



**EDUCATIONAL GAME-BASED LEARNING FRAMEWORK ABOUT  
LAWS OF THE GAME FOR FOOTBALL REFEREES**

**ULAŞ GÜLEÇ**

**JANUARY 2015**

**EDUCATIONAL GAME-BASED LEARNING FRAMEWORK ABOUT  
LAWS OF THE GAME FOR FOOTBALL REFEREES**

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THE GRADUATE SCHOOL OF NATURAL AND APPLIED  
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**BY  
ULAŞ GÜLEÇ**

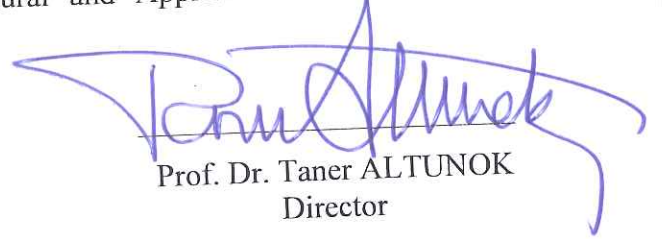
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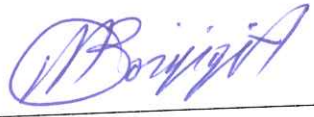
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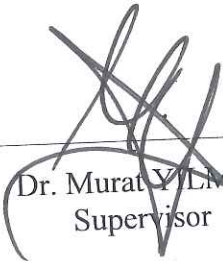
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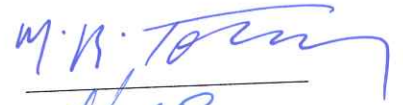
  
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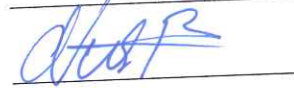
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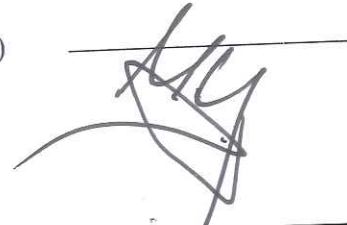
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## **ABSTRACT**

### **EDUCATIONAL GAME-BASED LEARNING FRAMEWORK ABOUT LAWS OF THE GAME FOR FOOTBALL REFEREES**

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Digital game-based learning environments provide emerging opportunities to overcome learning barriers by combining newly developed technologies, and traditional game design. Many scholars are actively pursuing serious gaming research, and adopting interactive learning techniques to complement classroom training. Serious games frequently focus on playful activities, which are connected with games and learning, and commonly concerned with the educational nature in a specific field. One particular example is that the FIFA (Federation Internationale de Football Association), which spends a significant amount of money on training referees annually (e.g. 40 million US dollars for 60 referees during the World Cup 2010). In addition, Turkish Football Federation is investing on the education and training of football referees about the football game rules (i.e. the Laws of the Game). However, no previous study has been conducted to reveal the importance of games to teach the football game rules to Turkish football referees.

This study proposes a mixed-method research approach to design a game-based learning framework particularly for improving the learning process of the football referees in Turkey. To evaluate the game and play activities of our approach, firstly, a paper-based prototype was designed and play-tested by a group of expert reviewers. Secondly, a serious game was developed, and tested on a group of referee candidates. The examination results of referees were compared with two sample t-test for the referees, who worked with traditional methods and for those who worked with the developed tool. The findings of the current study confirmed that a game-based learning environment has a lot of merits over paper-based approaches.

**Keywords:** Game-Based Learning, Educational Game Design, Football Referees, Laws of Game, Learning Process, Decision Making Mechanism.

## ÖZ

### **FUTBOL HAKEMLERİ İÇİN FUTBOL OYUN KURALLARININ EĞİTİMİ AMAÇLI OYUN TABANLI ÖĞRENME ÇERÇEVESİ**

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Dijital oyun tabanlı öğrenim araçları, kişilere yeni teknolojiyle geliştirilen araçlar ile geleneksel oyun tasarımı metodlarını birleştirerek öğrenme işlemini zorlaştıran engelleri ortadan kaldıran fırsatlar sunar. Birçok bilim adamı interaktif öğrenme teknikleri ile sınıf içi eğitimini adapte edebilmek için eğlencenin yanına öğrenimi de yerleştiren ciddi oyunların geliştirilmesi için araştırmalarına aktif bir şekilde devam etmektedirler. Eğlencenin yanına öğrenime de ağırlık veren ciddi oyunlar belirli alanlara yönelik geliştirilebilirler. Bu alanlara örnek olarak, Uluslararası Futbol Federasyonları Birliği (FIFA) 'nin 2010 dünya kupasında görev yapacak olan 60 futbol hakeminin eğitimine yıllık 40 milyon Amerikan doları harcaması ve buna ek olarak Türkiye Futbol Federasyonu'nun futbol hakemlerini futbol oyun kuralları hakkında eğitmek istemesi ve Uluslararası Futbol Federasyonları Birliği'nin Futbol Oyun Kuralları kitabından başka bir alternatifin bulunmaması bu alanda bir ihtiyacın olduğunu ortaya çıkarmıştır.

Bu çalışma, Türkiye'de ki futbol hakemlerinin öğrenme aşamalarını geliştirmek amacıyla oyun tabanlı öğrenim platformunu karışık araştırma metodunu kullanarak tasarlamayı hedeflemiştir. İlk olarak, oyunu ve oyunun oynanabilirliğini test etmek amacıyla masa oyununun prototip hali hazırlanmış ve oyun testleri hakemler tarafından oluşturulmuş gruplar tarafından yapılmıştır. Daha sonrasında, oyunun dijital hali geliştirilmiş ve futbol hakemleri tarafından test edilmiştir. Geleneksel yöntemler ile çalışan hakemlerin sınav sonuçları ile oyun platformunu kullanarak çalışan hakemlerin sınav sonuçları iki örneklem t-testi kullanılarak analiz edilmiştir. Yapılan çalışmanın sonuçlarına göre, oyun platformunun geleneksel yöntemlere göre birçok avantajının olduğu ortaya çıkmıştır.

**Anahtar Kelimeler:** Oyun Tabanlı Eğitim, Eğitici Oyun Tasarımı, Futbol Hakemliği, Futbol Oyun Kuralları, Öğrenim Aşamaları, Karar Verme Mekanizması.



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## LIST OF ABBREVIATIONS

FIFA	Federation Internationale de Football Association
UEFA	Union of European Football Associations
TFF	Turkish Football Federation
LOG	Laws of the Game
DGBL	Digital Game-Based Learning
SR	Soccer Referees
HTML	Hyper Text Markup Language
CSS	Cascading Style Sheets
JS	Java Script
SQL	Structured Query Language
LINQ	Language Integrated Query
URL	Uniform Resource Locator



## CHAPTER 1

### INTRODUCTION

Educating the football referees about the rules of the football game is a very hard and challenging task. Unfortunately, there are a limited number of digital resources especially for training the novice referees. There is a *Federation Internationale de Football Association (FIFA) - Laws of the Game (LOG)* book [26] that consists of the football game rules. The referees should study from this book to improve their knowledge level, however, we should present alternative ways to the referees, because reading book is not an interesting activity for individuals, especially for *males*. Here, we emphasize *males*, because, when we look at our group, male soccer referees are much more than female soccer referees. Gomleksiz [34] claims that females are more interested to study from a book than males. In support, Arslan et al. [6] determine the reading habit of students at Pamukkale University School of Sport Science and Technology. The results show that female students seem more eager to study from the books.

If novice football referees cannot improve themselves by using the LOG book as an educational tool sufficiently, they make important and critical mistakes while they are refereeing football matches. Maybe some authorities consider that how just one mistake can be so critical in a football match, however, the football game has a business segment, which is a significant economic force. Dobson and Goddard [20] claim that football game has expanded surprisingly in the early of 1990s. Players' salaries have risen incredibly. Football clubs have invested a lot of money to create successful teams. There has been a dramatic increment in the number of football fans. Football clubs have rebuilt their stadiums to accommodate more people. Thus, several million people watch the matches in the stadium in each season, and this is a

very huge source of income for teams. On the other hand, people, who do not have any chances to attend to watch the matches in the stadium, watch the matches via television. Hence, the contract revenues, which are organized between the football clubs and television channels, reach huge amounts. Additionally, sponsors put their logos on the team jerseys as an advertisement. Hamil and Walters [35] indicate that financial budgets of the clubs in the Premier League have increased by 900% from £170m to £1530m between 1992/1993 season and 2006/2007 season.

Guilianotti and Robertson [32] claim that football is the world's most popular sport. Approximately, 33.4 billion individuals are interested in football games. Turnovers, which were organized in 2001, have fetched £250 billion to FIFA. Morrow [59] describes the football game as *people's game*. He mentions that revenues have increased dramatically in the last decades. In fact, the football game produces a significant economic impact (i.e. jobs, income) on many countries. As the main decision-maker, team managers, players and supporters are aggressively protesting the referee if there is an inappropriate decision during the match. Sometimes, these aggressive behaviours can expand to rush the referees. In order to prevent these types of bad situations, we have to reduce the number of mistakes in the matches. Ultimately, the education of the referees comes into prominence.

In this study, our aim is to develop a serious game, which can be used by the football referees to improve their knowledge level about the rules of the football game and eventually advance on their decision making skills. Although the LOG book consists of the rules of the football game, it does not have any contents, which are useful for improving decision making skills of the football referees. In order to advance decision making skills of the referees, videos are very useful tools. Volandes et al. [88] indicate that visual contents improve decision making skills of individuals. In support, Trevena et al. [85] have similar work, which aims to improve individuals' understanding level and knowledge capacity and decision making abilities. The results show that communication tools, such as video, are useful to achieve this aim. Savoldelli et al. [72] state that video tools provide maximum learning. Plessner et al. [68] conduct a study that consists of more than 2000 videos, which are about fouls

and misconducts. The aim of their study is to increase accurate decisions, which are made by the football referees during the matches. This system can be described video test and feedback system for the referees. The results show that videos increase decision skills of the referees. In sum, many of the previously mentioned studies suggest that videos are beneficial tools for improving decision-making skills of individuals.

In the proposed game system, we have both text-based questions, which assess the participants' knowledge about the rules of the football game, and video questions, which show the critical positions in the matches to test the skills of referees for capturing debatable position. Thus, the system does not only offer practical information to improve individuals' knowledge level about the rules of the football game, but it also suggests a method for improving decision making abilities of the football referees.

The overall structure of the study takes the form of seven chapters; including this introduction chapter. This thesis is structured as follows:

**Chapter 2** begins by reviewing the literature of the research and gives several different game definitions, factors affecting game design and highlights the relevant topics such as digital game-based learning.

**Chapter 3** describes based on the research techniques, which are used in our study. Then, a research design used in this study is illustrated. After that, the mechanism of the game, game dynamics, game rules and participants of the study are clarified.

**Chapter 4** details the system description and requirement analysis. Then, we will explain the detailed information about the tools, which have been used by us to develop our game platform and the reasons why we have selected these tools. Furthermore, the interfaces of the system, the users and their functionalities in the system, the structure of our database design and the relationship between the data tables are introduced.

**Chapter 5** details our testing strategy and applied statistical tests. Then, the results of test are analyzed and illustrated by using visual elements.

**Chapter 6** summarizes the overall study. Then, the conclusion of the study is explained in detailed.

**Chapter 7** explains what we will do for this study in the future.

## CHAPTER 2

### BACKGROUND AND RELATED WORKS

#### 2.1 Introduction

This chapter starts with the definition of games, and explains its relationship with game-based learning. Furthermore, it details the advantages of digital game-based learning, and discusses the factors that affect digital game-based learning. Next, game-based learning studies, which were developed in sports area, are presented and analyzed in detailed. Finally, a brief summary of this chapter will conclude the literature review of the study.

##### 2.1.1 Definition of games

In order to comprehend the notion of games completely, one should analyze the meaning and definition of the game in much more detailed. There are a number of different definitions of game in the literature [39, 11, 79, 7, 17, 71, 42].

According to Huizinga [39], games are free events, which absorb the individuals from the life's common flow entirely and connect them into a social virtual world, which is constrained by its rules. Caillois [11] defines a game as a set of imaginary activities, which are played voluntarily by the participants and have distinctive outcomes based on players' strategies and unique rules. Suits [79] reports that results of games are formed by application of rules. Avedon and Sutton [7] claim that game mechanisms and rules bring into balance for outcomes of the game, which can be also called to prevent *disequibrial outcome*, which is a conflict between two forces where a game might likely to end with a winner.

Crawford [17] examines that games show up from the deficiencies and characteristics of human creation.

### 2.1.2 Factors affecting game design

In his game description, Crawford proposes a different perspective. He suggests that *conflict* should be considered as a factor affecting game design in addition to other three factors, namely representation, interaction and safety.

- **Representation** is a factor, which means that a game should reflect the real facts of the world. If the similarity ratio between the game and the real world is higher, the game becomes a huge success [17].
- **Interaction** factor should make the players to include into our game completely. The contents of games should not be static, they should be designed dynamically. The amount of dynamic content determines the interaction level between players and games [17].
- **Safety** factor is declared a dangerous factor, because, the game is a way to experience the facts of real world. This experience should not canalize the players to make violence in real world. Therefore, the contents of the games should also be designed carefully. In addition, there should be debate between the players, however, this debate should not continue in real world [17].
- **Conflict** factor is born from interaction factor naturally. The rules of games prevent the players to complete the game easily, however, the balance of difficulty level between players and game rules should be regulated conscientiously. The rules should not break the players' enthusiasm [17].

Salen and Eric [71] mention *conflict* as a factor in their definition of games, which states that there should be an artificial conflict between the players in order to get

quantifiable outcome. Juul [42] defines a game as a system, which is constituted by the rules that creates a relationship between the game, the player, and the outer world.

### **2.1.3 Digital game-based learning**

The games can be used in different areas. Hence, the definitions of the game should not consist of the same terms. They should change for purposes of the game. For instance, digital game-based learning is one of the area that is derived from the usage of the game. The main idea behind digital game-based learning (DGBL) is to educate the participants by using a video or a computer game [67]. The goal is to improve the learning process by utilizing a set of game elements and foster interactivity [66]. Starting from this point of view, the definition of digital game-based learning appears to have a significant overlap with game development, technologies, and research. In particular, serious games are the games explicitly focused on educational task, awareness, and learning. The aim of this kind of games is to educate and inform people about a variety of selected topics [1].

Prensky [69] emphasizes the importance of video games in the education domain. Furthermore, he states that the learners require to be guided with alternative choices to learn new things effectively. Computer and video games present these required novel ways for the learners. The most important advantage of using video games in education is that a clear majority of people have a procrastination behaviour (i.e. purposeful delay to start a study). The history of educational studies shows that individuals are not intrinsically motivated to study [47]. Through computers and video games' interesting characteristic, this problem can be gotten over. In addition, Knaus also quotes Ackerman's *play is our brain's favorite way of learning things*. Both this phrase and Prensky's statements [69] support the fact that games, especially computer games, have a significant impact in the education domain.

In support, Gomes and Teixeira [33] indicate that individuals, who live in twenty first century, try to seek alternative ways for learning. However, traditional education

does not meet the requirements of new generation people. In fact, video games become a significant part of educational activities for the new generation people, which present the learning objectives in various alternatives ways for (i) game-based [67, 45, 86], (ii) learning and simulation [30], (iii) improving intrinsic motivation [15], (iv) teaching mathematics [46, 49], teaching sports [91], training rugby referees [55], improving skills of tennis players [24], in high school computer science education [64], improving decision skills of soccer referees [74], and teaching rules of football [31, 74].

