**T.R.**
**YILDIZ TECHNICAL UNIVERSITY**
**GRADUATE SCHOOL OF SOCIAL SCIENCES**
**DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES**
**HUMANITIES AND SOCIAL SCIENCES MASTERS PROGRAMME**

**MASTER'S THESIS**

# THE EFFECTS OF GAME-BASED TEACHING ON ATTITUDE AND ACADEMIC ACHIEVEMENT IN HIGH SCHOOL MATHEMATICS

**ZEYNEP SARIKAYA İLHAN**
**10728102**

**THESIS ADVISOR**
**ASSOC. PROF. DR. SÜLEYMAN DOĞAN**

**ISTANBUL**
**2019**

TC
YILDIZ TEKNİK ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
İNSAN VE TOPLUM BİLİMLERİ ANABİLİM DALI
TEZLİ YÜKSEK LİSANS PROGRAMI

**YÜKSEK LİSANS TEZİ**

# THE EFFECTS OF GAME-BASED TEACHING ON ATTITUDE AND ACADEMIC ACHIEVEMENT IN HIGH SCHOOL MATHEMATICS

**Tezin Enstitüye Verildiği Tarih: 28/01/2019**
**Tezin Savunulduğu Tarih: 04/03/2019**

**Tez Oy birliği ile başarılı bulunmuştur.**

| | Unvan Ad Soyad | İmza |
|---|---|---|
| **Tez Danışmanı:** | Doç. Dr. Süleyman DOĞAN | |
| **Jüri Üyeleri:** | Prof. Dr. Ahmet Şükrü ÖZER | |
| | Prof. Dr. Hasan ÜNAL | |

**İSTANBUL**
**MART 2019**

# ÖZ

## LİSE MATEMATİK DERSLERİNDE OYUNLA ÖĞRENMENİN TUTUMA VE AKADEMİK BAŞARIYA ETKİSİ

**Zeynep Sarıkaya İlhan**

**Mart, 2019**

Eğitim felsefesinde ve öğretme yaklaşımlarında yaşanan gelişmelerle değişen ve gelişen dünyada matematik öğretiminin nasıl gerçekleşeceği ve yeni yaklaşımların matematik öğretimine nasıl uyarlanacağı sorularına ilkokul ve ortaokulda az sayıda da olsa yenilikçi ve eğlenceli etkinliklerle cevap verilmektedir. Ancak öğrenci lise eğitimine başladığında bunlar geride kalmakta ve yerini lise eğitiminin ciddiyetine bırakmaktadır. Öğretim programının genel çerçeveyi vermesi, uygulamayı öğretmen inisiyatifine bırakması sebebiyle pek çok ders geleneksel eğitim metotlarıyla işlenmektedir. Düz anlatım, soru cevap gibi ders anlatım teknikleri öğrencileri derste sıkmakta, pasif konumda bırakmakta ve derse karşı olumsuz tutum sergilemelerine sebep olmaktadır. Bu çalışmada, oyunla matematik öğretiminin lise öğrencilerinin matematik dersine yönelik tutumlarındaki ve akademik başarılarındaki etkisi incelenmiştir. Araştırmada örneklem ve kontrollü, ön test son test deneysel deseni kullanılmıştır. Araştırmanın örneklemini İstanbul Sultanbeyli'deki bir lisenin tutum ve akademik başarı yönünden birbirine denk iki 9. sınıfı oluşturmaktadır. Sınıflardan biri deney grubu olarak seçilmiş ve 10 hafta boyunca ilk iki ünite olan Mantık ve Kümeler öğretmen tarafından geliştirilmiş oyunlarla zenginleştirilerek işlenmiştir. Sınıflardan ikincisi ise kontrol grubu olarak seçilmiş ve dersler öğretmen merkezli, geleneksel öğretim yöntemleriyle anlatılmıştır. Deney ve kontrol gruplarına uygulanan ön test ve son testlerin SPSS 10 programıyla analiz edilmesi sonucu, deney gurubu lehine anlamlı farklılıklar çıkmıştır. Oyun ile öğretimin matematik dersine yönelik tutum ve

akademik başarıyı arttırdığı sonucuna varılmıştır. Lise seviyesinde hem uygulamada hem akademik araştırmalarda çok az yer verilen oyun temelli öğrenmenin önemine dikkat çekilmeye çalışılmıştır.

**Anahtar kelimeler:** oyunla öğrenme, matematik, tutum, akademik başarı

## ABSTRACT

## THE EFFECTS OF GAME-BASED TEACHING ON ATTITUDE AND ACADEMIC ACHIEVEMENT IN HIGH SCHOOL MATHEMATICS

**Zeynep Sarıkaya İlhan**

**March, 2019**

In a constantly changing world affected by the improvements in philosophy of education and in teaching approaches, the questions of how to teach Mathematics and how to implement these new approaches have been provided with an answer with innovative and fun activities in primary and secondary schools. However, once a student starts high school, all these activities are over and the seriousness starts. Traditional teaching methods results in bored, passive students with a negative attitude. This study examines the effects of game-based teaching on attitude and academic achievement of high school students in mathematics classes. In this research a controlled, pretest and posttest experimental design have been used. The sample of the research consists of two classes of $9^{th}$ grade students in Sultanbeyli in Istanbul who had equal levels of attitude towards mathematics and academic achievement. One of the classes was selected as the experimental group, and two first two units; "Logic" and "Sets" were studied with the games created by the teacher herself for 10 weeks. The second class was selected as the control group and the units were studied with traditional teaching method. The pre and posttest scores have been analyzed by SPSS 10 program and the results have depicted a significant difference in favor of the experimental group. The results revealed that game-based teaching increases the attitude and academic achievement level of the students in mathematics. This research

aims at drawing attention to game-based learning which is scarcely included in academic research and high school education.

**Key words:** game-based learning, mathematics, attitude, academic achievement

## ACKNOWLEDGEMENTS

Student-centered, activity-based interesting techniques and methods are essential in today's world in which traditional teaching methods fail to meet the needs of our era.

In this research, the effects of game-based teaching on mathematics attitude and academic achievement of high school grade students have been investigated. The result of the scientific analysis conducted after the use of authentic games in mathematics classes has revealed positive outcomes.

First of all, I would like to express my sincere gratitude to my advisor, Assoc. Prof. Dr. Süleyman Doğan who has provided patient advice, excellent guidance and support throughout the research process. I would also like to thank my family; my mother Tevriz Sarıkaya, my father Memet Sarıkaya, my big brother Hakan Sarıkaya, my sisters Gülizar Tuncay, Serpil Ala and my dear brother Fatih Sarıkaya who all have been there for me and supported me with love. Last but not least, I would like to express my love and gratitude to my husband Yusuf İlhan for his unwavering love, understanding and support.

Istanbul, March, 2019 Zeynep Sarıkaya İlhan

## TABLE OF CONTENTS

**TEZ ONAY SAYFASI……...ii**

**ÖZ……...iii**

**ABSTRACT……...……..v**

**ACKNOWLEDGEMENTS……vii**

**TABLE OF CONTENTS……viii**

**LIST OF TABLES…….……xi**

**LIST OF FIGURES…..……xii**

**ABBREVIATIONS …….xiii**

**CHAPTER 1. INTRODUCTION……..1**

1.1. The Problem of the Research……5
1.2. The Significance of the Study…….…..7
1.3. The Purpose of the Study……..8
1.4. The Limitations of the Study……8
1.5. The Assumptions of the Study……..9

**CHAPTER 2. LITERATURE REVIEW……....10**

2.1. Studies on Game-based Education……...10

2.2. Studies on the Attitude towards Mathematics and the Achievement Level in Mathematics Class……..17

**CHAPTER 3. CONCEPTUAL AND THEORETICAL FRAMEWORK…..…..28**

3.1. Philosophical and Theoretical Foundations…….28

3.1.1. Theoretical Foundation of Our Educational Philosophy……30

3.1.2. Methodology in Education…….33

3.1.3. Teaching Theories……..37

3.1.3.1. Behaviorism……38

3.1.3.2. Cognitive Theory……38

3.1.3.3. Affective Learning Theory……..40

3.1.3.4. Constructivist Theory…….……40

3.1.3.5. Gestalt Theory……43

3.2. The Concept of Game…….....45

3.3. Theories on Game……49
3.3.1. Classical Theories……..50
3.3.1.1. The Surplus Energy Theory……50
3.3.1.2. The Recreation/Relaxation Theory……50
3.3.1.3. Recapitulation Theory……51
3.3.1.4. Practice Theory……...52
3.3.2. Modern Theories……52
3.3.2.1. Psychoanalytic Theory……53
3.3.2.2. Cognitive Theory……54
3.3.2.3. Socio-Cultural Theory……55
3.3.2.4. Ecological Theories……56
3.4. The Methods and Techniques used in Teaching of Mathematics……..57
3.4.1. Direct Instruction Method……..57
3.4.2. Teaching Mathematics by Defining the Rules of a Subject……58
3.4.3. Question-Answer Method of Teaching……..58
3.4.4. Discovery Method of Teaching……59
3.4.5. Teaching by Defining a Mathematics Subject……59
3.4.6. Demonstrating Examples ……..59
3.4.7. Simulation Technique……59
3.4.8. Circulation Technique……60
3.4.9. Model Based Teaching Method……60
3.4.10. Teaching Strategy of Participation……...60
3.4.11. Discussion Method……..61
3.4.12. Teaching through Analysis……..61
3.4.13. Module-based Teaching……...62
3.4.14. Demonstration Method……62
3.4.15. Scenario-based Teaching Strategy……...62
3.4.16. Project-based Teaching……62
3.4.17. Cooperative/Collaborative Teaching Strategy……63
3.4.18. Problem-Solving Method of Teaching……63
3.4.19. Game-based Teaching Method……64
3.4.20. Technology-based Teaching……66
3.5. Teaching Mathematics Using Game-based Learning Method……..67
**CHAPTER 4. METHODOLOGY……...72**
4.1. Research Design……...72
4.2. Population and Sample……72
4.3. Research Group……73
4.4. Data Collection Tools……...73

4.4.1. Attitude Scale……73
4.4.2. Academic Achievement Assessment……74
4.5. Data Collection……77
4.6. Materials for Learning Mathematics with Games……77
4.6.1. Proposition or Not……..80
4.6.2. Sponge of Logic……80
4.6.3. Guess the Compound Proposotion……80
4.6.4. Pull if You Can!.....81
4.6.5. Set (Math Card Game)……...81
4.6.6. What Type of Set Are You?.....81
4.6.7. Maths Bingo……...81
4.6.8. A Menu of Sets……..81
4.7. Data Analysis……82
**CHAPTER 5. FINDINGS……...……...84**
**CHAPTER 6. CONCLUSIONS……...90**
6.1. Results……..91
6.2. Discussion ……92
6.3. Recommendations ……...……96
**BIBLIOGRAHPY……98**
**APPENDIX……..111**
**CURRICULUM VITAE……123**

## LIST OF TABLES

**Table 1:** Analysis of the mathematics test used in TEOG 2015……..76

**Table 2:** The Data Analysis Techniques and the Intended Use……...82

**Table 3:** One Sample Kolmogorov-Smirnov Test……..84

**Table 4:** The Analysis of the Difference between the Mathematics Pre-teaching Achievement Scores According to the Class (Mann-Whitney U)……85

**Table 5:** The Analysis of the Attitude Level towards Mathematics in Pretest According to the Class (Mann-Whitney U)……85

**Table 6:** The Analysis of the Posttest Scores according to the Class (Mann-Whitney U)……..86

**Table 7:** The Analysis of the Difference between the Pretest and Posttest Scores of the Mathematics Achievement Level of the Experimental Group (Dependent T-Test)……86

**Table 8:** The Analysis of the Difference between the Pretest and Posttest Scores of the Mathematics Achievement Level of the Control Group (Wilcoxon Test)……..87

**Table 9:** The Analysis of Difference between the Pretest and Posttest Scores of the Attitude Level of the Experimental Group (Dependent T-test)……..88

**Table 10:** The Analysis of Difference between the Pretest and Posttest Scores of the Attitude Level of the Control Group (Wilcoxon Test)……..88

## LIST OF FIGURES

**Figure 1:** Game-based Lerning Model……65

## ABBREVIATIONS

**EBA** **:** Eğitim Bilişim Ağı

**MEB** : Milli Eğitim Bakanlığı

**MEGEP** : Mesleki Eğitim ve Öğretim Sistemini Geliştirme Projesi

**TEOG** **:** Temel Eğitimden Ortaöğretime Geçiş Sınavı

## CHAPTER 1. INTRODUCTION

History of humanity is full of human efforts to take control of nature and the universe. For this reason, humankind, who seeks for understanding the mysteries of nature and universe; who wonders, learns, and follows the urge to research and discover has extended the civilization in the hands of science. Mathematics deals with the concepts and the relationship between these concepts which humankind has created to comprehend the subjective reality and to abstract this concrete reality to reshape it. For these means, it uses logic. Formulas and symbols are just a means or a language of mathematics. Therefore, mathematics is a system used in art, literature, law; shortly in all means of life (Tepedelenlioğlu, 1993, 9).

The method used to prove a theory in mathematics can be regarded as the same method used by the prosecutors or judges to prove someone guilty or not in a court. The most crucial issue in Turkish Educational System is to deliver the predetermined subjects and objectives to the students via several teaching methods and techniques. There has been an ongoing relationship between a teacher and a student for thousands of years. Although the environment, content or methods might differ in this system, the constants of this equation have always been the teacher and the student. In a constantly changing world, education has been shaped by the goals not only to teach information to the individuals but also to enable them to use, transfer and adapt the knowledge acquired. This can be observed in the changes in curriculum, teaching techniques and methods, and in the assessment tools used in the process of evaluation. Despite all these improved techniques and methods, when it comes to transferring knowledge, there is a limitation between the student and the teacher due to the unidirectional transfer of knowledge.

There is no theoretical difference in the educational techniques and methods applied in primary or secondary schools. However, once a student starts studying at a high school, she/he is expected to leave childhood behind. Although applied scarcely, fun activities are over and the seriousness of high school has started. Due to the fact that the curriculum provides only the framework and the implementation of the

methods and techniques depends on the personal judgment of a teacher, many lessons are delivered by traditional teaching techniques.

The high percentage of youth population, lack of facilities to benefit from higher levels of education and the elimination exams starting at the early stages of education have turned the educational system in our country into a racing track. It can be observed that academic achievement especially in mathematics is regarded as a crucial criterion to attain a better education ignoring the fact that individuals might have different traits and skills. Mathematics is essential not only for the achievement in national exams but also for all the steps in an individual's life and cognitive development. To gain a mathematical point of view is fundamental for all areas of life such as the areas that require verbal expression or art, sports and or even for non academic areas such as being a housewife or a mother.

Education of mathematics aims at raising individuals who are not only competent in math but also who can practice theory, do math, solve problems, communicate and take pleasure in doing these things (Olkun, Toluk, 2003). Developments in philosophy of education and in teaching approaches considerably affect the education of mathematics. In traditional teaching of mathematics approach, students are regarded as passive receivers. In the process of teaching mathematics, students prefer memorizing the information because most of the information taught is not based on reason.

Prejudice in society dictates that people who know mathematics is intelligent and who do not are just a failure. Although a student could continue his/her educational life meeting the necessities of a subject to pass the class, because of the teaching techniques and methods which ignore individual differences, mathematics continues to be a nightmare following him/her all through the life. Many students are intimidated by mathematics lesson. Mathematics is regarded as a chaos of formulas and equations that has to be memorized in order to pass the class. The disadvantages of the traditional teaching, the decrease in the success rate in mathematics in national and international exams have motivated the education community to seek new approaches in teaching. Recently many studies conducted in the field of education are related to create environments which can stimulate the students' interest during the delivery of information.

Mathematics has not only been a fundamental step in academic success but also it has closely affected science and technology and formed the basis of many different disciplines since it was born. Therefore, mathematics is an essential source of science.

Since mathematics has gained so much importance, teaching of mathematics has been of importance as well. In order to overcome the difficulties in teaching mathematics, many studies have been conducted and many methods have been developed. Teaching mathematics via traditional methods makes it boring for the students and causes negative attitude towards the class. Thus, it is resulted in failure in mathematics and inability to do math. In teaching of mathematics, student's attitude and point of view plays an important role in his/her achievement and overcoming the obstacles in learning a subject they cannot express themselves and feel involved in (Uğurel, 2003).

To what extent can mathematics contribute to cultural, social and technological development and the idea of benefiting from mathematics more effectively have led the communities to seek new approaches of teaching of mathematics. Olkun and Toluk have stated that traditional teaching of mathematics cannot meet the needs of constantly changing needs of our era. In this study, it is stated that although it was previously important to have the ability to process and do calculation, it has now gained importance to have the skills in problem solving, making assumptions or searching patterns. Teaching of mathematics and mathematical concepts are handled in a way which lacks content and concrete experiences. This approach causes children to memorize without knowing the meaning of mathematical concepts and the relationship between these concepts.

Mathematics, which is a universal language, is not only a way of thinking but also a n indispensible area for the individual, social, scientific and technological world. However, as it is regarded as a boring, unlikable and an abstract discipline, it is unlikely for the children to develop a positive attitude towards mathematics. Acar (2005) has defined mathematics as an intellectual system created by humanity. He has resembled this system to a process which is a result of structures, connections, correlations and the consecutive generalization and abstractions of these correlations. It is stated that it can be difficult to learn and teach mathematics which has abstract structure and therefore, it should be concretized by the materials and games. This has revealed the fact that it is fundamental to determine the right way of revealing mathematics in classes. As it is widely known, traditional teaching methods are teacher

centered. The purpose of education and several expectations change gradually and are reconstructed through the necessities of societies. Recently, it is observed that there has been change in the duty and functions of the teachers. Thus, problem posing and solving approach in teaching of mathematics should be the focus in mathematics activities at schools. No matter what the reasons, circumstances or the duration are, the general expectation of this education process is to enable the students to keep up with the rapidly increasing information in our changing world and to provide the skills such as problem solving to internalize and use this knowledge.

Mathematics is a formal language that helps us express our abstracts ideas as systematical information. In other words, it is a programming language or a software technology which gives us accurate feedback. Therefore, the need for the ability to use and understand mathematics has gained importance in our daily lives and this need is constantly increasing. In our ever-changing world, the individuals who understand or are interested in mathematics have more options to shape the future. In this process, we come across with two main problems; the first one is how to teach mathematics to the young learners and the second one is how the latest approaches in teaching theories can be reflected to the teaching of mathematics. What is actually intended to be achieved in mathematics is to introduce the colorful world of mathematics to the youth and to enable them to become self-sufficient individuals. For mathematics, learning and teaching is a lifelong process. This process will be under discussion as long as there are changes. Hence, project of mathematics education is a major and exciting goal for the future (Mirasyedioğlu et al, 2005).

In this prospective, high school education is a very critical phase. The method of teaching mathematics and how the new approaches are adapted is critical importance in this phase. The student is at the beginning of an adventure which is new and can affect his future with all the positive or negative attitudes in mind. Therefore, this is the phase where the importance and the need of this study become relevant. It is still a question under discussion whether the traditional education should be put aside or not. Teaching of mathematics does not have a system similar to buttoning a shirt where everything can go wrong if the first button is put wrong. A student can change his/her attitude as a result of positive examples he encounters in any phase of life. That is the reason numerous studies have been conducted on the factors that have effects on student achievement.

Teaching techniques play an important role in creating a positive or negative attitude on students' mind. Therefore, the teaching technique used in mathematics class affects the academic achievement and the attitude of a student. Student's playing an active role in the teaching process and expressing himself can affect his/her attitude positively. Game is an area where children can express themselves freely. The main question under discussion in this study is the difference in the attitudes of the students towards the lesson and their academic achievement if games are used in teaching of mathematics.

Many materials have been developed in this area in primary and secondary schools and teaching of mathematics via games is studied more in these levels. There are very limited situations where the subjects are studied in a game concept in high schools. Once in high school, the fun parts which were studied relatively almost disappear and the students become passive or partly participant if he knows something about the subject or if he/she has a question to ask. When the subjects become more difficult or more abstract, the student become less participant and also gets bored. The activities done in the class which are related to or important in real life are not adequate. In this study, games will be included in all the subjects and the effects of the use of games on the attitude and the achievement of the students will be researched.

Once the school life starts, educational games have been used as a teaching method with new rules, structure and objectives. Teaching with games is defined as one of the modern teaching methods. It has been proved the studies that teaching with games in primary and secondary schools has affected students' achievement, motivation and performance in a positive way. Games as a teaching method contributes to the enjoyment of the exercises, the skills to be able to study individually or as a part of a group, and to the reinforcement of the information taught in the class. The power of games in teaching is also emphasized in the new approaches based in active learning and multiple intelligence theory. Games are handled technically in active learning and they can be used in classes which the nature of induction, hypothesis and scientific studies are aimed at.

### 1.1. The Problem of the Research

In this study, the effects of the teaching mathematics with games on high school students' attitude towards the lesson and their academic achievement will be analyzed.

“What is the effect of teaching with games on the attitude of the students’ towards mathematics lesson and their academic achievement?” is the main question under discussion in this research. (Does learning with games have more positive effects on students’ attitude towards mathematics class and their academic achievement compared to traditional teaching methods?)

For the solution to this problem, the first two subjects of the $9^{th}$ grade mathematics class; logic and sets, have been selected. Any correlation between teaching via traditional methods and with games in terms of students’ attitude towards the lesson and their achievement has been researched and the sub problems have been determined as below;

1. Is there a significant difference between the pretest scores of the experimental group to whom teaching with games method has been implemented and the control group taught in traditional teaching environment?
2. Is there a significant difference between the pretest scores of the experimental group to whom teaching with games method has been implemented and the control group taught in traditional teaching environment before teaching in terms of their attitudes towards mathematics?
3. Is there a significant difference between the posttest scores of the experimental group to whom teaching with games method has been implemented and the control group taught in traditional teaching environment?
4. Is there a meaningful difference between the pretest and posttest scores of the mathematics achievement level of the experimental group (9-J) to whom teaching with games method has been implemented?
5. Is there a meaningful difference between the pretest and posttest scores of the mathematics achievement level of the control group (9-I) to whom teaching with games method has been implemented?
6. Is there a significant difference in the attitude level towards mathematics class between the pretest and posttest scores of the experimental group (9-J) to whom teaching with games method has been applied?
7. Is there a significant difference in the attitude level towards mathematics class between the pretest and posttest scores of the control group (9-I) to whom traditional teaching method has been applied?

## 1.2. The Significance of the Study

It is amusing how a serious, difficult and an abstract subject like mathematics is linked to a concept as fun as games. It is known that mathematics is taught via traditional methods in many high schools in Turkey. Even in the system called EBA (Educational Informatics Network) in which interactive exercises for almost all the classes can be found, fun activities for mathematics class is over for the 9$^{th}$ grade and direct, instructional methods start. This study is expected to contribute to the collection of meaningful data about 9$^{th}$ grade students' attitude towards mathematics and their academic achievement. Besides being the subject of many studies, game based learning is also used actively in practice. Although there have been studies on this area in our country, they have not reached at a satisfactory level. Studies have been restricted to theory and have not been able create a systematical practice area. Therefore, every study is of crucial importance in teaching of mathematics. This study is fundamental to eliminate the problems in teaching of mathematics and to contribute to its development. To be exact, the significance of this study can be counted as follows;

a. Mathematics and games have some common features and games are a means of education; no matter what grade the student is, it is important to use games in mathematics classes as they make a lesson more enjoyable and they enhance the concentration and the participation of the students to the class.
b. In order to melt the mathematics and games in the same pot; games which have been developed regarding the level of the students and the subjects can increase students' motivation and comprehension.
c. Although the educational functions of a game is vast and it is difficult to prepare games beforehand and to set the rules, games can be designed with very simple materials and can be blended in a lesson to make it more effective and flowing.
d. In order to eliminate the fear students feel as a result of the abstractness of mathematics, using fun activities such as games plays a significant role in enabling students to transfer the acquired knowledge to real life and to become more adaptable and participative in classes.
e. Due to the fact that studies on this issue are scarce, the materials developed in this study can be an essential resource for mathematics classes. The games used

in this research and the results of the research can create a new resource for teachers of high school mathematics.

### 1.3. The Purpose of the Study

The purpose of this study is to attain relevant data about the effects on the attitude of the students towards the mathematics class and their academic achievement as a result of game based teaching of the subjects "Logic" and "Sets ", which are the first two subjects studied in the $9^{th}$ grade. In a broader perspective, the main objective of this study is to reveal the data about to what extent the game based teaching of mathematics affects the attitude of the students and their academic achievement. Additionally, the purpose of this study is to determine the difference between the traditional learning and game based learning in terms of learning outcomes. The students' active involvement in learning process can contribute to their social skills and the level of pleasure they get during the process of learning. The comprehensiveness of the structure and the instructions of the games can not only help the development of a positive attitude towards the subjects but also it can help turn a negative attitude into a positive one.

Some obstacles experienced during the teaching of mathematics such as dislike, not taking pleasure or staying inactive and thus getting bored can be changed into positive attitude of the student is involved as a part of a game. What's more, this study might scientifically reveal the important role of the learning with games in high school education. All the reasons stated above should acknowledge the importance of this study. For these purposes, the answer to the questions "To what extent has the game based teaching has affected the academic success of the students in mathematics class?", "What kind of changes have been observed in students' attitude towards mathematics class as a result of game based teaching?" have been researched in this study.

### 1.4. The Limitations of the Study

The limitations experienced during this study are stated below;

a. The population of this research is the high school students studying in 2018-2019 academic year.

b. The sample of the study consists of the students in the classes of 9/I and 9/J in İbrahim Hakkı Anatolian High School.
c. The selected subjects for game based learning are "Logic" and "Sets" for which the implementation is determined by the goals and behavioral objectives of high school mathematics curriculum.
d. One of the classes is determined as the experimental group and the other as the control group. The stated subjects above are studied with games in the experimental group whereas with traditional methods in the control group.

### 1.5. The Assumptions of the Study

This research study is based on the following assumptions and premises;

a. In both of the classes that consist of the experimental and the control group, the subjects are studied by the same teacher using the game based teaching in the experimental group and traditional method in the control group. Therefore, the students are not exposed to a different impact resulted by the change of the teacher.
b. The subjects participating in this research have sincerely reflected the truth during the administration of the pretest and posttest and while answering the attitude scale. It is acknowledged that the answers given by the students to the attitude and assessment tests reflect their real behaviors.
c. The variables that cannot be controlled have affected the experimental and the control in the same manner.

# CHAPTER 2. LITERATURE REVIEW

During the research of the studies on the effects of game-based teaching on the attitude of students towards the lesson and their academic achievement, a simple division is considered. The studies conducted on game-based learning and the attitude towards mathematics and the factors that affect the achievement are examined separately. It can be observed that the studies on game based learning mostly concentrate on pre-school and primary school levels. In the suggestions section of these studies, it is suggested that studies on game-based teaching should be conducted on high schools as well. In game-based teaching of mathematics, there are two different groups of games; the computer based games which consist of dynamic software and the games developed without software. Some studies focuses on digital-based games whereas some on games developed with concrete materials. When it comes to the use computers for games, it can only be administered at schools and classes where physical facilities are satisfactory enough. Therefore, games developed with simple materials and rules can be more effective in educational areas. Besides, game-based learning has not only affected mathematics classes but also has been a question of studies of different fields.

## 2.1. Studies on Game-based Education

The book written by Karl M. Kapp and titled "The Gamification of Learning and Teaching: Game-based Methods and Strategies for Studying and Education" has been one of the most essential books on game-based study. It is mentioned in the book that game –playing instinct which is a part of human nature has made the concept of gamification a fundamental part of daily life or learning environments. This piece of work which has been written by the experts of different disciplines can be regarded as a go-to resource. It consists of 14 chapters shaped in the framework of 4 main themes. The first main theme mentions the concept of gamification and its components. The second main theme examines the results of the studies and aims to determine the situations in which game-based thinking and mechanics dominate. The third main

theme discusses the relationship the design and content during the implementation of gamification and game-based thinking in learning environments. The last main theme includes real examples of how gamification can be used in learning environments. To the writer's point of view, gamification can enable a richer learning environment and a permanent learning as it supports critical and strategic thinking, the feeling of being in control, dedication to the learning environment and participation. Hence, all the experts who are engaged in learning process and design should have gamification in mind. It is stated in the book that games can be presented to all ages of learners and therefore is a very important approach in terms of lifelong learning. In addition to these, the increasing interest in digital games has made gamification an important part of the process of learning and teaching. The main purpose of the book is to enable readers a detailed point of view about the educational power of games.

In a study conducted by Bayazıtoğlu (1996), in the class of Science of Life of 2nd graders, the effects of educational games on the achievement and performance have been studied. The classes in the experimental group were taught with educational games whereas with the traditional method in the control group. As a result, the students in the experimental group were observed to be more successful compared to the students in the control group.

In an experiment conducted by Karabacak (1996) the effects of educational games used in the "Science of Life" class on the achievement of the students in the 4th grade was studied and a significant positive difference has been discovered between the means of the achievement level of the students in the experimental and the focus group. Also, in a research done by Uğurlu (1996), game is discussed in terms of culture, art, philosophy, economy, politics and education. In this descriptive study, correlations between games and duration, rules and pattern have been discussed.

In a study conducted by Ercanlı (1997), the effects of games and models on the teaching of "Our Earth and the Sky" subject in Science class of the 4th graders have been analyzed and it has been concluded that these two affect success in a positive manner. It is also emphasized in the study that classes studied with games are more enjoyable and the knowledge acquired is more permanent.

