lisans öğrencisi Neslihan KALE'nin "Grup Çalışması ve Drama Temelli Öğretimin İlköğretim 7. Sınıf Öğrencilerinin Geometri Başarısına ve Geometriye Yönelik Tutumlarına Etkisi" konulu araştırmada veri toplama aracı olarak kullanılacak testlerin Ankara İli Afşin Bey İlköğretim Okulu, Haydar Aliyev İlköğretim Okulu, Türk Kent İlköğretim Okulu ve Emniyetçiler İlköğretim Okulunda uygulama izin talebi incelenmiştir.

Üniversiteniz tarafından kabul edilen onaylı bir örneği Bakanlığımızda muhafaza edilen (18 sayfa – 69 sorudan oluşan) testlerin belirtilen ilköğretim okullarında uygulanmasında bir sakınca görülmemektedir.

Araştırmanın bitiminde sonuç raporunun iki örneğinin Bakanlığımıza gönderilmesi gerekmektedir.

Bilgilerinizi ve gereğini rica ederim.

Cevdet CENGİZ
Bakan a.
Müsteşar Yardımcısı

EK :
Test Örneği (1 Adet-18 Sayfa)

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