Pivec et al. [67] state that there are not enough suitable and readable materials for learners. Therefore, the researchers try to seek new methods to impress the learners for studying and learning. There is a huge requisition to originate learning materials, which support participants' learning process. To realize this issue, it is essential to produce strongly active interaction between the user and training materials. Computer games play a very important role in this subject. The notion of game-based learning establishes a connection between simulation and the real world by using a game context. During the exploration of the game context, the players (we can call them learners) can improve their knowledge levels. Van Eck [86] identifies three main benefits regarding the games as educative tools where the notion of game-based learning should be so effective and popular.

By following Van Eck [86], these 3 benefits can be listed as follows:

- **The first benefit** is the number of resources. There are a large amount of resources on the basis of *educative game design* in the literature. Consequently, individuals can easily use these resources to utilize an educational game-based framework. In light of these, he suggests that more effective and useful games can be designed under the favour of newer findings. As more games are proved to be useful in education domain, new studies may follow up. Well-designed games breed high quality studies; well-researched studies breed top quality games. Therefore, this forms an advantageous loop here.



- **The second benefit** is that the traditional education system does not address for the new generation learners. They attach importance to learning materials practically, not theoretically. Therefore, typical parts of a game system such as visual components and editing materials provide quick interaction for the learners.
- **The third benefit** is that games are so popular on the last years and they are getting more popular day by day. In 2004, there were 293.6 million people in the United States and 248 million games were sold. This quantitative information shows how much the games are very popular, which can be beneficial in education.

Garris et al. [30] agree the factors that are suggested by Van Eck. In addition, their research confirms that computer games are commercially popular. In addition to this popularity, recently, computer games become more attractive in the field of education. This research also indicates some reasons, why games are becoming so popular in education field. Firstly, traditional education model in which the learner have to step to the lectures cannot answer the learners' requirements [30]. Hence, there is a transfer from traditional lecture-based model to new generation interactive model, which is certainly a learner-based model. In this approach, learners have more actively participating. Thus, learners become more motivated to work, because, they are at the center of the system. Secondly, some researches (e.g. Cordova and Lepper's study [15]) confirm that games are very efficient and useful tools for learning. Facer [23] indicates that there are a lot of people especially, young people, who spend a significant amount of time to play computer games. It shows that games have ability to pull toward the people to themselves. In order to benefit this motivational power of games, researchers and teachers start to design games for teaching. When the games are applied in the elementary education, a set of outcomes, which improve the child's skills, are attained. These outcomes are:

- **Communication and working with others:** When the children play a game, it is observed that they incorporate a communication between each other. They share their products and resources. In this way, they learn how to contact with the people and how to work or study in a group [23].
- **Problem Solving:** In general, a game offers several challenges to children. To address these challenges, children face several difficulties and eventually solve a set of problems. They must develop strategies to overcome these challenges. This helps to improve their problem solving abilities [23].

McFarlane et al. [56] report that games constitute a convention, which completes the learning process with reaching results of the assignments. During such a phase, knowledge level of the learners is increased through progressing context of games.

Papert [65] divides definition of enjoyable education with games into two parts by using the term *edutainment* as *edu* and *tainment*. The *tainment* part means that the player performs correct movements in order to pass to the next levels until reaching a final purpose. In order to achieve *edu* part, the challenges in the game should be generated by the school exercises, e.g. the four basic operations in mathematics. Designing *edu* part is so critical for the game designers. This part should not be boring and it should be also educative. Hence, the game designers should collectively figure out the nature of learning better than instructors. The contents should be designed to support creativity, and further they should be challenging and fun. Kirriemuir [45] emphasizes that computer games have been thought as de-motivator for students. However, today, researchers and designers of learning materials try to demolish this idea. Moreover, they try to change this idea to an opposite way, which is that computer games support a child's learning process. Several studies suggest that computer games have a great importance in our daily life.

Nowadays, the marketing values of games has reached billions of dollars [48, 54, 16]. Therefore, these values suggest that computer games can be beneficial in education. They should be used in a positive way. As we mentioned above, there are a lot of advantages of game-based learning in distinctive domains. However, if the

game cannot be designed effectively and relevantly, the learners cannot benefit from these advantages. Therefore, design of a game plays an critical role to make games useful in education. Kirriemuir [45] argues that designing a game is a complex activity. There are a lot of criteria, which should be considered like age, gender, study area, field of interest, location and the level of engagement, which is also called *flow* between player and game. In fact, it should be balanced carefully. In order to fulfill these quality constraints, game design should consist of some qualitative aspects. These aspects can be identified as follows:

- **Graphical design of the game** is necessary to attract learners' attention [45].
- **Defining clear assignments** are also important. The assignments should be well-balanced to keep individuals in game-play [45].
- **Continuous feedback** has a critical role, because, the learners would like to provide continuous feedback about a given task. In other words, they like to learn their level of progression [45].

In addition, Klawe [46] indicates other measure in her project, which is *E-GEMS* (The Electronic Games for Education in Maths and Science) project that surveys the effectiveness of using computer games for teaching mathematics for classes 4 to 8. Klawe points that intensive interactivity between lecturer vs student and student vs student. Hence, investigation, challenges, puzzles, grading, sound effects and graphics are very important topics, which should be materialized in a game design, to take learners' attention.

Johnson [40] recognizes four factors, which should be found in the design of a game. These factors are: *interface of the game*, *a sense of self-control*, *chance of improving strategies* and *the invention of new information*.

Rieber [70] brings different point of view for exploring knowledge, who considers that “*microworlds*” should be created for learners in form of a game. *Microworld* means that it is a small world that is customized by some special field of learners' interests and responses all requirements of the learners. Instead of feeling to study in

a subject area, learners should feel like living in a world. During such a process, the learners should be educated in their fields of interest. Rieber argues that the best way of learning Spanish is to go Spain. From this point of view, games should be designed similar to the real-world. In order to provide such an environment, simulations come into prominence of designing games. Interface, target system and feedback constitute successful simulation. Cavallari et al. [13] also support using simulations in game design. They claim that simulations support students to make decisions and interpretation by using information, gain having foresight ability and improve visual and drawing talents.

#### **2.1.4 Digital game-based learning in sports**

Games and mobile learning platforms help people to enhance their knowledge level. There are a variety of real life studies and applications about the subject matter. For example, Kuo [49] indicates that the games have ability to deal with the motivation problem of learners, especially for those who have problems for starting to study. In this study, the main problem in the education system is indicated that although there are many contexts to support learning, there are not enough contexts, which catch students' attention. Therefore, Kuo has separated the students into 2 groups, which are multimedia learning group without game features as a control group and game-based learning group as an experimental group. According to results of this case study, game-based learning environment enhances students' interest significantly. A reason for this is that trainees are interested in the software systems, which are developed by using new technologies.

Yang [91] develops visual referee learning system for volleyball referees. There are 2 different user types, which are instructors and students in this system. The instructors constitute item pool, which contains videos and questions. Also, the instructors can prepare quizzes from the related questions. The students can reach and solve these materials. As a result, they try to understand the effectiveness of the system of information technology and this system brings positive energy to the referees to improve their knowledge and judging levels.

To educate rugby referees by improving referees' decision making skills with using video based training programs, Mascarenhas et al. [55] conduct a case study. They separate the referees into 2 groups. A control group, which consists of 15 members, and an experimental group, which consists of 41 members. These two groups watch the same videos and participate both pre and post-tests. However, there is one difference between them: the members of control group do not have chance to receive experts' explanations on the positions. Finally, results show that video based training program has major advantages for enhancing referees' decision making skills.

Farrow and Abernethy [24] develop an application to help training of junior tennis players. The aim of this study is to gain prediction ability how the player should shoot the ball with intended properties such as speed, direction and shooting style. The players are divided into the groups equally. Some groups watch the videos and get the feedbacks of each video. Final results illustrate that the players, who watch the videos, improve the shooting ability much faster than other players, who do not watch the videos.

In addition, Papastergiou [64] has a study, which evaluates the use of computer games that are useful for computer science course in high schools in Greece. In this study, there are two groups for testing tool. One of them is gaming application group, which has 47 members, and the other one is non-gaming group, which has 41 members. The first group plays the game and receives feedback for each question in the game. The second group continues to study in a traditional way. At the end of the study, results, which are gotten from pre and post-test, show that computer games are beneficial for educating learners [64].

It has been observed that there are number of applications of game based learning approaches in different domains such as elementary education, high school education, sports etc. Similar to our objectives, there are a number of studies to develop for educating soccer referees about the laws of the game and improving their

decision making abilities. Hence, when we look the literature, there are some projects, which are completed for this aim. For example, Schweizer et al. [74] develop a video based training tool for improving the accuracy rate of soccer referees' decisions. During match duration, the referees have to make decisions for controlling the match. Helsen and Bultynck [37] observe that the average number of decisions in 31 matches, which were played in EURO 2000, is 137 per a match. Nearly 25 percentage of this number of decisions are incorrect. Another research, which was completed by Van Meerbek et al. [87], shows that 17 percentage of total number of decisions were incorrect in World Cup 1986, Mexico. These studies present that even though the referees do their business well, their decision making skills can be improved. In order to achieve this idea, referees are incorporated into system, watch videos, make decisions and collect their feedbacks and results in Schweizer and his friends' study [74]. According to the results, decision making skills of the soccer referees advance in positive way. Furthermore, Xian [90] considers the soccer referees as a comprehensive evaluation area including the division line, competition skills, and knowledge level about football game rules of referees. His aim is to develop a web based multimedia teaching system, which educates the referees about the rules of football competition. According to the results of cognitive and post-tests, this system can optimize the teaching process. Gilis et al. [31] develop an approach to explore the offside decision-making process, and the factors affecting the incorrect decisions. They conclude that more research needs to be conducted for investigating the benefits of computer-based training of referees for their decision-making skills. Catteuw [12] signifies that 7.6 percentage of offside decisions are incorrect. In order to reduce this ratio, there are 57 assistant referees (29 from assistant referees of Federation Internationale de Football Association (FIFA) and 28 from Belgium Football Federation), who join to system. In this system, there is a computer-based tool that demonstrates offside positions to the assistant referees as video. The results show that all assistant referees improve their decision making abilities, however, FIFA assistant referees are more successful than Belgian assistant referees [12]. As a summary, Table 1 shows that games and the systems, which are developed with using features of information technology, are very useful and effective tool for teaching learners in different areas.

<b>Authors</b>	<b>Target Group</b>	<b>Problem or Aim</b>	<b>Results</b>
Kuo [49]	Education of 3rd Grade Students	There are not enough contexts, which catch students' attention and motivation problem of learners, who have problems for starting to study	Game-Based Learning environment enhances students' interest significantly
Yang [91]	Training of Volleyball Referees	To improve knowledge and judging level of volleyball referees	The system, which was developed by benefiting the characteristics of information technology, is an effective tool to train the volleyball referees
Mascarenhas et al. [55]	Training of Rugby Referees	The aim is to improve referees' decision making skill with using video based training program	Video based training program is useful for enhancing referees' decision making skills
Farrow and Abernethy [24]	Training of Junior Tennis Players	The aim is to gain prediction ability about shooting and intended properties	Results show that videos are effective tools to develop shooting skills of the players
Papastergiou [64]	High School Students, who take Computer Science course in Greece	To evaluate computer games are useful for teaching Computer Science course	Computer games are beneficial for educating learners
Schweizer et al. [74]	Soccer Referees	To improve the accuracy rate of soccer referees' decisions with using a video based training tool	Decision making skills of the soccer referees advance in positive way
Xian [90]	Soccer Referees	To develop a web based multimedia teaching system, which educates the referees about the rules of football competition	This system can optimize the teaching process
Gillis et al. [31]	Assistant Football Referees	To improve decision making skills of assistant referees in offside positions	All assistant referees improve their decision making abilities

**Table 1: Details of Applications**

### **2.1.5 Summary**

To sum up, there are several approaches for the use of game technologies to educate learners in a variety of domains. In fact, research suggests that it may have great benefits for the football referees. Firstly, games are entertaining for majority of the population, therefore new generation of referees prefer to learn while playing a game. In particular, such young participants are more attracted with what the games might offer, e.g. cooperation, competition, challenges, achievements, etc [44]. Secondly, video games provide an economic advantage. A web-based training system can host hundreds (even thousands) of attendees. The cost of game-based education is, therefore, certainly cheaper than on-site referee education. Although several attempts have been made for educating referees, more researches are required for improving the quality of referee education and ultimately the decision making skills of assistant referees. This study purposes an approach to improve the learning process of the football referees particularly in Turkey. In the next chapter, the proposed research approach, for designing a game based learning framework, is detailed.



## CHAPTER 3

### METHODOLOGY

#### 3.1 Introduction

This section describes the methodology of the current study. It starts with a brief description of the qualitative and quantitative research techniques. Next, it explains the mixed-method study and the reasons why it is selected as the research strategy. In the next section, the proposed game model is described. The phase I of the study encompasses the qualitative phase of the study, i.e. creation of paper-based prototype, expert reviews and play-testing. Further, phase II of the study considers the quantitative phase of the study where we develop a serious game, select a group of referees for planned assessments, and built test scenarios for the testing the application. Finally, we conduct an analysis according to research plan and the results will be discussed in the next chapter.

The holistic view of research design (two phases) of the proposed system is illustrated in Figure 1. The study uses a mixed method approach, which encompasses both qualitative and quantitative methodologies. Next, section explains the details of these techniques.

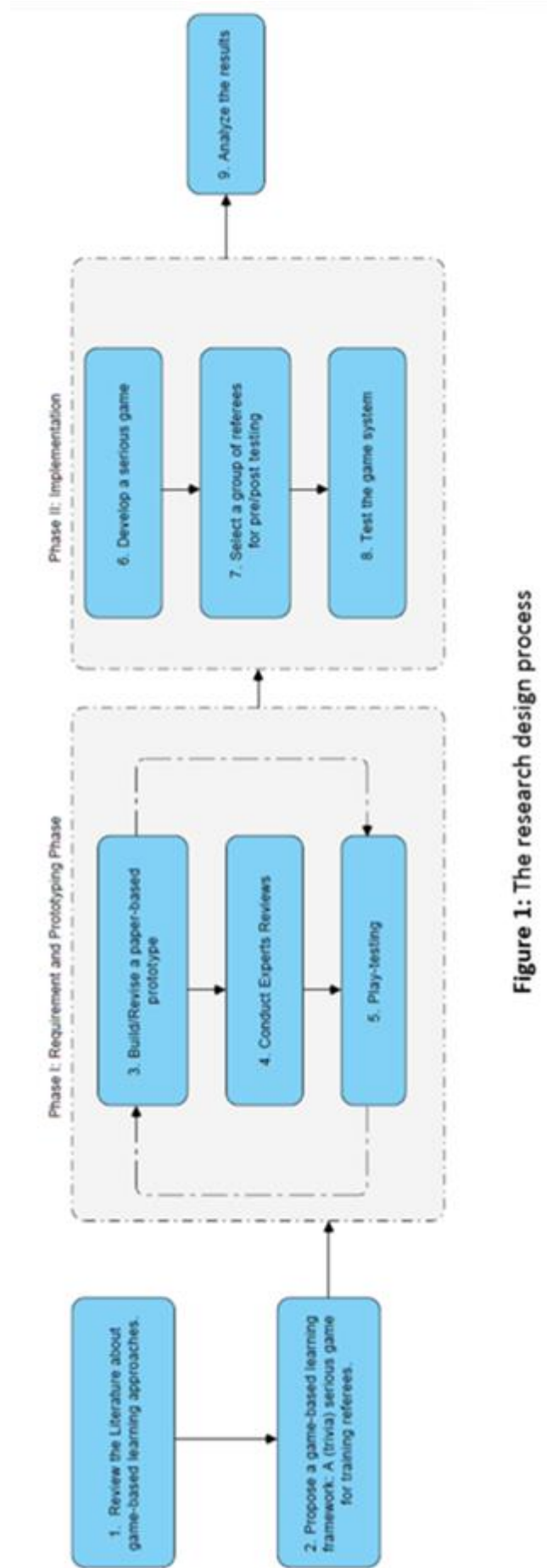


Figure 1: The research design process

### 3.2 Qualitative Research

Qualitative Research means that asking questions to people and observing the answers of the questions [83]. The main issue of this research type is to get individuals' opinions about the system with interpreting, observing, listening and surveying. This research methodology is also called “*numberless research*”. There is no numerical analysis in this methodology.