In a research of Pehlivan (1997) titled " The effects of Teaching with Games and Case Study on the Learning Level of Science of Life Class", the effects of teaching games and case study on the learning level of the students in the Life of Science class in the 4th grade have been discussed. There are two experimental groups and one focus

group in the study. Classes in the first experimental group were studied with games and studied with case study in the second experimental group whereas they were studied with traditional method in the control group. Although the results indicate an insignificant difference between the traditional method and case study, they indicate significant difference between the traditional method and game-based teaching method. Therefore, compared to case study and traditional method, games are concluded to be a more effective method.

In a study conducted by Yıldız (2001) in a private school, English has been taught via games. The developed games have been used in the class and it has been observed that games help increase in the interest of the students to the English lessons. It was concluded that students like playing games in the classes and teachers are advised to use games to make the lesson more interesting and entertaining.

In a research done by Doğanay (2002), the role of games in teaching of history was discussed. As a conclusion, it was stated that classes taught with games are more enjoyable and therefore will increase the motivation of the students.

In research done by Karaduğan (2003), the impact of educational games on Art classes in the 8$^{th}$ grade has been studied. A significant difference has been found between the posttest scores of the students in the experimental group and the control group.

In a study conducted by Taşlı (2003) and titled " The effect of Game-based Teaching on the Achievement of Primary School English Class", the subjects "numbers, phone numbers and telling the time" have been studied in the 4$^{th}$ grade. The subjects were studied with games in the experimental group and with traditional methods in the control group. It was determined that game-based method has affected the achievement of the students and the permanence of the knowledge more positively regardless of the gender of the students.

In a study done by Uğurel (2003), the opinions of intern teachers and teachers on teaching mathematics with games have been researched. The population of the study was 226 intern teachers and 44 teachers. As data collection tools, a preliminary form consists of 7 open-ended questions and a survey of 37 questions have been used. According to the findings gathered through the research, it can be stated that there is a significant difference in the opinions of the intern Mathematics teachers about the use of games and activities in Mathematics classes according to the gender. However, there is no significant difference in the opinions of the Mathematics teachers about the use

of games and activities in Mathematics classes according to the gender. No significant difference was determined on the opinions of the intern teachers about the use of games and activities in Mathematics classes related to the type of high schools they have graduated from and no significant difference was determined on the opinions of the teachers about the matter related to the type of schools they work in. As a result of the research, it was acknowledged that the knowledge of the teachers on games and activities are not adequate and further studies should be conducted to improve the knowledge of the teachers on the subject matter.

In research conducted by Shi (2003), the subjects of "equilibrium, probability and functions" were taught using examples of the rules of Volleyball. By this way, students have comprehended the concepts of mathematics easier and their interest in the lesson has increased. These activities have helped develop students' skills at associating the subjects with real life, thinking mathematically and solving problems.

In a study done by Flewelling (2003), traditional and game-based learning culture is compared. It was explained that the learning environment of game-based teaching is more positive and the students can be the center of the class and have more opportunity to discuss the subjects.

A study conducted by Yeşilyurt (2004) and titled "The Effects of Experiment and Games on Making Analysis and Synthesis Recalling the Subjects of Balance Scales and Dissolution", to what extent can the concepts related to the subjects "scales balance and the dissolution of solid in liquid" be recalled depending on the methods used was the research question. The subjects of the research have been taught through an experiment using games. The last stage of the experiment was ended and three possible outcomes of the experiment were asked to the students through a survey. The survey was administered to the control group before the experiment and as a result, the students in the experimental group proved to be more successful.

In research administered by Altunay (2004), the effects of game-based mathematics teaching on the achievement of the students and the permanence of the knowledge was discussed. Geometry subjects of the $4^{th}$ grade were studied with games to exercise and revise with the experimental group whereas with traditional methods with the control group. As a result of the research, it was stated that the game-based teaching of the experimental group has more positive effects on the achievement of the students compared to the traditional teaching methods studied in the control group.

What's more, in terms of permanence of knowledge, a significant positive difference was determined in the experimental group.

A study conducted by O'Brian and Barnett (2004) revealed the fact that although the low-performing students are generally less careful and successful, they have proven equally successful at games compared to the high-performing students.

In research done by Budak, Kanlı, Köseoğlu and Yağbasan (2006), it was indicated that in the reinforcement of the knowledge acquired in the Science classes which are regarded as difficult and boring, games have positive effects as they make learning easier and more fun.

Kaya (2007) has researched the effect of game-based teaching in English classes on the achievement compared to the traditional methods. In the study, quasi experimental method was administered. The sample of the research was 60 students in 5$^{th}$ grade, consisting of 30 female and 30 male students who were of similar age, intelligence, socio-cultural class. The results of the study have revealed the fact that the experimental group taught with games was more successful compared to the control group taught with traditional method in terms of achievement. Moreover, the study has proved that gender of the students have no effect on the achievement. Regarding the results of the study, it was suggested that game-based teaching should be used more by the writers of the textbooks, educational program developers and teachers.

In an experimental study done by Kılıç (2007) and titled "The effects of Rewarding in Game-based Teaching in Mathematics Class in the 1$^{st}$ grade on the Achievement of Mathematics", the effects of rewarding during game-based teaching on the achievement of the students in the 1$^{st}$ grade Mathematics class have been researched. The study was conducted within the unit "Addition with Natural Numbers". In the experimental group the lessons were studied with games and rewards and with just games in the control group. As a result of the study, it was stated that teaching of Mathematics with games can increase the achievement of the students in mathematics compared to the traditional methods and rewarding can play an important role in teaching Mathematics.

A study conducted by Biriktir (2008) and titled "The Effects of Games in Teaching Geometry Subjects on the Achievement of the 5$^{th}$ Graders" is an experimental study that aims at determining the achievement level of the students in classes where games were used and not. Significant difference in the achievement level

of the students has been determined between the groups to whom games and traditional methods were used to teach 5th grade Geometry class subjects and the difference is positive on behalf of the experimental group game-based teaching method was used.

In his study "Does Gamification Work?" Hamari (2014) has researched whether gamification enables the desired outcomes or not by analyzing the experimental studies. The motivational resources used in the studies were determined. As a result, it was discovered that in only 2 of the 24 studies, all the tests have positive results. Additionally, in 13 studies results were partially positive and in 7 studies only diagnostic statistics were revealed. In studies done in educational field, mostly positive results have been determined in the motivation and engagement in learning process. However, as for the negative outcomes to be aware at are stated as rising competitiveness, the difficulties in task assessment and structural features. It was also discovered that eliminating gamification from the environment might also have negative effects on the learning environment.

In their articles titled "Gamification and Education" (2014), Yıldırım and Demir have conducted a theoretical study on how gamification can be adapted to education. The subject of "Data" has been selected from the 9th grade Mathematics curriculum and the learning outcomes have been suggested to be rewarded with scores and medals. It was suggested that the monitoring of the process can be done with a software program and the fundamentals have been stated.

A study presented in a conference titled "Interaction Design and Children", children were expected to finish a test on mobile devices in an experimental study by being motivated via gamification. The children participating in the experiment were expected to draw shapes and push some buttons on the touch screen. They could get points for every right move and with these points they earned rewards which did not worth more than 0.5$. As a result of the study, it was observed that 73% of the children in the control group finished the tests whereas 97% of children in the group games were used finished the tests. (Brewer et al., 2013)

In a study published in 2013, the researchers have researched the effects of the leaderboard, score and levels which are regarded as the 3 fundamental gamification elements on motivation. In this study, a system of tagging a photograph has been gamified. According to the results, it has been observed that the elements of gamification have affected the performance but they have no effects on motivation (Mekler et al., 2013).

In research conducted in 2013, the researchers have gamified a web based system in a college course. The study which consists of 57 participants revealed the fact that the participants of the group trained in the gamified application have a higher motivation level although they get lower scores in written exams. The in-class participation of the group has been low as well (Dominguez et al., 2013).

In his thesis study, Larsen (2013) has prepared an educational program gamified for the Programming class in University of Oslo. The purpose of the study is to determine the needs and the difficulties encountered during the preparation of gamified teaching environment. As a result of the study, it was stated that the software program is favored by the students.

In his research, O'Donovan (2012) tried to gamify an online course taken by 90 university students. In the study, Sakai System was used gamified. The researcher conducted the BrainHex Gamer Typology Survey to determine the typology of 27 players in the experimental group. According to the survey results, the most common typology of the players is the Mastermind, Conqueror and Seeker. Following the survey, O'Donovan researched which gamification technique was more effective on the experimental group. The progress bar, the leader board and the medals have been observed to be the most motivational gamification elements.

In this thesis study Bozoğlu (2013) studied the effects of game-based teaching of the relationship between circumference and area in Mathematics class on the achievement. The subject was studied with games in the experimental group whereas with activity-based method in the control group. A pretest was given to both groups before the study and a Geometry achievement test developed by the researcher as a posttest after the study. As a result of the study, a significant difference has been determined between the achievement levels of the students in favor of the experimental group which was taught via game-based method. Depending on this result, it can be stated that game-based teaching is more effective on increasing students' achievement level compared to activity-based teaching method.

In his doctoral thesis, Hazar (2016) discussed one of the most important problems of era; digital game addiction, and he researched the effects of the games including physical activity on the digital game addiction of 11-14 age group secondary school students. In this quantitative research, experimental design was used and 29 female and 51 male students were chosen as the population. After a 12 week training on "games with physical activity", a posttest was given to the participants in the

experimental and control groups. As a result, a significant difference was determined on the addiction level between the pretest and posttest scores of the experimental group and it was stated that the scores in their posttest was lower than the scores in the pretest. Besides, a significant difference in the pretest and posttest scores depending on the duration spent playing digital games. The duration of time spent playing digital games decreased in the experimental group whereas increased in the control group. Consequently, it was concluded that the addiction level of the students decreased as a result of the games including physical activity.

Sağlık (2017) studied on the effects of the gamified game-based and traditional teaching of vocabulary on the vocabulary knowledge and the motivation of EFL students at a private college preparatory school in her thesis. The study revealed the fact that teaching vocabulary with gamified game-based method to the Turkish EFL students has a positive effect on their motivation and significant difference was determined in the motivation level of the students in the experimental group. However, no significant difference was determined on the improvement of the vocabulary knowledge between the experimental and the focus group. The results also indicate that gamified game-based teaching of vocabulary is perceived as a beneficial method that can be used in preparatory classes. Consequently, gamified game-based vocabulary teaching can be regarded as an effective method that increases the students' motivation in teaching a foreign language. This study proves that teaching of games could have positive effects on higher level of students as well.

As a result, no significant difference in students' motivation and attitude score was determined between the experimental group and the focus group. However, the achievement level of the students in the experimental group increased compared to the focus group. Additionally, as a result of the collected data the frequency of game playing has no effect on students' attitude and achievement in Mathematics lesson.

## 2.2. Studies on the Attitude towards Mathematics and the Achievement Level in Mathematics Class

The experiences students have related to mathematics causes students to develop positive or negative attitude towards mathematics. Considering the fact that attitudes have power on behaviors, it can be stated that there is relation between attitude towards mathematics and the achievement in mathematics. (Akdemir, 2006)

As a result of this relation, it can be concluded that positive attitudes of the students increase and negative attitudes decrease the achievement level of the students in mathematics. Moreover, Baykul (2004) also stated that one of the main reasons why students fail in mathematics is their negative attitude towards it. In another study, Eldemir (2006) points out that negative attitudes towards mathematics is one of the main reasons why the achievement level in mathematics is not at a desired level. According to Duru, Akgün and Özdemir (2005), as the experience with mathematics increases, this affects the development of positive or negative attitude towards mathematics. Therefore, for the development of positive attitudes, it is highly important that first primary school teachers and then Mathematics teachers do their best. Attitude towards an object or an individual can be determined by a number of ways; inference by physical reactions, inference by behaviors and scale development (Kan and Akbaş, 2005).

Turpçu (2014) researched the achievement level and the attitude of students towards Mathematics class. It was concluded that students with negative attitude outnumbered the students with positive attitudes and therefore their achievement level proved to be lower.

Arslantürk (2013) discussed the relationship between the individually selected learning strategies of the students and their attitude and achievement. Additionally, he researched whether these can differ as a result of some variables or not. He concluded that no meaningful difference was determined. Therefore, it can be stated that learning strategies show no meaningful difference depending on any variables. However, significant difference was determined between the attitude towards mathematics and school type, education level of the mother, the achievement level at secondary and high schools.

In her Doctoral research, Karataş (2013) discussed the effects of differentiated Mathematics instruction to gifted students in the $5^{th}$ grade on their attitude towards Mathematics class. The developed curriculum proved to increase the students' achievement, creativity and attitude towards Mathematics in a significant level.

In their study titled "The Effects of Learning Activities According to Students' Learning Styles on Students' Academic Success and Attitude Towards Mathematics within a Scope of Constructivist Learning Approach: a Sampling of Functions and Derivative Concepts" Özgen and Alkan (2014) aimed at identifying the effects of learning activities according to students' learning styles on students' academic success

and attitude towards mathematics within a scope of constructivist learning approach. A mathematics attitude scale was used as data collection tool. Data analysis indicated that, the learning process in which activities appropriate for students' learning styles were used to contribute to an increase in the students' academic success. Yet, there was no statistically significant difference in students' attitudes towards mathematics.

Reyes (1984) stated that a student who has positive attitude towards Mathematics is more likely to succeed compared to the students who has a negative attitude.

Önal (2013) has developed an attitude scale to research the attitude of secondary school students towards Mathematics. As a result, 4 factors have been determined about attitude; interest, love, studying and necessity.

Kulm (1980) indicated in his study that teachers' behaviors and attitude towards Mathematics affect students' attitude and behaviors in a positive way.

Bekdemir (2007) stated in his study that the teachers' negative attitude and behaviors have affected the students' Mathematics achievement, thus; teachers who have rigid, mean, insulting behaviors create fear and anxiety of mathematics in students.

In Tural (2005)'s master's thesis "The Effects of Games on Students' Achievement in the Teaching of Mathematics", students in the 3$^{rd}$ grade was taught the subjects "rhythmic counting, natural numbers, addition, subtraction, multiplication and division" with games and activities in the experimental group and with traditional method in the control group. As a result, a significant positive difference was observed in the attitudes of the experimental group.

As a result of the thesis research of Aksoy (2010) "The Effects of Game-based Teaching of Mathematics on Students' Achievement, Motivation, Self- Sufficiency and Attitudes", it was indicated that game-based teaching affects the development of the students' achievement, self-sufficiency and attitudes towards Mathematics. Moreover, a significant difference was determined in the relationship between the development of achievement level and the attitude and self-sufficiency of the students.

In their study "the Effects of Gamification on the Problem-Solving Skills and Attitude Towards Mathematics of the 5$^{th}$ Grade Students", Gelen and Özer (2010) have researched the effects of gamification on the problem solving skills and the attitude towards Mathematics of the 5$^{th}$ grade students and concluded that there is a significant

difference in the development of positive attitude of the students in the experimental group compared to the control group.

In their study, Işık and Çagdaşer (2009) aimed at deciding the effects of constructivist algebra education on the attitudes towards mathematics of 6th grades students. In relation with this purpose, also it was studied that whether there was a significant difference between the attitudes toward mathematics and achievement levels/genders of students as a result of the constructivist approach or not. This study showed that the students' attitudes toward mathematics were positively changed by the constructivist approach-based education process. Regarding to achievement levels, although after the application period the students in both achievement levels performed positively changed attitudes, the low-achievement students' attitude levels almost reached the new positive attitude level of high achieving students.

In their experimental study "The Effect of Dramatization Method on the Students' Attitude To Mathematics", Şengül and Ekinözü (2006) aimed at determining whether there is any difference between the attitudes to mathematics of the experimental group, with whom the dramatization method is used, and the control group, with whom the traditional teaching methods are used, in teaching the subject of "Permutation and Probability" in 8th grade Mathematics. As a result of the t test applied in the study, there has been a positive change in the students' attitude towards mathematics in the classes where the dramatization method and the traditional methods have been used.

As a result of their study which aimed at finding out whether the multiple intelligences theory based instructions in grade 6th Mathematics lessons have any effect on the students attitude to mathematics, Şengul and Öz (2008) have indicated that instructions based on the Multiple Intelligences Theory have a positive effect on 83 students' attitude towards mathematics and the level of interest to mathematics when compared to the traditional teaching techniques.

In his study aiming at determining the relationship between the attitude of primary school students (191 students studying in the $5^{th}$, $6^{th}$, $7^{th}$, and $8^{th}$ grades) to Mathematics and the demographical variables which can be related to it, Yenilmez (2007) indicated that while the students, whose favorite courses were numeric, have positive mathematics attitude, students, who have low mathematics success, have negative mathematics attitude.

In their research Özgen and Pesen (2008) conducted to examine the effects of Problem Based Learning (PBL) approach on students' attitude towards mathematics lesson in the teaching of "relation-functioning-process" subjects in the 9th grade Mathematics class, as a result a significant difference was determined after the experimental study in the attitude of the experimental group studied with problem-based learning approach and the control group studied with traditional teaching approaches. It can be concluded that problem-based learning approach is more effective in increasing the level of positive attitude of the students compared to the traditional teaching approaches. The use of problems chosen from daily life and prepared activities accordingly is effective on the increasing level of interest and motivation of the students.

The sample of the study "The Examination of the Attitude of the Gifted Students to Mathematics in Terms of Different Variables: The Sample of Manisa Science and Art Center" of Kuloğlu and Uzel (2013) included 68 primary and secondary school students studying at Manisa Science and Art Center 'Getting Discover Individual Talents Program' (GDITP) in the academic year 2012-2013. The research data is collected within "Abbreviated Mathematics Attitude Scale for Elementary' and 'Kolb Learning Style Scale'. As a result of the research on the analysis, a significant diversity in mathematics is found between students' learning styles and with total scores of Mathematics attitude. Students who have assimilating and separating learning styles; their total mathematical attitude is higher than students who have inserting and modifying learning styles. According to gifted student's gender, there is no significant difference among the total math attitude scores. However, in the level of perceived size of mathematics achievement male students have been seen more positive attitude than female students. For mathematics courses; it is found that the female students have more positive attitude than the male students.

In her thesis study, "The Effects of Mathematics Education with Musical Games on the Academic Success and The Attitude in Primary Schools" Dinçer (2008) examined the effects of musical math participants on academic success achievement and attitudes towards mathematics exercised in the second grades in elementary schools. Each of which consists of 29 students, an experimental group and a control group was formed for this purpose. In the research, Musical Math Games prepared for the subjects to be covered in May such as "Measuring of Lengths, Measuring of

Liquids, Geometric Objects and Multiplication Table" were applied to the experiment group while the control group was taught math using conventional mathematics teaching methods. The results indicated that math taught with musical math games was more effective in terms of students' success and it was found out that teaching math using musical math games was more effective on enhancing students' attitudes towards the course in comparison to the conventional teaching.

In his research Taşdemir (2009) aimed at determining the attitudes of students at secondary school towards Mathematics lesson. The sample of the study included a total of 401 random selected students; 184 female and 217 male; studying at the 6th, 7th and 8th grades. The students' attitude towards Mathematics has been determined by a mathematics attitude scale developed by Baykul (1990). The study indicated that there is a significant difference in the mathematics attitude of the students of different schools and different teachers and that the higher the grade the lower the attitude of the students.

In his research, Norman (1977) studied on the effects of gender on the attitude towards mathematics and arithmetic from the 2th grade level to the college level. It was indicated in the study that for both gender, the higher the level is the poorer the attitude gets and that females had significantly poorer attitudes than males from grade 9 on. It was also stated that the most radical change in students' attitude towards Mathematics is observed in adolescence.

Melancon and others (1993) used a 75 piece Fennema-Sherman mathematics attitudes scales survey in their study population of which is 623 students in $6^{th}$ grade to $12^{th}$ grades at a primary school in the USA. Surprisingly, it was discovered that female students have higher attitudes to Mathematics compared to male students, however; that female students have higher level of Mathematics anxiety compared to male students.

Cai, Moyer and Wang (1999), studied the link between the role of parents on students' attitude and their achievement in Mathematics. In the research, a Parental Involvement Questionnaire (PIQ) was applied to the parents of 220 students and 60% of the parents returned the survey. In the survey, 5 different roles were determined for the parents;

a- Motivational

b- Resourceful

c- Administrative

d- Consultant

e- Learning Guide

As a result of the research, it was indicated that the students whose parents are supportive proved to be more successful at mathematics and have more positive attitudes compared to the students whose parents are not supportive enough. The achievement level of the children of the parents who have not returned the survey was lower and their attitude was more negative.

Telese (1997) studied on the students' attitude towards Mathematics and the frequency of the use of the traditional (teacher-centered) and research-based activities in the classes. In the research applied with 226 Spanish students, it was indicated that and the female students' attitude towards Mathematics is more negative compared to the male students' and female students are more likely to participate the classes studied with teacher-centered activities. As a result of the data collected during the research, it was concluded that teacher-centered activities used more frequently than the research-based activities and that there is positive link between the achievement level and students' attitude.

Wiener (2001) studied the effects of Dance-Mathematics Project on students' attitude to mathematics. Dance-Mathematics Project is a project aims at enhancing students' interest in Mathematics classes and motivating students to use different problem-solving techniques with the use of dance in the classes. In this study the data was collected by observation, a survey and interviews. A 13-piece scale named AMI (Academic Motivation Inventory) developed by Ginsborg, Block and Fantuzzo (1998) was applied to 202 students of the $2^{nd}$, $3^{rd}$, $4^{th}$ and $5^{th}$ grades. Individual and group interviews were done to the teachers of the classes the project was administered and was not. As a result of the study, it was revealed that the attitude scores of the students taught with dance were higher than the scores of the students taught via traditional method. The teachers stated that a result of the classes studied with games, students were able to exhibit their mathematics knowledge more comfortably, showed more interest in the lesson and related between the subjects of Mathematics easier.

Özdemir and Tabuk (2003) studied on the effects of computer-aided instruction to the achievement and attitude in Mathematics. The sample of the study consisted of 7th grade students in two different classes in Istanbul. Before the application, both groups were given an attitude pretest and posttest. The subject "Cycle and Cylinder" was studied with traditional method in the control group and with computer-aided teaching method to the experimental group and a posttest was given to both groups after the application. As a result of the analyzed data, it was concluded that a significant difference was observed between the instruction with computer-aided method and the traditional teaching method. The instruction with computer-aided method has increased the achievement level of students in Mathematics. A significant difference was also observed in the attitude of the students studied with the instruction with computer-aided method compared to the attitude of the students studied with traditional method. The students in the first group have developed a more positive attitude to Mathematics.

In a study conducted by Aydın, Bolat and Bölükbaş (2005), it was examined whether there is a significant difference in the attitudes of high school students' in Niğde towards mathematics in terms of gender, types of school. An "Attitudes towards Mathematics Scale" was applied to 827 students (504 males and 323 females). It was observed in the findings of the study that there is no statistically significant difference in students love attitude subscale towards mathematics lessons. However, the agreement level of the statement "Mathematics is one of my favorite lessons" of the female students is higher than the male students. There is also no statistically significant difference in professional preference subscale scores however; the agreement level of the statement "I consider using mathematics in my professional life" of the female students is higher than the male students. The scores of fear subscale revealed no significant difference, nonetheless; the agreement level of the statement "even hearing the word mathematics makes me uncomfortable" of the male students is higher than the female students. In terms of the type of school, the agreement level of some of the statements in the professional subscale, the students at the private high schools proved to be at the top of the list. Regarding the agreement level of some of the statements in the fear subscale, the students at the general state schools proved to be at the top of the list. Regarding the agreement level of some of the statements in

the love attitude, pleasure, interest and confidence subscales, the students at Anatolian Teaching Training High school proved to top the list.

Lianghuo and others (2005) assessed the attitude of Singapore first grade secondary school students' toward Mathematics and Mathematics learning. This study used a questionnaire survey to collect responses from 1215 secondary one students. 22 items were developed using a nine-point Likert Scale. The results of this study were reported based on the four categories identified above, including the reliability and item-total correlations of the items. That is, students' general view towards mathematics and mathematics learning, students' anxiety level in the learning of mathematics, students' perceptions of their own performance in mathematics, and students' beliefs about the usefulness of mathematics.

a. The data showed that students generally feel that mathematics is interesting to them (73%) and they enjoy doing mathematics (74%). However, interestingly, only about 63% of students like to attend mathematics lessons and less than half of the students (49%) like spending time on studying mathematics. Moreover, 37% of the students respond that mathematics is hard for them and 22% don't have good feeling about mathematics
b. It has been found that students are generally anxious about their mathematics learning. In particular, more than 30% of the students have the feeling of being stressed when they attend mathematics lessons and about the same percentage of students' claim that they cannot think clearly, feel lost, and are nervous when doing mathematics problems. Furthermore, about 22% of the students are afraid of doing mathematics and 30% do not have confidence when it comes to mathematics.
c. The students' responses revealed that they believe that they have ability to perform and perform well in mathematics. The corresponding data show that 77% of the students are sure that they can learn mathematics well and 61% believe that they can get good grades in mathematics. However, consistently to the results in students' general view, many students do not like to solve challenging mathematics problems (31%).
d. The majority of Singapore secondary-one students believe that mathematics is useful (91%), important (89%), and learning mathematics is not wasting their

time (84%). However, only 64% of the students claim that they will use mathematics a lot as an adult.

Şen and Koca (2005) aimed at determining the change of the attitudes of students depending on their gender and academic level. The population of the study was the students which studied in 1st grade (36%), 2nd grade (32%) and 3rd grade (32%) at 6 different high schools in Ankara. As a result of the study, students indicated that among Mathematics, Physics, Chemistry and Biology; Mathematics is the most entertaining, enjoyable lesson that they would like to study more hours and that Biology is the most interesting lesson. The study indicated no significant result in the participation rate in terms of gender and academic level.

In her thesis research, Akdemir (2006) studied on (a) primary school students' attitudes towards mathematics lessons (b) the relationship between attitudes towards mathematics lesson and gender, socio economic status of school, educational status of students' mother and father, type of school (c) their achievement motivations (d) the relationship between their achievement motivations and gender, socio economic status of school, educational status of students' mother and father, type of school and (e) the relationship between attitudes towards mathematics lesson and achievement motivation. The research has discerned that students' attitudes towards mathematics are significantly varied in terms of social status of school, the educational status of mother and father and type of school but they don't significantly vary in terms of gender. The achievement motivation of primary students' vary significantly in terms of gender, socio-economic status of school, educational status of mother and type of school but they don't significantly vary in terms of educational status of father. It has determined that there is a positive but weak relationship between students' attitudes towards mathematics and their achievement motivation.

When studies both on game-based teaching and the attitudes of the students toward Mathematics are examined, it is undeniable that there have not been adequate studies conducted on teaching with games. The studies conducted so far have mostly focused on pre-school, primary school and secondary school levels. In teaching Mathematics in high school, regarding that the age of the students is not appropriate for games; traditional teaching methods are widely preferred. The achievement level of Mathematics is at its lowest in the national and international exams held in our

country. It is indicated in many studies that one of the most important factors proved to be the attitude of the students. As a result of these studies, it can be observed that there is a positive correlation between the attitude of the student and the achievement level. Therefore, it can be stated that studies that can alter students' attitude are not satisfactory enough. In the experimental studies conducted so far, it can be observed that a change in the use of teaching methods and techniques can result in meaningful changes. In most of the studies, it is suggested that game-based teaching should be applied on the higher level of students as well and the teacher should play a role in enabling students' autonomy, setting objectives suitable to the level of the students and increasing the intrinsic motivation of the students. The use of technology is not suggested for the application of gamification. Computer- based games cannot be effective regarding the physical facilities of schools. Considering all these studies, it is can be stated that it is of crucial importance to conduct more studies which emphasize the fact that the skills at developing a product or a material and gamification are the fundamentals of a teacher and which focuses on the new products developed regarding individual differences and design-based differences.

# CHAPTER 3. CONCEPTUAL AND THEORETICAL FRAMEWORK

## 3.1. Philosophical and Theoretical Foundations

Teachers are like farmers who can harvest their product the latest. A doctor can observe if his patient is healed or not. A commander can reach to an end by a triumph or a defeat. It is only a teacher who has to wait for generations to see the triumph. Yet, this wait is for a genuine change. Unlike all forms of art, a teacher works on his master work called change of a human. Although all forms of art are priced with huge amounts, a teacher remains a hero forgotten in the shadow of his work. A teacher raises all revolutions and prepares all reformations. Only he knows to sacrifice the small gaining of the day, for the whole gaining of the future. If the triumph of humanity is the culture created all through history, teachers are the non voluntary and unknown soldiers of this triumph. Considering the fact that philosophy is the idea on the culture, the most important front should be the philosophy of education and teaching. (Ülken, 2001, 7)

Today, preparations should be done for the future and future world rather than for the problems of our century. Dramatic improvements in technology such as the use of robots in arms, the organization of energy sources, improvement of war industry and the use of this technology especially in the production of deadly weapon, the fear of atomic war, the direction of the world by the computers and the promises of a new world by the engineers of Genetics beyond all these things are the issues concerning education and they force education to the new horizons. As these improvements cannot be ignored, education is directly about the existence of the nationalities (Shane, 1992).

It is believed that education is the foundation of every problem we encounter socially or individually, every difficulty we have to overcome or every step we have to take. "Education is a must" is a motto we can come across every part of our daily life; in the most serious academic discussion or in the funniest commercials. In all these situations, formal education is emphasized more than the informal education

taking shape casually. Formal education is a process of creating deliberate and intentional changes of individual behaviors through his/her life (Ertürk, 1986, 12). In this definition the word “deliberate” is used to show that the change is pre-designed and the word “intentional” is preferred to exclude the situations which create the pre-designed change as a result of a coincidence or the situations that are unintentional.