In our study, we have 2 different expert types, which are:

- Experts on Laws of the Football Game.
- Experts on Computer Science.

When we have prepared the questions, which are in 3 different question categories, we have taken views of experts, who are responsible for education of football referees in Turkish Football Federation. The contents of the questions should be prepared carefully. Answers of the questions are not disputable and difficulty level of the questions should be observantly, because they are used for education. Hence, we have used the questions, which are prepared by UEFA (Union of European Football Associations) and are sent to each European Local Football Federations.

Here, we have selected the questions for our game platform according to experts' opinions. As a second type, when we have designed of our game platform, we have benefited remarks of the experts, who have experienced in Computer Science, about the mechanism of the game and the design of the user interfaces, because, both mechanism of the game and user interfaces should be interesting and keep the users into the system. The mechanism of the system should be educative and should not be boring. Also, the user interfaces should be designed user-friendly. In order to achieve these tasks, we have presented our game platform to the experts and have taken their feedback.

### **3.3 Quantitative Research**

Quantitative Research means that collecting numerical data and analyzing them with using mathematical and statistical methods [60]. After analyzing the data, the results will appear and the researchers will pass judgment on the related subjects. Hopkins [38] defines quantitative research as specifying the relationship between an independent variable and a dependent outcome variable by using numerical analysis techniques. In order to determine such a relationship, experimental and control groups are constituted.

In this study, we have the same structure for determining relationship between experimental and control groups. We have 2 groups, which are control and experimental groups. The individuals, who are in the control group, do not have authorization for use of our system. They can use “Laws of the Game” book for developing themselves about the football game rules. The individuals, who are in the experimental group, can use our game platform to develop themselves about the football game rules. We assume that the individuals, who are in the experimental group, do not use book as an educational tool. In order to compare the effectiveness of our game platform and “Laws of the Game” book, we have tested the referees before starting education as a pre-test. Then, we have started training period for 1 month. After completing the training period, we have applied the test, which is the same as the pre-test and have attained the results of the post-test. Thus, we have gotten numerical data to understand effectiveness of the tools.

### **3.4 Mixed Research**

Johnson et al. [41] define the *Mixed Research* that is the combination of both qualitative and quantitative research methodologies. This methodology consists of both numeric and non-numeric analysis. Creswell and Clark [18] declare the *Mixed Research Methodology* as a bridge, which connects qualitative and quantitative research methodologies to each other. It benefits from advantages of both

methodologies. Tashakkori and Creswell [81] indicate that mixed research methodology utilizes the properties of qualitative and quantitative research methodologies in one research methodology.

In our study, we have selected to benefit from the properties of mixed research methodology, which consists of the properties of both qualitative and quantitative research methodologies. We have developed a game platform, which runs on Internet. Before developing this platform, we have gathered opinions, which are belong to individuals, who are experts in refereeing and computer engineering areas respectively, with interpreting them in order to develop effective educational tool, which supplies the standards of education and computer techniques as qualitative data. After developing the platform, we have applied pre-test and post-test to our target group in order to evaluate the effectiveness of our educational tool. We have reached the grades of each individual, who has joined to our education program, from both tests as quantitative data.

### **3.5 Mechanism of The Game**

As previously mentioned, we design a serious game to train the soccer referees regarding the rules of the football game. The game is a trivia game, which tests your knowledge about different aspects of football. The goal is to improve their decision making skills of referees using the element of fun. To avoid the complexities of programming and to test the initial game idea with experts, we initially build a paper-based prototype of the game model.

The prototype has four different kind of questions, which are related with the laws of the football game. These kinds are:

- **True/False Questions**
- **Multiple Choice Questions**
- **Video Questions**
- **Visual Questions**

In the first two categories, which are *True/False* and *Multiple Choice*, there are questions, which are taken from the real exams that are organized every year to measure referees' knowledge level about football game rules. In order to continue to be a referee, all referees have to participate and take valid scores from these exams. The third category, which is *Video Questions*, consists of videos from the critical positions, which occur in the matches that are played during whole season. In Turkey, the referees have to attend seminars, which are arranged every month. In these seminars, a person, who is from National Education Committee, shows the selected videos and tries to learn referees' opinions about the related video. The people, who are responsible for education in Turkish Football Federation, consider that videos are so important and effective tools to train the referees [58]. Also, the referees have to pass video test exams, which are constituted from these videos, in order to advance to higher division. Hence, this category is definitely necessary both referees and educators. In the fourth category, there are images, which show the critical positions of the matches. In each category, there are 25 questions. In order to win the game, a player should answer the questions correctly and finish the questionnaire before the other players.

### **3.5.1 The game dynamics**

To set-up flow of our game and put the rules into the game, we searched the notion of “game-dynamic” in literature. Schreiber [73] mentions this notion in his book. Schreiber defines this concept as model of play, which should be thought before the game mechanism, which is defined as the relationship between the all players and their moves to achieve winning condition of the game [93]. The game dynamic changes from game to game and affects core mechanics of a game. There are 10 different game dynamics. Nagarajan et al. [61] explain these dynamics as in the below:

- **Territorial Acquisition:** In this kind of a game dynamic, games present limited sources to players. Players try to be successful at the end of a game and survive during the game with using these limited sources. In order to remain alive in the game, the players should develop strategies. “Risk” and “Carcassonne” are example games of this kind of game dynamic [61].
- **Prediction:** This game dynamic urges the player to estimate what will occur in the next step and be awarded if players' decisions are correct. “Roulette” and “Rock-Paper-Scissors” are examples of this game dynamic [61].
- **Spatial Reasoning:** In general, this game dynamic includes puzzles. Players try to pair up game elements in correct form. “Tetris”, “Tic-Tac-Toe” and “Connect Four” are instances of this kind of game dynamic [61].
- **Survival:** Players scramble constant life-and-death struggle in this kind of the game dynamic. The players have a constant life value and try to defend this value against reducing by the other players or computer. “Call of Duty” is an example of this game dynamic [61].
- **Destruction:** This game dynamic is similar to “*Survival*” game dynamic. The players destroy the game elements with using their weapons to progress in the game [61].
- **Building:** In this game dynamic, the players create their avatars and start to develop avatars' abilities and skills. The aim is to create better character in the game. “SimCity” can be shown as an example of this game dynamic [61].
- **Collection:** This game dynamic is seen in card games generally. In these type of games, the players try to collect the most amount of resources like gold coins, buildings, rings etc. to win the game [61].

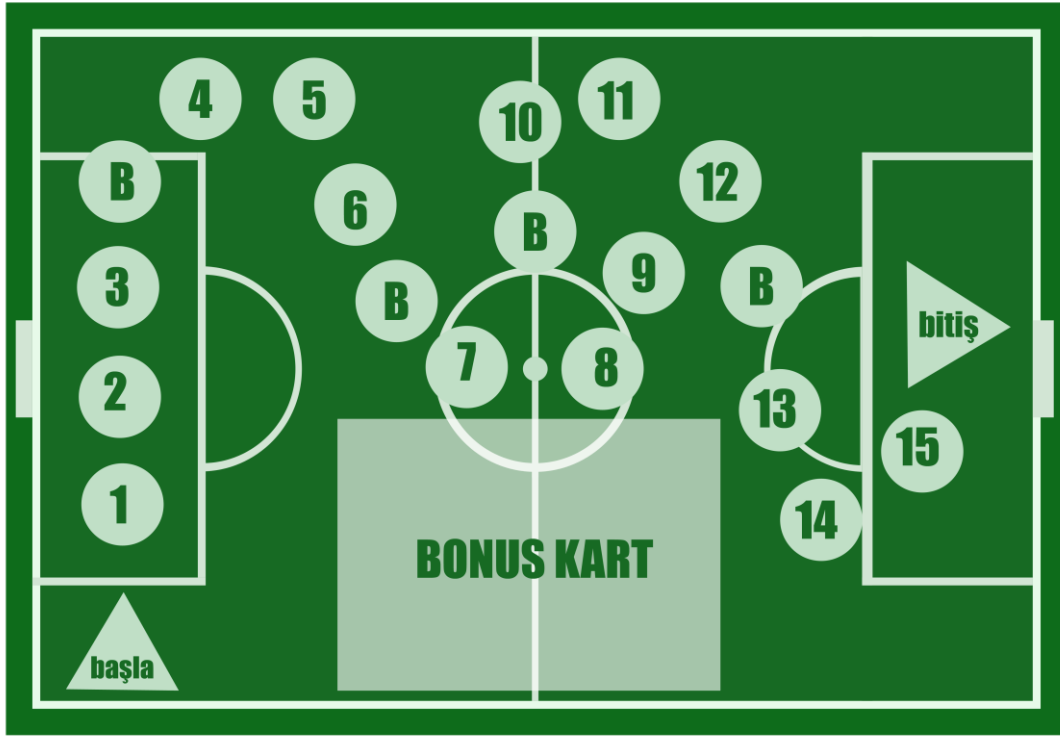
- **Chasing and Evading:** The aim of this game dynamic is that players try to catch objects, which gain points for the players or run away from objects which damage to players. “Pac-Man” is an instance of this dynamic [61].
- **Trading:** In this game dynamic, players can cooperate with each other in order to win the game. The resources can be exchanged by the players [61].
- **Race to the End:** There is a raceway, which should be completed by players to win a game, in this kind of game dynamic. During finishing the raceway, players face problems. This kind of game dynamic can be thought as training program [61].

After carefully discussing the possible game dynamics with a group of experts, “*Race to the End*” has been selected for the proposed game. Due to the fact that the game is like a training program for the football referees and in order to complete this training program, the referees should complete the racecourse. There are 4 players and 1 racecourse, which consists of 15 normal steps and 4 bonus steps that repeat in every 3 steps like in Figure 2. There will be a winner, who completes the racecourse before the others. In order to advance on the racecourse, the players have to use dice, which is formed with 4 numbers, because, we have 4 different categories as we mentioned above and each number represents each category like in the below.

- 1 represents True/False Questions
- 2 represents Multiple Choice Questions
- 3 represents Video Questions
- 4 represents Visual Questions

For example, when a player throws the dice and the dice shows 3, the player takes 1 question from the third category, which is Video Questions.





**Figure 2:** Board of the game

### 3.5.2 The game rules

There are some resources and rules in our game. The resources and rules are defined in the below statements:

- There are 125 cards that are separated as 25 question cards in each category and 25 bonus cards in total.
- There are 5 different bonus card types, which are red cards, yellow cards, joker cards, rust cards and change the question cards.
- If a player takes a red card, he can use this card at any time during the game. When he uses this card, he has to show it to another player in his turn. The player, who is shown a red card, will go 4 steps back.
- If a player takes a yellow card, he can also use this card at any time during the game. When he uses this card, he has to show it to another player in his turn. The player, who is shown a yellow card, should be careful in order not to be

shown again one more yellow card, because, a player, who gets 2 yellow cards, will go 2 steps back, which is less than red card's punishment, because, the punishment of red card is more than 2 yellow cards' punishment in real life situations.

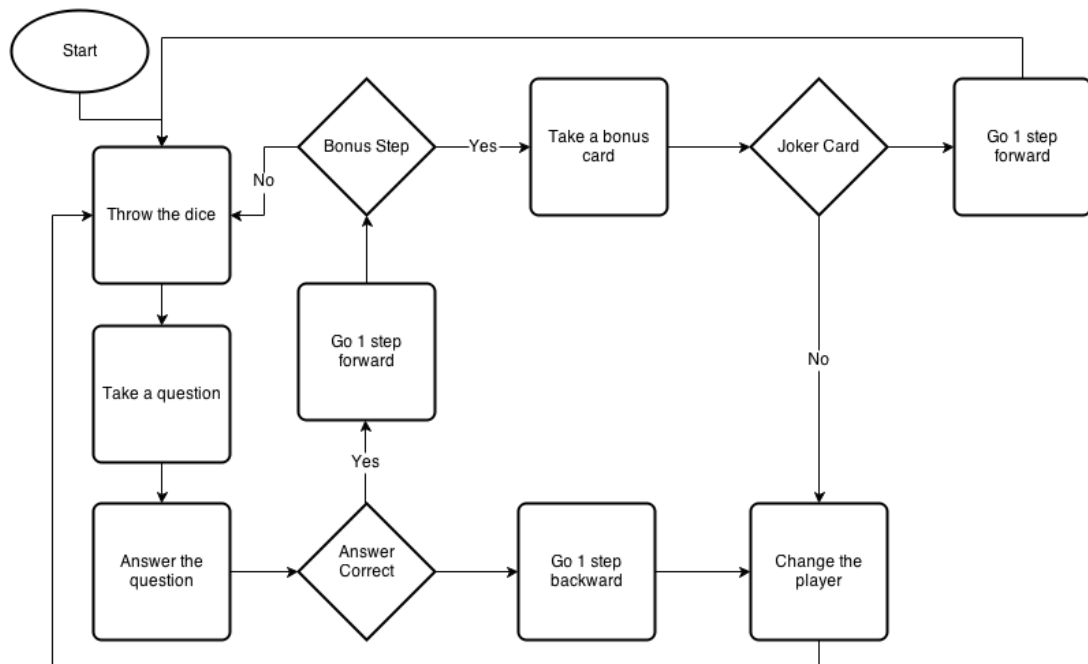
- If a player takes a rust card, he can use this card at any time during the game. When he uses this card, he refuses to answer the question, does not move forward or backward and the turn moves to the next player.
- Change the question cards help the players to change the question if they do not have any information about the related question. When the player uses these cards at any time during the game, he throws the dice one more time and get new question according to number on the dice. At this time, the player has to answer the new question if he does not have more change question bonus cards.
- The last type of bonus cards is joker card, which is the most advantageous card type in the game. They provide that a player, who has a joker card, proceeds one more step on the board without answering any questions. In addition, these cards have another important property. In our game, the players can advance until the bonus steps on the board if they do not have any joker cards. The joker cards provide that the player can pass this bonus step without answering any questions and has chance to take new question and advances on the board until the next bonus step. This case is very special and beneficial for the players.

The systematic flow (Figure 3) of the game is explained in the below steps:

1. At the beginning of the game, each player throws the dice and a player, who throws bigger number than the other players, starts the game.
2. The player, who starts the game, throws the dice one more time. The number on the membrane specifies the category according to above match up.
3. The player reads the question, which is selected from determined category with using dice and answers the question in 45 seconds.

4. If the player gives correct answer, he moves one forward step and continues to throw the dice and does the same process by the above process until he gives wrong answer or reaches the bonus step, which is shown with “B” character on the board. In fact, we assume that bonus steps are like checkpoints. The players can advance until reaching bonus steps. Except of one special situation, which we explained in above, the turn passes to other player. We proposed this challenge, because, if one player has higher knowledge level than the other players, he can finish the game before other players cannot join to the game. We have to prevent this case, because, this game is an educational game for the referees and our aim is that all referees, who participate the game, should improve themselves about the football game rules by playing the game. If the other referees do not have any chances to join the game, they cannot find out anything about the football game rules. Therefore, this rule is so necessary for us. Another property of “*bonus step challenge*” is that if one player passes the first bonus step, he cannot regress from this bonus step. He can move backward until regressing the last bonus step. We claim that these types of challenges add fun to the game. Von Ahn and Dabbish [89] supports this idea in their study. They indicate that challenge is the most important feature, which should be designed carefully in the game. Another study, conducted by Pagulayan et al. [63], claims that the game is not enough enjoyable without the challenges. In addition, Lazzaro [50] points out that when people overcome the difficult challenges in the game, they become so poised, because, they satisfy themselves. She claims that challenges create emotions including fun.
5. If the player gives wrong answer, he moves one backward step, the turn passes to another player and this player starts to do same operation.
6. If the player cannot give the answer in the determined time, we assume that this player gives wrong answer. Hence, he goes one backward step and the turn passes to the next player.
7. If the player reaches the bonus step, he takes a bonus card. The bonus cards can only be drawn in forward way. If the card is not a joker card, the turn passes to the next player. If the card is a joker card, the player moves one step

forward without answering any questions, throws the dice and continues to do same process by the above process until one player wins the game.



**Figure 3:** The systematic flow of the paper prototype of the game

### 3.5.3 Pros and cons of the paper prototype

After having completed paper prototype of our game, we have conducted the game play tests using a group of football referees. According to the results of the play tests, the game was successful in terms of playability and educational materials, however, the referees, who have played the game, claimed that the visuals on the cards, which are in the Visual Questions category, were not clear and understandable. The surrounding areas of the positions on the visual question cards do not inform so much information about the positions, because, the images are stationary. Therefore, this circumstance directs the referees to make wrong decisions about the positions. Hence, this effects to get completely correct data about the knowledge level of the referees. This case can be thought a disadvantage of the board game version of our game. Another disadvantage is that there are not enough number of boards now. Therefore, it limits the number of players, who benefit from the game. If we want to

produce more boards, the cost of this production is so high, because, producing boards is not enough. We have to also press the game cards. This game is not profit-oriented. It is developed for education. Hence, in order to fix these disadvantages, we develop computerized version of our game.

#### **3.5.4 Advantages of the computerized version**

Computer games have more advantages than board games. Computer technologies present a variety of benefits for creating non-static content. The first benefit is that we do not use fixed images on the card, which are in “Visual Questions” category in the computer version of the game. We have chance to use pictures, which are generated in graphics interchange format (GIF). In this way, the positions on the cards become more understandable and clear. The other advantage is that we can share our game with the community of practice via Internet. Therefore, lots of football referees can have opportunity to play the game at the same time via Internet. Thus, we have removed both limitations of cost of producing boards and cards, and number of players, who play the game. Bjork and Holopainen [8] indicate that computer games are more interesting than board games for new generation people according to marketing values of computer games and board games.

The average age of our referees is 19 that can be considered as an advantage for the study. In addition, we have increased the number of questions in each category, because, we did not have any concerns about the printing cost. We keep the questions in our database, and this does not bring extra costs for us. Consequently, the scores of the players are kept in our database. We can analyze the results, which are gathered from the answers of the referees for each question, quickly and provide feedback to the referees. Therefore, the referees can see their weak knowledge and have a chance to fix them rapidly.

Chan [14] indicates that the main disadvantage of board games is that amount of feedback is restricted for the participants. Moreover, we have used QR code technology to play the videos in board version. We have printed QR codes on the

cards and have used mobile phones to read the code and show the video. This operation wastes of time for participant in every video question, and playing videos on the screens of mobile phones does not develop eye coordination skill at the desired level. Susi et al. [80] determine that video games are useful for developing eye coordination ability. This is another advantage of computer version in both time and coordination subjects.

Lastly, the computer version of our game is more reachable and portable than board version of our game. A video game offers us the ability to access anytime and anywhere even by using mobile technologies such as smart phones, pads etc.

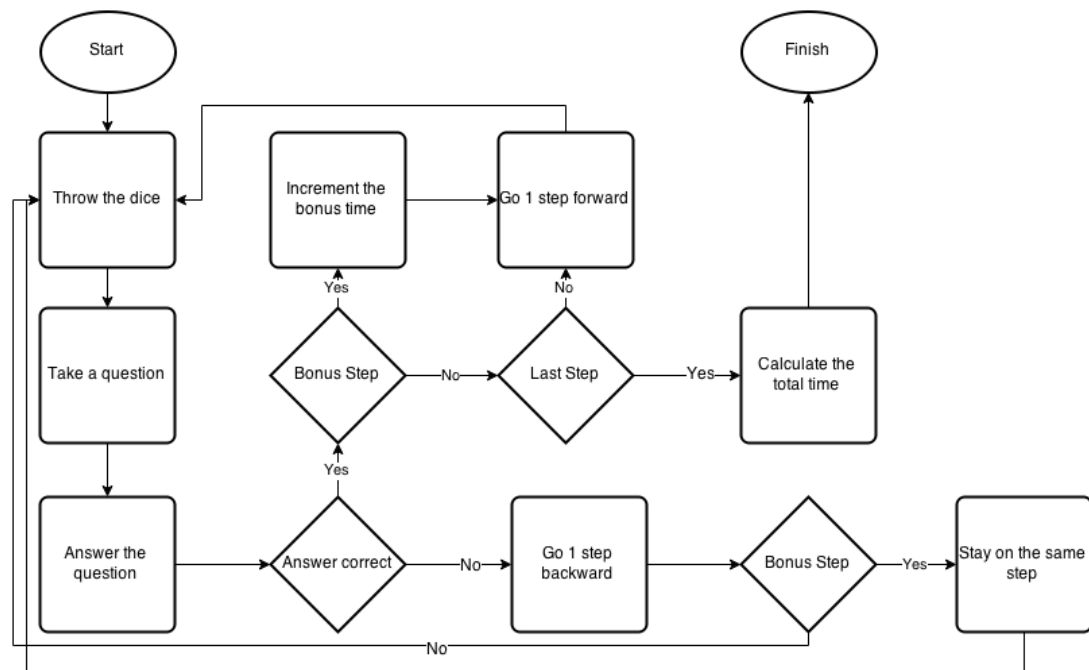
### **3.5.5 Game mechanism of the computerized version**

In computerized version of our game, we slightly altered the mechanics and flow (Figure 4) of our game. First of all, we removed multi player task from our game, because, this is a boundary for the players about individual learning. A player, who wants play the game, has to wait the other players, but now, the player enters to the system and can play the game whenever he wants. Since the game is played by 1 player, the winning condition has changed. Actually, there is no an exact winning condition. When the player starts to play the game, we start to time. When the player finishes the racecourse, we stop to time. In the meantime, we procure time for each player separately. At the end, we compare the time of completing racecourse for each player and create grading table with starting less time to much time. A player, who stays on the top of the list, will be a winner. Finally, we removed bonus cards, because, the bonus cards are necessary and useful when there are more than 1 player in the game. At this moment, when the player gives correct answer in the bonus steps, we decrease time, which is 5 seconds for first bonus step, 10 seconds for second bonus step, 15 seconds for third bonus step and 20 seconds from the fourth bonus step, from the total time.

To evaluate the effect of computer version of our game correctly, we should create a sample from the referees, have them to play the game, and apply play tests by using

their answers. Creating sample is a necessary topic to get valid results. The members, who join to the sample group, should have the similar characteristics. In order to provide similarity, there should be a set of criteria for determining our target group, which is constituted by selecting the referees. These criteria are:

- City where to be a referee
- Experience level
- Age



**Figure 4:** The systematic flow of the computerized version of the game

At first, we develop this system for the referees, who conduct matches in Ankara, the capital city of Turkey. Secondly, our aim is to select new referees, who started as a referee 14 months ago by taking seminars, which were organized in Ankara. The referee committee can call them as “*inexperienced referees*”. We want to educate the inexperienced referees especially, because, according to studies in literature [82, 57, 52, 3, 76], inexperienced people make more mistakes than experienced people. This idea is valid in whole areas. Tenenbaum et al. [82] report that experience is the most effective factor for making correct decisions. In addition, Mensing and Oliver [57] denote inexperienced staffs as a factor, which causes to improve error rate. In support, Lowell [52] indicates that inexperienced people make unreliable decisions in

percent of between ages 33 and 37. Albers [3] calls this situation as “*Knowledge-Based Mistake*”. He points out that lack of experience directs the people to make wrong decisions. Sinha [76] evaluates the factors that affect the decision making processes. The results show that experience is the most powerful reason that affects decision-making. Frankenhaeuser and Lundberg [27] indicate that challenges in the environment such as emergency situations increases the adrenaline level. The challenges, which are indicated as soccer players, coaches, and supporters in the study [29], also increases the adrenaline level of the referees during the match. Hence, experienced referees can control their adrenaline levels better than inexperienced referee because of their background. In support, Thomas [84] claims that experienced people can control their feelings and emotions under challenging conditions.

Another criterion is age. Our age boundaries are between 16 and 22. We have put these boundaries, because, new generation people are more curious about computer games and new technologies than the others, and they are more open and willing to learning. Erkan [21] signifies that young learners and instructors tend to technology more than older individuals. In support, Delveccio [19] reports that old people abstain from using computer and new technologies. For learning rate, Bratkowski [9] specifies that young individuals find out keener in learning new things because of their learning capacity. In addition, Alessio [4] defines that the learning ability of young people is higher, because, the capacity power of their memories is so strong. Another study, which is completed by Alessio [5], shows that young brains produce large number of interconnected synapses. Therefore, their learning capacity should be higher.

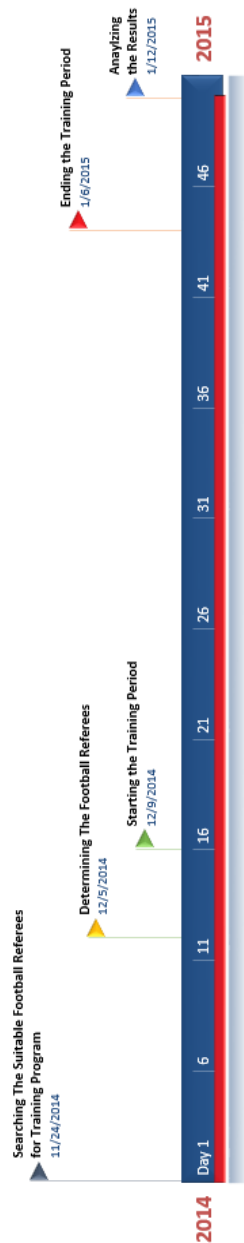
### **3.6 Participants**

During this study, we found 78 referees, who matched to our constraints, however, we randomly selected 54 participants among them. Then, we randomly separated these 54 selected referees into two groups, which are namely the control group and the experimental group. After conducting the selection process, we have had 2



groups, which consist of 27 referees. The referees, who are in the control group, are not allowed to log in to our game system. They have only chance to study for learning football game rules via “*FIFA - Laws of the Game*” book [26]. The other referees, who are in the experimental group, have authorization to log in to our game system. We force that the referees, who are in the experimental group, do not study with the book of football game rules. The training time is 1 month. During this training time, in order to measure the difference of knowledge level about the football game rules, we have applied pre-test for these 54 referees. The pre-test consists of 50 questions, which are formed by 35 questions from Multiple Choice Questions and 15 questions from Video questions. After one month, we have organized post-test, which was the same as the pre-test. After getting the results, we have used statistical tests to measure the variance of each group.

The time line of this study is shown in Figure 5.



**Figure 5:** Time line of the study

We started to search the suitable football referees, who matched to our constraints, on November 24, 2014. This operation has continued for 11 days. At the end of this operation, we found 78 referees. Then, we randomly determined 54 football referees among these 78 referees between December 5, 2014 and December 7, 2014. After determining the novice football referees, we organized a pre-test on December 9, 2014. Thus, we started to our training period. This period has continued one month. At the end of the training period, we organized a post-test on January 6, 2015. After getting the results of both pre and post-test, we analyzed these results between January 6, 2015 and January 12, 2015.

## **CHAPTER 4**

### **DESIGN AND IMPLEMENTATION**

#### **4.1 Introduction**

The purpose of this part is to explain a detailed description of our game platform. It consists of system descriptions and requirement analysis, the detailed information about the tools, which have been used to develop our game platform. In addition, why we have chosen these tools, the interfaces of the system, the users and their functionalities in the system, the structure of our database design and the relationship between the data tables are illustrated. Also, we mention the encountered problems during development phase of the game platform and the solutions of these problems.

#### **4.2 System Description and Requirement Analysis**

This game platform will be an educational tool, which is designed to train the inexperienced football referees about the rules of the football game. This system will be used by TFF. This platform will be designed to increase decision making skills and the knowledge level of the football referees about the football game rules. Also, this system can be useful for preparing them to decide on critical positions, which may occur during a football game. In addition to above properties, the referees have a chance to prepare themselves for the exams, which are organized every year to evaluate the knowledge level of the football referees about the football game rules. In order to provide these properties, we selected the questions, which were asked in the real exams and used the videos, which consist of the positions occurred in the matches.

In this platform, there are 3 different user types in our system. These are:

- Administrator
- Educator
- Referee

The functionalities of the systems differ according to the role of the users, however, the main idea of this platform is that administrator and educators prepare the contents and the questions, and upload them into the systems. The novice referees join the game and try to progress on the racecourse by answering a set of selected questions, correctly. The system functions and modules are presented in detail as follows:

- **Add New Person:** The application should consist of new individuals to educate or to be educated. In this module, the system should offer the easiest way to record the individuals' personal information. During recording users' personal information, authorized person, who has authority to add new person to the system, has to select the roles of new individuals. Thus, authority assigning task can also be completed in this module.
- **Add New Question:** The application should consist of new questions for the users. As the time passed, new questions will be created. Hence, these questions should be included to the system. This module will help to import new questions to our system.
- **Add New Division:** From past to present, there have been lots of changes about the divisions of the soccer referees. One division may be removed or one division may be included. Hence, the application should offer a module that adds the information of new divisions and can have ability to update them if it is necessary.
- **Add New Role:** There have also been lots of alterations, which are similar to divisions. Thus, the application should also offer a module that adds the information of new roles and can have ability to update them if it is necessary.
- **Other Add Methods:** This module may not be used frequently, however, it is necessary to design them, because if FIFA may change the rules of the

football game or TFF may add new properties to the system, the application should also change necessary parts and supply these demands. This module consists of *Add New Football Rule*, *Add New Bonus Type*, *Add New Game Rule*, *Add New Role*, *Add New Division* and *Add New Question Category*.