Training is the learning and teaching activities created for a purpose under the scope of a program or a plan which enable individuals the information and the skills required and which create good habits, improve skills, create personality, prepare for life and in a way educate (Kemertaş, 2001, 12). Training is defined as the organized and planned application of education (Demirel, 2005, 9). After the determination of the goals and objectives, that is; curriculum is prepared, the process of fostering these behaviors to student starts. All the teaching activities done for this purpose is called training (Baykul, 2004, 4).

Training is a part of education applied with a plan and a program at schools. When we think of training, we understand the information transferred by mind. Although training and education are two different concepts, they are also the processes that complete each other. Training represents the mind and education represents the soul and the personality. The former gives information whereas the latter gives the values (Ülken, 2001, 9). Although it takes it moves forward dynamically, education takes its pace from the history and traditions. Regarding the fact that educational system aims at raising people in harmony with his current rhythm benefiting from the experiences of human history, it can be called humane. In every country, such a system takes power from its own culture and it can be called national as its history bases its foundation to the tradition that creates its current existence shedding the remnants of its customs and traditions (Ülken, 2001, 14).

No matter which humane or national philosophy it arises from; either from classical rationalism or from a pragmatic and practical philosophy, an educational system will always ask the same question: What and how should a child be taught? All the issue is how to start training. Should it start on the desks at schools or in the gardens or in the laboratories? No rationalistic person would agree to leave the theoretical information taught as only formulas on the blackboard and in his memory. He certainly practices it in the garden and laboratory as long as he is not a slave of scholastic ideas that terminates all kinds of creative thinking. On the other hand, no pragmatist would

agree to let the information be in the limits of empirical knowledge. In any case, he would raise that knowledge to the level of reason by the words of memory, the classification of consciousness or the formulas of mathematics. Otherwise, he cannot claim that it is the real knowledge. Therefore, two opposite ways unite in one result. In both ways, education actually turns into a training system and either way training is the fundamental in raising a child. The child learns what the training teaches without using his own initiative, or creates training directly with his own creativity and rising from practice to theory on the basis the teacher prepares. These two ways are not as opposite as the pedagogical books claim. In modern circumstances, no teacher does or can insert the knowledge to the mind of a student by taking his initiative away. In such a procedure, a student must use the power to process the knowledge in his own mind. In solving a mathematics problem, a student should involve in the process and recreate the knowledge in his mind as much as he does in the physics laboratory or in science class. Otherwise, the process called comprehension is not accomplished (Ülken, 2001, 34).

Training takes the difficult responsibility to revive the history of civilization on the mind of the youth. Maybe because of that, although it was possible for the youth to readily process the limited knowledge as it was, now the vast experience area, the discussions on the principles and the activity of thinking becoming a progressive process cause the knowledge to be recreated. This leads to the birth of new ideas where practice outweighs the theory. Taking all these into consideration, it is not necessary to ask whether the knowledge was given or created by the student. Therefore, it can be understood that the opposition between the sociological ideas of Durkheim who regarded education as the transition of knowledge from the old generations to the new ones and pragmatic ideas of John Dewey who regarded training as nothing more than an active process in student's mind is just a unilateral idea that discusses just a single issue of the reality (Ülken,2001, 35).

### 3.1.1. Theoretical Foundation of Our Educational Philosophy

Education represents a constantly changing process depending on the developments in its own world or on the occurrences and developments outside its world. If a system aims at staying the way as it is, it should not only involve all the improvements in its own field but also it should base on strong theoretical foundations

to defend its authenticity. The developments in humankind, society and science are reviewed and new perspectives are developed over these. Social, psychological, philosophical, technological and scientific developments are reinterpreted. It is considered if they can be adapted to education or not. All these are eliminated by the process of thinking. In education, people cannot propose whatever they desire or cannot put them into practice. The adaptation of these developments is put through a strict questioning. A large group of philosophers analyze the issue with all its aspects and handles it in terms of history. The possible future effects are estimated. Curriculum, student, the intelligence level of student, his internal qualifications and his improvement as a whole, the improvement of education under these circumstances and its future form is examined thoroughly. In this regard, educational philosophy is a strong stand where educational theories are developed (Tozlu, 2014, 234).

The priority in improving a human being is to know him well. Therefore, human nature and the qualifications of this nature determine the education. Information and curriculum which is suitable to this structure and which can improve it constitutes the framework of education and educational plans. There are two aspects of human nature; a physical and spiritual. Hence, curriculum should have the quality to improve these two aspects. The physical aspect should be enhanced by the science and techniques based on positive knowledge and the spiritual aspect should be improved by the satisfaction of the existence through the soul, the heart, will-power and wisdom (Tozlu, 2014, 242).

Educational philosophy indicates the qualities of the "human type" intended to be educated. Philosophy of education examines the assumptions, beliefs, decisions and standards that shape the educational policies and implementations in terms consistency and meaning (Ergün, 2014, 5). The development of education, training and curriculum and planning the program for these is based on philosophy. The generated programs are used to organize lesson plans. A country's educational goals are formed as according to the answers to the questions such as "Why educate people?" The constitution of the educational programs based on systematical models which are at a theoretical level. For this reason, every educational program is based on a philosophy. Philosophy is of essential help in educational programs and planning. "Philosophy is one of the basic determinants of the determination of general aims, specific objectives; development of learning activities; determination of the roles of

the staff and the instruction of learning tactics and strategies in class" (Wiles and Bondi, 2002, 57, as cited in Erkılıç)

19th century in the Ottoman Era is the period when the westernization of culture and the governance of the crown speeded up. Our educational system was also affected by these. Our educational system had its own system before the westernization. When it was discovered that this system was insufficient, we turned our faces to westernization. Since then, we have always been in an imitation and reform crisis and we have not been able to develop our own unique system (Bolay, 2014, 228). Ortaylı (1996, 462) also points out that the reform in education has been made for the governmental, economic and military purposes and a reformed education also indicates a new world perspective.

In the last period of the Ottoman Empire, several ideas such as Turkism, Ottomanism and Westernization were put forward by the Ottoman intellectuals in the fields of economy, society, politics and education. It was considered essential to develop a new system based on these new movements to solve the problems of the Ottoman Empire and to readjust the current system through criticism. In the Republic Period, similar approaches could be observed. With the proclamation of the Republic of Turkey, westernization of education was introduced as the new philosophy. Kaynardağ (2002, 5) considers the Republic Period as the period in when the enlightenment movement came to light, the cultural problems intensified and when the solution to these problems could be found by revolutions starting with the Tanzimat period. In the Republic of Turkey, the gathering of all the educational institutions under a single institution economically, administratively and educationally was only possible in the Republic Period. It was aimed at raising good citizens, who were devoted to the Republic, who prioritize secularization and westernization by educational institutions (Güven, 2010, 388). In the first years The Republic of Turkey was founded, the basic foundation of the education was to ensure the Turkish national culture, national identity and national consciousness (Başar, 1997, 17-18). In that century which was called as the intellect and science era, the definition of westernization was defined by these ideas. Those were the pragmatic, modern, democratic and positivist ideas and the reconstruction based on these ideas was the basic philosophy. Experts coming from abroad such as John Dewey, Kuhne, Omer Buyse influenced the Turkish educational system and politics (Güven, 2010, 389). In

his report on Turkish educational system, Dewey insisted on the fact that education should be reconstructed to be productive and to serve a purpose. (Gökçe, 2012, 179). As a result of the destruction after World War II, a new understanding which based on human love, and which put human in the core in education was born. Turkish educational philosophy was affected by this humanist philosophy as well. In this period when there was rural-urban migration, the need for the opportunity to get education and the equality of opportunity became more eminent. In 1960s, the new legislation also had an impact on education. As a result, long term planning of education was purposed. This planning was based on the pragmatic approach (Çetin, 1994, 659-678).

Nurettin Topçu argued that the positivist and pragmatic approaches which became eminent with the Republic Period have been evolved into American pragmatism as an intellectual attitude and he pointed out that this has caused the foregrounding of the classes that teach and produce technology and disfavor of the classes related to culture which constitutes moral identity (Taşdelen, 2015). According to Büyükdüvenci (2006), the positivist approach which is grounded on facts has isolated education from human and society and limited its functions. This has resulted in the limitations of "Thinking", briefly; it was considered as "the Abdication of Thought". From the beginning of its foundation, Turkish Educational Philosophy intended to be developed in terms of westernization, therefore; it was constructed according to pragmatic philosophy and its principles. However, for the authority and continuity of the newly founded regime, a philosophical approach was reflected on educational system and idealistic and realistic philosophies and their principles were also included. From then on, the educational system intended to be designed by educational philosophies has been a dysfunctional figure and it was deprived of educational or other programs based on the internalized philosophies (Kurt, 2016).

### 3.1.2. Methodology in Education

Chekhov's uncle brings a rat to the room where the kitten is, but the kitten does not care the rat at all as its hunting instinct has not been developed yet. Upon this, he beats the kitten. The next day, same things happen and the following day and the next following day. The kitten gets beaten over and over. Finally, the professor believes that the kitten is brainless and incapable of learning. When the kitten grows up, it turns

out to be a perfectly normal cat except it is horrified and escapes in terror whenever it sees a rat.

Today, a single program and the subjects organized by it and the type of learning which is based on one-dimensional, narrow and limited human understanding has long been abandoned. It has been in the dusty pages of history of methodology to consider pushing against memory as the one and only method. Today, due to the research done on almost all the fields, we have a huge amount of information about human beings. Hence, teaching methods have also developed and diversified. That is to say, from the methodology of Skinner which has been criticized for not involving social interaction, to the methodology based on the teaching of machine and from the teaching method based on audio and vision, to the computerization several methods have been developed. According to Prof. Dr. Necmettin Tozlu, the deficiencies in methodology are listed as;

*Memory:* Memory has its own structure and development and each person has a different type of memory. Although, we have 3 types of memories; sensory, short-term, long-term; (Fantanio, 1947 as cited in Tozlu, 2014) it is a dead end as the restoration methods can differ in each person. Even though several facts have been revealed about memory so far, memorization is still considered as an effective method. This is resulted in the fact that memory is regarded as a tool. That is, life of memory is handled passively and it is even believed that it can be improved by education. However, one of the most important characteristics of human memory is its continuity, liveliness and being in constant interaction. Therefore, stability and passiveness cannot be an option for memory (Tozlu, 2014, 121). For this reason, a great mathematician and logician A. North Whitehead thought that teaching of mathematics today is a repetition of several formulas which are inadequate, based on memorization, away from real life, non relevant to each other and to the whole and he had the need to analyze the issue in details (Whitehead, 1965, 30-32 as cited in Tozlu, 2014). Whiteheads points out the importance of integrity of the education and training and gives importance to the teaching of the skills to evaluate the overall and integrity. He even argues that the educators of today dismember the educational programs; the life and its integrity. Instead, he suggests the teaching of the subjects prepared in terms of the integrity of life. Thus, instead of being independent pieces of information, the subjects should be taught with a point of view which is integrant, reviving and related

to real life. By this way, they can be a part of the life of the learners. In such a case, students learn by the feeling of the pleasure of learning in their souls instead of learning automatically. They can have the opportunity to use and comment on the obtained knowledge in any subject by the skill of evaluating the whole. To use an idea on the information on any subject does not mean one practices it. It also means that it is processed, evaluated and gained vitality. All these explanations show us the place, importance of teaching methods and its total relation with cultural values and the integrity of human beings. In other words, it reveals the insufficiency of the ideas which handles the concept of methodology in a narrow and limited point of view (Tozlu, 2014, 121). It is impossible to overcome this difficulty we face as an inevitable problem by a dogmatic and a classical approach because the methodology approach which is generally expressed by exact formulas in epistemology have the risk of narrowing down and suspension of the width and openness of the methodology (Egemen, 1965, 66 as cited in Tozlu, 2014).

*The inconsistency between the environments:* One of the deficiencies observed in methodology is the inconsistency between the environments. The first environment of a child is the family. This followed by friend, street, school and social environments. The essential issue is the difference in mentality between these environments. To decrease the level of this difference, to extend the domestic conditions and life to the other theories or to create environments similar to these environments shall result in a radical change in methodology (Tozlu, 2014, 122). The first mission of education in all the growing up phases should be to form a convenient basis for pre-school children (Ülken, 2001).

In a regular family in real life, love and encouragement are the essentials. Depending on these, respect and responsibility, duty and division of labor follow. If these fundamental values can exist in other environments and theories, it can be possible to raise a desired human type and therefore to raise the humankind to the level desired. However, it is not an easy task to achieve this. Especially in our age, a home which cannot be organized considering the developments in society is not been able to meet the needs of the children. That is to say, many problems in family affect their ability to raise and make the roles of the family unstable. Love and motivation as a method is extremely important. More importantly, egoism which causes many problems can be avoided right at the beginning in the hearts enlightened with love.

This aspect is one of the fundamentals of our era. Because of this, individual egoism can be at least minimized for the health and development of society. Every person thinks of their personal benefits; thus, humanistic love and respect has been gradually diminishing. World and people even the incidents happening right in front of us interests us in terms of the benefits and harms, if not we become indifferent to everything around us. Discovering our inner world, the outer world and life can be only possible by love. Otherwise, seeking for wealth and economical development shall decrease the human worth and human being will act against his existential purpose of life (Tozlu, 2014, 122). With such an approach, many profits can be made in terms of humanity and positive results will be accomplished in the field of education. Such a learning environment where a student is motivated and loved will be a driving power for teaching. The youth who are just a receiver and an imitator in the learning environment have the tendency to spend more time with technology which promises fun and pleasure and interiorize these external agents meaninglessly, non-directionally and lavishly. However, integrity, diligence, patience, attention and sense of responsibility should be taught to a child starting from the family environment till the end of his educational life.

*The ability to distinguish between a learner and a non-learner:* In many circumstances, this issue cannot be applied properly. Since people who do not work, linger and laze around are rewarded, this shakes the foundation of the level of training, effort, enthusiasm, the rights and justice, in short, the whole educational system and the society the system is based on. A valid methodology should not cause deficiencies and negligence that would result in such consequences. In the light of this issue, we should discuss the necessity of evaluating human as a whole. If examined carefully, it can be observed that although a desire for a one-dimensional human being is opposed today, some mistake is repeated in a different way as the issue is not evaluated thoroughly. This time around, a person's emotional life and heart is highly neglected and only the intellectual quality is focused. However, a human being is not all about intellect. In his life and nature, feelings are as important as the intellect. How can we prevent a constant egoism, endless desires and materialistic relationships without the warmth of heart? How can the feelings which are the foundation of a balanced life of satisfaction and austerity, patience and faith be taught to the individuals? In that case, as for methodology; an approach which deals with an individual with all of his

qualities, which leads him to a satisfactory life in society and in future, which can satisfy his heart, mind and soul should be adopted. In this perspective, it is obvious that methodology is more than a technique. More importantly, it is a matter of mentality and philosophy. The evaluation of a person depends on the way he is perceived and usually cannot be separated from the dominant mindset of the era. The philosophical resource of methodology is the mindset of the people of that specific era. We try to raise people in the way we understand and perceive them. This has been the case all through the history. If it is believed that a person is born to be a slave or a servant, they are raised in way to complete these missions. In this perspective, methodology is used as a tool of mindset to ensure obedience. Beyond any doubt, educational institutions will be shaped with this perspective. Hence, as Aristo regarded slavery as natural fact, he developed his methodology around this fact. Needless to say, all these were a part of the mindset of that era (Tozlu, 2014, 124). It is the same in our age; the dominant idea is freedom and democracy. This idea is completely a result of the governmental and political system. Therefore, the educational institutions and the philosophy they raise upon stems from the democratic perspective. The sense of freedom which is created by this philosophy is the perception determinant and dominant in all educational institutions. In such a case, the raising system cannot be oppressive, suppressive or exclusive. Hence, methodology both in theory and individually should ensure a humanistic, free and guided structure. This eliminates a designed, one-dimensional, narrow and limited approach and a teaching based on it (Tozlu, 2003, 79-90). In addition to Tozlu's stimulating and comprehensive point of view, we should also mention the fact that the technological improvements and the informal information the new generation get is more colorful, fun and yet preferable compared to the formal education methods. It can be suggested that it has become harder to arouse interest, ensure concentration of the students who are the determinants of teaching methods and prevent the outer impacts on them.

### 3.1.3. Teaching Theories

Humankind is always in interaction with his environment. Through this interaction, learning happens. Learning is the alteration of behavior, thought and perceptions resulted in the interaction with the environment. As a result of the studies on how teaching can be realized, theories have come out. Alkan and Altun (1998) pointed out that the proper definition of the use of learning models will make learning

more effective. In this section, the theories and theoreticians which will constitute the basis of this research have been mentioned. The stated theories and theoreticians below believe that learning is created as a result of the incidents and situations in the environment and all mental means are used to achieve learning. Learning theories are listed in 5 main groups; Behaviorism, Cognitivism, Effectiveness, Structuralism and Gestalt. These theories are explained briefly below:

#### 3.1.3.1. Behaviorism

The theory of Behaviorism acknowledges that learning is developed by the establishment of a bond between the stimulant and the behavior which is the reaction given to the stimulant and it is the alteration happens via reinforcement (Özden, 1998, 22). Traditional behaviorism emphasizes the importance of change of environment to create the conditioned behavior and the desired reaction regarding the arguments of Aristo, Descartes, Lock and Rousseau on learning (Demirel, 2000, 33). The leading representatives of this theory are Watson, Thorndike and Skinner. The principles of this theory are listed below (Fidan and Erden, as cited in Uğurel, 2003, 30):

1. Learning by practice is fundamental. Student is active.
2. Reinforcement and motivation is crucial in learning.
3. Revision is essential in permanent learning and the acquisition skills.

#### 3.1.3.2. Cognitive Theory

According to the Cognitive theory, learning is a mental process that cannot be observed (Özden, 1998, 25). Cognitive theory focuses on comprehension, thinking, perception and creativity. On the contrary to behaviorists, the pioneers of the cognitive theory prefer to promote principles in students' minds depending on the situation. Piaget, Glaser, Bruner and Bloom are the famous scientists who have done research on this field. The essence of this theory developed by Piaget based on the ideas that to deeply analyze the children's ways of reaching information will offer an insight on the birth and development of information. Cognitive development is the development of the mental activities which enables an individual to comprehend and learn the world around him. Cognitive development is the process in which the ways of understanding the environment and world become more complex and effective (Senemoğlu, 1997, 39). Bruner regards learning as an active process and suggests that the teaching and training activities should be promoted with the active participation of a student. In this

approach, the teacher prepares the problem and presents it to the students to discover; she directs the students during their research and encourages them to use new ways of thinking. Bruner wrote many books about teaching and learning process. In his books, he pointed out the importance of understanding the structure of subject matter. He also stated that the best way to understand this structure is the individual's activeness in learning and discovery. Learning by discovery is a teaching approach that encourages the students to arrive at a conclusion based on the individual activities and observations. According to Bruner, the role of a teacher should be to create an environment a student can learn by himself rather than exhibiting the preset information and instead of teaching the principles herself; a teacher should encourage a student to experiment and discover the concepts and the principals. Bruner (1996) explained the learning of a students as "knowing is not a product but a process" (Senemoglu, 1997, 470-471). Discovery learning is an effective strategy that can be used in language teaching, mathematics and science classes. Baykul (2003, 13) explained the results of discovery learning on teaching of mathematics as stated; Discovery learning is the most appropriate model for the structure of mathematics. It is the model that can contribute to the improvement of problem-solving skills. As a result of teaching via this model;

a. Students discover mathematics on their own with the help of teaching activities and the teacher's guidance;
b. They understand the value of discovery, enjoys achievement and develops a positive attitude towards these;
c. As a result, their self-confidence in mathematics is built.

Bruner's discovery learning strategy has been one of the basic resources that shape the learning practices on teaching of primary school mathematics.

The teaching principles of Cognitive Theory are listed below (Fidan and Erdem as cited in Uğurel, 2003, 30);

1. New information is built on former information. Therefore, the teachers and students should be aware of the former knowledge.
2. Learning means to attribute a meaning. Therefore, adjustments should be made to learn the details and the core of the subject.
3. A student should have the opportunity to practice the information learned.

4. Rather than being the authority, a teacher should have the role of a guide.

Considering the list and the explanations above, it is inevitable to indicate that cognitive theory is the most effective theory in teaching of mathematics as it is a cognitive fact. Designing game-based classes in order to objectify mathematics class which is abstract in nature and examining the effects of this design on students' attitude and academic achievement has been selected as the problem of this research.

### 3.1.3.3. Affective Learning Theory

Affective Learning Theory is defined as an individual's recreation of learning by self according to his effectiveness and mind. It focuses on the results of learning rather than the nature of it. It gives importance to the development of ego and morals (Özden, 1998, 29). The primary principles of affective learning theory are listed below.

1. Teaching should improve self-confidence and the academic achievement expectation of the learners (Özden, 1998)
2. It should help improvement of self-respect (Rogers, as cited in Özden, 1998)
3. A learner should learn his weaknesses and strengths. It should help the student create their self-representation (Özden, 1998).

Considering the principles listed above, attitude developed towards mathematics class plays an important role in teaching of mathematics. If a student's self-confidence is supported and his achievement is approved, he will display a positive attitude towards the lesson (Özden, 1998).

### 3.1.3.4. Constructivist Theory

Constructivist theory is an approach emphasizes the construction of information rather than transferring information or recording the information given by (Özden, 1998). Constructivism which is defined as the construction of a structure by putting the pieces together focuses on the nature of information, the way it is constructed and which information can a person know or not (Baki and Bell as cited in Uğurel, 2005, 60). In this approach, the student is in the center of teaching and the teacher serves as a guide. According to Constructivism, new information is built upon the former information. The stimulation of the former knowledge, focusing on improvement and effective communication plays an important role in this theory.

Vygotsky is one of the leading figures of this theory. The primary principles of the Constructivist theory are listed below:

1. Learning is an active process. A meaningful learning occurs in this process.
2. An effective learning language is essential for a meaningful learning.
3. Learning is social and contextual.

In "Student-Centered Education Model" issued by Ministry of Education in 2003, student-centered education is defined as "It is the reconstruction of the educational process regarding the individual differences and ,in a way a student can participate in each step, to create individuals who can think scientifically, who has learned to learn, who is productive, who can reach and use information, who has communicative skills, who adopted the universal values, who can use technology effectively and who has been able to realize his self" (MEB, 2003, 14). In this educational system, learning programs, teaching techniques and methods, students' performance evaluation methods and new textbooks are based on the constructivist approach and a student-centered active learning based on lifelong learning is intended. In student-centered education, the effective use of guidance service is designed to discover the students' interests, skills and abilities.

According to the Student-Centered Educational Model of the Ministry of Education, the objectives of Student-Centered Education on students are listed below;

1. He recognizes his self and his individual differences.
2. He is enthusiastic about individual improvement.
3. He realizes his self.
4. He is willing for individual and group work.
5. He learns to learn.
6. He improves thinking skills.
7. He transfers academic skills to life skills.
8. He obtains effective communication skills.
9. He uses technology effectively.
10. He uses time and energy productively (MEB, 2003, 14-15).

According to the study conducted by Ali İhsan Özçakır, the former chief inspector of the Ministry of Education, in 2003, the principles of Student-Centered Education is listed below;

1. Each student can learn.

2. Learning the learning is the principal.
3. Each student establishes a connection between the new and the former information.
4. It is to teach creative thinking.
5. To assign homework that stimulates curiosity, creativity and complex-thinking.
6. Each student improves in a different time, way and pace.
7. Student-centered education is based on cooperation.
8. Each student has different abilities.
9. Each student learns the new information in his own way.
10. Learning becomes difficult when it is restrained by some negative experiences.
11. The sense of achievement promotes intrinsic motivation.
12. The interaction of the students of different characteristics makes learning easier.

The qualities of a student-centered classroom according to Student-Centered Education Model (MEB, 2003, 51) of the Ministry of Education are listed below;

1. Student-centered,
2. Based on Constructivism,
3. Progressive,
4. A model of the Information Age,
5. Based on standards,
6. Profound,
7. Integration of subjects,
8. Process and product centered,
9. Block-based programming,
10. Learning based on cooperation,
11. Experimental information.

As can be observed in the studies, an education based on constructivism with the employment of progressive philosophy is intended in a Student-Centered classroom. Progressive teaching philosophy is the adjustment of pragmatism to education. Pragmatic philosophy considers change as the base of fact. The principles of Progressive education are listed below:

1. Education should be active and appropriate for the child's interests,
2. Problem-solving technique should be the principle of teaching,
3. School should be the life itself rather than preparing for it,
4. Teacher's duty is not the management but the guidance,
5. School should encourage and motivate cooperation rather than competition,
6. A democratic teaching environment (MEB, 2003, 51).

It can be observed that Constructivism which adopts Progressive philosophy is adjusted suitable for the needs and values of the era.

In the light of the information stated above, it is pointed out that in order to employ game-based teaching of mathematics as an effective teaching method; it should be taken into the scope of Student-Centered Education.

#### 3.1.3.5. Gestalt Theory

Gestalt theory gives a great importance to perception. In their studies, Gestalt theoreticians introduce the perceptions laws such as figure-ground relation, closure, proximity, continuation, similarity and simplicity.

Gestalt theoreticians argue that a learned principle of a problem can be used to solve another problem. This process is called "transfer". Although the similarity between the problems does not affect the transfer, the understanding of the principle which is used in problem solving does (Ulusoy, 2002, 23).

Gestalt theory was started by Wertheimer and its principles were developed by Koffka. According to the Gestalt theoreticians, the whole is greater than its parts and an individual perceives the whole by not isolating its parts but as a unified whole. For Hill (1990), a configuration or a pattern formed by the dynamic and organized relations of its parts is a fact independent from the deduction of its parts (Senemoğlu, 1997, 244).

According to the Gestalt theoreticians, we perceive the world as a unified whole. We see the stimulus as meaningful and organized whole rather than isolated parts. Instead of stimulus-response pattern, Gestalt theoreticians suggested the formula of a response based on stimulus pattern-perceptual organization of organism- response based on stimulus (Senemoğlu, 1997, 245-246).

As stated by the Gestalt theoreticians, an individual perceives the whole by not isolating the parts but as a meaningful whole. Then, he discovers the relationship between the whole and its parts. Simplicity, similarity, proximity, continuation and figure-ground relation is important for perception. The processing of the units starting from simple to difficult, unknown to known provides continuation, therefore; makes learning easier. Thus, the achieved a student feels, the less he needs an external reinforce and he is able to reinforce himself internally (Senemoğlu, 1997, 248-249).

Gestalt psychologists believe that psychological reality is more effective on behavior than the physical environment. In this case, a student's beliefs, values, needs and attitudes have an important effect on making sense of the physical stimulus in his teaching-learning environment. That is to say, external circumstances become meaningful depending on student's internal circumstances. Thus, teachers should organize their teaching methods in a way that they can meet the needs of the students, not contradict their values and improve their attitudes.

One of the most important contributions of Gestalt psychologists to education are the applications of "insightful problem solving and productive thinking". In order to promote insightful problem solving, a student should be introduced all the components of a problem. An appropriate environment should be prepared for the students to understand the nature of the problem, to discover the relations between its components, to organize the ways of solutions and to discover. For this purpose, students' curiosity is prompted.

To enable the productive thinking, a student should be guided to understand the nature of the problem and the foundations of the principles used in the solution of the problem. The application of insightful problem solving and productive thinking requires a strong teacher-student interaction.

Gestalt psychologists regard revision related to learning beneficial since it enables the students to discover new relations and to improve the trails in memory. For Gestalt theoreticians, the use of the learned information in different circumstances; to transfer, is essential.

As stated by the Gestalt theoreticians, former experiences create new experiences through the interaction of the external sensory stimulus (Senemoğlu, 1997, 264-266).

In Gestalt theory, a strong teacher-student interaction is emphasized for the sense-making of the physical stimulus in teaching-learning environment, for the use of the information in different circumstances, for the revision of the information, the discovery of new relations and for the application of insightful problem solving and productive thinking. This can be realized by the effective use of the relationship between mathematics and games. That is, an educational approach of teaching mathematics with games plays a crucial role in changing the negative attitudes of the students and avoiding boredom during classes. Regardless of the stage, using integrated games in mathematics classes can make comprehending mathematical concepts and operations much easier for students.

### 3.2. The Concept of Game

Babies and infants are in constant motion starting from birth and they play games with the objects and the people around. They recognize every object via five senses, they acquire knowledge of these objects with their own experiences and they actually enjoy doing these. Games are activities that give joy and happiness to children. For educators, games are the foundation of learning (Tüfekçioğlu, 2003).

Games give children the opportunity to recognize the objects and solve the problems. By this way, a child can learn several concepts and mental operations such as shape, size, color, dimension, weight, volume, measurement, counting, time, place, distance and space (Yılmaz, Sığırtmaç, 2006, 2-3). Seyrek and Sun (1997, 5) who defines the concept most comprehensively suggests that games are meant for children and should be educational and they should be designed and organized for this purpose since they are an important tool that improves psycho-motor, psycho-social, mental and affective skills of a child. According to Seyrek and Sun (1997, 51-53), game is the primary factor in raising healthy and strong children, in improvement of their personality, independence, creativity, memory, perception and attention, and in teaching of desired behaviors; shortly, in enhancing the emotional and physical development of children. Thus, any subject can be taught to children via games (Yılmaz, Sığırtmaç, 2006, 2).