- **Join a Game:** The application should present a game platform and game materials to the users, who need to be educated, and information, which guides them how they can play the game. This module should also evaluate the performance of the users, who join and complete the game.
- **View Attended Games:** The application should give feedbacks to the users, who join and complete the game. In this module, the users can see the detailed information of the game and their performance, which is performed to complete the game.
- **View Overall Ranking:** The application should show the ranks of each user, who completes the game, within all users according to completion time of the game. This module also shows the winner of each week.
- **View and Update User Profile:** The application should offer user-friendly method to change their personal information. This module helps the users to change their personal information without some fixed information fields such as name, ID number etc.

## 4.3 Tools and Databases

### 4.3.1 Bootstrap

Bootstrap is the popular and useful HTML, CSS and JS framework for developing responsive web design, which is also called “*Adaptive Web Design*” [36]. Natda [62] defines the responsive web design that it is a framework, which shows the web sites properly, elegantly and smoothly in every size of screen of devices like mobile phones, tablets, notebooks, and any size of desktop monitors. Natda also indicates that responsive design is one of the currently developed, revolutionary and useful technology. In support, Bryant and Jones [10] determine that responsive design is one the most useful invention for developers, who have to develop web site for each

device. Before responsive design, the developers have to develop separate web sites for computers and mobile devices.

Our game platform should be designed responsively, because, one of the important advantage of our platform is that it can be usable in anywhere. Hence, the users can login to our game platform with using any devices. In order to provide this case, we have selected Bootstrap to design our game platform responsively. The reasons, why we have selected Bootstrap, are:

- It consists of the HTML elements, CSS components and jQuery plug ins.
- It consists eye-pleasing elements.
- Easy to use.
- It has a great documentary, which guides developers about how to use the elements.

#### 4.3.2 Microsoft SQL Server

Microsoft SQL server is a database tool, which is developed by Microsoft Cooperation. We have chosen Microsoft SQL Server, because, we are accustomed to use it. Another reason is that we use “*LINQ to SQL*” methodology, which is one of the extension property of C# for Microsoft SQL Server, because, it is easy and understandable way to reach data and do necessary operations on them. In support, Sehirli and Ozdemir [75] indicate that this extended property is an easy way to reach data from application side with creating understandable queries. They point out that the most important advantage of this property is using object oriented approach. In this way, the data can be reused and modified less effortlessly. In addition, Kanjilal [43] remarks that this property is more secure to query data.

In our database design, we have 14 tables, which are:

1. **USER:** In this table, we reposit the personal information of each user. This information consists of roles of the user such as administrator, referee or

educator, division of the user such as super league, national league etc., identification number, license number, which is given to each referee and observer uniquely, name, surname, email, phone number, gender, user name, password, registration date and approve, which controls whether the user are still referee or observer or not. We keep the role and division properties of the user as foreign keys in this table. We store the values in **ROLE** and **DIVISION** tables and take the id numbers, which belong the related values, from these tables with creating relationship between **USER-ROLE** and **USER-DIVISION**.

2. **STEP:** As we mentioned in above chapters, we have a racecourse (Figure 2), which has 15 steps on itself. In this table, we keep step number and its position values on the screen for each step.
3. **ROLE:** In this table, we store the values of the roles, which are assigned to each user according to user's real life position. This value determines the scope of the authority of the user in the system.
4. **QUESTION:** In this table, we keep the detailed information of each question. This information includes question category such as true/false, multiple choice or video, text of the question, photo and video URL if the question has photo or video. In order to increase efficiency, we do not keep the video or photo file inside of the database. We keep the videos and photos in the files and record the URL of each photo and video into the table. We store the question category value as a foreign key in this table. We keep the values in **QUESTION\_CATEGORY** table and take the id numbers, which belongs the related values, from this tables with creating relationship between **QUESTION-QUESTION\_CATEGORY**.
5. **FIFA\_RULE:** This table consists of the definitions of FIFA football game rules. At the moment, there are 17 FIFA football game rules, however, FIFA works on the topic to add new rules for the football game. Hence, this table can also keep the new rules if they are invented.
6. **QUESTION\_FIFA\_RULE:** This table can be thought as a relationship between **FIFA\_RULE** and **QUESTION**, because, each question has to be associated with at least one FIFA football game rule. In order to create this

relationship, we have the fields, which keep name of the question and definition of the FIFA rule as foreign keys.

7. **QUESTION\_CATEGORY:** We can store the question categories, which are True/False, multiple choice and video, in this table.
8. **GAME\_SESSION:** In this table, we keep the game sessions, which are constituted by the users of the system. We record the id number of the user with creating a relationship between **GAME\_SESSION-USER**, start and finish dates, bonus time value, which is gained in the related session to answer the questions correctly on the bonus steps, a boolean value to figure out whether the user is playing the game as on-line or not, and finally, a boolean value to understand whether the user finishes the game or not. Thus, this table gives the information how many times the user opens a game session during the education time.
9. **PLAYER\_POSITION:** In this table, we store the positions of each player, who plays the game, on the racecourse for a game session. The fields are, id number of the user, the number of game session as foreign key, first and last positions of the player. Hence, we can understand which step the player gives wrong answer or which step the player gives true answer, because, if the player gives wrong answer, he goes one step backward or if the player gives true answer, he goes one step forward. In order to take these values, we have relationships between the tables, which are **PLAYER\_POSITION-USER**, **PLAYER\_POSITION-GAME\_SESSION** and **PLAYER\_POSITION-STEP**.
10. **ONLINE\_USER:** This table keeps the users, who are on-line in the system. Through this table, we can show the on-line users to other users. In order to show that, we have a relationship between **ONLINE\_USER-USER**.
11. **LOG:** In this table, we keep the dates, when the user log in to the system and log out from the system. Thus, we can easily understand whether the user uses the system actively or not with creating a relationship between **LOG-USER**.
12. **DIVISION:** In refereeing, there are divisions to distinguish successful referees from the others. The successful referees are improved to upper



divisions. In order to distinguish the referees in our system, we create this table to keep the information of real divisions.

13. **CHOICE:** In our game platform, a question has at least 2 choices and at most 4 choices. The choice numbers differ according to the category of the question. In order to store the choices, we design this table. This table consists of the id number of the question as foreign key with creating a relationship between **CHOICE-QUESTION**, the definition of the choice and a boolean value to understand whether this choice is correct answer or not.
14. **ANSWER\_LOG:** This table informs us about who gives which answer for which question in which game session on which date. In order to provide this information, we have field that are the id number of the game session, the id number of the player, the id number of the question and the id number of the choice as foreign keys with creating relationships between **ANSWER\_LOG-GAME\_SESSION**, **ANSWER\_LOG-USER**, **ANSWER\_LOG-QUESTION** and **ANSWER\_LOG-CHOICE**, respectively.

The diagram of the whole relationships between the database tables, which are explained in above, is shown in Figure 6. In this figure, there are 13 associations between the tables. These associations connect the tables via arrows. It means that the tables, which the tip of arrows shows them, involve foreign keys of the other tables, which arrows start from them. Thus, we do not need to keep same data inside of all necessary tables. It is enough to keep the identification number, which is unique for each item.

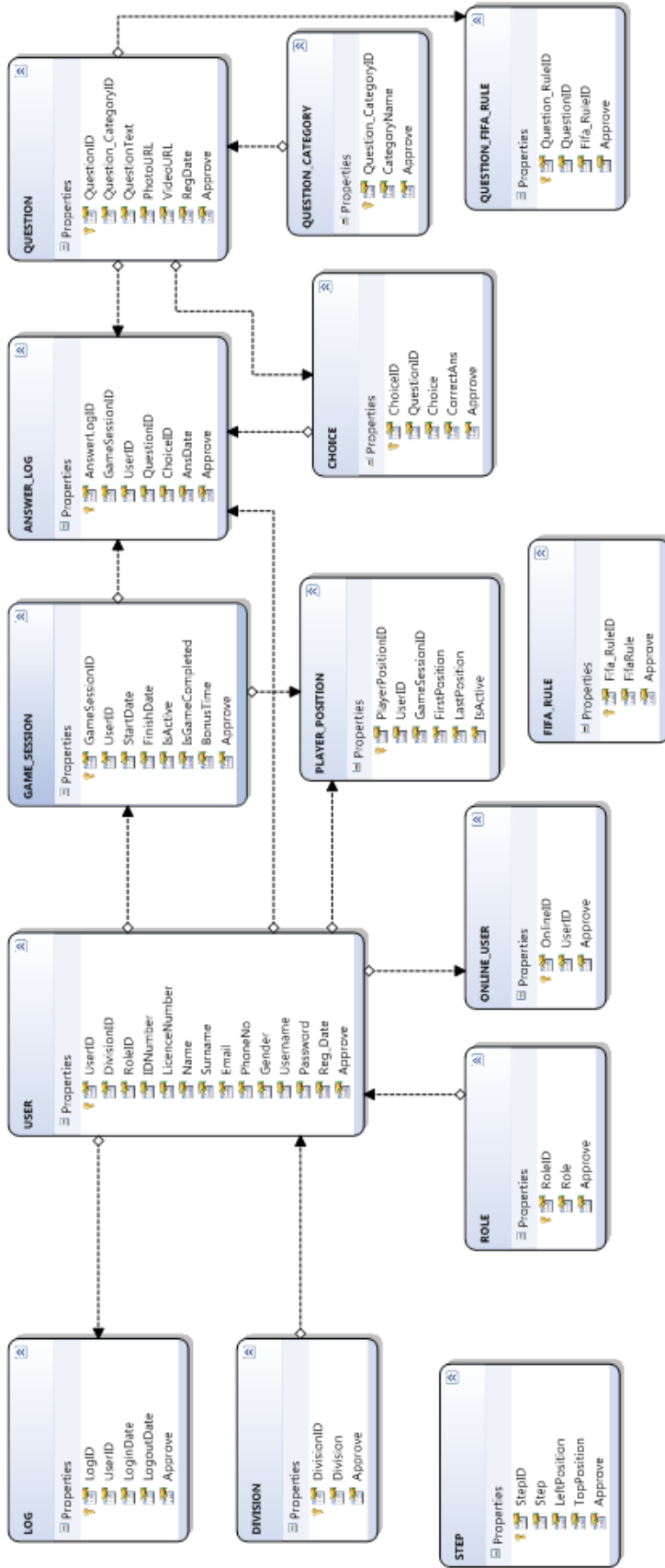


Figure 6: Database relationship diagram

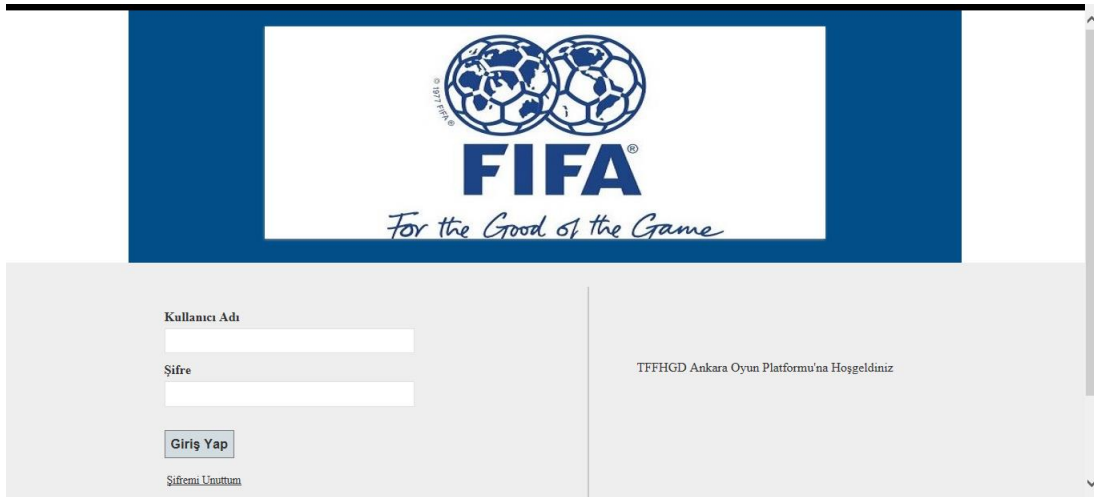
### 4.3.3 ASP.NET

.NET is a technology that consists of everything from creating Windows applications to querying SQL prompts and designing a web site [53]. Alaluf [2] remarks that .NET is a platform, which has several advantages to other platforms, for building integrated and service-oriented applications.

There are several advantages of using .NET to develop an application, which runs on the web server. Lui et al. [51] illustrate that .NET has high implementation efficiency and manageability. In addition, Esposito [22] remarks that .NET is compatible platform for working with HTML editors and other programming tools such as JavaScript, CSS, AJAX etc. In addition to these advantages, we have an experience with this platform to develop web applications. Hence, we have used this technology to build our game platform.

## 4.4 System Functions and Module Implementation

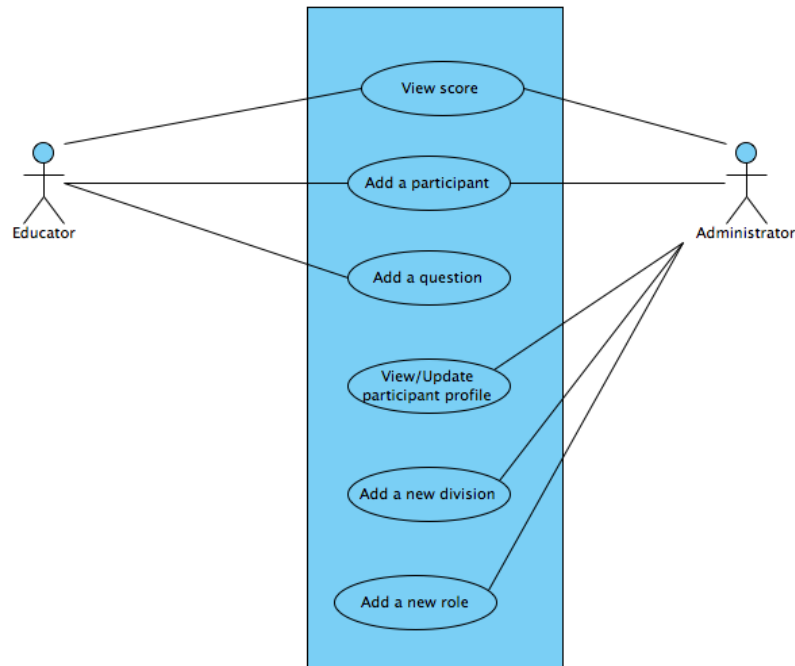
Based on system description and requirement analysis, which are explained in the previous section, this system is an educational tool for the soccer referees about the football game rules. The system's functions are divided into the groups according to user types, which are administrator, educator and referee. There is only one function that is general for the whole user types. This function is “**Login**”. In order to login into the system, all users have to fill correctly the necessary fields, which are user name and password, on the below page (Figure 7).



**Figure 7:** Login page

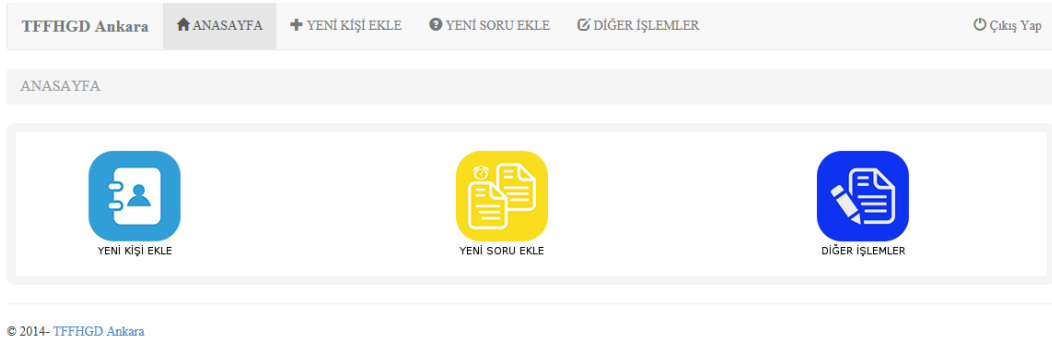
#### 4.4.1 The functions of administrator

The administrator is the authorized user type in the system. The individuals, who are assigned to this user type, can add new users in all user types, can have ability to insert new questions into the system and can organize other systematic operations. The use-case diagram of the administrator, which shows the visualization of the relationship between administrator and its functions, is shown in Figure 8.