Games can be included in several disciplines such as anthropology, psychology, pedagogy and communication sciences. Therefore, each scientist defines game regarding his field. A psychologist defines game in terms of psychology whereas

a scientist defines it in terms of physical qualities or a socialist in terms of society (Hazar, 1997, 5). One of the reasons game is defined in different terms is that it directly includes the concept of development. Many different definitions can be observed for the term "development". For instance, development as a concept includes all the past and future changes a living being experiences all through its life (Binbaşıoğlu, 1990). The definition of game can vary since games are various in types such as traditional games like hide and seek, blind man's buff, dodge ball or board games like backgammon, check and chess, or archaic computer games like Tetris, mine craft (Binark et al., 2009, 25).

As an irreplaceable way of life for children, the concept of game is a various and versatile activity; thus, the definitions of game might differ (Aral et al., 2001). Below are examples on the definition of the concept of game;

Game is an act which is a source of interest and creativity; an activity the purpose of which is in its essence (Adıgüzel, 1993).

Game is a fun activity which is done for the purpose of improving social adaptation and emotional maturity with the help of physical and mental skills, which does not expect material benefits, which has its own unique rules, which happens in a limited time and space and which engages all the voluntary participants (Tamer, 1990).

Turkish Language Institution (2008) defines game as "an entertainment which improves skills and intellect, which has definite rules and which helps spend enjoyable time".

Oğuzkan (1994) defined game as "any activity that has no long-term objectives or a relation with a prospective feeling of satisfaction and the purpose of which is in its essence".

The mentioned definitions mostly focus on the fun and pleasure giving aspects of games. However, game is as serious and important as an adult's work and it is a way of development for children. A child feels the need to play games just as a silk worm feels the need to eat leaves (Lombrosso, 1896 as cited in Kavasoğlu, 2010).

The United Nations Convention on the Rights of the Children (1959) declares that a child shall have full opportunity to play and recreation, which should be directed to same purposes as education; society and public authorities shall endeavor to

promote the enjoyment of this right. Play is basic need for a child and every child has the right to play games. Game is one of the methods used in active learning. Educational games are activities which enable the reinforcement and revision o the acquired knowledge (Demirel, 1999).

Tezcan defines game as an aspect of relaxation, recreation, self-expression and social culture (Tezcan, as cited in Turgut, 21998) whereas Demirel (2005) defines it as an act of an individual or a group which aims at reaching a goal by following the rules, competing and cooperation. Dewey defines game as the first step of facing something new whereas Hutt defines it as an effort to find the answer for the question; "What can I do with this object?" rather than the question "What is the purpose of this object?" (Uğurel, 2003) Faulkner (1995, 231-287), on the other hand, explains game a process which is based on real life experiences in which mathematical thinking is the basis.

Game is generally defined as a part of real life for a child which has a purpose and rules or not, yet which in both case something a child is engaged voluntarily and a part of real life which is the foundation of the physical, cognitive, language, emotional, and social development of a child and it is the most effective learning process for a child (Baykoç, 1992, 1243). As Baykoç stated, game is a part of real life and the most effective process of learning. Game is a fundamental activity for the cognitive development of a child. For the purpose of learning, children have to acquire knowledge by investigation, experiment and discovery. Through the use of games, children find answers to their questions about the world, test new ideas and concepts and practice their skills at problem solving and reasoning (Akman, 2002, 2).

Topkaya (2004, 5) defines game as a physical education, an educational tool which plays an important role in almost all the stages of human development and Gürün (1984) defines it as an activity that entirely affects a child's personality.

Dönmez (1992) defines game as "an important learning process and the foundation of development which may or may not have rules but always participated voluntarily." He also explains in detail that game is a part of life and the most effective learning process which may or not have a purpose, which does or does not have rules, always participated voluntarily and in joy, which is the basis of physical, cognitive, language, emotional, and social development of a child. Game is a means for children

to learn the subjects no one can teach by their own experiences. Game is an activity done for fun without considering the result. Game is regarded as the opposite of "work" because in "work" a result is expected. Game is an activity which motivated intrinsically, which has no definite purpose, which develops naturally by the rules set not but adults but by children, which is consisted of behaviors that aim pleasure. Game is an act chosen by the child himself or by the other children in the group and which has ground rules in itself (MEGEP, 2009, 4).

Game is fun activity done with the help of physical and mental skills for the development of social adaptation and emotional maturity and which is played with rules in a definite time and place (Tamer, as cited in Tural, 2005, 65).

According to Gross, game is a rehearsal for maturity (Özdoğan, 2000, 101). Game is a way relaxing. For children game is something they play all day long. Game is life and life is a game. There is no difference between game, learning and occupation for children. Children are natural born players. They take pleasure playing games and they can always play games. For children, game is a natural, spontaneous, pleasing activity which they focus on the meaning rather than the result (Aksoy and Dere Çiftçi, 2014, 2). Game which can be considered as a waste of time is an important opportunity for a child to express his feelings, improve his abilities, to express his creativity and develop his mental, social, emotional and motor skills. Shortly, game is the most natural and active learning environment for a child (Mangır and Aktaş, 1993, 14).

According to Prensky (2001), there are 6 elements of a game:

● Rules: Rules determine the limitations of a game and offer ways to reach the result. The most important difference between game and any entertainment is that games have rules.

● Goal and Objectives: They create a sense of responsibility in a player and provide voluntary participation. A game without a goal cannot be expected to be motivational for a player. It is very difficult for an unmotivated player to continue playing and to replay the game.

●Feedbacks: How a player performs in a game to reach the goal is notified by the feedbacks. When circumstances change as a result of a behavior of the player, a feedback is given.

● Struggle/Contest/ Challenge/ Rivalry: They are the elements that make the player continue and finish playing the game. They are consisted of pieces of a problem the players try to solve.

● Interaction: It means the social situation the players create during a game.

● Representation and Story: They explain what the game is about. The story of a game can be presented directly at the beginning of a game or can be given indirectly during the game (Çankaya and Karamete, 2008).

### 3.3. Theories on Game

Games are indispensible structures that exist in all the stages of our lives and that we use for different purposes in all ages. Its diversity, form, level and content vary from person to person. Games have always been a part of our lives since the beginning of time. In a way, game is one of the basic human behaviors. Today, game is an activity much preferred by the adults as well.

Cohen indicates that one of qualities post-modern adults should have is the enthusiasm to play games (Zülal, as cited in Uğurel and Moralı, 2008). At this point, the most important question to be answered may be the question of "why a person plays a game?" Psychologist M. J. Ellis answers this question as; all the mammals have a vitality level which they try to reach in their brains. In order to reach and protect this level, brain always forces the organism to do activities which are not important for sustaining life. These activities are called games (Zulal, as cited in Uğurel and Moralı, 2008). According to Eric Bern, each person has different personalities in his self. These are the personalities as a child, a mother, a father or an adult. All these personalities have different desires and the individual needs to play games to meet the desires of these personalities without even realizing this (Zülal, as cited in Uğurel and Moralı, 2008). In his research, Nicholas Yee tried to reveal the motivational reasons that push individuals to play games and he determined 5 basic reasons which are; relationship, immersion, grief (stemming from the competition with the other players), achievement and leadership (Yee, 2002).

There are several theories that attempt to explain why people of any age play games. Some of these theories were popular in past whereas some are still popular. However, all these theories fail to explain the reason why people play games

comprehensive enough (Cole, Morgan, 2001, 229). When examined thoroughly, these theories show that games differ in terms of goal and application. The theories attempting to explain the reasons and results of playing games started to be developed in the late 19thCentury. Below are the most comprehensive classification done by Seefeldt and Barbour of the theories of game:

### 3.3.1. Classical Theories

Classical theories focus on exploring the purpose and content of games and they consider work and game as different activities.

#### 3.3.1.1. The Surplus Energy Theory

The Surplus Energy Theory has been revealed by F. Schiller (1873) and an English philosopher H. Spencer (1878). To this theory, human beings are born active and they store energy. The energy left after all the needs are met becomes surplus energy. A child can obtain a healthy balance when he can get rid of this surplus energy. A child who plays a lot of games is a healthy child. Children use this energy for pleasure through games. When a child isolated from the classmates in the playground is observed, it can be realized that this surplus energy theory is realistic. According to this theory, going out to the open playground enables children to act freely and therefore, they have more fun playing games. According to this theory, a human being is born active and stores some of his energy. He uses this energy to for entertainment if he does not have to use it to sustain life. An English philosopher who lived in the 19thCentury came up with this theory inspired by the steam released by the industrial machines. To this theory, game is way of releasing energy for children. In this way, a child uses this surplus energy on an activity which he can enjoy and improve himself, and which is not harmful. Thus, he can relieve his tension (Pehlivan, 2005, 33). The Recreation Theory and The Surplus Energy Theory distinguish the time for game and work. In accordance with this point of view, there are classes to work and breaks to play. By this way, children get rid of the indolence occurring in lessons and relax; and they restore energy.

#### 3.3.1.2. The Recreation/Relaxation Theory

This theory which defends just the opposite ideas of The Surplus Energy Theory indicates the ideas of German M. Lazarus (1883). The Recreational theory

defends the idea that the individuals should restore the energy they have lost. Playing games helps restore all the energy lost during work. In modern societies, it is very difficult for an individual brain and fine muscles to restore the energy in working environment because work life causes physical stress. The relaxation theory suggests that gross motor activities release energy and the body relaxes more while doing such activities (Aksoy and Dere Çiftçi, 2014, 25). According to this theory, forceful activities wear the mind and the body; therefore, a person needs to relax and sleep. However, a real relaxation can be through dealing with other activities rather than responsibilities of life and a person can be restored by this way. Children play games as a result of their need to relax (Sevinç, as cited in Evcin, 2010, 5). Games are benefited to restore the energy used or lowered during work. Activities that require the use of gross muscles are quite appropriate for relaxation. This theory suggests a balance in the activities in children programs; such as academic and non academic activities (Bruce, 1991). The energy consumed during academic study is restored by games. According to this theory developed by Lazarus (1824-1909), game is a way of relaxation and recreation. Therefore, this approach can especially be used for the children who do not want or like to study. The permission to play games after the study is finished shall ensure the motivation of the child to study. Briefly; through games the lost energy can be restored (Öğretir, 2008, 95).

#### 3.3.1.3. Recapitulation Theory

A North American child psychologist Stanley Hall (1846-1924) has developed the Recapitulation Theory in children's games. This theory focuses on the instincts as well. According to Hall, children reanimate the developmental stages of human evolution such as, animal, the wild people or a member of a tribe. Game follows the stages of human evolutions. Therefore, children climb trees like the wild people before they play group games. The aim of game is to get rid of the instincts which are not needed any more in the modern world. Through games, primitive instincts weaken. For example, children can release their energy by playing sports such as baseball just like a hunter uses his bat for hunting. Moreover, game is considered as a way of preparing children for modern life (Aksoy and Dere Çiftçi, 2014, 26). According to recapitulation theory, game is a reflection of the culture a child lives in. While playing games, children reveal a development in parallel with the cultural stages of human evolution, and reflect the lifestyle of their ancestors. Game is a bridge between past

and future (Altunay, 2004). As stated in this theory developed by Stanley Hall, unwanted qualities of a human being can be eliminated by games. Childhood games are a summary of human evolution and development (Öğretir, 2008, 95). Children switch from the game phase which is simpler to the real life activities which are more complicated.

#### 3.3.1.4. Practice Theory

Practice Theory which was introduced by philosopher K. Groos (1898), also known as instinct theory. According to this theory, game prepares the children for the responsibilities they will need in future and the roles in their future. Gross believed that game serves to strengthen the instincts that will be needed in the future rather than revealing the instincts (Aksoy and Dere Çiftçi, 2014, 26). According to Groos, is the emergence of the natural abilities that will help a child in his future life and prepare him for real life. As stated in this theory, a child instinctively tries the behaviors and roles he will experience in the future through games. As a result, the child develops some skills and these skills enable him to maintain his life. Regarding this, game is believed to have a function for the continuity of species (Sevinç, as cited in Evcin, 2011, 5). For instance; while playing a socio-dramatic game and play the role of a parent, they use the materials related to them. Therefore, they obtain the parenting skills they will need in future by practice. Practice and experience is fundamental for the kids to maintain the life and they also enables the children to be prepared and qualified for the skills they will need in real life (Aksoy ve Dere Çiftçi, 2014, 24-26). According to Pre-Exercise Theory, game is an activity that prepares children for adult life and is instinctive. Since the maturity process of a human being is a long process, a child researches how to live as an adult and has the opportunity to practice this with the help of games. According to Gross, game is a stimulating factor that helps physical development. He also points out that game has a function of purification and it purifies an individual from his anti-social tendencies (Pehlivan, 2005, 33).

### 3.3.2. Modern Theories

The way children shape their games and the content of these games have been determined by the modern game theories. Unlike the classical theories, modern theories focus on how a game is played rather the reasons of it.

### 3.3.2.1. Psychoanalytic Theory

Psychoanalytic Theory based primarily on the studies of Freud and later on the studies of Erikson. According to this theory, games have psychological basis. Game is the combination of the biological needs during the process of growing up and the desire to grow up of a child. This theory developed by Sigmund Freud (1905-1920), puts emphasis on the role of the physical development of a child. According to Freud, game facilitates an environment in which a child can get rid of the pressure of the reality and can release aggressive instincts. By this way, a child is relieved and gains power. Childhood games do not occur coincidentally but they reveal the feeling and dreams that a child has consciously or not. To Freud's point of view, a person can overcome their fear, inhibition or social conflicts through games. Game can be effective in social maturity and finding the inner self (Toksoy, 2010, 205). According to Freud who took the imitative behaviors and the power of imagination in to consideration, children tend to be selective in choosing whom to imitate in their games. They imitate the people they love and respect, and they fulfill their desire to be like them. The imitation of the people they fear or resent helps them to control the anxiety they experience (Oktay, 2003, 43). Game is a very effective tool to know a child. The repetition of the anxiety, excitement and contradictions of the child might be helpful in decreasing those feelings. This theory focuses on the important role of games on the emotional development of a child. Freud considered game as a fact which helps to be informed about a child's psychological problems. Since game facilitates a child to be temporarily isolated from the negativities of the real life, he feels stronger. Erikson Game Theory (1950) examined the contributions of game to the development of personality. To Erikson, game is the use of power of imagination for authority and adaptation. Game is the expression of feelings, revival of the past and dreaming of future. Through game, children's power of initiation increases and they become stronger against disappointment and failure. A problem that cannot be solved in real life can be solved in games. Unlike Freud, Erikson explained game not only as a psychoanalytic but also as a physical and cultural fact. Erikson is the first scientist to use game in therapy. He stated that behavior is dependent on biological and socio-cultural factors and game is essential for the future of a child (Öğretir, 2008, 96). Similar to Freud, Ericson (1950) used the psychoanalytic theory to explain the concept of game and examined the contributions of game on the personality development of

an individual. According to Erikson, game is the mirror of the psycho-social development of children. Adler (1948), on the other hand, considers game as a method to be used in the therapy sessions of troubled children. He points out that the therapists should see through the eyes and hear through the ears of the child while communicating with him. Adler also indicates that children of age 4-9 tend to express their feelings as they play with their toys; therefore, can be reached using a game therapy.

#### 3.3.2.2. Cognitive Theory

Cognitive development is the development of mental abilities which are used to comprehend and perceive (Erden and Akman, 1998). Cognitive Theory handles the issue of game in terms of the cognitive development of an individual. A Swiss psychologist Piaget (1896-1980) considered game as an improving tool for the cognitive development of a child. He also regards game a part of cognitive development and as a process of assimilation and accommodation. The accommodation process plays an important role in psychological aspects such as socializing, cooperation and language acquisition. Piaget developed the theory that the cognitive development of a child can be resembled to the biological development and it consists of some qualitative changes just as in the structure of an organism. According to Piaget (1962), most of the activities considered as a game are mostly mental activities. Game is the activities done to discover, investigate and experiment the things in the environment. Piaget considered game as the basis for the process of maturity and the cognitive development. He also believed that cognitive structures should be practiced and game can serve as a setting for this practice (Kabadayı, 2004, 2). The foundation of Piaget's game theory based on the principles of assimilation and accommodation. Assimilation is the ability of an organism to incorporate the new conditions and problems into its existing mechanism. In other words, it is to fit something into its existing self. Accommodation, on the other hand, is the alteration of the organism to accommodate the new information in its existing self. That is to say, accommodation is the effort an organism put in to fit the new information. Both assimilation and accommodation are equally essential in cognitive development and game facilitates cognitive development. Piaget indicated three kinds of plays; Sensorimotor Play, Symbolic Play and Games with Rules.

1. Sensorimotor Play: These games include the sensory-motor stage of a child. Sensorimotor play starts in the first months of a life and they are unintentional activities a child does as a result of the feeling of joy controlling things around as in the example of a baby jiggling his rattle repeatedly. Starting from birth until the age of 2, babies start moving and it associates and classifies the stimulus in the environment with the 5 senses during the cognitive development.

2. Symbolic Play: Symbolic games start at the age of two as dramatic games and it is observed that imaginary behaviors turn into a game. At this age, a child cannot comprehend the defined rules. These games are played between the ages 2 to 7-8. These games include exercises, signs, symbols and assumptions. By pretending, a child recreates the reality of his own. He tries to express his ideas through symbolic games since he cannot express them with his undeveloped language skills. As a result, by the repetition of these signs and activities assimilation occurs.

3. Games with Rules: Games with rules include social organization, are played by a group and involve the ages of 7-11 which is the concrete operations stage. These games involve the stage after the ages of 7-8 in a child's development phase. First of all, the child starts imitating the games of older ages. Sensorimotor and symbolic games tend to be played less whereas games with rules played more as the child gets older. This motivates the child to socialize. Game is the utmost expression of self-centered thinking and is the transition from imagination to actual thinking (Pehlivan, 2005, 36). Following Piaget, many researchers have studied on how children present the social life in their games. According to Bretherton, children offer new alternatives of "reality" by changing an event. Gary and Brandt examined the content and process of games in which children pretend and discovered that the beginning and the result is important in a game. Besides, game facilitates children with a mutual communication through the use of symbolic alternatives of the social reality.

### 3.3.2.3. Socio-Cultural Theory

A Russian psychologist Lev Semenovich Vygotsky (1896-1938) believed that game has a greater role in cognitive development and game is learned by the isolation of the physical qualities of an object from its meaning (Öğretir, 20018, 96). According to Vygotsky, game is an imaginary situation a child creates. Game is a new formation created by a child to release the tension resulted by the needs that are not met by the

environment. In addition to including some parts of reality, this formation also increases the development of a child to the utmost level in its limitations. To Vygotsky's point of view, game has a crucial role in the development of the ability to use symbols. In the development process, a child's actions and behaviors turn into cognitive operations. Game helps the isolation of thoughts from behaviors and objects. Thus, a child can distinguish between object and behavior and its meaning by means of a game. Considering that game has a greater role in cognitive development, Vygotsky stated in his book "Play and its Role in the Mental Development of a Child" that play is learned by the isolation of the physical qualities of an object from its meaning. For instance; when a child is playing with a bat, he calls the bat as "a horse" and uses the bat as "a horse. This means that he has learned the meaning of a horse. Vygotsky calls this "the perception of reality" and indicates that the world is not all about shape and colors but emotion and meaning matter as well. He also states that the socialization of a child is not only a result of the social environment but also of the behaviors in the physical environment. According to him, the cognitive function of an individual is founded upon the biological construct. Vygotsky is regarded as an important figure not because he developed a theory but because he integrates different theories.

Bruner mostly focused on the creativity and flexibility of a game. Bruner (1972) discovered that the meaning found in a game is more important than the results of it. To his point of view, children reach their goals in a play since they do not do any mistakes and by this way, they can experiment new behaviors with new combinations. Additionally, children can use these behaviors to solve real life problems. Therefore, this increases the options and provides children to act at ease. The most important function of play is considered as to enable an individual to learn in less risky environments (Öğretir, 2008, 94-100).

#### 3.3.2.4. Ecological Theories

Ecological theories focus on the organization of the play environment and the effects of these environments on child's behaviors rather focusing on the effects of games on children and the relation between game and areas of development. It is of crucial importance how a play environment is organized and which facilities are offered to a child (Oktay, 2003). The factors that affect the play are; the numbers of

participants, the materials that are used, the gender, adult control and creative open playgrounds. According to Chamberlin (1998), the positive effects of the playgrounds on child development are listed below:

1. It helps the physical and psychological development of a child.
2. The child recognizes the environment and shed fear.
3. It empowers the concentration and develops his skills.
4. It improves the sense of responsibility.
5. It improves the sense of cooperation and collaboration.
6. It enhances the assertiveness of a child in society (As cited in Pehlivan, 2005, 52).

For these reasons, playgrounds should be designed to facilitate children to develop their skills, learn new things and meet their needs.

### 3.4. The Methods and Techniques used in Teaching of Mathematics

Different methods and techniques have been experimented for an effective teaching in the process of teaching and many methods and techniques have been developed for this means. Method is defined as a particular procedure or process to attain an object (Yıldırım, as cited in Uğurel, 2003). A teaching method is defined as a means to accomplish an object in teaching activities (Altun, 2002). These means can vary in accordance with the type of a class. According to Altun, what is expected from a method is that it should be result oriented, low cost and should guarantee learning. Teaching methods are termed as strategy or technique by some whereas they are considered as a head piece of technique by others. This issue causes confusion (Uğurel, 2003).

The methods, techniques and strategies used in teaching of mathematics are listed below;

#### 3.4.1. Direct Instruction Method

Direct Instruction method of teaching is a teacher-centered method. It is defined as the teacher's informing the students by delivering the information she has (Altun, 2002). Student is passive. It can be more effective in crowded groups. This

method can be used in a short period of information delivery, to draw attention to a point and to summarize. Long lecture should be avoided in this method. Students should be given the opportunity to express themselves and the explanations should be done clear and comprehensible (Altun, 2002, 25).

### 3.4.2. Teaching Mathematics by Defining the Rules of a Subject

The rule to be taught to students can be a simple rule just as teaching them to first add the units digit and then the tens digit for the addition of the two-digit numbers. Teaching mathematics by defining the rules of a subject is not a suitable strategy to deliver a concept for a starter. Rules are introduced, with other techniques, to summarize after the explanations of the reasons and ways of operations. Rule features the idea intended to be developed. When a child has difficulty in calculations, a concept developed by rules should be continued with periodic exercises. As long as the reason of the rule is not developed by another technique, it is unlikely for a child to remember the rule. Rules are used as a tool to summarize the concepts. Rules are beneficial in summarization of the development of a concept. However, it is not an effective strategy to start the delivery of a concept by the rules. Once forgotten, it is difficult to recall a concept learned by the rules.

### 3.4.3. Question-Answer Method of Teaching

Question-answer method is used in all the teaching approaches. It is one of the most widely-used techniques in in-class activities. This technique is fundamental to facilitate the students with the practice of thinking and speaking and is used in teaching of all classes. All the students should be given the opportunity to think about the answers to the questions and the student who will answer the question should be chosen after 3-5 seconds (Demirel, 1999). The right answer should be reinforced immediately. The incorrect answers should be corrected by the repetition of the right answer. Student is active in question-answer method of teaching. In this method, teacher and student are in constant communication. Deductive reasoning skills are aimed to be improved by this method. While applying this method, teacher should first address the question to the whole classroom and then choose a student to get the answer. The question should be of all difficulty levels and adequate time should be given to students depending on the difficulty level of the question. The suitable question should be chosen for the students' level and the question should be clear and

comprehensible. The answers should be corrected if inadequate or incorrect and students should be given positive feedbacks (Altun, 2002, 28).

### 3.4.4. Discovery Method of Teaching

It is a student-centered method in which teacher only serves as a guide. In this method, relevant or irrelevant examples of a concept are given together to the students without giving the definition of the concept. The students are expected to discover the concept with these examples (Altun, 2002, 28). During the application of this method, goals and objectives should be stated clearly, the examples should be appropriate to the students' level and time should be used effectively.

### 3.4.5. Teaching by Defining a Mathematics Subject

Teaching by defining a mathematics subject is mostly used in the application of demonstration teaching method and to enable the students with the acquisition of information behaviors. Besides being a teacher-centered teaching strategy, it generally is used in the process of delivering the information to the students. In this method, after the definition of a concept is explained, relevant and irrelevant examples are given for better comprehension. Students express their opinions on each example and participation is achieved by a class discussion.

### 3.4.6. Demonstrating Examples

It is one of the most versatile strategies among all the other teaching strategies. It can be used in all the stages of teaching. Besides correcting the incorrect facts, it is generally linked to the other methods. Examples are used to explain "how" a fact occurs. Especially, when a concept has many variables, more than one example should be demonstrated. A teacher can use this method to correct a misunderstanding when conceptual mistakes emerge.

### 3.4.7. Simulation Technique

Simulation method of teaching is used in discovery teaching strategy and develops the comprehension skills of students. Simulation is a teaching technique which enables the students to do educational studies by the assessment of a real world situation in the classroom (Demirel, 1999). In Mathematics classes, this method is used to give examples of the real life situations students can observe in their social

environment in order to teach some concepts and relations in mathematics. The examples given should be chosen effectively if permanent learning is aimed at. The students should not be informed about the goals in the application of this technique. According to the studies conducted in teaching by simulation, it increases student participation and motivation, eliminates the abstractness of learning and enables concrete learning by reproduction of real life. Teacher should be meticulous in choosing the right simulation for the subject; and ensure that the chosen simulation is from the students' social environment and can be visualized by the students. The questions should be appropriate for the goals during the reproduction.

### 3.4.8. Circulation Technique

Is used in discovery learning strategy and enables the students with the development of comprehensive behaviors. Prior concepts tend to show similarity with the new concepts in terms of structure. This strategy is a method to develop a new concept. For instance, the rule on the addition of decimal fractions can be discovered by the knowledge about the addition of fractions. However, in this case; students should know the relations between the previously and newly learned concepts very well (Pesen, 2008).

### 3.4.9. Model Based Teaching Method

In teaching methods, model is defined as the representations of a concept's dynamic systems with concrete entities, pictures or objects. This method is used frequently to decrease the concreteness level of a concept and students favor this method very much. Models minimize the complexity of concepts. Models are used mostly in teaching of concepts related to numbers, operations, problem solving, geometry and measurement. A model should be chosen effectively. That is to say, a model should not cause misunderstanding about the concept. Models are used in all the stages of teaching process; however, it is generally used in the introduction of a concept when its abstractness requires to be decreased.

### 3.4.10. Teaching Strategy of Participation

Teaching strategy of participation is one of the most beneficial strategies in teaching of mathematics. This strategy attracts students' attention. One of the three types of participation listed below is mostly used in classrooms.

a. Verbal participation: Activities such as choral rhythmic counting.
b. Physical participation: Participation of students to several activities can be given as an example. A second example can be the students' clapping their hand while they are rhythmic counting.
c. Written or Symbolic participation: Each student writes down an answer to a problem and they show their answers when the teacher announces "show me your answers". One or two types of participation can be used at the same time. This method ensures the permanence of the concepts aimed at teaching. It provokes students' attention and when applied carefully and skillfully, it is an effective strategy on classroom management as it allows a limited time for students to be distracted. Compared to the other activities, verbal and physical participation is a powerful tool to determine how well an operation is learned a student. However, verbal participation may not be used for this purpose.

### 3.4.11. Discussion Method

It is a conversation made between the students and the teacher on a topic to reach a goal. This method is beneficial for students as it develops the skills of listening, speaking, defending an idea, judgment, analyzing and synthesizing (Altun, 2002, 30). During the implementation of this method, an appropriate discussion environment should be provided and digression from the subject should be avoided.

### 3.4.12. Teaching through Analysis

Teaching through analysis is to separate a concept to its parts and explaining the concepts stepwise.

Analysis is one of the most effective strategies to explain the reasons of a concept. Altun (2002) defines this method as a strategy that aims at understanding a concept through examining and analyzing all its steps in sequence. It is mostly used in teaching of theorem and theories. It provides a model and a better comprehension of mathematical structures and it is enables to prove the theorems and theories. In the application of the theory, the steps should be handled individually, necessary explanations should be made in each step and an appropriate level of mathematical language should be used. Students should be given the opportunity to practice (Altun, 2002, 32).

### 3.4.13. Module-based Teaching

It is a method which aims at teaching the subjects of lesson through a unit which is prepared by the experts and studied in a limited time. The subjects are divided into units and each module gives an opportunity for evaluation. This method is appropriate for group work. It is more effective if prepared by an expert (Altun, 2002, 32).

### 3.4.14. Demonstration Method

Demonstration method is way teaching through the demonstration and explanation of an operation or the use of an instrument such as a divider or a quadrant and subsequently making students exercise and practice. This method is used to explain the information related to a subject and used in the process of the implementation of the necessary applications to transfer the knowledge into skills. This method is mostly used to develop skills in practice and is also effective in improving the psycho-motor skills of the students. Students learn by practice and experience (Demirel, 1999). In this method, a subject, an operation or an objective is explained and exemplified by the teacher. Following the explanation and examples, the students are expected to do research and practice. Especially during the teaching of mathematics and geometry, the teacher should use necessary instruments and demonstrate examples that address the five senses to teach a subject or an operation. Adequate time should be given to the students during application (Altun, 2002, 32).

### 3.4.15. Scenario-based Teaching Strategy

It is a way of teaching through a creation of virtual or imaginary environments and role-playing in these environments. In this strategy, it is essential to select a scenario appropriate for the subject and students' level and to be cautious at allocating the roles (Altun, 2002, 32).

### 3.4.16. Project-based Teaching

It is a planned and purposeful study that aims at gathering the necessary information, instruments etc. together on a subject and creating something new. This study might develop the skills and habits of doing research, collecting and gathering data and making a reasonable deduction. It is fundamental to choose suitable instruments and select a subject appropriate for students' level (Altun, 2002, 33).

### 3.4.17. Cooperative/Collaborative Teaching Strategy

They are the studies a group of students do to in collaboration to achieve a common goal. Each student has a duty; therefore, both individual and group study is provided for the students by this strategy. Since students can communicate more, they have the opportunity to exchange information through questions and discussions. In this strategy, student is active and it can be used in all types of classroom environments (Hacısalihoğlu et al., 2004, 27-28).

### 3.4.18. Problem-Solving Method of Teaching

Problem solving is defined as selecting effective and beneficial instruments and behaviors over many other options and to use them to achieve a desired goal. Problem-solving teaching method is mostly used after the cognitive objectives are achieved to enable the practical objectives of a subject and to improve the skills of making analysis and synthesis (Demirel, 1999). Problem-solving method is more different than the traditional classroom environment which is based on a teacher-dominant teaching in. Problems are used to determine the daily use of the operations. In other words; the use of problems and models in teaching of mathematical concepts and operations might improve the comprehension and the skills of applying these into daily life problems in a more effective way. A study done by Van de Walle based on the studies of Carpenter and Mooser indicates that while solving a problem, students should first focus on the structure of a problem and teachers should first facilitate the students with the concept of an operation to draw students attention on the prior knowledge and how to analyze it during the discussion of the solutions to a problem. It is also stated in the study that it is more effective to reveal the problem first and find the appropriate model for the solution; then study the operation concept and apply it in a solution instead of presenting a problem that can be solved by a specific operation. Otherwise, students tend to apply the related operation without analyzing if problems are given after the operational concepts (Baykul, 1999). Thus, problem-solving method of teaching is more different than problem solving activities which are done right after the instruction of the information on the concepts and operations and done to improve the comprehension and the skills of students at solving the daily life problems. In problem-solving method of teaching, the teacher assists the students in understanding the not apprehended information and in the process of investigating and deduction. The

teacher's role is to provide the necessary instruments, to encourage the students to think over the problem and come up with solutions to the problem. The selection of the problem is the one of the most important issues in this method. Teacher can reveal some problems of daily life and transform these problems into a mathematical problem with students. Student might sometimes determine the problem. Teachers should be patient during the application of problem-solving method. Forcing the students into a solution in a short time will restrain the flexibility required for problem solving. It is more effective if the teacher controls the learning indirectly. Teachers who have been motivated by an incorrect teaching activity are mostly concerned about giving the right answers to the students in a short time. Teachers should provide the students an opportunity to determine their own goals and to experiment the results of their actions. Students are likely to achieve more this way (Gutek, 2001).

This method enables the students to use the functions such as analysis, synthesis and generalization, and to be problem solver (Özgen ve Pesen, 2008). According to Polya, problems solving consists of four steps; understanding the problem, planning a solution, solving the problem and testing the solution (Özgen ve Pesen, 2008). Using this method, students gain several skills such as analyzing and doing research. While applying this method, the quality of the problem and the level of the students should be taken into consideration (Altun, 2002, 30).

### 3.4.19. Game-based Teaching Method

Altun (2008) has explained game-based teaching as a method used especially for the teaching of young learners. Games are mostly used to reinforce the information learned. The most effective game is the one that does not directly ask for a mathematical activity but that makes it a must to do mathematical activities to win the game. There is a question or are questions in a game. The question is asked to the students and a competitive environment is created. The student or the group shows the answer to the teacher and if the answer is correct they are rewarded with a rank (such as the first rank or the second rank) and if the answer is incorrect, they rethink over the question. Students can compete individually or as a group. It is essential for the teacher to know or design various kinds of games for each class and subject. In game-based teaching method, it is of crucial importance for the students to be active in the process. Student should create and reach his answer by himself. Although teaching

with games makes a lesson versatile, it is undeniable that it increases the teacher's burden in relational teaching and it demands more materials, extra work, more time and effort. However, according to Baykul (2003) relational learning has several benefits such as;

1. It makes learning enjoyable and students feel joy in learning,
2. It makes it easier to recall the learned information and makes it permanent.
3. It provides an opportunity to learn new concepts more effortlessly and to need less help in learning a future concept as it improves self learning skills,
4. It enhances the achievement in this field as it improves problem solving skills,
5. It improves self-assurance, reduces mathematics anxiety and helps develop a positive attitude towards mathematics (Baykul, 2003, 41).

This method which promotes the learning of a subject through entertainment and competition with the help of games can be applied in all levels. The implementation can be done individually or as a group depending on the subject, duration and purpose. The teacher should make sure mathematics knowledge is used sufficiently during the game. A thorough planning before the practice, preparing a game relevant to a subject and pre-determining the stages of a game will make the implementation simpler (Uğurel, 2003, 80).

Game is an instrument or an activity which involves on-task behaviors and possibilities, and a winner or winners. Game-based teaching is an activity which is favored by students. The on-task behaviors of the participants is essential, therefore, this method is used in later stages of teaching since it improves behaviors as an activity-based method. Even though game-based teaching might require more time compared to the other teaching techniques, it facilitates a better comprehension of a concept. Games are activities that can be loud.

In a study of Garris, Ahlers and Driskell, the input, outcome and process of game-based learning is modeled (Figure 1).

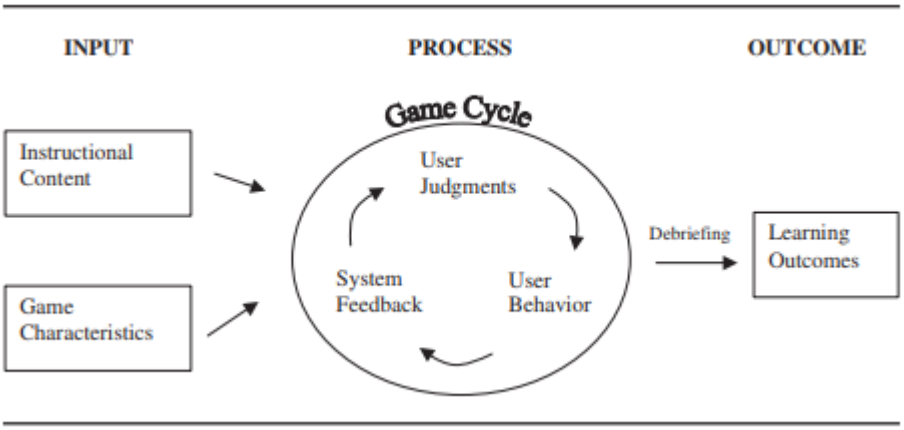



**Figure 1:** Game-based Lerning Model (Garris, Ahlers ve Driskell, 2002)

### 3.4.20. Technology-based Teaching

This method is mentioned in order to raise awareness on the effects of technological resources and their effects on the motivation of learning. When the word technology is used for teaching of mathematics, it is generally associated with calculators or computers. In a series of reports prepared by the National Council of Teachers of Mathematics (NCTM) for pre and secondary schools in the USA, it is declared that each student should be able to use a suitable calculator if necessary, each classroom should have a computer for demonstration and each student should learn how to use a computer (Ersoy, 2000). Technology has changed the lives of the humanity. Hence, it is not a surprising fact how this technology is effective at schools. It also obvious that although television, video players or other technological resources play a minor role in teaching of mathematics, computer technology plays a great role in it (Reys et al., 1998). Teaching approaches should include computer-based teaching to assure student participation which is an important component in teaching. Two different approaches can be observed in computer-based teaching of mathematics. The first one is the use of this technology to do calculations and to demonstrate graphics and diagrams during the problem solving process in order to empower the learning in mathematics class. The second and the most effective approach is to use computers as an instrument for simulation, research and experiment. In such a learning environment, students can have the opportunity to develop self knowledge (Baki, 1995). Computers can be beneficial depending on the fact that the applications and the programs used are relevant and the teachers know how to use them effectively (Reys et al., 1998). Software packages can be used to reinforce and support the knowledge with the

activities appropriate for the goals right after a subject is taught. There are interactive software programs developed for almost all the subjects studied in mathematics classes. Data can be delivered and demonstrated easily through various graphics with the help of a computer. Complex geometric shapes with different symmetrical patterns can be drawn using computers. There are several software programs that are developed in order to support learning insufficiency and eliminate learning difficulties. Software packages intended to be used in teaching should be analyzed attentively (Milli Eğitimi Geliştirme Projesi, 1997). Apart from these, power point presentations which are not considered as a part of computer-based teaching but are beneficial computer applications can be prepared (Pesen, 2003).

### 3.5. Teaching Mathematics Using Game-based Learning Method

Game has many contributions in terms of participation, cooperation, creativity, and self expression and it increases motivation of an individual since it arouses curiosity. Teaching becomes easier in an environment where a child can feel comfortable, does not feel fear or provocation and is not oppressed or suppressed. It is fundamental to analyze the meaning a child attributes to a game and use it effectively for educational purposes. Mathematics is a universal language which is abstract in self but can also be practiced concretely (Hacısalihoğlu, Mirasyedioğlu and Akpınar, 2004). The most important reason why students feel fear and anxiety towards mathematics is that it is difficult to comprehend abstract concepts, and the relations and transitions between them. For instance, game is of crucial importance in concretizing abstract concepts for the secondary school students who transition from concrete operational to formal operations stage of Piaget's cognitive development stages. According to Piaget, formal operations stage is the final stage of cognitive development and students like playing intelligent and logic games at this stage. Games facilitate students with concrete experiences. Game is a fiction for children to which they reflect their inner world. Therefore, by playing a well-designed game, a child can have fun, learn, improve his abstract thinking skills, relates the learned concepts and socialize at the same time. Playing a game is an experience (Winnicott, 1971 as cited in Kavasoğlu 2010, 16). Thus, learning with games makes information a meaningful experience rather than being a senseless memorization. Game is an opportunity for a child to use both his intelligence and body. He realizes his self and expresses it to the

other people through a game. With the realization of his skills and an environment where he can use these skills, his self-confidence is boosted and he starts taking responsibilities. Both educators and researchers agree on the fact that children love games. The flexible thinking, symbolization and creation of rules are regarded as the foundation of human intelligence (Tüfekçioğlu, 2003).

In classes which students fear and feel insecure and which involve many abstract concepts, teachers should aim at creating environments students can be active in and making the classes enjoyable for the students. The best way to achieve this is to use games.

Throughout history, mathematicians have always been interested in games. This might be caused by the curiosity felt for the unknown, the urge to discover something and the joy of solving a problem etc. One of the actual reasons why mathematicians are interested in games might be because they identify games with mathematics due to the resemblances between these two or even because they consider mathematics itself as a game (Umay, 2002). Numerous games have been developed by mathematicians for ages and these games have been focus of interest and a guide for many mathematicians. Recorde and Cardano's "Ring Puzzle", Lucas' Tower of Hanoi, the problems created by Fibonacci, Taylor's "Knight's Tour Problem", Königsberg's "Bridge Problem", Euler's "Thirty-six Officers Problem", Raymond Smullyan's "Chess Mysteries", Hungarian Ernö Rubik's "Magic Cube" are the most famous games. With the help of these games, mathematicians have been able to contribute to the development of mathematics and to enable a positive attitude and sympathy to mathematics (Ugurel and Morali, 2008). In game-based teaching method, the process of teaching mathematics is combined with games or designed as a game (Fauvel and Manen, 2000). The purpose of teaching mathematics with games is to develop a liking for mathematics using the subjects students are interested in at a specific age (Köroğlu and Yeşildere, 2002).

Mathematical games are specifically designed games for Mathematics classes. They are used for presentation, reinforcement and evaluation of the lessons. Many games used for teaching purposes can be used easily for teaching of mathematics as well (Tural, 2005). Unfortunately, game which plays an important part in a child's life is not included enough in the teaching process. The main reasons for this issue can be listed as the physical environment, lack of time and game materials and teachers' lack

of awareness on the importance of games (Tural, 2005). Given that necessary materials are provided, appropriate classroom environment is created and teachers are well educated on the issue, games can be used in teaching effectively. As an effective teaching instrument, game can be used in primary schools both as a method and a tool in all the fields. The main purpose of teaching via games is to improve the participants' physical and cognitive skills with the help of the feelings of joy and competition a game provides. In secondary schools, students learn by experiences rather than learning by thinking. As a result of game-based teaching, learning becomes more permanent and the skills at comparison and decision making of a student is improved. Thus, student behaviors are affected positively (Aracı, as cited in Tural, 2005, 89). Game-based teaching is effective in focusing students' attention. In mathematics classes, students tend to be distracted easily and when they face a difficult subject, they engage in different things other than the subject. Through game-based teaching, students are able to stay focused (Tural, 2005).

Group games that involve the subjects of mathematics play an important role in the development of the concept "we" due to the collaboration and communication between the students. In these group games, students make effort to finish the game, to meet their responsibilities and assert themselves in the group; and feel the urge to learn mathematics by doing mathematical activities (Altunay, 2004).

Teaching of mathematics should be interesting and enjoyable. According to Köroğlu and Yeşildere (2002), when students love mathematics classes, their learning level and motivation also increases.

With the help of a game, even the most unenthusiastic student can participate in the lesson. As long as the goal of a subject is not distracted, using games in teaching will attract students' attention and affect their attitude towards the class in a positive way (Tural, 2005). Game is crucial for the children of primary or secondary school age since games provide an opportunity to improve their power of imagination. In opposition to the common idea, game does not cause distraction but attention if applied appropriately. As a result, a child develops with games. Using games in the process of development and teaching will enhance the development of a child. The use of games in educational field will result in a more effective learning (Tural, 2005).

Studying with games enables the students with self learning skills and helps them create new designs rather than learning through other people's experiences or learning theoretically. Although educators' ideas on using games in teaching might differ, according to Garris, Ahlers and Driskell (2002, 441-467) games are appropriate for teaching purposes as they can be guiding. Thus, games are considered in the scope of teaching by the educators for several reasons such as an individual can learn by experience in games, games are student centered, students can play an active role during the problem solving process, it provides an interactive practice and it enhances motivation.

It can be observed that studies on children games and the role of these games in their development have been of interest recently (Bağlı, 2004). Turning the already existing interest of children in games to account of learning have been a question of research of many academicians and it is considered that games make a significant contribution to the development of a child (Bakar et al., 2008). Game is the most natural way of learning for children. Game and learning are not opposite acts but go hand in hand (Uluğ, 1997). Demirel, Seferoğlu and Yağcı (2003) have defined educational games as "Programs which enable the students with learning of subjects in lessons using a game format or which improve their problem solving skills".

Premack Principle dictates that high probability behaviors can be used to reinforce low probability behaviors (Selçuk, 2000). The use of games which are one of the most preferred behaviors by children in learning process offers many options to benefit from the Premack Principle (Cüceloğlu, 1992, 197). Games can be very effective in teaching if planned well and applied in the right and time and setting. Since games are indispensible for children, teaching activities can be organized considering this fact. Educational games provide a livelier classroom environment and promote all the students' participation in learning process (Güven, 2008). Games are used mostly in reinforcement stage of teaching (Altun, 2005). However, they can be used in the introduction, presentation or in practice stages of a lesson (Demirel, 2000).

The perception of mathematics as a pile of abstract concepts which can be observed in traditional teaching and the problem of not being able to concretize these concepts can be eliminated by game-based teaching method. Games which are considered very simple by adults play a significant role in a child's life. Game provides a creative environment for a child (Yavuzer, 1993). A child can reach the highest level

of creativity in such an independent environment and learns the ways to discover and use information. Game assists several developments of a child such as physical, emotional, social, cognitive, spiritual and linguistic developments (Tüfekçioğlu, 2003). Children discover that other people are needed in a game and to continue a game, therefore learn to develop communication with other people. They recreate the familiar roles and discover new ways (Tüfekçioglu, 2003). Through games, a child gains a sense of responsibility and skills to meet the responsibilities of a role in a group (Binbaşıoğlu, 1997). Games provide a cheerful and comfortable environment for students and bring about a change in in-class activities (Demirel, 1999). Games can make the subjects of a lesson more interesting and they can enable the participation of even the most unenthusiastic students (Demirel, 1999). Hence, subjects which can only be comprehended by a limited number of students can be comprehended by all students if game-based teaching method is applied. A child learns sometimes consciously but mostly unconsciously via games. The most effective game is the one that does not directly ask for a mathematical activity but that makes it a must to do mathematical activities to win the game (Altun, 2005). Considering the significant role of game in a child's life, it is inevitable to use games in all grade levels especially when teaching a subject students find difficult to learn since games provide an approach which is a way of communicating the students in their own language.

In order to improve the negative attitude of students towards mathematical subjects, subjects can be presented in a game (Dede and Yaman, 2003). By this way, games can be used to make students love mathematics and to enable the students with the skills of making deduction and synthesizing (Soylu, 2001). The main purpose of using games in teaching mathematics is to make students love mathematics. With the help of games, mathematics class becomes concrete and its boring and monotonous qualities can be eliminated (Köroğlu and Yeşildere, 2002). Games can be used in two different ways in teaching of mathematics; incorporating mathematics content in a game and gamification of the content in mathematics class (Biricik, 1999).

# CHAPTER 4. METHODOLOGY

This chapter outlines the research design, the population and the sample of the research, the population, data collection tools, the materials used in game-based teaching and the data and criterion applied in the analysis of the research.

## 4.1. Research Design

Experimental design is used in this research.

Researchers defined "experimental design" as stated below:

According to Karasar (1995, 73), experimental method is the techniques that will offer solutions to problems of which the question and answers are likely to be discovered prospectively.

According to Ural and Kılıç (2005, 19), experimental research is the most reliable research due to the fact that theories can be built since the relationship between one reliable to another can be determined precisely and that it is controlled and the results are exact.

This research is of a "sample based and controlled, pretest and posttest model" research. In this research which was conducted in the first semester of $9^{th}$ grade in high school, the difference between the pre and posttest scores of the attitude and the achievement level of the experimental and control groups have been examined.

## 4.2. Population and Sample

The population of this research is the high school students studying in 2018-2019 academic year. The sample of the study consists of the students in the classes of 9/I and 9/J in İbrahim Hakkı Anatolian High School in Sultanbeyli district in Istanbul.

### 4.3. Research Group

The students in 9/I and 9/J in İbrahim Hakkı Anatolian High School consisting of the sample of the research group have been selected using Purposive Sampling Method.

Kaptan (1995, 119-120) explained Purposive Sampling Method as "the researcher can directly select the individuals from the population which suits the best purpose of the study to collect the most useful data for the research."

### 4.4. Data Collection Tools

In this research, "Mathematics Attitude Scale" developed by Baykul (1990), questions of TEOG applied in 2015 and an assessment test have been used as data collection tools.

#### 4.4.1. Attitude Scale

In this study, "Mathematics Attitude Scale" developed by Baykul (1990) has been to measure the attitudes of the students towards mathematics. (Appendix 1) "Mathematics Attitude Scale" has been extracted from Baykul's (1990) research titled "Changes in the Attitudes towards the Mathematics and Science Courses from the Fifth Grade of Primary School to the Last Grade of High School (or equivalent education level) and Some Factors Considered to be Associated with the Success of the Student Selection Examination". While developing the mathematics attitude scale, Baykul (1990) prepared 80 positive and negative statements divided equally. These statements were examined by OSYM Test Development and Research Unit Turkish Branch experts and advisors. As a result of the examination, first elimination and readjustments were made and 62 statements were selected for the mathematics attitude scale. A preliminary form was applied to a total of 1056 students which consist of students in $5^{th}$ grade in primary school, $1^{st}$, $2^{nd}$, $3^{rd}$ grades in middle school, $1^{st}$ grade in a high school, $2^{nd}$ and $3^{rd}$ grade students of science and literature branches at the same school and $1^{st}$, $2^{nd}$, $3^{rd}$ grades in a trade vocational high school. Factor analysis has been conducted separately to each type of school on the results of the preliminary tests and 36 statements with highest factor1 loadings were selected. Following, factor analyses was repeated for the selected statements and a total of 30 statements

consisting of 15 positive and 15 negative statements with factor1 loadings .40 and higher have been selected and the attitude scale has been finalized. The alpha reliability coefficient of the mathematics attitude scale has been determined as 0.96. The scale is a 5 point Likert scale considered efficient enough in terms of reliability and validity (Baykul, 1990). There are 5 options of attitudes for each statement which are; "Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree". To enable the participants to respond the scale accurately and easily, a short instruction is added to the scale. Each statement is assigned with a numerical value ranging from 1 to 5 and since the statements 3, 4, 7, 8, 9, 13, 14, 15, 19, 20, 22, 24, 28, 29 and 30 are negative statements, they have been labeled as negative. As all the other statements are positive, they have been labeled as positive. To exemplify, a positive statement corresponded to the "Strongly Agree" response is assigned with a numerical value of 5 whereas the response "Strongly Disagree" is assigned with a value of 1. The highest score is 150 and the lowest score is 30 in the scale.

The Cronbach Alpha reliability coefficient of the Mathematics Attitude Scale is 0.96. Therefore, this score proves that the scale is considered efficient in terms of reliability and validity (Özgüven, 2014). The reliability and validity analysis of the mathematics attitude scale has been repeated by Kandemir (2011). The scale was applied to 340 students of three different high schools. 129 students of the population were $10^{th}$ graders and 211 students of the population were $11^{th}$ graders. As a result of this application, the Cronbach Alpha reliability coefficient of the Mathematics Attitude Scale was determined as 0.976. This coefficient proves that the scale is efficient in terms of reliability and validity.

### 4.4.2. Academic Achievement Assessment

The students included in our sample have been assigned to their high schools after they have selected a number of schools in their neighborhood. Therefore, we do not hold the scores or the achievement ranks of the students of a specific achievement exam. Due to the fact that they are $9^{th}$ grade students and have just started studying at a high school and the pretests were applied in the first week of the academic year, instead of assessing the limited information delivered in the first week, a central common examination administered at the end of the academic year of $8^{th}$ grade by

MEB for high school placement has been selected for academic achievement assessment pretest.

The common examinations used to cover six core courses and be administered twice in each term of the 8th grade academic year. The first exam used to cover the courses which had two exams in a term and the second exam used to cover the courses which had three. The common examinations used to be prepared grounding on the curriculum of the courses of Turkish, Mathematics, Science and Technology, Religion and Morals, Revolution History and Kemalism and Foreign Language. The questions used to be prepared basing on the goals and objectives of the current curriculum of each lesson and aimed at assessing the students' skills such as critical thinking, analyzing, problem solving, making deduction and interpretation (MEB, 2016).

In this research, a pretest consisting of 20 mathematics questions asked in TEOG exam which was administered by the Ministry of Education in 2015 was used for the assessment of the academic achievement of the students. (Appendix 2)

A test statistic is a quantity derived from the sample used in statistical hypothesis testing. Besides validity and reliability, one of the fundamentals of educational and psychological instruments is the expedient statistics derived from an instrument applied to an individual (MEB, 2016). Below is the analysis of the mathematics test used in TEOG exam administered in 2015 which have been used as an assessment tool for determining academic achievement level in terms of reliability, difficulty and discrimination strength.

Reliability Coefficient: It is the consistency with which a test yields the same result in measuring whatever it does measure. The reliability coefficient is expressed by a number ranging between 0 and 1.00. The higher the reliability coefficient value, the more stable and dependable results it is considered to provide. The reliability coefficient of this test is determined as 0,969. The reliability coefficient of the mathematics test is determined as 0,870.

Difficulty Index: It is the proportion derived from the division of the mean of the test to the highest score of the test. The possible range of the item difficulty index is 0 to 1. The higher the value the easier the test is. The item difficulty value of this test is determined as 0,574. The item difficulty value of the mathematics test is 0,428.

Discrimination Index: It is an index of a test's effectiveness at discriminating those related to whatever it does measure from those who do not. The discrimination index value of the test is determined as 0,600 and of mathematics test as 0,687.

Item Difficulty Index: It is a measure of the proportion of examines who answered the item correctly (Turgut and Baykul, 2010). Item difficulty index is ranged between 0 to 1 and the higher the value is the easier the item is. 20 questions asked in the test is listed in table 1.

Item Discrimination Index: It is an index of a item's effectiveness at discriminating those related to whatever it does measure from those who do not. Since this differentiation is related to whether an item is able to measure a desired behavior or not, it is also called as item validity (MEB, 2016). The discrimination index of the items of the test is listed in table 1.

The difficulty index value of the test is determined as 0, 42.

**Table 1:** Analysis of the Mathematics Test used in TEOG 2015

| Item No | Item Difficulty Index | Difficulty Index | Item Discrimination Index |
|---|---|---|---|
| 1 | 0,43 | 0,42 | 0,64 |
| 2 | 0,44 | | 0,62 |
| 3 | 0,15 | | 0,3 |
| 4 | 0,6 | | 0,56 |
| 5 | 0,49 | | 0,63 |
| 6 | 0,51 | | 0,44 |
| 7 | 0,49 | | 0,58 |
| 8 | 0,52 | | 0,57 |
| 9 | 0,26 | | 0,41 |
| 10 | 0,51 | | 0,43 |
| 11 | 0,56 | | 0,66 |
| 12 | 0,39 | | 0,55 |
| 13 | 0,25 | | 0,52 |
| 14 | 0,28 | | 0,62 |
| 15 | 0,52 | | 0,62 |
| 16 | 0,48 | | 0,51 |
| 17 | 0,47 | | 0,61 |
| 18 | 0,44 | | 0,36 |
| 19 | 0,27 | | 0,38 |
| 20 | 0,5 | | 0,55 |

As a posttest, the results of a common exam which covers the subjects taught with games in 9th grade were analyzed. Since these exams were compiled from the achievement tests prepared by MEB and as they are considered to reflect the objectives of the subject, they have not been tested in terms of reliability.

### 4.5. Data Collection

As the sample of this research, two 9th grade classes in İbrahim Hakkı Anatolian High School were selected and they were both taught by the same teacher. Both classes were given an attitude test to determine their attitudes to mathematics in the first week of the academic year. In order to gather a meaningful data on students' academic achievement level, 20 questions asked in TEOG exam which was administered in 2015. The results of these two tests which were applied as a pretest have been compared and it was determined that there is no significant difference between the scores of both groups.

It was announced to the students in the experimental group that 3 of 6 hours of mathematics classes would be taught with games. Some games are used in the introduction of a subject, some are used for reinforcement and some are for practice. In control group, on the other hand, classes were taught with traditional teaching method. The teacher explained the subject and examples were expected from the students after a few problems were solved by the teacher. A teacher-centered teaching in which students are passive was applied in these lessons.

The implementation lasted 10 weeks in total. At the end of 10 weeks, the first unit "Logic" and the second unit "Sets" had been studied. At the end of this 10-week period, the same attitude scale was applied to the experimental and control groups. As for the assessment of the academic achievement level, the results of the common examination given to all 9th grade students were analyzed (Appendix 8).

### 4.6. Materials for Learning Mathematics with Games

Educational games are the activities that provide the reinforcement and revision of the learned information in a more comfortable environment. Games provide a cheerful and comfortable atmosphere for students and bring a new perspective to in class activities. Educational games can make a subject more interesting and can make

even the most passive student active in these activities. Considering these, several games have been designed related to the first two subjects of the 9th grade Mathematics which are “Logic” and “Sets” for the students in the experimental and control groups. In designing the games, the qualities of game-based teaching which make it divergent from the other teaching methods have been taken into consideration. The qualities of a game according to Prensky (2001) are mentioned below:

Rules: Rules determine the limitations of a game and offer ways to reach the result. If a game does not have rules, it is not a game but a leisure entertainment. The most important difference between game and any type of entertainment is that games have rules. While designing a game, rules are determined and explained to the students before the game starts. Rules of each game designed and played were explained to the students before the game started.

Goal and Objectives: Reaching a goal in a game plays a major role in motivating the player. A game without a goal cannot be expected to be motivational for a player. It is very difficult for an unmotivated player to continue playing and to replay the game. Goals and objectives in a game create a sense of responsibility in a player and provide voluntary participation. In most games, the goal is determined at the beginning of a game such as to get the highest score, to reach an end or to capture the flag. In this study, the goals and objectives of the games designed and played were explained before the game started. These goals can be exemplified as to give 3 correct answers, to reach a predetermined score, to act accordingly to finish the game or to be able to be the last contestant after elimination.

Feedbacks: How a player performs in a game to reach the goal is notified by the feedbacks. When circumstances change as a result of a behavior of the player, a feedback is given.

Struggle/Contest/ Challenge/ Rivalry: These are the elements of a problem which is tried to be solved in a game. While solving a problem, a problem is solved. The player can feel fear and excitement without facing real danger in a game. This motivates him and enables the player to continue and finish playing the game. While teaching with games in the class, the students were made to compete with each other and they were faced with cognitive obstacles that make them to think mathematically.

Interaction: Prenksy (2001) handles interaction in two perspectives. The first one is human-computer interaction which can be regarded as a feedback and the second one is the social environment the players create while playing a game together. It is difficult to find the elements a computer provides in books or movies owing to the fact that computer games provide a different kind of interaction that can be attained in books or movies and they let the player experiment and fail. The situations in books and movies are independent from the lives of the reader or the audience. When a book is read or a movie is watched for the second time, the same incidences or endings are observed. However, when a game is played for the second time, the course of events and the ending might change depending on the decisions made by the player. Since digital media is not used in this research, the interaction is provided by the feedbacks given to the players and the interaction between the players as a team or as an individual. As a matter of fact, the students who played the game desired to play the game over and over in game-based teaching process.

Representation and Story: They explain what the game is about. Chess is a game of opposition. Tetris requires recognizing the shapes and placing them. Age of Empires is about martial arts. The story of a game can be presented directly at the beginning of a game or can be given indirectly during the game. At the beginning of a game, explanation is made about the game and the story might be hidden in this explanation. For instance in Checkers, there is a conflict with an opponent and this fact is hidden in the game. There is no need for an explanation. After playing the game for a while, the player might have an opinion about the game. It is intended to draw attention to the bits of information hidden in entertainment in mathematical games.