**Figure 8:** Use case diagram of administrator and educator

When the administrator logs in to the system, the main page of the administrator is shown on the screen as indicated in Figure 9.

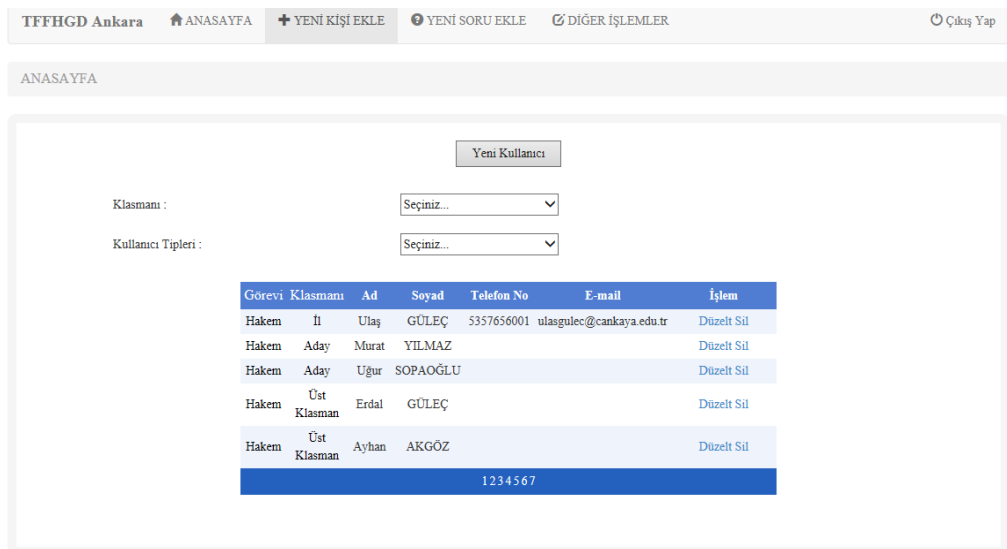


**Figure 9:** Main page of administrator

In the above page, there are 3 options, which are “Add New User”, “Add New Question” and “Other Operations”. The administrator can reach these operations to click the related buttons. The detailed explanations of these operations are described in the next sections.

#### 4.4.1.1 Add new user

If the administrator selects the first option, the related page, which is shown in Figure 10, appears on the screen.



**Figure 10:** List of all users

In this page, there is a grid view to present the detailed information of the users and the operations. These operations are:

- Update the information of the user
- Delete the user from the system

There are also two drop down list items to list all divisions and user types that are recorded in the database. When the administrator selects an element from these drop down lists, the information on the grid view is automatically filtered according to the value of selected element. Thus, the administrator can easily see the necessary users for his purpose instead of seeing whole users in the system. There is a button on the top of the page. This button directs the administrator to other page as show in Figure 11, which has fields that should be filled with the information about the user.

The screenshot shows a web interface for adding a new user. At the top, there is a navigation bar with 'TFFHGD Ankara', 'ANASAYFA', '+ YENİ KİŞİ EKLE', 'YENİ SORU EKLE', 'DİĞER İŞLEMLER', and 'Çıkış Yap'. Below this, there is a breadcrumb trail 'YENİ KİŞİ EKLE / KULLANICI BİLGİLERİ'. The main content area is titled 'KULLANICI BİLGİLERİ' and contains the following fields:

Kullanıcı Tipi :	<input type="text" value="Seçiniz..."/>	Klasmanlar :	<input type="text" value="Seçiniz..."/>
Ad :	<input type="text"/>	Soyad :	<input type="text"/>
T.C. Kimlik No :	<input type="text"/>	Lisans No :	<input type="text"/>
Telefon No :	<input type="text" value="Örnek Tel: 5551234567"/>	E-Posta :	<input type="text"/>
Kullanıcı Adı :	<input type="text"/>	Şifre :	<input type="text" value="≠ ! - işaretleri kullanmayınız"/>
Cinsiyet :	<input type="text" value="Seçiniz..."/>		

At the bottom right, there are two buttons: 'Kaydet' and 'İptal'.

**Figure 11:** Add new user page for administrator

These fields are designed to determine:

- User type
- Division
- Name

- Surname
- Identification number
- License number
- Phone number
- Email
- User name
- Temporary password
- Gender

of the user. There are also two buttons in this page. These buttons help the administrator to save the information of the new user into the database or to surrender from adding new user into the system.

#### 4.4.1.2 Add new question

If the administrator chooses the second option, the below page, which is shown in Figure 12, displays on the screen.

The screenshot shows the 'YENİ SORU EKLE' (Add New Question) page. The form includes the following fields:

- Soru Kategorisi : Seçiniz... (dropdown)
- Soru Metni : (text area)
- Seçenek Sayısı : 2 (dropdown)
- Doğru Seçenek : Seçiniz... (dropdown)
- Seçenek 1 : (text input)
- Seçenek 2 : (text input)

On the right side, there is a table for setting rules:

Tümü	Kural
<input type="checkbox"/>	KURAL 1
<input type="checkbox"/>	KURAL 2
<input type="checkbox"/>	KURAL 3
<input type="checkbox"/>	KURAL 4
<input type="checkbox"/>	KURAL 5
1234	

Below the table, there are two radio buttons:  Resim and  Video.

At the bottom right, there are two buttons: 'Kaydet' (Save) and 'İptal' (Cancel).

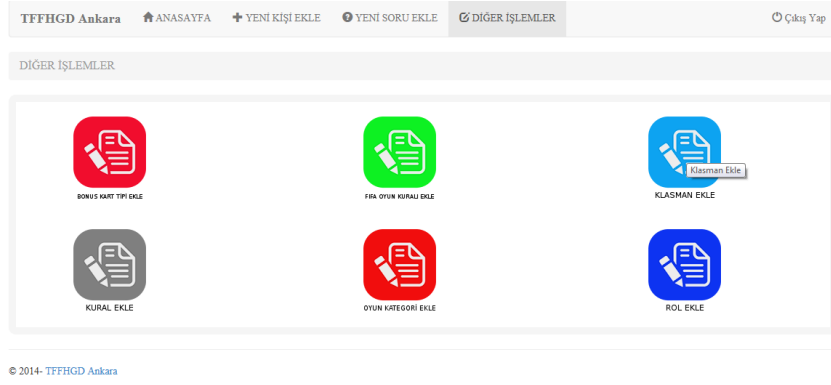
**Figure 12:** Add new question page for administrator

In this page, there is a grid view to display FIFA football game rules, because, a question should be related with at least one football game rule. In order to assign football game rules to the question, there are check boxes near each FIFA football game rule inside of the grid view. If the administrator wants to assign the rule, he has to check the check box near the related rule. There are also two drop down lists in this page. One of them is designed to list all question categories and another is designed to be selected the number of choices. The administrator determines the category of the question and the number of choices for the new question with using these drop down lists. There is a multi-lined text box, which is designed for text of the question. There are also at least two text boxes, which help the administrator to write the contents of the choices. The number of these text boxes is changed dynamically, because, if a question has four choices, then the administrator has to select four in the related drop down list. Through this operation, the number of text boxes increase to four dynamically. There are also two radio buttons to insert an image or a video. If the question consists of an image, the administrator has to select the first radio button or if the question consists of a video, he has to select the second radio button. The administrator cannot choose both radio buttons at the same time, because, the question cannot have both image and video at the same time. Finally, there are 2 buttons in this page. These buttons help the administrator to save the information of the new question into the database or to surrender from adding new question into the system.

#### **4.4.1.3 Other operations**

If the administrator prefers the third option, the related page, which is shown in Figure 13, is presented on the screen.

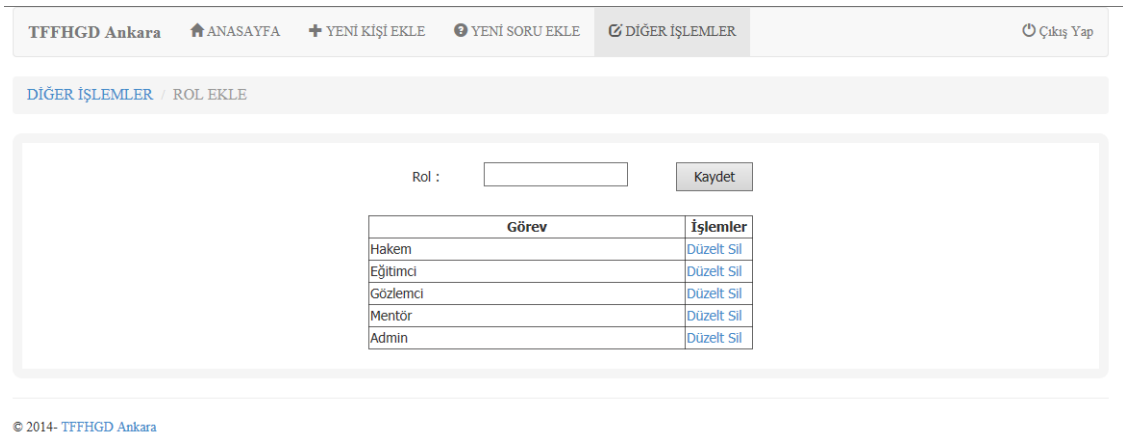




<http://tutkop.cankaya.edu.tr/Pages/DetailIslemler.aspx>

**Figure 13:** Other operations page for administrator

In the above page, there are 6 options, which are “Add New Bonus Type”, “Add New Football Rule”, “Add New Division”, “Add New Game Rule”, “Add New Question Category” and “Add New Role”. These operations may be not used so actively, however, it is important to develop these modules because of providing dynamic flow of the platform. The concept and page design of all operations is the same. For example, the design of “Add New Role” page is shown in Figure 14.



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**Figure 14:** Add new role page for administrator

In the above page, there is a grid view to present the definition of the roles and the operations. These operations are:

- Update the definition of the role
- Delete the role from the system


There is also a text box and a button to write the definition of the new role and record it into the database.

#### 4.4.2. The functions of educator

The operations, which are organized by educators, are nearly same as the operations, which are organized by the administrator, however, the authority scape of educator user type is limited than administrator's authority scape. In this user type, the individuals can add new users, can have ability to insert new questions into the system and can update their personal information. Although the administrator can add new users in all user types in “*Add New User*” operation, the educator cannot add insert users in all user types. The educator can only add new referees into the system. All functions of the educator is shown in Figure 8 as a use-case diagram. Apart from this difference, the designs and the systematic functions of the pages are the same as administrator's for both “*Add New User*” and “*Add New Question*” operation as shown in Figure 10, Figure 11 and Figure 12. The other operation, which is “*Update Personal Information*”, is done when the educator selects the third option. After choosing the third option, the below page (Figure 15) is shown on the screen.

PROFILİM

Kullanıcı Tipi	Eğitimci	▼
Klasman	II	▼
T.C. Kimlik No		
Lisans No		
Ad	ulus	
Soyad		
Cinsiyet	Erkek	▼
Telefon	*Örnek Telefon:5551234567	
E-mail		
Kullanıcı Adı	ulus	
Şifre	123	



**Figure 15:** Update personal information for educator

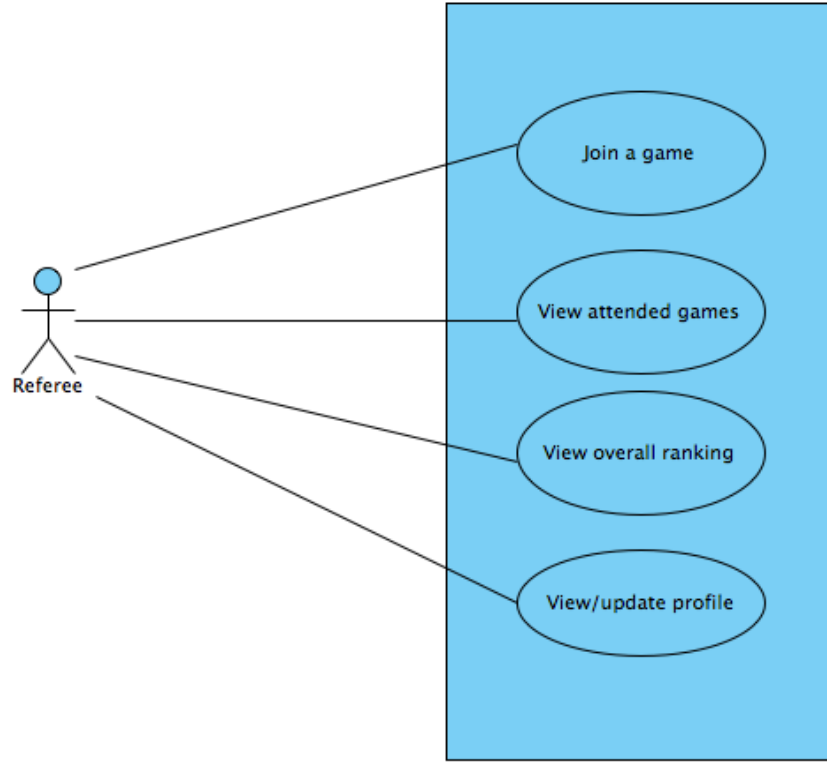
In this page, there are several fields that display the information about the user. These fields are:

- User type
- Division
- Name
- Surname
- Identification number
- License number
- Phone number
- Email
- User name
- Temporary password
- Gender

of the user. The fields, which are user type, division, identification number, license number and gender, has grey background, because, they cannot be changed by the user. Hence, these fields are enabled to be reached by the user. Other fields can be changed by the user and can be recorded into the database with using the related button, which is at the bottom of the page.

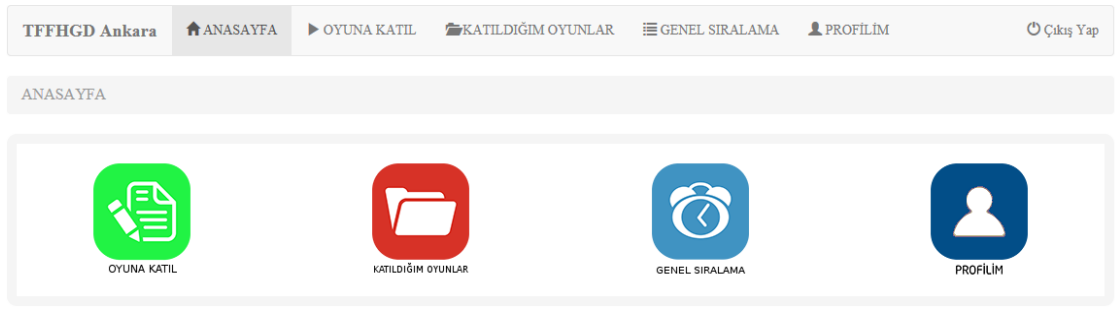
#### **4.4.3 The functions of referee**

The referee is the least authorized user type in the system. The individuals, who are assigned to this user type, can join the game, can get feedback about their past games, can see their positions in overall ranking and can update their personal information. The functions of the referee is shown in Figure 16.