The games designed regarding all these elements were designed with very simplistic materials. Digital or computer based games have not been chosen due to the insufficiency of physical facilities. In order to prevent obstacles stemming from the lack of materials, readily available materials were used during the implementation. The role of the teacher is to enable the students with the necessary information before the game and to prepare the materials. Another role of the teacher is to control the game process and pay attention. The teacher can use games starting a lesson to revise a previous subject or can use them in the flowing stages of a lesson. The decision is of the teacher depending on the class dynamics. One of the most significant points is to

ignore the mistakes done by the weak students and enable a whole participation during a game.

4 games for the subject “Logic” and 4 games for the subject “Sets” have been created which are mentioned below. Only the winners were rewarded in the games. The rewards varied from a concrete reward such as a book, pencil or the game itself, or points that might affect the performance grade of a student. The students who did not achieve lost nothing but a reward. The visuals of some games are submitted in the appendix.

### 4.6.1. Proposition or Not

Statements which might be a proposition are written on a colored piece of paper. Three voluntary students are selected and placed in the front desks. The rest of the class is silent and a competition atmosphere is created. The competing students are given a red or a green card attached to a tongue depressor. They are asked to raise the green card if they think the statement is a proposition and the red card if it is not. The names of the competing students are written on the board and a plus is added for each correct answer of each individual. The first student to get three pluses wins the game. If there happens to be a tie, one extra question is asked. If the tie cannot be broken with the extra question, both players are announced as the winners. (Appendix 3)

### 4.6.2. Sponge of Logic

The connectives “and, or, if, but, if…then” which join two or more propositions together to form a connective proposition have their own truth values. For the reinforcement of these operations, pieces from a pool noodle are cut and put in a tube or a paper tower roll. All the possible propositions are written on the pieces and the students are competed. (Appendix 4)

### 4.6.3. Guess the Compound Proposotion

This game is created inspired by the game “Guess Who”. Students are placed in front of a screen made of carton which can be opened, closed or flipped and on which some compound propositions are written. The opponents have the same kind of carton screen as well. They are asked to choose a compound proposition from the screen in front them. The answer is attached with a paper-clip. Each player asks the opponent team to guess the compound proposition written on the chosen card. (Appendix 5)

### 4.6.4. Pull if You Can!

A compound proposition is written on each block of a Jenga game. The players must answer the question correctly to pull a block. This game has been improved in process of time as new subjects or more complex equations are studied.

### 4.6.5. Set (Math Card Game)

Set is a real-time card game designed by Marsha Falco in 1974 and published by Set Enterprises in 1991. 81 cards that are different configurations of shapes, colors, numbers and fills are prepared. The cards are shuffled and 12 cards are spread for the start. The players are asked to form a set with at least 3 cards which have common elements. The cards which form a set such as the cards with a round shape or with color red are collected. New cards added from the deck replacing the removed ones. The player holding the highest number of cards wins the game. (Appendix 6) This game has been improved in process of time as the subjects of "Divisibility Rules" and "Number Sets" are studied.

### 4.6.6. What Type of Set Are You?

Two sets are either separated or have intersection or one set is the subset of the other. In order to reinforce this subject, a Venn diagram is drawn in school garden using colored duct tape or colored clothes line are is used to create sets. A specific group feature is announced to the students and they are expected to settle in the announced set, for instance, girls/boys in the class, boys in the class/students wearing glasses, girls in the class/girls wearing a scarf. The students with this specific feature are expected to settle in the appropriate set drawn.

### 4.6.7. Maths Bingo

Bingo cards are prepared similar to a regular bingo game card. Several equations of logic and sets are written replacing the numbers in a regular bingo card. If the answer is in the number drawn, the player covers the equation in his card. The player who covers all the equations in his card wins the game. (Appendix 7)

### 4.6.8. A menu of Sets

A role play activity about ordering food from a restaurant menu is done in the classroom. The menu with two columns of "Food" and "Beverages" is written on the

board. Some students are asked to volunteer to play the role of a customer and each student tries to order food or beverage which has not been ordered by a previous customer. Thus, the students are enabled to see all the subsets of a set. They have to keep track of all the orders given before them and have to ensure that their order has not been given by someone else. The students who can achieve this are able to tell the subsets of the menu set and they win the game.

### 4.7. Data Analysis

The analysis of the data collected was carried out using SPSS 23 program after the coding of the data. The techniques and the intended use of these techniques are shown in the table.

**Table 2:** The Data Analysis Techniques and the Intended Use

| **Data Analysis Techniques used in the research** | **The Intended Use** |
|---|---|
| Kolmogorov-Smirnov | A test that examines if a variable follows a given distribution in a population. |
| Mann-Whitney U Statistics | A test that is used to compare differences between two independent groups (9-J and 9-I) when the dependent variable is either ordinal or continuous, but not normally distributed. |
| The Median | The median is the middle score for a set of data. For instance: in a variance of “3, 5 12 18 20”, “12” is the median. |
| p-value | It is the level of marginal significance within a statistical hypothesis test. If the p-value is less than 0,05, it is assumed that the hypothesis is true and if the p-value is greater than 0,05, it assumes that it a null hypothesis. In |

| | |
|---|---|
| | Kolmogorov-Smirnov test, p-value should be greater than 0,05 for normal distribution. |
| Wilcoxon Sign Test | It is attest designed to evaluate the differences between two categories (9-J and 9-I) where there are dependant variables (such as the achievement level means of pre and posttests). It is different than the Mann-Whitney U test since the distribution of the dependant variables (the mean score of the achievement level after the teaching) is not normal and is done between the dependant groups. If the distribution had been normal, Mann-Whitney test would have been used. Hence, Wilcoxon test has been used. |

**Tablo 2 - continue**

## CHAPTER 5. FINDINGS

In this section, the statistical analysis of the collected data on each sub-problem in this research and the discussion of the gathered results are mentioned.

In this research, a pretest is first applied to the students in 9-J and 9-I who are included in the sample in order to determine their achievement level in mathematics. Prior to the determination of the difference level in the test results, they were analyzed to discover whether the distribution is normal or not. Kolmogorov-Smirnov Test is carried out for this purpose and the results are listed in the table below.

**Table 3:** One Sample Kolmogorov-Smirnov Test

| | Mathematics Pretest Score |
|---|---|
| Test Statistic | ,110 |
| p | ,017 |

The results in Table 3 indicate that p-value is less than 0, 05, therefore the distribution of the pretest scores is not normal. Thus, Mann-Whitney U Test is used to analyze the difference between the mathematics pretest scores of the students in 9-J and 9-I. The result of the pretest mentioned is revealed in Table 4 below. This result also has provided an answer for the first sub-problem in this study.

1. *Is there a significant difference between the pretest scores of the experimental group to whom teaching with games method has been implemented and the control group taught in traditional teaching environment?*

**Table 4:** The Analysis of the Difference between the Mathematics Pre-teaching Achievement Scores According to the Class (Mann-Whitney U)

| | Class | N | Median | U | Z | p |
|---|---|---|---|---|---|---|
| **The median of pre-training Mathematics Achievement Scores** | 9-J<br>9-I | 40<br>40 | 36,19<br>44,81 | **627,50** | **-1,66** | **,68** |

The results indicate that there is no significant difference between 9-J (experimental group) and 9-I (control group) in terms of their mathematics achievement scores. Thus, mathematics achievement level of both groups is considered equal before game-based teaching.

2. *Is there a significant difference between the pretest scores of the experimental group to whom teaching with games method has been implemented and the control group taught in traditional teaching environment before teaching in terms of their attitudes towards mathematics?*

**Table 5:** The Analysis of the Attitude Level towards Mathematics in Pretest According to the Class (Mann-Whitney U)

| | Class | N | Median | U | Z | p |
|---|---|---|---|---|---|---|
| The median of Mathematics attitude before training | 9-J<br>9-I | 37<br>39 | 41,03<br>36,10 | **628,00** | **-0,97** | **,33** |

The results of the test indicate that there is no significant difference between 9-J (experimental group) and 9-I (control group) in terms of their attitudes towards mathematics. Thus, the attitude level of both groups towards mathematics is considered equal before game-based teaching.

A total of 70 students are included in the sample for the comparison of the pre and posttests on the basis of dependent groups. 2 students who have been removed from the sample were not given a posttest as they dropped out of school.

3. *Is there a significant difference between the posttest scores of the experimental group to whom teaching with games method has been implemented and the control group taught in traditional teaching environment?*

**Table 6:** The Analysis of the Posttest Scores according to the Class (Mann-Whitney U)

| | Class | N | Median | U | Z | p |
|---|---|---|---|---|---|---|
| **The median of Posttest Scores of Mathematics Achivement Test** | 9-J<br>9-I | 35<br>35 | 41,47<br>29,53 | **403,50** | **-2,45** | **0,01** |

The results of the test indicated that that there is a significant difference between 9-J (experimental group) and 9-I (control group) in terms of their achievement level of mathematics after training in favor of 9-J. Hence, it was concluded that game-based teaching increases the mathematics achievement level of students.

4. *Is there a meaningful difference between the pretest and posttest scores of the mathematics achievement level of the experimental group (9-J) to whom teaching with games method has been implemented?*

**Table 7:** The Analysis of the Difference between the Pretest and Posttest Scores of the Mathematics Achievement Level of the Experimental Group (Dependent T-Test)

| | Class | N | Mean | t | Degree of Freedom | p |
|---|---|---|---|---|---|---|
| The Difference between the Pre and Posttest Scores of 9-J | Before Training<br>After Training | 35<br>35 | 30.67<br>58.77 | **-5,54** | **34** | **0,00** |

According to the test results, a significant difference between the pre and posttest scores of 9-J (experimental group) in terms of their achievement level of mathematics after training has been determined (p=0, 00<0, 05). Therefore, it can be

stated that game-based teaching has increased the level of mathematics achievement of the experimental group. T-test is preferred in dependent samples due to the fact that the mean value of the Mathematics Achievement Score after Training (dependent variable) revealed a normal distribution as a result of Kolmogorov-Smirnov Test (p=0, 00<0, 05).

5. *Is there a meaningful difference between the pretest and posttest scores of the mathematics achievement level of the control group (9-I) to whom teaching with traditional method has been implemented?*

**Table 8:** The Analysis of the Difference between the Pretest and Posttest Scores of the Mathematics Achievement Level of the Control Group (Wilcoxon Test)

| | **Class** | **N** | **Median** | **Z** | **p** |
|---|---|---|---|---|---|
| **The Difference between the Pre and Posttest Scores of 9-I** | Before Training<br>After Training | 35<br>35 | 15.20<br>20.10 | **-1,42** | **0,15** |

The test results indicate that there is a no significant difference between the pre and posttest scores of 9-I (control group) in terms of their academic achievement level in mathematics (p=0,15>0,05). Therefore, it can be stated that traditional teaching method has not increased the level of mathematics achievement of the control group. T-test is preferred due to the fact that the mean value of the Mathematics Achievement Score after Training (dependent variable) revealed a normal distribution as a result of Kolmogorov-Smirnov Test (p=0,019<0,05).

6. *Is there a significant difference in the attitude level towards mathematics class between the pretest and posttest scores of the experimental group (9-J) to whom teaching with games method has been applied?*

**Table 9:** The Analysis of Difference between the Pretest and Posttest Scores of the Attitude Level of the Experimental Group (Dependent T-test)

| | Class | N | Mean | t | Degree of Freedom | p |
|---|---|---|---|---|---|---|
| The analysis of the difference between the pre and posttes scores of 9-J | Before Training<br>After Training | 35<br>35 | 81.94<br>105.31 | **-5,58** | **34** | **0,00** |

According to the test results, a significant difference between the pre and posttest scores of 9-J (experimental group) in terms of their attitude towards mathematics after training has been determined (p=0, 00<0, 05). Therefore, it can be stated that game-based teaching has increased the level of positive attitudes of the experimental group. T-test is preferred in dependent samples due to the fact that the mean value of the Mathematics Achievement Score after Training (dependent variable) revealed a normal distribution as a result of Kolmogorov-Smirnov Test (p=0,20>0,05).

7. *Is there a significant difference in the attitude level towards mathematics class between the pretest and posttest scores of the control group (9-I) to whom traditional teaching method has been applied?*

**Table 10:** The Analysis of Difference between the Pretest and Posttest Scores of the Attitude Level of the Control Group (Wilcoxon Test)

| | **Class** | **N** | **Mean** | **t** | **Degree of Freedom** | **p** |
|---|---|---|---|---|---|---|
| **The analysis of the difference between the pre and posttes scores of 9-I** | Before Training<br>After Training | 35<br>35 | 78,88<br>78,94 | **-0,09** | **34** | **0,99** |

The test results indicate no significant difference between the pre and posttest scores of 9-I (control group) in terms of their attitude towards mathematics after training (p=0,993>0, 05). Therefore, it can be stated that traditional teaching method has not affected the level of attitudes of the control group. T-test is preferred in dependent samples due to the fact that the mean value of the Mathematics

Achievement Score after Training (dependent variable) revealed a normal distribution as a result of Kolmogorov-Smirnov Test (p=0,20>0,05).

## CHAPTER 6. CONCLUSIONS

In this chapter, the results of the data collected in this study and suggestions are included. This study aiming at determining the effects of game-based teaching on the attitudes of the students towards mathematics and their academic achievement, has been conducted with a sample based and controlled, pretest-posttest experimental design. Students in 9-J and 9-I classes in Sultanbeyli İbrahim Hakkı Anatolian High School has been selected as the population of this research which was held in the first semester of 2018-2019 academic year. As a pretest, a mathematics attitude scale and an academic achievement test has been given to both classes. The results of the tests were analyzed with statistical methods and as a result, no significant difference between the classes has been detected in terms of their attitudes towards mathematics and academic achievement level. Therefore, these two mentioned groups have been considered equal in terms of their attitude and academic achievement. A mathematics attitude scale and academic achievement tests have been used as data collection tools. Mathematics Attitude Scale which has been developed by Baykul (1990), the questions of TEOG exam which was implemented by MEB and the results of the common exam which was applied in the first term as the 1st exam have been used as data collection tools. Regarding the fact that the results of the pretest proved an equal result, one of the two groups has been selected as the experimental group and the other one as the control group. 9-J has been selected as the experimental group and game-based teaching of mathematics was applied on this group. On the other hand, traditional teaching methods such as direct-instruction method were applied and problem solving examples were given in 9-I which has been selected as the control group for 10 weeks. After studying the subjects of "Logic" and "Sets" for 10 weeks in both classes, the mathematics attitude scale which had been given to the students as a pretest was reapplied. In order to assess the academic achievement level of the students, a common exam which was prepared based on the achievement tests of MEB in the first term as the 1st exam was applied to both groups. In consideration of the findings obtained

from the analysis of the collected data, the results listed below have been presented and following recommendations which are believed to contribute to the literature have been made.

### 6.1. Results

1. No significant difference has been detected between the experimental group to whom game-based teaching has been applied and the control group taught in traditional teaching environment in terms of their attitudes towards mathematics before the implementation. Accordingly, it can be indicated that the students both in the experimental group and the control group were considered to have an equal attitude level before the application of the teaching methods.

2. No significant difference has been detected between the pretest scores of the experimental group to whom game-based teaching has been applied and of the control group taught in traditional teaching environment. Accordingly, it can be indicated that the students both in the experimental group and the control group were considered to have an equal academic achievement level in mathematics before the application of the teaching methods.

3. Taking the results of the mathematics attitude scale which was given as a posttest both to the students in the experimental group to whom game-based teaching has been applied and in the control group taught in traditional teaching environment into consideration, it can be stated that there is a significant difference in terms of the attitude towards mathematics in favor of the experimental group. Game-based teaching has increased the positive attitude level of the students. Accordingly, it is concluded that game-based teaching method of mathematics is more effective in enabling the development of a positive attitude towards mathematics compared to the traditional teaching methods.

4. In order to assess and compare the academic achievement, exams were given as a posttest to the students in both groups. As a result, a significant difference has been detected between the scores of the students in the experimental group to whom game-based teaching has been applied and in the control group taught in traditional teaching environment in terms of their academic achievement level in favor of the experimental group.

## 6.2. Discussion

It is not possible to explain the reasons why a student fails in mathematics and develops a negative attitude by a sole factor. There might be many factors that cause this situation. Furthermore, all these factors are in constant interaction with each other. In their study, Dede and Dursun (2004) determined the factors which affect students' achievement basing on literature and listed 10 factors. These 10 factors were reported to 38 Mathematics teachers working at 8 primary schools in Sivas in 2001-2002 Year of Education. The results of the study indicated that the teachers are well aware of the fact that the achievement of the students in mathematics is affected by several factors. Additionally, according to the responds given by the teachers, the most important factor (100%) that affects the achievement of students in mathematics classes is students' attention to the lessons, the second factor (86%) is teacher's competence and the third factor (72%) is the teaching strategies and methods applied in classes.

The studies conducted on the issue indicate that the most applied methods in mathematics classes are listed as; problem-solving, direct instruction and question-answer methods. The least applied methods can be listed as, dramatization method, group-work and project-based teaching method (Aktepe et al., 2015).

If studies conducted on this problem examined, it can be observed that there are some studies which support this research and some which indicate different results. To exemplify;

In her thesis study titled "The Investigation of the Effects of Game-based Mathematics Teaching Program on the Children's Development", Sevigen (2013) studied on the sample of Osmaniye Cumhuriyet Pre-scool. Regarding the results of the pretest, posttest and the object permanence test, the Game-based Mathematics Teaching Program is proved to be effective on children's development on mathematics and the its effect is permanent.

In his thesis study, Kavasoğlu (2010) examined the effect of game-based teaching on student achievement in teaching of "Probability" in $6^{th}$, $7^{th}$, $8^{th}$ grades mathematics classes and detected a significant difference between the achievement levels and permenance.

The results of this thesis study bear a resemblance to the results obtained from the studies conducted on the sample of preschools and secondary schools. The results of Ar's (2016) study which was conducted on high school level show similarity to the

results of this research as well. Ar (2016) conducted a design and development research in order to determine the effects of gamification on academic achievement and learning strategies of the students in a vocational high school. As a result of the research, it was indicated that the students who were taught with gamification were more successful compared to the students taught with traditional methods. According to the results, learning via gamification has improved the academic achievement of the students in a vocational school. Students considered learning via gamification to be more fun, effective and competitive.

In a study conducted by Köroğlu and Yeşildere (2002), some subjects in Mathematics class of the 7th grade are taught with developed games and scenarios. In the data collected after the experimental study, it was indicated that the success level of the students in the classes taught with games and scenarios has increased and no significance has been determined between the pre and posttests. After the experiment, a survey of "Perspective on Mathematics games" was administered. According to the survey results, 87% of the students expressed a positive opinion on the statement "I love Mathematics" and 72% of the students disagreed with the statement "Mathematics lesson is boring". 86% of the students stated that they love playing games and of 77% that they want to play games related to the subjects studied. 78% of the students expressed that learning mathematics with games is fun and of 71% that they would love Mathematics lesson more if games are involved.

A study by Tural (2005) and titled "The effects of Game and Activity-based Teaching of Primary School Mathematics on the Achievement and Attitude" was conducted dealing with the subjects "rhythmic counting, natural numbers, addition, subtraction, multiplication and division" in the 3rd grade. A significant positive difference has been detected between the achievement and attitude levels of the students in the experimental group taught with games and the students in the control group taught with traditional methods.

In a study conducted by Songur (2006) and titled "The effects of Games and Puzzles on Teaching of the Subjects of Expressions and Equations with Letters on the Achievement of Mathematics Class", the experimental group was taught with games and puzzles whereas the control group with traditional methods. As a result of the study, a significant positive difference was determined in the experimental group and teaching with games and puzzles have proven to affect the attitude of the students towards Mathematics in a positive way.

In his study of Doctorate, Aksoy (2014) has researched the effects of digital game-based teaching of the Mathematics subjects on the academic achievement and the affective behaviors (achievement motivation, self-sufficiency and attitude) towards Mathematics class. In the study, pretest and posttest experimental design with two groups and eclectic approach have been used. It was also administered in two steps as pilot and final study with the duration of 14 weeks. As a result of the study, it was stated that there is a significant positive difference between the achievement level in pretest and posttest in favor of the experimental group. With the reapplication of the scales after the administration, it was concluded that statistically, there is a significant difference in the scores of the experimental group in their achievement motivation and attitude towards Mathematics class compared to the scores of the control group. The collected data about the students' opinions about the use of educational digital games in teaching of Mathematics point outs the fact that they are useful and effective. However, it was stated by some of the students that looking at a computer screen for such a long time causes headache and sore eye.

In her thesis study Aslan (2014) aimed at determining the effects of games-based teaching on students' achievement and attitude and collected data resulted from analysis of the study conducted on the experimental and focus groups of which the population was primary school students. As a result of the analysis of the data collected, no meaningful effect of the use of educational computer games in learning environments was discovered. As a consequence of the interviews performed with the students about the use of educational computer games in Mathematics classes, it was concluded that the study conducted was regarded as entertaining by the students, that it has positively contributed to the relationship between educational computer games and Mathematics classes and that the use of games in classes is suggested to be used as a supporting instrument in the classes. Additionally, the teachers interviewed after the study stated a positive attitude towards the use of games in classes. The games selected from the educational web portal "Vitamin" were proven to have positive effects on learning as well. However, regarding the deficiencies in the games, they were suggested to be improved.

Türkmen (2017) investigated the effects of game-based learning on the achievement and attitude of $5^{th}$ grade students in mathematics classes. To this end, the lesson plan for the unit of "Fractions" was prepared incorporating gamification and Educational Informatics Network was used as a teaching tool. The lessons were

delivered with the activities based on the constructivist approach in the curriculum and the text books determined by the Ministry of Education in the focus group and they were delivered with gamification method in the experimental group. As a result, no significant difference was detected in students' the motivation and attitude scores between the experimental group and the focus group. However, the achievement level of the students in the experimental group increased compared to the focus group. Additionally, as a result of the collected data, the frequency of game playing has no effect on students' attitude and achievement in mathematics classes.

In his thesis study, Bakar (2018) discussed the effects of the use of technology in derivative Teaching has on the students' Mathematics success, their attitude to Mathematics, Mathematics beliefs and reflective thinking. This study indicated a different result than the similar studies. The search is a semi-experimental design with pre-test and post-test groups. The Graph 4.3 software, which is used for the solution of minimum and maximum problems, has been applied to the experimental group. The lesson plan, which was prepared according to 5E plan for the solution of maximum and minimum problems, has also been used for the students. Quantitative Data obtained at the end of the study has been analyzed by SPSS 18.0 pocket-program. The Graph 4.3 software, which is used for the solution of maximum and minimum problems studied by the support of technology, has caused some changes in the students' beliefs and reflectivity and the changes have been found meaningful. But the result shows that there is no change in their attitude to Mathematics and academic success. It's seen that by the result of Mathematics, which is studied with traditional method, Mathematics academic success of the control group has been increased. This result shows that technology has no effects on the school which has students in %1 percentile rank in these kinds of studies. For this reason, it is recommended not to use it at 12th grades and high schools that are qualified as academically successful schools.

On the contrary to the studies conducted by Aslan (2014), Türkmen (2017) and Bakar (2018), a significant difference has been determined in achievement and attitude level in this research.

As can be seen in the literature review of this research, game-based learning in high schools has rarely been included both in practice and in academic research. A great majority of the studies conducted on game-based learning have targeted primary or secondary school students. In this research, high school has been selected as the

population. The effects of the situation in which how the information transfer between the teacher and student is implemented by which methods and techniques depends on the personal judgment of a teacher has been pointed out in this research. Today, the low mathematics achievement scores in international exams and the negative attitudes of the students towards mathematics can be considered as the consequences of this situation. If these consequences are meant to be eliminated, the reasons should be examined thoroughly. The positive results of the use of games created with simple materials rather than using traditional teaching methods in high schools can be observed in this study. In this research, it is aimed at drawing attention to the game-based learning which is a trending method in our constantly changing world and which is on the other hand included rarely in practice and academic studies in high schools.

### 6.3. Recommendations

Regarding the findings of the research, following recommendations have been made in order to increase students' achievement in mathematics and to develop positive attitude in students:

1. Game-based learning approach can be benefited from in high school mathematics classes order to increase students' achievement in mathematics and to develop positive attitude in students.
2. In teaching mathematics, teachers can develop games that might attract students' interest using simple materials and they can benefit from the approaches which enable students to be more active in classes.
3. In service training on game-based learning can be provided for teachers to facilitate them with a better knowledge to apply game-based teaching method in their classes.
4. Game-based learning materials for mathematics classes can be prepared in cooperation with the other colleagues, and these materials can be shared between. An online platform can be provided to the students where they can find materials and games for all levels. Every teacher can contribute and use the materials developed for a specific subject.
5. The effect of the research on the permanence of knowledge has not been examined in this study. A further study conducted on the permanence as well is recommended for the improvement of the research.

6. The fact that the results of this research reflect a limited situation, that is to say it only involves two classes of $9^{th}$ grade level in a high school, limits the research. In a research which is conducted on a larger group of students, the effects of game-based teaching on students' attitude and academic achievement in mathematics classes can be examined in a broader scope.
7. Further studies are recommended to be conducted in order to obtain relevant data to facilitate the effective use of game-based teaching method in other classes other than mathematics to reach the goals and objectives of a lesson.

## BIBLIOGRAHPY


Acar, Cengiz. 2005. Aktif Öğrenmenin Matematik Başarısı Üzerine Etkisi. Yüksek Lisans Tezi. Y. Y. Ü., Fen Bilimleri Enstitüsü, Van.

Açıkgöz, Kamile Ün. 2003. **Aktif Öğrenme.** 6.bs. İzmir: Eğitim Dünyası Yayınları.

Adıgüzel, H. Ömer. 1993. Oyun ve Yaratıcı Drama İlişkisi. Yüksek Lisans Tezi. Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü.

Akdemir, Ömüray. 2006. İlköğretim Öğrencilerinin Matematik Dersine Yönelik Tutumları ve Başarı Güdüsü. Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü.

Akkuş, Fatma. 2013. Oyun Temelli Matematik Eğitim Programı'nın Çocuğun Matematik Gelişimine Etkisinin İncelenmesi. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Akman, Berrin. 2002. Okulöncesi Dönemde Matematik. **Hacettepe Üniversitesi Eğitim Fakültesi Dergisi**. c. 23. s.2002:244-248.

Aksoy, Nuri Can. 2010. Oyun Destekli Matematik Öğretiminin Öğrencilerin Başarı Gelişimleri, Başarı Güdüsü, Öz-Yeterlik Ve Tutumlarının Gelişimlerine Etkisi. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

_____. 2014. Dijital Oyun Tabanlı Matematik Öğretiminin Ortaokul 6. Sınıf Öğrencilerinin Başarılarına, Başarı Güdüsü, Öz-Yeterlik Ve Tutum Özelliklerine Etkisi. Doktora Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Aksoy, Ayşe B., Hale Dere Çiftçi. 2014. **Erken Çocukluk Döneminde Oyun.** Ankara: Pegem.

Aktepe, Vedat, Mustafa Tahiroğlu, Tuncel Acer. 2015. Matematik Öğretiminde Kullanılan Öğretim Yöntemlerine İlişkin Öğrenci Görüşleri. **Nevşehir Hacı Bektaş Veli Üniversitesi Sosyal Bilimler Enstitüsü Dergisi.** c.4. s.2:127-144.

Alkan, Hüseyin, Murat Altun. 1998. **Matematik Öğretimi.** Anadolu Üniversitesi, Açıköğretim Fakültesi Yayınları.

Altun, Murat, 1998. **Matematik Öğretimi.** Eskişehir: Anadolu Üniversitesi Açık Öğretim Fakültesi Yayınları.

_____. 2002. **İlköğretim İkinci Kademede Matematik Öğretimi.** Bursa: Erkam Matbaacılık.

_____. 2005. **Eğitim Fakülteleri ve İlköğretim Öğretmenleri İçin Matematik Öğretimi.** Bursa: Erkam Matbaacılık.

Altunay, Derya. 2004. Oyunla Desteklenmiş Matematik Öğretiminin Öğrenci Erişisine ve Kalıcılığa Etkisi. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Ar, Necmettin Alp. 2016. Oyunlaştırmayla Öğrenmenin Meslek Lisesi Öğrencilerinin Akademik Başarı Ve Öğrenme Stratejileri Kullanımı Üzerine Etkisi. Yüksek Lisans Tezi. Sakarya Üniversitesi Eğitim Bilimleri Enstitüsü.

Aral, Neriman, Figen Gürsoy, Aysel Köksal. 2001. **Okul Öncesi Eğitimde Oyun.** İstanbul: YA-PA Yayınları

Arslantürk, Emine. 2013. Lise Öğrencilerinin Öğrenim Stratejileri İle Matematik Tutumları Arasındaki İlişki (Balıkesir İli Manyas İlçesi Örneği). Yüksek Lisans Tezi. Yeditepe Üniversitesi Sosyal Bilimler Enstitüsü.

Aslan, Fatma. 2014. Oyun Tabanlı Öğrenme Ortamlarının Öğrenci Başarısı Ve Görüşlerine Etkisi. Yüksek Lisans Tezi. Fırat Üniversitesi Eğitim Bilimleri Enstitüsü.

Aydın, Şevket, Orhan Bölükbaş, Ümit Polat. 2005. Niğde İli Orta Öğretim Kurumlarında Okuyan Öğrencilerin Matematik Dersine Karşı Kalıplaşmış Tutumları. XIV. Ulusal Eğitim Bilimleri Kongresi, 28-30 Eylül 2005. Denizli: Pamukkale Üniversitesi.

Bağlı, Melike Türkan. 2004. Oyun, Bilişsel Gelişim ve Toplumsal Dünya: Piaget, Vygotsky ve Sonrası. **Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi.** c.3. s.2:137-169.

Bakar, Ayşegül, Hakan Tüzün, Kürşat Çağıltay. 2008. Öğrencilerin Eğitsel Bilgisayar Oyunu Kullanımına İlişkin Algıları: Sosyal Bilgiler Dersi Örneği. **Hacettepe Üniversitesi Eğitim Fakültesi Dergisi.** s. 35:27-37.

Bakar, Serkan. 2018. Ortaöğretim 12. Sınıfta Okuyan Öğrencilerin Türev Öğretiminde Teknoloji Kullanımının Öğrencilerin Başarısına Ve Matematiksel İnancına, Yansıtıcı Düşüncesine Ve Matematik Tutumuna Etkisi. Yüksek Lisans Tezi. Balıkesir Üniversitesi Fen Bilimleri Enstitüsü.

Baki, Adnan. 1995. Matematik Öğretiminde Bilgisayar Her Şey Midir? ODTÜ Fen Bilimleri Sempozyumu 11-13 Eylül 1995. Ankara.

Başar, Erdoğan. (1997). Türk Yükseköğretim Sisteminin Dünü, Bugünü, Yarını (Üniversitelerin İleriye Dönük Gelişmeleri Üzerine Görüş Ve Öneriler). **Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi**. c.10:17-51.

Bayazıtoğlu, Ethem Nazif. 1996. İlköğretim İkinci Sınıf Hayat Bilgisi Dersinde Eğitsel Oyunlar, Erişi ve Kalıcılık. Yüksek Lisans Tezi. Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü.

Baykoç Dönmez, Necate. 1992. **Oyun Kitabı.** İstanbul: Esin Yayınevi.

Baykul, Yaşar. 1990. **İlkokul 5. Sınıftan Lise ve Dengi Okulların Son Sınıflarına Kadar Matematik ve Fen Derslerine Karşı Tutumda Görülen Değişmeler ve Öğrenci Seçme Sınavındaki Başarı ile İlişkili Olduğu Düşünülen Bazı Faktörler.** Ankara: ÖSYM Yayınları.

_____. 1999. **İlköğretimde Etkili Öğretme ve Öğrenme Öğretmen El Kitabı. Modül 6.** Ankara: Meb Yayınları.

_____. 2003. **İlköğretimde Matematik Öğretimi 1-5. Sınıflar İçin**. Ankara: Pegem Yayıncılık.

_____. 2004. **İlköğretim Matematik Öğretimi 6 – 8 Sınıflar İçin**. Ankara: Pegem Yayıncılık.

Bekdemir, Mehmet. 2007. İlköğretim Matematik Öğretmen Adaylarındaki Matematik Kaygısının Nedenleri Ve Azaltılması İçin Öneriler (Erzincan Eğitim Fakültesi Örneği). **Erzincan Eğitim Fakültesi Dergisi**. c.9. s.2:131-144.

Binark, Mutlu, Günseli Bayraktutan Sütçü, Işık Barış Fidaner. 2009. **Dijital Oyun Rehberi - Oyun Tasarımı Türler Ve Oyuncu.** İstanbul: Kalkedon.

Binbaşıoğlu, Cavit. 1990. **Gelişim Psikolojisi.** Ankara: Kadıoğlu Matbaası.

_____. 1997. Çocuk Eğitiminde Oyun**. Çağdaş Eğitim.** c. 22. s. :231: 19-21.

Biricik, Gülsün. 1999. İlköğretim 2. Sınıf Matematik Öğretiminde Aktif Etkileşimli Öğrenme Yaklaşımının Öğrenci Başarısına Etkisi. Yüksek Lisans Tezi. Uludağ Üniversitesi Sosyal Bilimler Enstitüsü.

Biriktir, Aydın. 2008. İlköğretim 5. Sınıf Matematik Dersi Geometri Konularının Verilmesinde Oyun Yönteminin Erişiye Etkisi. Yüksek Lisans Tezi. Selçuk Üniversitesi, Sosyal Bilimler Enstitüsü.

Bolay, Süleyman Hayri. 2014. Milli Aklın Gölgesinde Eğitimin Felsefi Temelleri Ve Medeniyet Tasavvurumuz. **1. Eğitim Kongresi Bildiriler, 28-30 Kasım 2014.** MEB Özel Öğretim Kurumları Genel Müdürlüğü, Antalya: 227-257.

Bozoğlu, Ufuk. 2014. Dijital Oyun Tabanlı Matematik Öğretiminin Ortaokul 6. Sınıf Öğrencilerinin Başarılarına, Başarı Güdüsü, Öz-Yeterlik Ve Tutum Özelliklerine Etkisi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Bruce, Tina. 1991. **Time to Play in Early Childhood Education.** London: Hodder and Stoughton.

Budak, Eylem., Uygar Kanlı, Fitnat Köseoğlu, Rahmi Yağbasan. 2006. Oyunlarla Fen (Fizik, Kimya, Biyoloji) Öğretimi. VII. Ulusal Fen Bilimleri ve Matematik Kongresi, 7-9 Eylül. Gazi Üniversitesi Eğitim Fakültesi Ankara.

Büyükdüvenci, Sabri. 2006. Eğitim Felsefeleri Işığında Çağdaşlaşma Ve Ulusal Eğitim Sisteminin Sorunları. **Atatürk Döneminden Günümüze Cumhuriyetin Eğitim Felsefesi ve Uygulamaları Sempozyumu Bildirileri, 16-17 Mart 2006.** Gazi Üniversitesi, Ankara: 274-277

Brewer, Robin, Lisa Anthony, Quincy Brown, Germaine Irwin, Jaye Nias, ve Berthel Tate. 2013. Using Gamification to Motivate Children to Complete Empirical Studies in Lab Environments. In Proceedings of the 12th International Conference on Interaction Design and Children, June 2013. New York. pp. 388-391.

Cai, Jinfa, John C. Moyer, Ning Wang. (1999). Parental Roles in Student's Learning of Mathematics **:**An Exploratory Study. **Research in Middle Level Education Quarterly.** v. 22. i.3:1-18

Carlson, E. (1971). Games in the Classroom. **The Study of Games.** New York: John Wiley & Sons.

Cole, Luella, John J.B. Morgan. 2011. **Çocukluk ve Gençlik Psikolojisi**. İstanbul: Milli Eğitim Basımevi.

Çankaya, Serkan, Ayşen Karamate. 2009. The effects of educational computer games on students' attitudes towards mathematics course and educational computer games. **Procedia Social and Behavioral Sciences**. v. 1. i.1:145-149.

Çetin, Hasan. 1994. Eğitimden İdealist Beklentiler Pragmatist Yaklaşımlar. **Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi.** c. 27. s. 2:659-678.

Çubukçu, İbrahim Agâh. 1986. **Türk Düşünce Tarihinde Felsefe Hareketleri.** Ankara: Ankara Üniversitesi Basımevi.

Cüceloğlu, Doğan. 1992. **İnsan ve Davranışı: Psikolojinin Temel Kavramları.** İstanbul: Remzi Kitabevi.

Dede, Yüksel, Şemsettin Dursun. 2004. Öğrencilerin Matematikte Başarısını Etkileyen Faktörler Matematik Öğretmenlerinin Görüşleri Bakımından. **Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi.** c. 24. s. 2:217-230.

_____. 2008. İlköğretim II. kademe öğrencilerinin matematik kaygı düzeylerinin incelenmesi. **Uludağ Üniversitesi Eğitim Fakültesi Dergisi**. c.11. s.2: 295-312.

Dede, Yüksel, Süleyman Yaman. 2003. Fen ve Matematik Eğitiminde Proje Çalışmalarının Yeri, Önemi ve Değerlendirilmesi. **Gazi Eğitim Fakültesi Dergisi.** c. 23. s.1:117-132.

Demirel, Özcan. 1999. **Öğrenme Sanatı.** Ankara: Pegem A Yayıncılık.

_____. 2000. **Karşılaştırmalı Eğitim.** Ankara: Pegem A Yayıncılık.

_____. 2005. **Eğitim Sözlüğü.** Ankara: Pegem Yayıncılık.

Demirel, Özcan, S. Sadi Seferoğlu, Esed Yağcı. 2003. **Öğretim Teknolojileri ve Materyal Geliştirme.** Ankara: Pegem A Yayıncılık.

Deringöl Karataş, Yasemin. 2013. Farklılaştırılmış Matematik Öğretiminin Üstün Zekâlı Ve Yetenekli Öğrencilerde Erişiye, Yaratıcılığa, Tutuma Ve Akademik Benliğe Etkisi. Doktora Tezi. İstanbul Üniversitesi Eğitim Bilimleri Enstitüsü.

Dinçer, Melike. 2008. İlköğretim Okullarında Müziklendirilmiş Matematik Oyunlarıyla Yapılan Öğretimin Akademik Başarı Ve Tutuma Etkisi. Yüksek Lisans Tezi. Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü.

Doğanay, Gülüzar. 2002. Tarih Öğretiminde Oyun. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Domínguez, Adrián, JosebaSaenz-de-Navarrete, Luisde-Marcos, Luis Fernández-Sanz, Carmen Pagés, José-Javier Martínez-Herráiz. 2013. Gamifying learning experiences: Practical implications and outcomes. **Computers & Education**. v.63. i. April 2013:380–392.

Duru, Adem, Levent Akgün, M. Emin Özdemir. 2005. İlköğretim Öğretmen Adaylarının Matematiğe Yönelik Tutumlarının İncelenmesi. **Kazım Karabekir Eğitim Fakültesi Dergisi** c.0. s.11:520-536.

Eldemir, Hasan Hüseyin. 2006. Sınıf Öğretmeni Adaylarının Matematik Kaygısının Bazı Psiko-Sosyal Değişkenler Açısından İncelenmesi. Yüksek Lisans Tezi. Cumhuriyet Üniversitesi Sosyal Bilimler Enstitüsü.

Ercanlı, Dilek. 1997. İlköğretim Okullarının 4. Sınıflarında Dünyamız ve Gökyüzü Ünitesinin Öğrenilmesinde Oyun ve Modellerin Başarıya Etkisi. Yüksek Lisans Tezi. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü.

Erden, Münire, Yasemin Akman. 1998. Eğitim Psikolojisi Gelişim-Öğrenme-Öğretme. Ankara: Arkadaş Yayınları.

Ergün, Mustafa. 2014. **Eğitim Felsefesi**. 4. bs. Ankara: Pegem Akademi.

Erkılıç, Turan Akman. [15.11.2018]. Eğitim Felsefesi Tanımı Konusu Özellikleri Ve Gelişimi. https://docplayer.biz.tr/27458942-Egitim-felsefesi-tanimi-konusu-ozellikleri-ve-gelisimi-yrd-doc-dr-turan-akman-erkilic.html

Erkin Kavasoğlu, Burcu. 2010. İlköğretim 6, 7 ve 8. Sınıf Matematik Dersinde Olasılık Konusunun Oyuna Dayalı Öğretiminin Öğrenci Başarısına Etkisi. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Ersoy, Yaşar. 2000. Son Dönemde Okullarda Matematik/ Fen Eğitiminde Çağdaş Gelişmeler ve Genel Eğilimler. **Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi**. c. 2000. s.12:235-246.

Ertürk, Selahattin. 1986. **Eğitimde Program Geliştirme**. Ankara: Meteksan A.Ş.

Evcin, Savaş. 2011. Bilgisayar Oyunlarının İlköğretim İkinci Kademe Öğrencilerinin Saldırganlık Eğilimine Etkisinin İncelenmesi. Yüksek Lisans Tezi. Maltepe Üniversitesi Sosyal Bilimler Enstitüsü.

Faulkner, Dorothy. 1995. **Play, Self and The Social World.** Oxford: Blavkwell Puplishing.

Fauvel, John ve Jon V. Maanen. 2000. **History in Mathematics Education.** Dordrecht: The IICMI Study.

Flewelling, Gary, William Higginson. 2003. **Teaching With Rich Learning Tasks: A Handbook.** The Australian Association of Mathematics Teachers Inc.

Flewellıng, Gary, 2003. Sense Making: Changing the Game Played in the Typical Classroom. **Australian Mathematics Teacher Journal**, v. 58. i. 1: 8-16.

Garris, Rosemary, Robert Ahlers, James E. Driskell. 2002. Motivation and Learning: A Researchand Practise Model. **Simulation and Gaming**. vol. 33. issue. 4:441-467.

Gelen, İsmail, Bayram Özer. 2010. The Effects Of Teachıng Through Play Students's Problem Solvıng Skılls In And Attıtude Towards Mathematıcs. **E-Journal of New World Sciences Academy**. v. 5. i. 1: 71-88.

Gökçe, Asiye Toker. 2012. Eğitim Felsefesi Akımlarının Türkiye Cumhuriyeti Eğitim Sistemine Etkileri**. Eğitim Felsefesi.** ed. Nurten Gökalp, Şengül Çelik. 1. bs. İstanbul: Lisans Yayıncılık:174-183.

Gutek, Gerald L. 2001. Eğitimde Felsefi ve İdeolojik Yaklaşımlar. Ankara: Ütopya Yayıncılık.

Güven, İsmail. 2010. Türk Eğitim Tarihi. Ankara: Naturel Yayıncılık.

Güven, Meral. 2008. **Programda Öğretme-Öğrenme Süreci, Öğretim İlke ve Yöntemleri.** Ankara: Maya Akademi.

Hacısalihoğlu, Hilmi, Şeref Mirasyedioğlu, Ahmet Akpınar. 2004. **Matematik Öğretimi.** Ankara: Asil Yayın ve Dağıtım.

Hamari, Juho, Jonna Koivisto. Harri Sarsa, 2014. Does Gamification Work? A Literature Review of Empirical Studies on Gamification. In proceedings of the 47th Hawaii International Conference on System Sciences, January 6-9. Hawaii, USA.

Hazar, Muhsin. 1997. **Beden Eğitimi Ve Sporda Oyunla Eğitim**. Ankara: Tutibay Yayınları.

Hazar, Zekihan. 2016. Fiziksel Hareketlilik İçeren Oyunların 11-14 Yaş Grubu Ortaokul Öğrencilerinin Dijital Oyun Bağımlılığına Etkisi. Doktora Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Işık, Esin, Başak Tuğba Çağdaşer. 2009. Yapısalcı Yaklaşımla Cebir Öğretiminin 6.Sınıf Öğrencilerinin Matematiğe Yönelik Tutumlarına Etkisi. **Kastamonu Eğitim Dergisi**. c:17. s.3:941-954.

Kabadayı, Abdulkadir. 2004. Cumhuriyet Devrinde Konya'da Oynanan Çocuk Oyunlarının Çocuğun Gelişim ve Eğitimine Katkıları. XIII. Ulusal Eğitim Bilimleri Kurultayı. 6-9 Temmuz. İnönü Üniversitesi, Eğitim Fakültesi.

Kan, Adnan, Ahmet Akbaş. 2005. Lise Öğrencilerinin Kimya Dersine Yönelik Tutum Ölçeği Geliştirme Çalışması. **Mersin Üniversitesi Eğitim Fakültesi Dergisi.** c. 1. s. 2:227-237.

Kandemir, Mehmet Ali. 2011. Modelleme Etkinliklerinin Öğrencilerin Duyuşsal Özelliklerine Problem Çözme Ve Teknolojiye İlişkin Düşüncelerine Etkisinin İncelenmesi. Doktora Tezi. Balıkesir Üniversitesi Fen Bilimleri Enstitüsü.

Kapp, Karl. 2012. **The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education.** New York: John Wiley & Sons Inc.

Kaptan, Saim. 1995. **Bilimsel Araştırma ve İstatistik Teknikleri.** Ankara: Tekışık Web Ofset.

Karabacak, Nermin. 1996. Sosyal Bilgiler Dersinde Eğitsel Oyunların Öğrencilerin Erişi Düzeyine Etkileri. Yüksek Lisans Tezi. Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Karaduğan, Özden. 2003. İlköğretim II. Kademede Sanatın Öğretiminde Eğitsel Oyunların Uygulanması ve Sonuçları. Yüksek Lisans Tezi. Selçuk Üniversitesi Sosyal Bilimler Enstitüsü.

Karasar, Niyazi. 2006. **Bilimsel Araştırma Yöntemi.** Ankara: Nobel Yayın Dağıtım.

Kaya, Ümit Ünsal. (2007). İlköğretim I. Kademede İngilizce Derslerinde Oyun Tekniğinin Erişiye Etkisi. Yüksek Lisans Tezi. Afyonkarahisar Kocatepe Üniversitesi Sosyal Bilimler Enstitüsü.

Kaynardağ, Arslan. 2002. **Türkiye'de Cumhuriyet Döneminde Felsefe: Düşünceler Etkinlikler Filozoflar-Söyleşiler.** 1.bs. Kültür Bakanlığı. Ankara: Başbakanlık Basımevi.

Kemertaş, İsmet. 2001. **Uygulamalı Genel Öğretim Yöntemleri.** 4.bs. İstanbul: Birsen Yayınevi.

Kılıç, Meral. 2007. İlköğretim 1. Sınıf Matematik Dersinde Oyunla Öğretimde Kullanılan Ödüllerin Matematik Başarısına Etkisi. Yüksek Lisans Tezi. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü.

Köroğlu, Hayrettin, Sibel Yeşildere. 2002. İlköğretim II. Kademede Matematik Konularının Öğretiminde Oyunlar ve Senaryolar. V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, 16-18 Eylül 2002. ODTÜ Kültür ve Kongre Merkezi, Ankara.

Kulm, Gerald. 1980. Research on Mathematics Attitudes, Research in Mathematics Education. **National Council of Teachers of Mathematics.** pp.356-387.

Kuloğlu, Serkan, Devrim Uzel. 2013. Üstün Yetenekli Öğrencilerin Matematiksel Tutumlarının Farklı Değişkenlere Göre İncelenmesi: Manisa Bilim Ve Sanat Merkezi Örneği. **Üstün Yetenekli Eğitimi Araştırmaları Dergisi**. c.1(2). Özel Sayı:97-107.

Kurt, İbrahim. 2016. Eğitim Felsefesinin Mahiyeti, Fonksiyonu Ve Geleceğine İlişkin Bir İnceleme. Yüksek Lisans Tezi. Atatürk Üniversitesi Eğitim Bilimleri Enstitüsü.

Larsen, Eline Valen. 2013. Master of Exams. Master's Thesis. University of Oslo.

Lianghuo, Fan, Quek Khiok Seng, Zhu Yan, Yeo Shu Mei, Lionel Pereira-Mendoza, Lee Peng Yee. 2005. Assesing Singapore Student's Attitudes Towards Matehematics and Mathematics Learning: Findigs From a Survey Of Lower Secondary Students. ICMI Regional Conference: The 3rd East Asia Regional Conference on Mathematics Education, August 2005. Shanghai, Nanjing, and Hangzhou, China.

Mangır, Mine, Yaşare Aktaş. 1993. Çocuğun Gelişiminde Oyunun Önemi. **Yaşadıkça Eğitim.** c. 8. s. 26:14-18.

MEB. 2003. Öğrenci Merkezli Eğitim ve Öğretim Modeli. Ankara.

MEGEP. [11.01.2019]. Meslekî Eğitim ve Öğretim Sisteminin Güçlendirilmesi Projesi, Çocuk Gelişimi ve Eğitimi; Oyun Etkinliği-I. http://www.megep.meb.gov.tr/mte_program_modul/moduller_pdf/Oyun%20Etkinlikleri%20-1.pdf

Mekler, Elisa D., Florian Bruhlmann, Klaus Opwis, Alexandre Nicholas Tuch. 2013. Do Points, Levels and Leaderboards Harm Intrinsic Motivation?: An Empirical Analysis of Common Gamification Elements. Gamification'13 Proceedings of the First International Conference on Gameful Design, Research, and Applications, October 02 - 04 2013. Toronto.

Melancon, Janet G., Bruce Thompson, Shirley Becnel. 1993. How Elementary School Children Think about Mathematics. Annual Meeting of the Southwest Educational Research Association, January 28-30, 1993. Austin, TX.

Milli Eğitim Bakanlığı. 2016. 2015-2016 Eğitim Öğretim Yılı I. Dönem Ortak Sınavı Test Ve Madde İstatistikleri. http://odsgm.meb.gov.tr/test/analizler/docs/2015-2016-ortak-sinav-1-donem-madde-istatistikleri.pdf . [12.11.2018].

Milli Eğitimi Geliştirme Projesi. 1997. **İlköğretim Matematik Öğretimi.** Ankara.

Mirasyedioğlu, Şeref, Murat Peker. 2003. Lise 2. Sınıf Öğrencilerinin Matematik Dersine Yönelik Tutumları Ve Başarıları Arasındaki İlişki. **Pamukkale Üniversitesi Eğitim Fakültesi Dergisi.** c.2. s.14: 157-166.

Mirasyedioğlu, Şeref, Yılmaz Aksoy, Yurdanur Başyiğit, Devrim Çakmak, Ali Çelik, Ercan Durudoğan, Coşkun Kılıç, Alparslan Oğuz, Aydın Tiryaki, Ali Zafer Yılmaz. 2005. **Orta Öğretim Matematik (9, 10, 11, 12. Sınıflar) Dersi Öğretim Programı.** Ankara: Talim ve Terbiye Kurulu Başkanlığı, Orta Öğretim Genel Müdürlüğü, Millî Eğitim Basım Evi.

Norman, Ralph D. 1977. Sex Differences in Attitudes Towards Aritmetic-Mathematics From Early Elementary to College Levels. **Journal of Psycology**. v. 97. i.2: 247- 256.

Oktay, Ayla. 2003. Oyuna Kuramsal Yaklaşım. Çocukta Hareket, Oyun Gelişimi ve Öğretimi. 3. bs. Eskişehir: Anadolu Üniversitesi Yayınları.

Oktaylar, Hasan Can. 2006. **Öğretmen Adayları İçin Konu Anlatımlı, Örnek Çözümlü KPSS Eğitim Bilimleri.** Ankara: Yargı Yayın evi.

Olkun, Sinan, Zülbiye Toluk. 2003. **İlköğretimde Etkinlik Temelli Matematik Öğretimi**. Ankara: ANI Yayıncılık.

O'Brien, Thomas C., Judy Barnett. 2004. Hold On To Your Hat. **Mathematics Teaching.** v. 187. i. June.

O'Donovan, Siobhan. 2012. Gamification of the Games Course. Technical Report. University of Cape Town Department of Computer Science.

Oğuzkan, Ferhan. 1974. **Eğitim Terimleri Sözlüğü.** Ankara: Türk Dil Kurumu Yayınları.

Ortaylı, İlber. 1996. Maarifin Son 150 Yıldaki Serencamı. **Yeni Türkiye Dergisi.** c.Ocak Şubat 1996. yıl.2. s:7:462-466.

Öğretir, Ayşe Dilek. 2008. Oyun ve Oyun Terapisi. **Gazi Üniversitesi Endüstriyel Sanatlar Eğitim Fakültesi Dergisi.** c.8 s.22:94-100.

Önal, Nezih. 2013. Ortaokul öğrencilerinin matematik tutumlarına yönelik ölçek geliştirme çalışması. **İlköğretim-Online**. c.12. s.4:938-948.

Özçakır, Ali İhsan. [11.01. 2019. Öğrenci Merkezli Eğitim Nasıl Olmalı? https://sites.google.com/site/aliihsanozcakir/ogrenimmetodveteknikleri

Özdemir, Ahmet Ş., Mesut Tabuk. 2003. Matematik Dersinde Bilgisayar Destekli Öğretimin Öğrenci Başarı ve Tutumlarına Etkisi. **Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi.** c. 4. s. 1:50-52.

Özden, Yüksel. 1998. **Eğitimde Yeni Değerler.** Ankara: Pegem A Yayıncılık.

Özdoğan, Berka. 2000. **Çocuk ve Oyun**. 3. bs. Ankara: Anı Yayıncılık.

Özgen, Kemal, Hüseyin Alkan. 2014. Yapılandırmacı Öğrenme Yaklaşımı Kapsamında, Öğrencilerin Öğrenme Stillerine Uygun Öğrenme Etkinliklerinin Akademik Başarı Ve Tutuma Etkileri: Fonksiyon Ve Türev Kavramı Örneklemesi. **Turkish Journal of Computer and Mathematics Education.** v.5. i.1:1-38.

Özgen, Kemal, Cahit Pesen. 2008. Probleme Dayalı Öğrenme Yaklaşımı Ve Öğrencilerin Matematiğe Yönelik Tutumları. **Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi**. c.2008. s.11:69-83.

_____. 2008. Probleme Dayalı Öğrenme Yaklaşımı ve Öğrencilerin Matematiğe Yönelik Tutumları. **Ziya Gökalp Eğitim Fakültesi Dergisi.** c.2008. s.11:69-83.

Özgüven, İbrahim Ethem. 2014. **Psikolojik Testler.** Ankara: Nobel Akademi Yayıncılık.

Pehlivan, Hülya. 1997. Tutumların Doğası ve Öğretimi. **Çağdaş Eğitim**. Tekışık Yayıncılık. s.233: 46-48.

Pehlivan, Hülya. 2005. **Oyun ve Öğrenme.** Ankara: Anı Yayıncılık.

Pesen, Cahit. 2003. **Matematik Öğretimi**. Ankara: Nobel Yayın Dağıtım.

Prensky, Marc. 2001. Fun, Play and Games: What Makes Games Engaging. From Digital Game-Basedlearning. http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Game-Based%20Learning-Ch5.pdf [12.12.2019]

_____. 2001. Computer Games and Learning: Digital game-based learning revoluation. http://marcprensky.com/ [11.10.2018].

Randel, Josephine M., Barbara A. Morris. (1992). The Effectiveness of Games for Educational Purposes: A Review of Recent Research. **Simulation & Gaming.** v. 23. i. 3: 261-276.

Reyes, Laurie Hart. 1984. Affective Variables and Mathematics Education. **The Elementary School Journal.** v.84. i.5:558-580.

Reys, Robert E., Marilyn N. Suydam, Mary Montgomery Lindquist, Simth, H. L., 1998. Helping Children Learn Mathematics, Allyn and Bacon, Boston, U.S.A.

Sağlık, Ece. 2017. The Impact Of Gamified Game-Based Vocabulary Teaching On Success And Motivation. Master's Thesis. Graduate School Of Educational Sciences Of Bahçeşehir Unıversity

Seefeldt, Carol, Nita Barbour. 1990. **Early Childhood Education.** New York: Macmillan Publishing Company.

Selçuk, Ziya. 2000. **Gelişim ve Öğrenme.** Ankara: Nobel Yayın Dağıtım.

Senemoğlu, Nuray. 1997. **Gelişim Öğrenme Ve Öğretim Kuramdan Uygulamaya.** Ankara: Özsen Matbaası.

Seyrek, Hilmi, Muammer Sun. 1997. **Okul Öncesi Eğitimde Müzik.** İzmir: Müzik Eserleri Yayınları.

Shane, Scott A. 1992. Why do some societies invent more than others? Journal of Business Venturing. v. 7. i. 1: 29-46.

Shi, Yixun. 2003. Using Volleyball Games As Examples In Teaching Mathematics. **Teaching Mathematics and Its Applications: An International Journey of the IMA.** v. 22. i. 2: 53-62.

Songur, Ahmet. 2006. Harfli İfadeler ve Denklemler Konusunun Oyun ve Bulmacalarla Öğrenilmesinin Öğrencilerin Matematik Başarı Düzeylerine Etkisi. Yüksek Lisans Tezi. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü.

Soylu, Yasin. 2001. Matematik Derslerinin Öğretiminde (I. Devre 1, 2, 3, 4, 5. Sınıf) Başvurulabilecek Eğitici-Öğretici Oyunlar. Yüksek Lisans Tezi. Atatürk Üniversitesi Fen Bilimleri Enstitüsü.

Sönmez, Veysel, İsmail Bircan, Ali Rıza Erdem, Turan Akman Erkılıç, Kasım Karakütük, Nuray Senemoğlu, Ali Ekber Şahin, Mahmut Tezcan, Tuğba Yanpar Yelken. 2011. **Eğitim Bilimine Giriş.** 8.bs. Ankara: Anı Yayıncılık.

Şen, Ahmet İlhan, Aslı Özgün Koca. (2005). Orta Öğretim Öğrencilerinin Matematik ve Fen Derslerine Yönelik Olan Olumlu Tutumları ve Nedenleri. **Eurasian Journal of Educational Research(EJER).** v. April(2006). i. 23:137-147.

Şengül, Sare, İbrahim Ekinözü. 2006. Canlandırma Yönteminin Öğrencilerin Matematik Tutumuna Etkisi. **Kastamonu Eğitim Dergisi**. c.14. s.2:517- 526.

Şengül, Sare, Caner Öz. 2008. İlköğretim 6. Sınıf Kesirler Ünitesinde Çoklu Zekâ Kuramına Uygun Öğretimin Öğrenci Tutumuna Etkisi. **İlköğretim Online**. c. 7. s.3: 800-813.

Tamer, Kemal. 1990. **Beden Eğitimi ve Oyun Öğretimi.** Eskişehir: Anadolu Üniversitesi Yayınları.

Taşdelen, Vefa. 2015. Nurettin Topçu'nun Türkiye'nin Maarif Davası İsimli Eserinde Eğitimin Güncel Sorunları. Türkiye'de Eğitim Felsefesi ve Sorunları. **TYB Akademi Dergisi**. c.13. s. Ocak:39-54.