**Figure 16:** Use case diagram of referee

When the referee logs in to the system, the main page of the referee is shown on the screen as indicated in Figure 17.



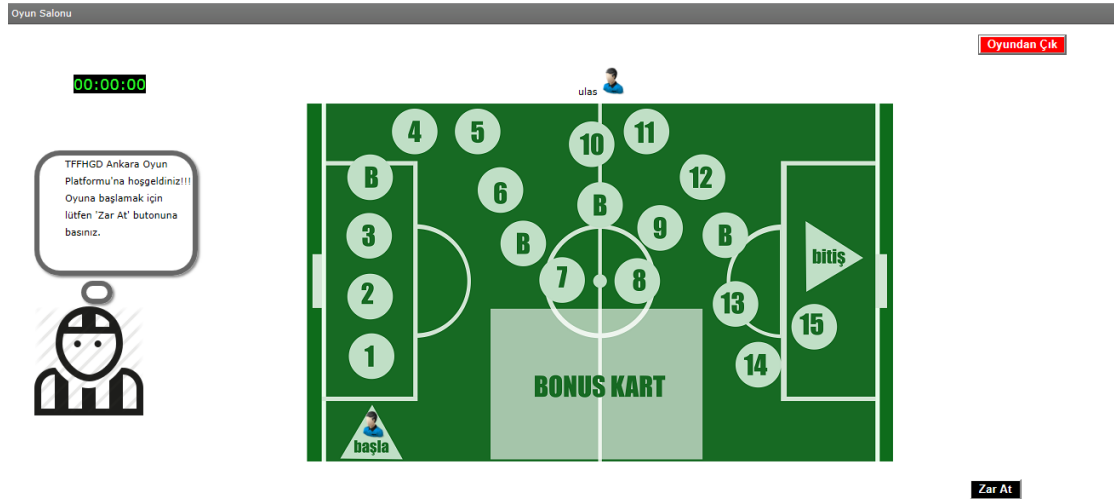
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**Figure 17:** Main page of referee

In the above page, there are 4 options, which are “*Join the Game*”, “*Attended Games*”, “*Overall Ranking*” and “*Update Personal Information*”. The referee can reach these operations to click the related buttons. The detailed explanations of these operations are described in the next sections.

#### 4.4.3.1 Join the game

If the referee selects the first option, the related page, which is shown in Figure 18, appears on the screen.



**Figure 18:** Join the game page for referee

In this page, there are two images. One of them shows the racecourse of our game and another shows the character of a referee. The image, which shows the referee, progresses on the racecourse when the player gives correct answers to the questions. In order to start the game and take a question, the player should click the “Roll Dice” button. When this button is clicked, the timer, which is on the left corner, starts to count the time. At the same time, the system produces a random number between 0 and 4 to determine the category of the question. After determining the category, the questions, which are in the determined category and have not been solved by the user in the same game session, are listed and one of them is chosen randomly. If the random number, which determines the category of the question, is equal to one, one of the “True/False Question” is selected. In order to show this question, a pop-up window opens as in Figure 19.

Soru

Eğer bir oyuncunun ayakkabısı istemeden ayağından çıkar ve hemen topla oynar ve/veya gol atarsa bir ihlal söz konusu değildir ve gol geçerli sayılır çünkü ayakkabısı istemeden ayağından çıkmıştır.

Doğru

Yanlış

Cevapla

**Figure 19:** True/False question

In this pop-up window, texts of the question and choices are displayed by labels. The player has to select one of the choices as the answer of the question and clicks the button whether the answer is correct or not. If the answer is correct, the feedback is given to the player as indicated in Figure 20.

Soru

Eğer bir oyuncu, tehlikeli şekilde oynayarak bariz gol şansını engellerse bu oyuncuyu hakem oyundan ihraç etmelidir

Doğru

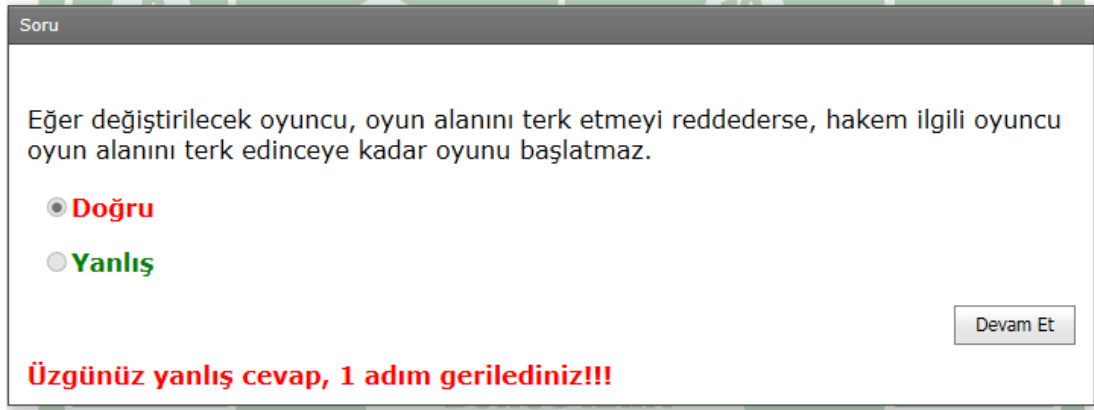
Yanlış

Devam Et

Tebrikler doğru cevap, 1 adım ilerlediniz!!!

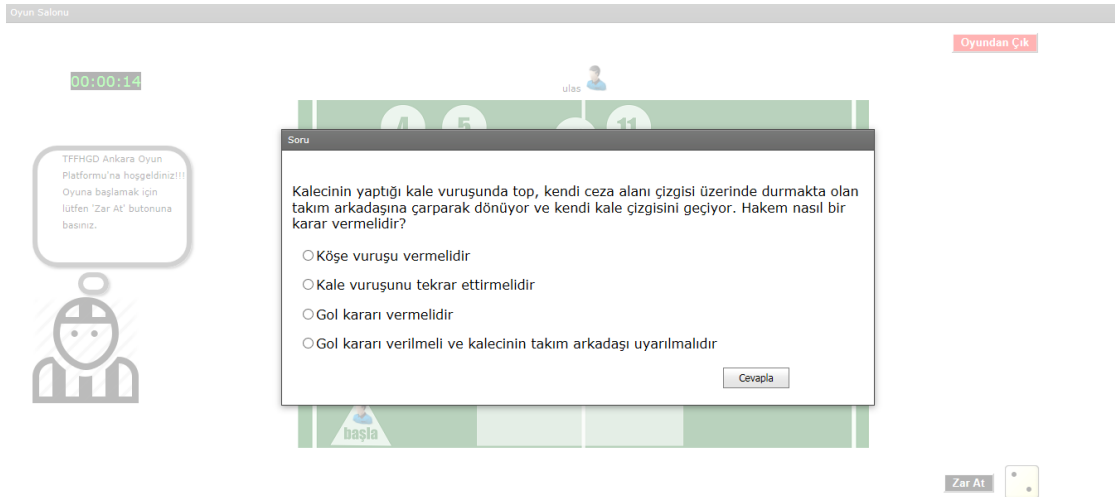
**Figure 20:** True answer

If the answer is wrong, the feedback is given to the player as shown in Figure 21.



**Figure 21:** Wrong answer


If the random number is equal to two, one of the “*Multiple Choice Question*” is chosen. A question is shown in a pop-up window as in Figure 22.



**Figure 22:** Multiple choice question

If the random number is equal to three, one of the “*Video Question*” is selected and displayed in a pop-up window as in Figure 23.

Soru



Görüntüdeki pozisyonla ilgili kararınız nedir?

Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç

Endirekt serbest vuruş ve şiddetli hareketten dolayı ihraç

Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç

Endirekt serbest vuruş ve ciddi faullü oyundan dolayı ihraç

Cevapla

**Figure 23:** Video question

The other procedures are the same as the explanation, which is clarified in above. The player takes questions and answer them until he finishes the racecourse. During the progress on the racecourse, there is an icon, which includes an image of referee. This icon gives hints to the player and directs him how he should do in the related steps. Finally, there is also a button that helps the player to finish the game without completing the game in normal way.

#### 4.4.3.2 Attended Games

If the referee prefer the second option, the related page, which is shown in Figure 24, is displayed on the screen.



KATILDIĞIM OYUNLAR				
Oyuna Başlama Zamanı	Oyunun Bitiş Zamanı	Oyun Süresi	Kazandığım Bonus Süresi	İşlemler
10.12.2014 13:29:38	10.12.2014 13:46:41	972,97	50	Detay
10.12.2014 15:02:04	10.12.2014 15:13:22	627,507	50	Detay
10.12.2014 23:59:33	11.12.2014 00:14:33	849,963	50	Detay
11.12.2014 15:09:58	11.12.2014 15:23:29	760,656	50	Detay
15.12.2014 20:16:14	15.12.2014 20:26:23	558,997	50	Detay
		1234		
Toplam Cevaplanan Soru Sayısı :	32			
Doğru Cevaplanan Soru Sayısı :	24			
Yanlış Cevaplanan Soru Sayısı :	8			

**Figure 24:** Attended games page for referee

In this page, there is a grid view to present the detailed information of the game session, which was created by the user, and one operation link that shows the total number of solved question, the total number of correct answer and the total number of wrong answer for the related game session.

#### 4.4.3.3 Overall ranking

In order to display this page, the referee should select the third option. When the referee selects the third option, this page is shown on the screen as indicated in Figure 25.

SIRA NUMARASI	AD	SOYAD	OYUN SÜRESİ (sn)
1	Rifat	ERGAN	00:03:21
2	Asil Olgay	KARACA	00:03:56
3	Türker	ÖZER	00:04:24
4	Hakan	YURTSEVEN	00:04:49
5	Emre	AYDIN	00:07:01
6	Kıvanç	YILMAZ	00:07:28
7	Oğuzhan	KEÇECİ	00:09:34
8	Göktun	ŞAHİN	00:10:28
9	Burak	ALIM	00:12:03
10	Ferhat	ŞAHİN	00:53:16

**Figure 25:** Overall ranking page for referee

In this page, there is a grid view to show rank order, name and surname of the user, and the completing time of the game in seconds. In order to display this information, we take the best completing time of each user, which is the least one, out of whole completed game sessions. Then, we order the users according their completing times and this order is updated in every one second.

#### **4.4.3.4 Update personal information**

This module has the same functionality as educator's module. The referee can have ability to update their personal information by using this module.

### **4.5 Encountered Problems and Solutions**

#### **4.5.1 Loading times of the videos**

Although the videos are not stored in the database, the loading times are sometimes too long. Actually, in order to prevent this situation, we keep the URL of the videos in the database instead of keeping videos, however, the pilot videos are loaded slowly because of limited bandwidth capacity of our server. We conclude that a video serving service, such as YouTube, can be used to increase response time, however, the copyrights of these videos are belong to UEFA. UEFA does not want to share these videos with the individuals, who are not football referees. Hence, we do not have any chance to upload videos on YouTube because of this reason. The short term solution is to increase the bandwidth of our server, however, it does not solve this problem persistently. In order to solve this problem permanently, we should find a way to convince UEFA for uploading videos on video hashing services.

#### **4.5.2 Creating stopwatch for each user**

Our game platform is an on-line platform for the users. We need to get completing time for each user when they play the game. In order to provide this situation, we

have used a stopwatch element, which can be found in .NET framework, to evaluate the players' completion time for the game, however, when there are more than one player in the game, the stopwatch shows the same time for both players. We need to separate the time according to users. Hence, we create a list, which consists of the stopwatches for each user. When the user logs in to the system, we create a stopwatch for him and add it into the list. When the user log outs from the system, we record the time value into the database and remove the stopwatch of the user from the list.

#### **4.5.3 Logging out from the system with closing browser**

It is very hard to recognize that the user closes the browser or he goes to another page. We need to capture this situation, because, some users do not use buttons, which are designed for logging out from the system, to log out from the system. They close the browser. It is very important to catch log out time of the user, because, we want to evaluate how long the user stays on-line in our game platform. There are several JavaScript codes to differentiate this situation, however, most of them do not work properly on all browsers. At the end of long research and several attempts, we have found a JavaScript code, which works properly on each browser.

#### **4.5.4 On-line movements on the racecourse**

It is very important to display the movements on the racecourse instantaneously. In order to solve this problem, we callback the related page in every 1 second, however, when we do this method, another problem is occurred. This problem is that we cannot redirect the user to another page inside of the callback method, but, we have to do this, because, when the user completes the racecourse, he needs to be redirected to overall ranking page. At the end, we have used a script manager to redirect the user to another page.

## CHAPTER 5

### ANALYSIS AND TEST RESULTS

#### 5.1 Introduction

In this study, we have control and experimental groups, as we mentioned in the previous chapters. The individuals, who are in the control group, are not allowed to log in to the training system, however, they should use “Laws of the Game” book for improving themselves about the football game rules. The individuals, who are in the experimental group, can use our training platform to improve themselves about the football game rules. During the training period, we asked our participants not to use the book for training in a limited period of time. In order to compare the effectiveness of our game platform and “Laws of the Game” book, we have assessed the knowledge level of the selected referees before starting education as a pre-test. Then, we have initiated training period for one month. After completing the training period, we have applied the post-test and have attained the results of this test. At the end, we have applied two sample hypothesis test to measure the effectiveness of both educational tools by using the results of both pre-test and post-test for both groups as numerical data. In this chapter, we will illustrate the details of the pre and post-tests. Then, we analyze and show the results of both assessments.

#### 5.2 Pre-Test

As we have mentioned in above section, we have organized a pre-test (see Appendix I for the content of the questions) for a selected group of football referees for our training program at the beginning of the training period. This test consists of 50 questions. These questions are separated into 2 parts. These parts are: “*Multiple*

*Choice Questions*” and *Video Questions*”. There are 35 multiple choice questions and 15 video questions in the proposed test.

To build a proper assessment tool, we have interviewed an expert from TFF. We determined the number of question in the test and selected the contents of the questions with him. He told that *“there are 50 questions in real exams, which are organized every year to measure the knowledge level of the football referees about the football game rules”*. In light of this, we have determined 50 as the number of questions that should be in the pre-test. Also, we want to observe the progress of the referees in both areas, which are multiple choice and video. Hence, we have divided the questions into 2 groups. The number of the questions in both groups were also determined by the expert from TFF.

We have organized a pre-test on December 9, 2014. There were 54 football referees as participants. As we have mentioned in above sections, we have 2 groups, which are experimental and control groups. The pre-test results of both groups are shown in Table 3 for experimental group and Table 4 for control group, respectively. When we have calculated the average scores of both groups in all parts, the results are shown in Table 2.

	<b>Multiple Choice(70)</b>	<b>Video (30)</b>	<b>Total (100)</b>
<b>Experimental Group</b>	38.3	16.8	55.1
<b>Control Group</b>	38.4	17.3	55.7

**Table 2:** Average Scores of Both Groups for All Parts in Pre-Test

There are important points when we have analyzed these quantitative data. The first important point is that the average scores of both groups are so close to each other in all parts of the exam. It means that the knowledge level of the football referees, who are in both groups, and about the football game rules are nearly same at the beginning of the education program.