Taşdemir, Cahit. 2009. İlköğretim İkinci Kademe Öğrencilerinin Matematik Dersine Karşı Tutumları: Bitlis İli Örneği. **Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi. s.**12: 89-96

Taşlı, Feriha. 2003. İlköğretimde İngilizce Öğretiminde Oyun Tekniğinin Erişiye Etkisi. Yüksek Lisans Tezi. Niğde Üniversitesi Sosyal Bilimler Enstitüsü.

Telese, James A. 1997. Hispanic Students' Attitudes Toward Mathematics And Their Classroom Experience. Annual Meeting of the Southwest Educational Research Association, January 23, 1997. Austin, TX.

Tepedelenlioğlu, Nazif. 1994. **Kim Korkar Matematikten**. 6.bs. İstanbul: Sarmal Yayınevi.

Toksoy, Atilla Coşkun. 2010. Yarışma Niteliği Taşıyan Geleneksel Çocuk Oyunları. **Acta Turcica.** c.Ocak. s.1:205-220.

Topkaya, İsmail. 2004. **Oyun, Beden Eğitimi ve Spor Öğretiminin Eğitsel Temelleri.** Ankara: Nobel Yayın Dağıtım.

Tozlu, Necmettin. 2003. **İnsandan Devlete Eğitim**. Ankara: Yeni Türkiye Yayınları.

_____. 2014. **Eğitimden Felsefeye 1-2-3.** Bayburt Üniversitesi Yayınları.

Tural, Hüseyin. 2005. İlköğretim Matematik Öğretiminde Oyun ve Etkinliklerle Öğretimin Erişi ve Tutuma Etkisi. Yüksek Lisans Tezi. Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü.

Turgut, İhsan. 1998. **Kaostaki Eğitim.** 1. bs. İzmir: Anadolu Matbaacılık.

Turpçu, Levent. 2014. Lise Öğrencilerinin Matematik Dersi Başarısızlık Nedenleri (Adana İli Örneği). Yüksek Lisans Tezi. Okan Üniversitesi Sosyal Bilimler Enstitüsü.

Tüfekçioğlu, Umran. 2003. **Çocukta Hareket, Oyun Gelişimi Ve Öğretimi.** Eskişehir: Anadolu Üniversitesi Yayınları.

Türkmen, Gökçe Pelin. 2017. Oyunlaştırma Yöntemiyle Öğrenmenin Öğrencilerin Matematik Başarılarına Ve Derse Yönelik Tutumlarına Etkisi. Yüksek Lisans Tezi. Erciyes Üniversitesi Eğitim Bilimleri Enstitüsü.

Uğurel, Işıkhan. 2003. Ortaöğretimde Oyunlar ve Etkinlikler ile Matematik Öğretimine İlişkin Öğretmen Adayları ve Öğretmenlerin Görüşleri. Yüksek Lisans Tezi. D.E.Ü. Eğitim Bilimleri Enstitüsü, İzmir.

Uğurel, Işıkhan, Sevgi Moralı. 2008. Matematik ve Oyun Etkileşimi. **Gazi Üniversitesi Eğitim Fakültesi Dergisi**. c. 28. s.3:75-98.

Uğurlu, Zişan. 1996. Kültürel Bir Olgu Olarak Oyun. Doktora Tezi. Ankara Üniversitesi Sosyal Bilimler Enstitüsü.

Ulusoy, Ayten. 2002. **Gelişim ve Öğrenme.** Ankara: Anı Yayınları.

Umay, Aysun. 2002. Öteki Matematik. **Hacettepe Üniversitesi Eğitim Fakültesi Dergisi.** c. 2002. **s**.23:275- 281.

Ural, Ayhan, İbrahim Kılıç. 2005. **Bilimsel Araştırma Süreci ve SPSS ile Veri Analizi.** Ankara: Detay Yayıncılık.

Ülken, Hilmi Ziya. 2001. **Eğitim Felsefesi.** 2.bs. İstanbul: Ülken Yayınları .

Weiner, Linnette. 2001. Changing Student Attitudes Toward Math: Using Dance to Teach Math. Center for Applied Research & Educational Improvement, University of Minnesota.

Yavuzer, Haluk. 1993. **Çocuk Psikolojisi.** İstanbul: Remzi Kitabevi.

Yee, Nicholas. 2002. Facets: 5 Motivation Factors for Why People Play MMORPG's. http://www.nickyee.com/facets/home.html [12.11.2018].

Yeşilyurt, Selami. 2004. İlköğretim 4. ve 5. Sınıf Öğrencilerinin Terazi Dengesi ve Çözünmeyi Hatırlayarak Analiz ve Sentez Yapmada Deney ve Oyunun Etkisi. İlköğretim-Online.org.tr c. 3. s. 1: 11-19. http://ilkogretim-online.org.tr/index.php/io/article/view/2037/1873 [14.12.2018].

Yenilmez, Kürşat. 2007. İlköğretim Öğrencilerinin Matematik Dersine Yönelik Tutumları. **Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi**. c.23. s.1:51-59.

Yıldırım, İbrahim, Servet Demir. 2014. Oyunlaştırma ve Eğitim. **International Journal of Human Sciences,** v.11. i. 1:655-670.

Yıldız, Ayşe Aylin. 2001. Teaching English To Young Learners Through Games. Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü.

Yılmaz, Emine, Ayperi Sığırtmaç. 2006. Sayı ve İşlem Kavramının Kazanılmasında Müzikli Oyunların Etkisi. **Ege Eğitim Dergisi.** c. 7. s. 2:43-56.

Zülal, A. 2000. Oyun Oynamak Herkesin Hakkı. **Bilim ve Teknik Dergisi.** Tübitak Yayınları. c.Temmuz. s.393:62.

# APPENDIX

## Appendix 1. Mathematics Attitude Scale

| | Kesinlikle Katılmıyorum | Katılmıyorum | Kararsızım | Katılıyorum | Tamamen Katılıyorum |
|---|---|---|---|---|---|
| 1 Matematik, çok sevdiğim dersler arasındadır. | | | | | |
| 2 Matematik çalışmak beni dinlendirir. | | | | | |
| 3 Matematik dersindeki konular azaltılırsa mutlu olurum. | | | | | |
| 4 Matematik çalışırken canım sıkılır. | | | | | |
| 5 Matematikle uğraşmak beni eğlendirir. | | | | | |
| 6 Bos zamanlarımda matematik çalışmaktan zevk alırım. | | | | | |
| 7 Matematik dersinden korkarım. | | | | | |
| 8 Matematik problemi çözmek beni yorar. | | | | | |
| 9 Matematik bana korkutucu görünür. | | | | | |
| 10 Matematik problemi çözmekten zevk alırım. | | | | | |
| 11 Matematik derslerin en güzelidir. | | | | | |
| 12 İleride, matematikle yakından ilgili bir meslek seçmeyi isterim. | | | | | |
| 13 Matematikten hiç hoşlanmam. | | | | | |
| 14 Programda matematik ders saatlerinin sayısı azaltılırsa mutlu olurum. | | | | | |
| 15 İleride, matematikle ilişkisi en az olan bir meslek seçmek isterim. | | | | | |
| 16 Elime geçen her matematik problemini çözmek isterim. | | | | | |
| 17 Matematik konusundaki her şey ilgimi çeker. | | | | | |
| 18 Dersler arasında en çok matematikten hoşlanırım. | | | | | |
| 19 Matematik oyunlarından hoşlanmam. | | | | | |
| 20 Mümkün olsa matematik yerine başka bir ders alırım. | | | | | |
| 21 Matematik ödevlerini sıkılmadan zevkle yaparım | | | | | |
| 22 Matematik derslerine mecbur olduğum için çalışıyorum. | | | | | |
| 23 Bos zamanlarımda matematik problemleri çözmek bana zevk verir. | | | | | |
| 24 Bir matematik sorusunun cevabını bulmak için kendi kendime uzun bir zaman harcamaktansa, onu bir bilenden sorup öğrenmeyi tercih ederim. | | | | | |
| 25 Matematik dersinde kendimi rahat hissederim. | | | | | |
| 26 Diğer derslere göre, matematiği daha büyük bir zevkle çalışırım. | | | | | |
| 27 Bana göre, matematik en çekici derstir. | | | | | |
| 28 Matematik dersinde konular azaltılsa sevinirim. | | | | | |
| 29 Matematik dersinden çekinirim. | | | | | |
| 30 Matematik dersine, sadece sınıf geçmek için çalışıyorum. | | | | | |

## Appendix 2. Mathematics Test in TEOG 2015

A

2015-2016 EĞİTİM - ÖĞRETİM YILI 1. MERKEZİ ORTAK SINAVI

MATEMATİK

1. Bu testte 20 soru vardır.
2. Cevaplarınızı, cevap kağıdına işaretleyiniz.

**1.** $\frac{1}{6^{-2}}$ sayısı aşağıdakilerden hangisine eşittir?

A) $\frac{1}{36}$ B) $\frac{1}{12}$ C) 12 D) 36

**2.** $(0,7)\cdot(0,7)\cdot(0,7)=(0,7)^a$ ve $\frac{1}{5}\cdot\frac{1}{5}\cdot\frac{1}{5}\cdot\frac{1}{5}\cdot\frac{1}{5}=5^b$ olduğuna göre $a+b$ kaçtır?

A) $-3$ B) $-2$ C) 5 D) 8

**3.** $5^{-4}$ sayısı aşağıdakilerden hangisine eşittir?

A) 0,0005 B) 0,0002
C) 0,0016 D) 0,0025

**4.** Aşağıdakilerden hangisi bir sayının bilimsel gösterimidir?

A) $3,4\times10^{9}$ B) $0,99\times10^{9}$
C) $0,7\times10^{-6}$ D) $11\times10^{-8}$

**5.** $4^6$ ile $\frac{1}{8}$ sayılarının çarpımı aşağıdakilerden hangisidir?

A) $2^3$ B) $2^6$ C) $2^9$ D) $2^{11}$

**6.** Birler basamağı 9 olan üç basamaklı kaç tane tam kare sayı vardır?

A) 4 B) 5 C) 6 D) 7

ÖLÇME, DEĞERLENDİRME VE SINAV HİZMETLERİ GENEL MÜDÜRLÜĞÜ

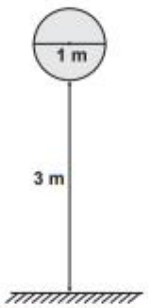
**7.** $2x(3x-5) = 6x^2 - ax$
**ifadesi bir özdeşlik olduğuna göre a kaçtır?**

A) $-5$ B) $-3$ C) 7 D) 10

**8.** $\sqrt{12} + \square = \sqrt{75} - \sqrt{3}$
**Bu eşitliğe göre □ yerine aşağıdaki sayılardan hangisi yazılmalıdır?**

A) $2\sqrt{2}$ B) $2\sqrt{3}$ C) $3\sqrt{2}$ D) $3\sqrt{3}$

**9.**




Bir okçu, yukarıda gösterildiği gibi çapı 1 metre olan daire şeklindeki bir hedef tahtasına atış yapmaktadır. Hedef tahtasının yerden yüksekliği 3 metredir.

**Atılan ok hedef tahtasına isabet ettiğine göre, saplandığı noktanın yerden yüksekliği, metre cinsinden aşağıdakilerden hangisi olabilir?**

A) $\sqrt{6}$ B) $\sqrt{8}$ C) $\sqrt{15}$ D) $\sqrt{18}$

**10.** **Q** rasyonel sayılar kümesini,
**Z** tam sayılar kümesini,
**I** irrasyonel sayılar kümesini ve
**N** doğal sayılar kümesini göstermektedir.

**Bu kümelerden hangi ikisinin birleşimi gerçek sayılar kümesini oluşturur?**

A) Q ve I B) I ve Z
C) Z ve Q D) I ve N

**11.** **Aşağıdaki eşitliklerden hangisi doğrudur?**

A) $\sqrt{40} = 4\sqrt{10}$ B) $\sqrt{48} = 2\sqrt{6}$
C) $\sqrt{72} = 6\sqrt{2}$ D) $\sqrt{99} = 9\sqrt{2}$

**12.** **$5^6$ tane kalemin tamamı, 25 boş kutuya eşit sayıda yerleştirildiğinde her bir kutuda kaç kalem olur?**

A) $25^3$ B) $25^2$ C) $5^3$ D) $5^2$

ÖLÇME, DEĞERLENDİRME VE SINAV HİZMETLERİ GENEL MÜDÜRLÜĞÜ

**13.** $\sqrt{80}$ metre uzunluğundaki bir telin $\sqrt{20}$ metresi kullanılıyor.

**Buna göre geriye telin kaçta kaçı kalmıştır?**

A) $\frac{3}{4}$'ü B) $\frac{1}{2}$'si

C) $\frac{2}{5}$'si D) $\frac{1}{4}$'i

**14.** **Alanı 4,41 cm² olan karenin bir kenarının uzunluğu, alanı 1,96 cm² olan karenin bir kenarının uzunluğundan kaç santimetre fazladır?**

A) 2,55 B) 2,45 C) 1,7 D) 0,7

**15.** $\frac{27 \cdot 3^2}{3^4}$ **işleminin sonucu kaçtır?**

A) 1 B) 3 C) 9 D) 81

**16.** **Alanı 24 cm² olan bir dikdörtgenin kenar uzunlukları aşağıdakilerden hangisi olamaz?**

A) $4\sqrt{2}$ cm ve $3\sqrt{2}$ cm

B) $4\sqrt{3}$ cm ve $2\sqrt{3}$ cm

C) $3\sqrt{8}$ cm ve $2\sqrt{8}$ cm

D) $4\sqrt{6}$ cm ve $\sqrt{6}$ cm

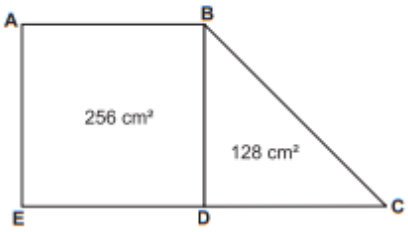
**17.** **Aşağıdakilerden hangisi bir irrasyonel sayıdır?**

A) $\sqrt{28}$ B) $0,\overline{3}$

C) $\sqrt{4}$ D) $\frac{-7}{25}$

ÖLÇME, DEĞERLENDİRME VE SINAV HİZMETLERİ GENEL MÜDÜRLÜĞÜ

**18.**




Şekildeki ABDE karesinin alanı 256 $cm^2$ ve BCD dik üçgeninin alanı 128 $cm^2$ dir.

**Buna göre |EC| kaç santimetredir?**

A) 20 B) 24 C) 28 D) 32

**19.** **$\sqrt{288}$ kilometrelik bir yolun yarısını dakikada $\sqrt{8}$ kilometre, diğer yarısını dakikada $\sqrt{18}$ kilometre hızla giden bir araç, bu yolun tamamını kaç dakikada gider?**

A) 4 B) 5 C) 6 D) 7

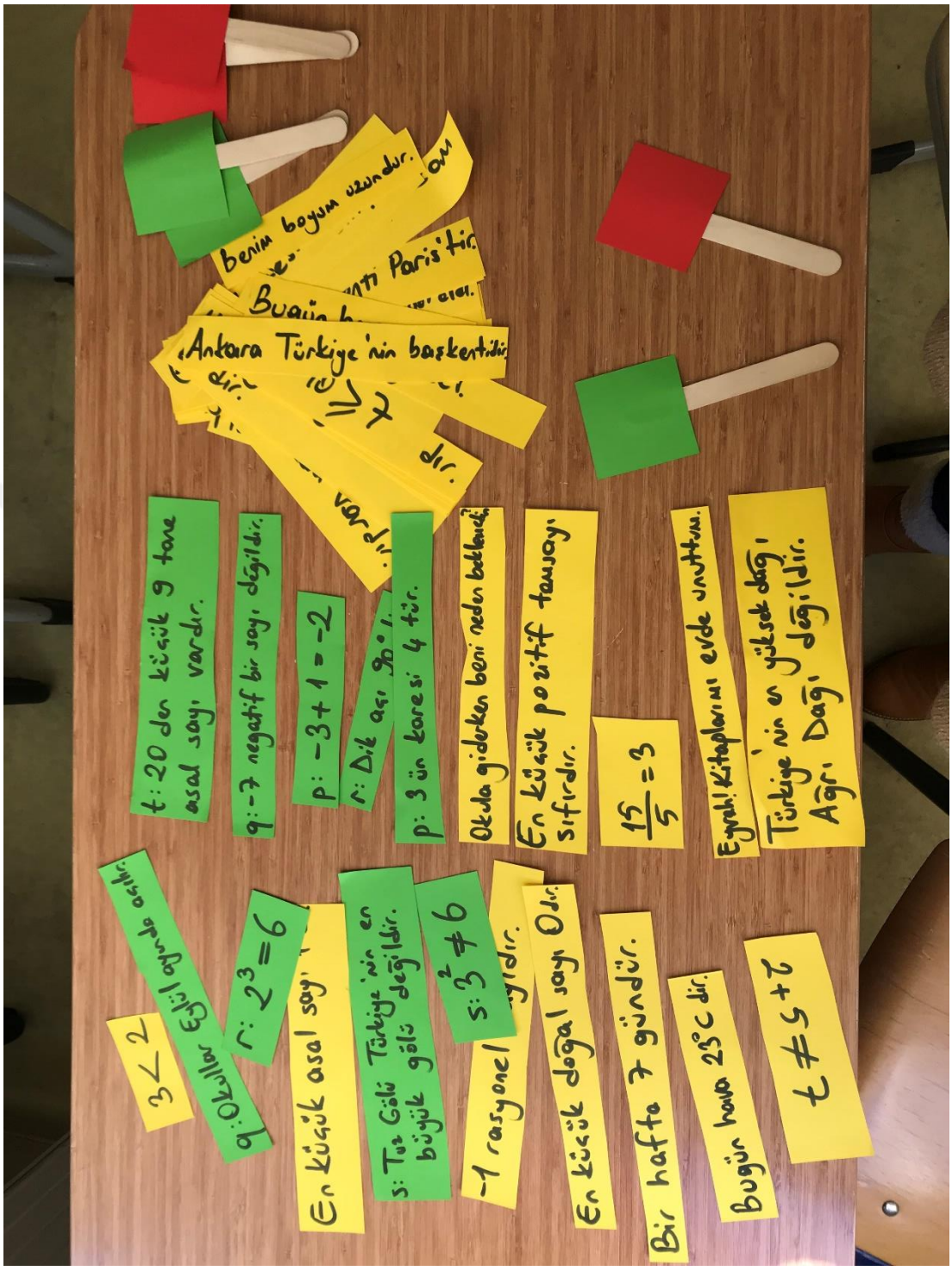
**20.** **Aşağıdakilerden hangisi bir aritmetik dizinin ilk beş terimi olabilir?**

A) 1, 1, 2, 3, 5
B) 1, 4, 9, 16, 25
C) 2, 4, 8, 16, 32
D) 3, 7, 11, 15, 19

**TEST BİTTİ.**
**CEVAPLARINIZI KONTROL EDİNİZ.**

ÖLÇME, DEĞERLENDİRME VE SINAV HİZMETLERİ GENEL MÜDÜRLÜĞÜ

**Appendix 3. Game of Proposition or Not**



## Appendix 4. Game of Sponge of Logic









## Appendix 5. Game of Guess the Compound Proposotion

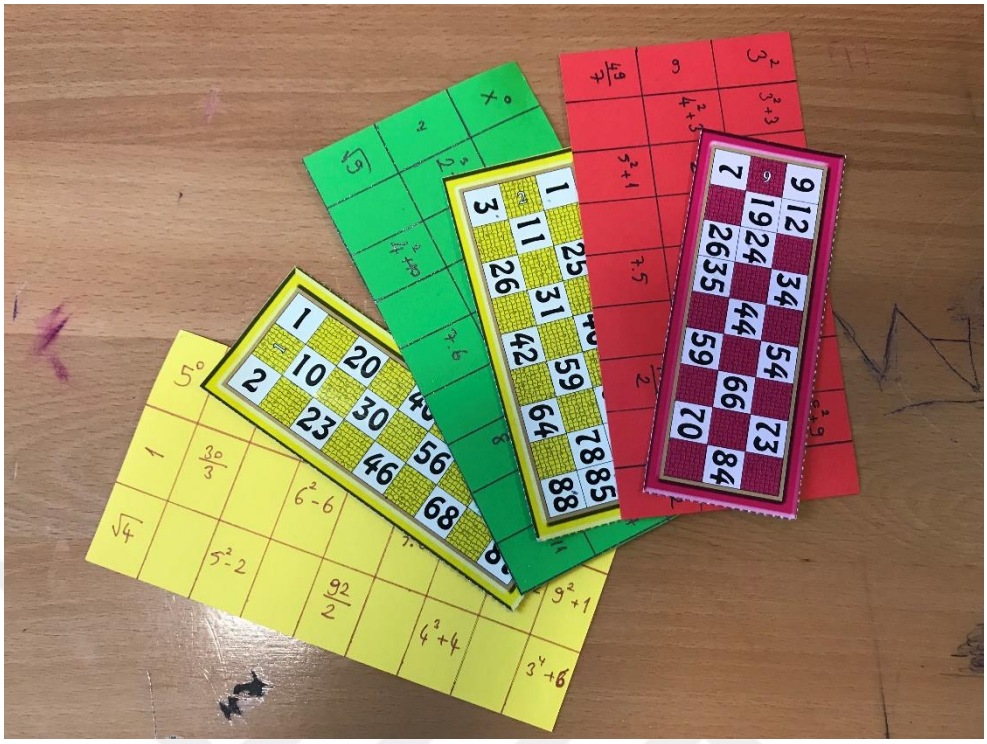


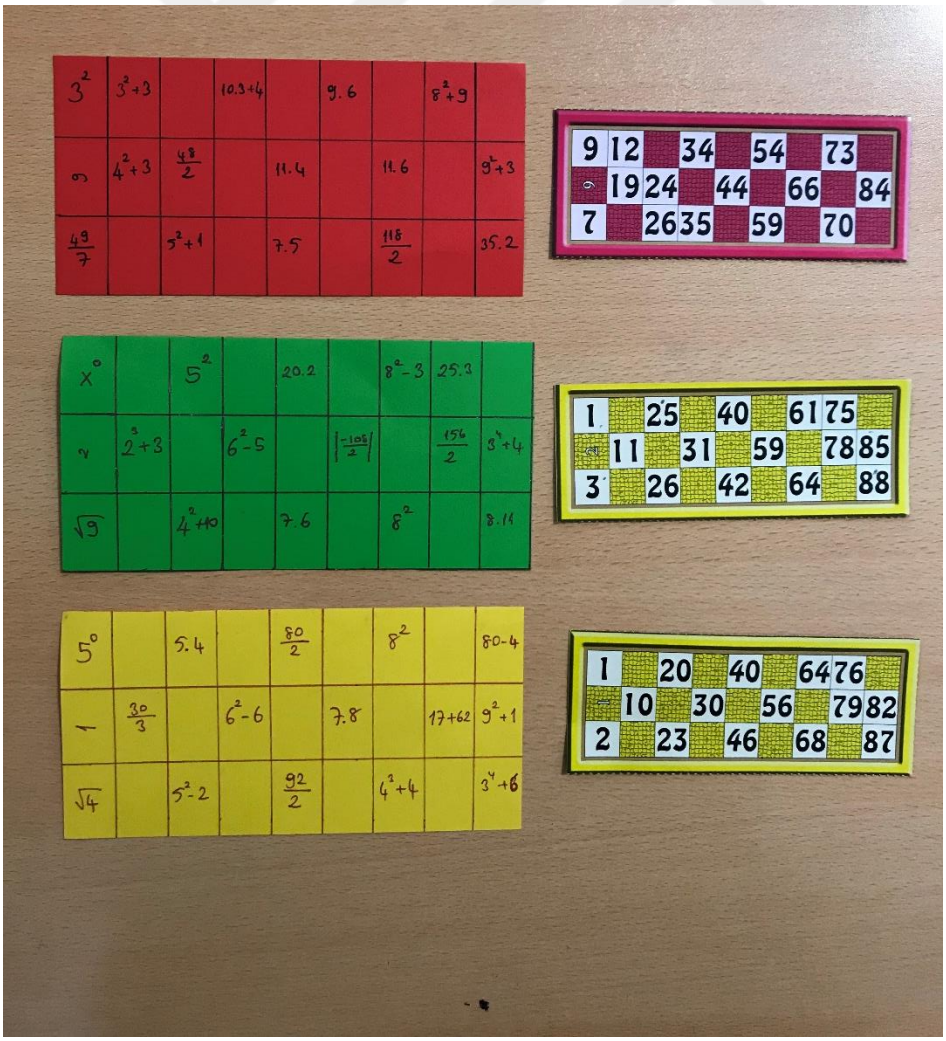
**Appendix 6. Set Game**





## Appendix 7. Maths Bingo Game





## Appendix 8. Common Examination as used Posttest

2018-2019 EĞİTİM ÖĞRETİM YILI İBRAHİM HAKKI ANADOLU LİSESİ

MATEMATİK DERSİ 1. DÖNEM 1. YAZILI SINAVI

| | |
|---|---|
| 1-) Aşağıdaki ifadelerden önerme olan ve olmayanları belirtiniz.<br>(……) 10 tane rakam vardır.<br>(……) Hep birlikte sinemaya gidelim.<br>(……) -1 rasyonel sayıdır.<br>(……) Bugün hava soğuktur.<br>(……) Bugün hava -5 °C dir. | 4-) $p \vee p \equiv 0$ , $r \Leftrightarrow q' \equiv 1$<br>olduğuna göre aşağıdaki önermelerin doğruluk değerlerini bulunuz.<br>a. $q \wedge (p' \Rightarrow r)$<br>b. $r \Rightarrow (p \vee q')$ |
| 2-) Aşağıdaki ifadelerin olumsuzlarını yazınız.<br>a. Doğal sayılarda çarpma işleminin değişme özelliği yoktur.<br>Olumsuzu:<br>b. 7-2=5<br>Olumsuzu:<br>c. $\forall$ x $\in$ R için $x^2 \geq 0$<br>Olumsuzu:<br>d. $\exists$ x $\in$ Z için, $\frac{x-1}{x} \in$ Q<br>Olumsuzu:<br>e. Okullar eylül ayında açılmaz.<br>Olumsuzu: | 5-) Aşağıdaki önermelerin eşitini yazınız<br>a. $p \vee p$<br>b. $p \veebar p'$<br>c. $p \Rightarrow 0$<br>d. $p \wedge 0$<br>e. $1 \vee q$<br>f. $p \Leftrightarrow p$<br>g. $1 \Leftrightarrow p$<br>h. $1 \veebar$ p<br>i. $p \Rightarrow p'$<br>j. $p \wedge p'$ |
| 3-) $p \equiv 1$ , $q \equiv 1$ , $r \equiv 0$<br>Buna göre;<br>a. $(p \wedge q) \Rightarrow r$<br>b. $(p \Rightarrow q)' \vee (q \Rightarrow r)$<br>c. $(p \veebar$ r) $\wedge$ (q $\veebar$ p) | 6-) $(p \vee 0) \wedge (p' \vee 1)'$<br>Önermesinin doğruluk değerini bulunuz. |

| | |
|---|---|
| 7-) A= $\{1,2,a,\{b\},\{1,2\}\}$ kümesi ile ilgili aşağıdakilerden hangileri doğrudur?<br>a. s(A)=6<br>b. 1∈A<br>c. {1} ∈A<br>d. {1,2} ∈ A<br>e. $\{2,a\}$ ⊂A | 10-) A, B ⊂ E olmak üzere<br>s(A)=15, s(B)=8 ve s(A∪B)=20 olmak üzere, s(A∩B) kaçtır? |
| 8-) K= $\{x\mid -2<x\leq 4, x\in\mathbb{Z}\}$<br>L= $\{x\mid x<11, X=2k, k\in\mathbb{N}\}$<br>kümeleri verilmiştir. Buna göre;<br>a. K ve L kümelerini liste ve Venn şeması ile gösteriniz<br>b. K ve L kümelerinin alt küme sayılarını bulunuz. | 11-) Bir toplulukta piyano veya keman çalanlarla bu enstrümanlardan hiçbirini çalmayanlar vardır. 4 kişi sadece piyano, 8 kişi sadece keman çalmakta ve 7 kişi de hiçbir enstrüman çalmamaktadır. Bu toplulukta 21 kişi bulunduğuna göre keman çalan kaç kişi vardır? |
| 9-) A=$\{x,y,z,1,2\}$ kümesinin alt kümelerinin kaç tanesinde<br>a. 1 bulunuz?<br>b. x bulunmaz?<br>c. 2 ve y elemanı birlikte bulunuz? | 12-) Futbol, voleybol ve basketbol sporlarından en az birinin oynandığı bir toplulukta, futbol ve voleybol oynayan 7, voleybol ve basketbol oynayan 5, futbol ve basketbol oynayan 6 kişi vardır. Her üç oyunu da oynayanların sayısı 4 , yalnız bir oyun oynayanların sayısı 15 olduğuna göre, bu toplulukta kaç kişi vardır? |

## CURRICULUM VITAE

I was born in Fatih, Istanbul in 1987. I studied middle and high schools in Istanbul. In 2010, I graduated from the Department of Mathematics in Faculty of Arts and Sciences in Yıldız Tecnical University. In order to become a teacher, I got Pedagogical Formation Certificate in Yıldız Technical University in 2012. After taking the required exams, I started teaching Mathematics in public schools in Sanliurfa and Ankara, Turkey. I am married and have been teaching in Istanbul since 2015. Despite the fact that I have majored in Mathematics, I have studied in Humanities and Social Sciences Postgraduate Program due to my personal interest in and enthusiasm for social sciences.