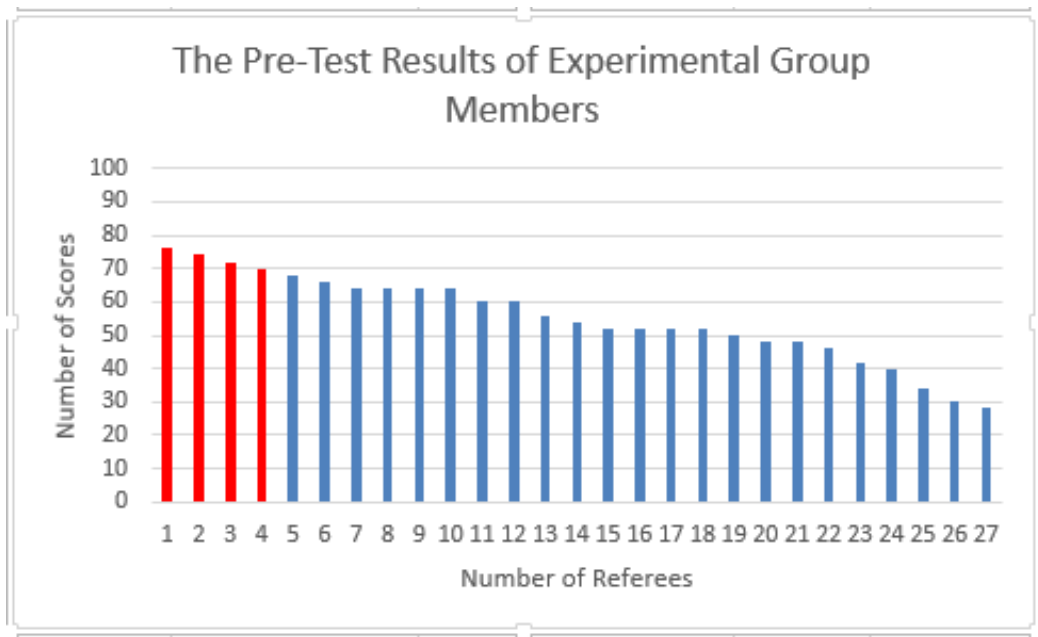
<b>Experimental Group</b>		
<b>Multiple Choice (70)</b>	<b>Video (30)</b>	<b>Total (100)</b>
56	20	76
56	18	74
52	20	72
42	28	70
48	20	68
44	22	66
44	20	64
48	16	64
46	18	64
46	18	64
42	18	60
46	14	60
38	18	56
38	16	54
38	14	52
36	16	52
40	12	52
38	14	52
36	14	50
30	18	48
30	18	48
32	14	46
22	20	42
32	8	40
12	22	34
26	4	30
16	12	28

**Table 3:** The Pre-Test Results of Experimental Group Members

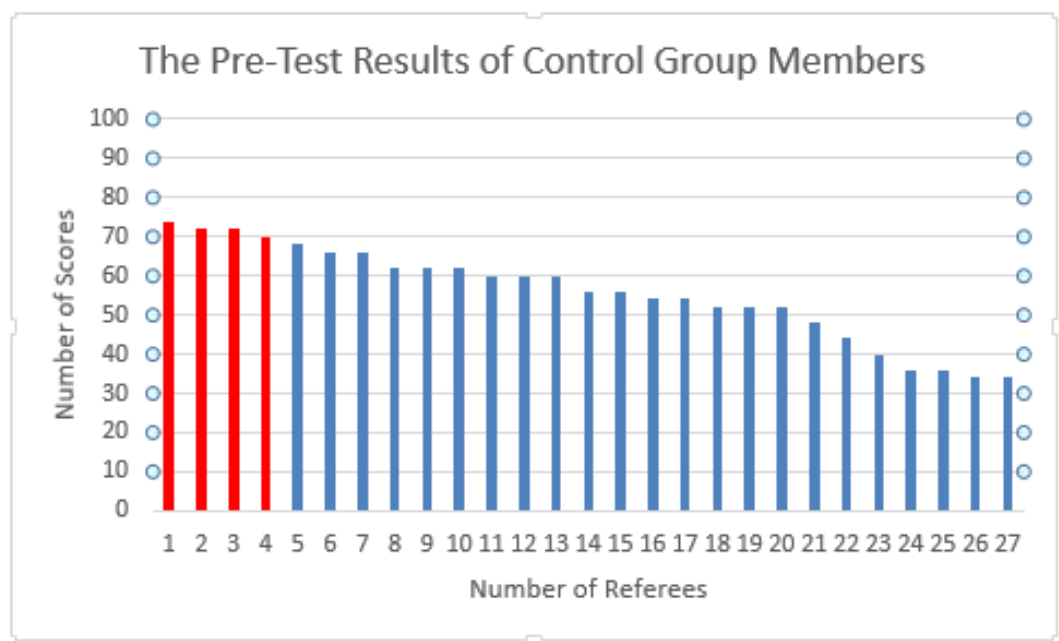
<b>Control Group</b>		
<b>Multiple Choice (70)</b>	<b>Video (30)</b>	<b>Total (100)</b>
46	28	74
48	24	72
58	14	72
46	24	70
54	14	68
40	26	66
52	14	66
42	20	62
42	20	62
42	20	62
46	14	60
36	24	60
38	22	60
32	24	56
42	14	56
40	14	54
38	16	54
38	14	52
34	18	52
36	16	52
32	16	48
32	12	44
26	14	40
24	12	36
26	10	36
24	10	34
22	12	34

**Table 4:** The Pre-Test Results of Control Group Members

The second important point is the number of successful referees in the exam. In real exams, 70 is the threshold to be successful for the referees out of 100. When we have examined the pre-test results, there were 4 individuals, who could pass the exam in the experimental group out of 27 as shown in Figure 26, and 4 individuals, who passed the exam in the control group out of 27 as shown in Figure 27. In total, there were 8 referees, who were successful, out of 54 referees.



**Figure 26:** Successful referees for experimental group in pre-test



**Figure 27:** Successful referees for control group in pre-test



### 5.3 Post-Test

At the end of the training period, we have conducted a post-test (see Appendix I for the content of the questions) for a selected group of football referees. This test is the same as pre-test. The number and the content of the questions are the same, because, we have to keep the difficulty level of the questions same between pre and post-test in order to provide validity. In the pre-test, the answers of the question and the scores were not announced to the participants. Also, it is nearly impossible to find the solutions of the pre-test. Hence, there is no problem to apply same test.

We have organized a post-test on January 6, 2015. There were 54 football referees, who were selected for the training program as experimental (27) and control (27) groups. The post-test results of both groups are shown in Table 6 for experimental group and Table 7 for control group, respectively. When we have calculated the average scores of both groups in all parts, the results are shown in Table 5.

	<b>Multiple Choice(70)</b>	<b>Video (30)</b>	<b>Total (100)</b>
<b>Experimental Group</b>	43.6	22.6	66.1
<b>Control Group</b>	41.2	20.9	62.0

**Table 5:** Average Scores of Both Groups for All Parts in Post-Test

There are also important points when we have analyzed these quantitative data like analyzing the quantitative data, which were attained by pre-test. First of all, the average scores of experimental group in all parts are higher than the average scores of control group. It means that the participants, who are in the experimental group, are more successful than the participants, who are in the control group.

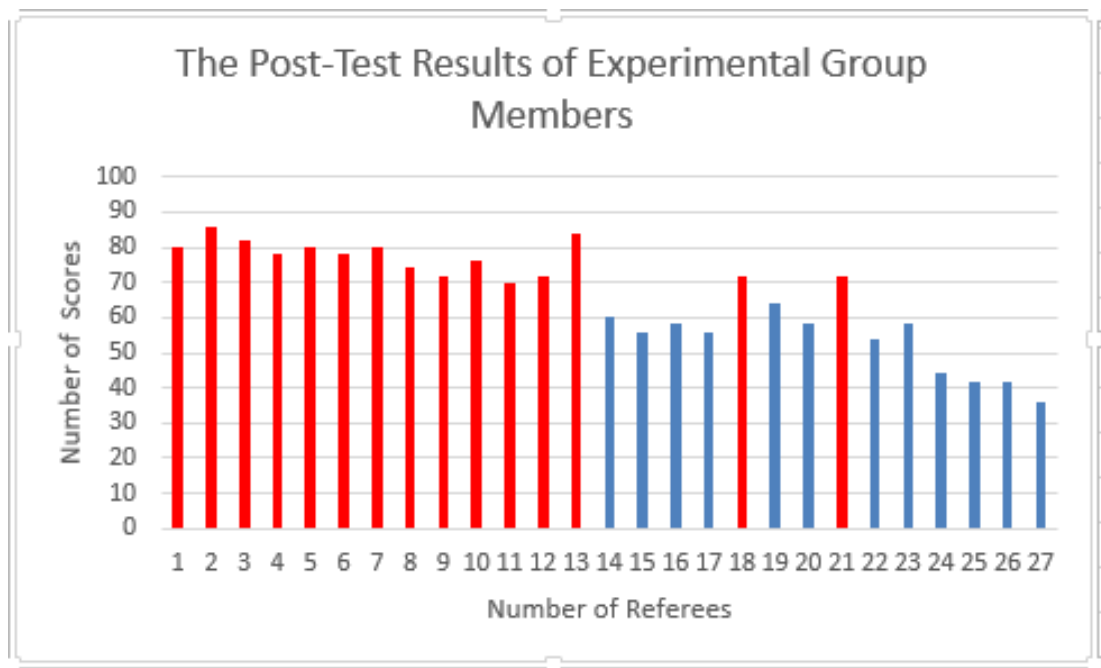
<b>Experimental Group</b>		
<b>Multiple Choice (70)</b>	<b>Video (30)</b>	<b>Total (100)</b>
54	26	80
60	26	86
54	28	82
48	30	78
54	26	80
54	24	78
56	24	80
52	22	74
50	22	72
48	28	76
48	22	70
48	24	72
56	28	84
36	24	60
38	18	56
36	22	58
40	16	56
50	22	72
42	22	64
36	22	58
42	30	72
34	20	54
38	20	58
30	14	44
22	20	42
30	12	42
20	16	36

**Table 6:** The Post-Test Results of Experimental Group Members

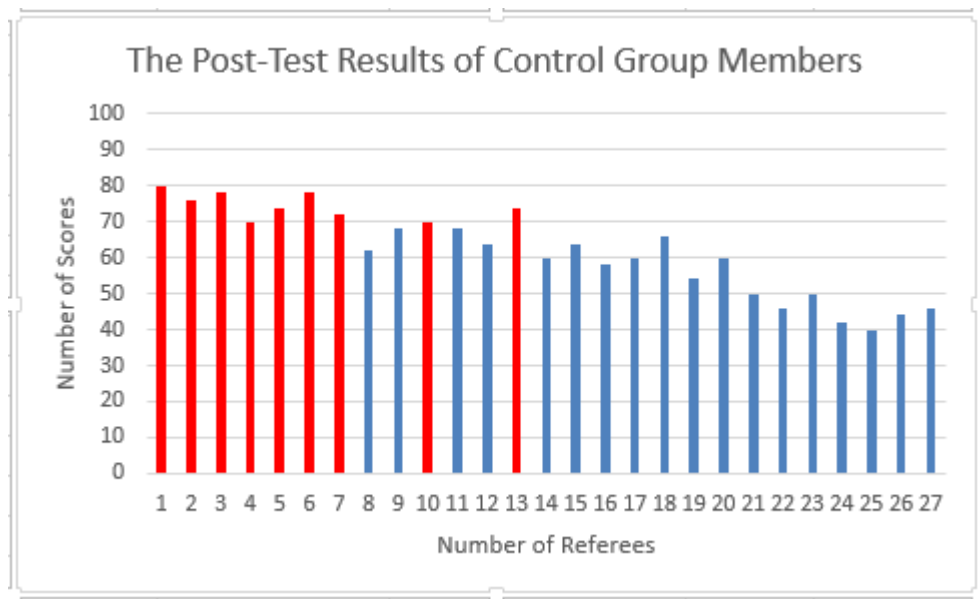
<b>Control Group</b>		
<b>Multiple Choice (70)</b>	<b>Video (30)</b>	<b>Total (100)</b>
54	26	80
52	24	76
52	26	78
44	26	70
50	24	74
42	26	68
48	18	66
42	20	62
44	24	68
46	24	70
50	18	68
38	26	64
42	20	62
40	20	60
44	20	64
38	20	58
46	14	60
48	18	66
36	18	54
36	24	60
34	16	50
32	14	46
32	18	50
26	16	42
22	18	40
28	16	44
30	16	46

**Table 7:** The Post-Test Results of Control Group Members

The second important point is the number of successful referees in the exam. In real exams, a referee has to get at least 70 points out of 100 in order to be successful and pass the exam as we have indicated above section. When we have examined the post-test results, there were 15 individuals, who passed the exam in the experimental group as shown out of 27 in Figure 28, and 9 individuals, who passed the exam in the control group out of 27 as shown in Figure 29. In total, there were 24 referees, who were successful, out of 54 referees.



**Figure 28:** Successful referees for experimental group in post-test



**Figure 29:** Successful referees for control group in post-test

#### 5.4 Comparison Between Pre-Test and Post-Test Results

When we analyze the results of both pre and post-test, there are several differences between the results of these tests. Firstly, the number of successful referees in the post-test is higher than the number of successful referees in the pre-test. In the pre-test, there are 4 successful referees in the experimental group and 4 successful referees in the control group. Hence, there are 8 successful referees in total. In the post-test, there are 15 successful referees in the experimental group and 9 successful referees in the control group. Thus, there are 24 successful referees in total. These values show that both education tools are useful for the referees, however, digital game-based learning platform is more beneficial than traditional learning book, because the number of referees, who improve their knowledge level by using training platform, is more than the number of referees, who improve their knowledge level by using FIFA book. Second difference is the average scores of both test. For the experimental group, the average score of multiple choice category is 38.3, the average score of video category is 16.8 and the average score in total is 55.1; for the control group, the average score of multiple choice category is 38.4, the average score of video category is 17.3 and the average score in total is 55.7 in the pre-test. In the post-test, the average score of multiple choice category is 43.6, the average score

of video category is 22.6 and the average score in total is 66.1 for the experimental group; the average score of multiple choice category is 41.2, the average score of video category is 20.9 and the average score in total is 62.0 for the control group. These numerical values show that although the referees in the control group increase their scores, the referees in the experimental group increases their scores more than the control group members in all parts of the exams.

In addition to above comparison, we have applied *two sample t-test* in order to illustrate statistically whether the training platform is more beneficial than the FIFA book or not. The definitions of the variables, which are used in the formula of two sample t-test, are shown as follow:

- $\mu_1$ : the population mean of the differences between pre and post-test for the experimental group
- $\mu_2$ : the population mean of the differences between pre and post-test for the control group
- $N_1$ : the sample size of the experimental group
- $N_2$ : the sample size of the control group
- $\bar{Y}_1$ : the sample mean of the differences between pre and post-test for the experimental group
- $\bar{Y}_2$ : the sample mean of the differences between pre and post-test for the control group
- $s_1^2$ : the sample variance of the differences between pre and post-test for the experimental group
- $s_2^2$ : the sample variance of the differences between pre and post-test for the control group
- T: test statistic
- $t$ : critical value
- $p$ : probability value of differences

*Two Sample T-Test Statistic Formula:*

$$T = \frac{\overline{Y}_1 - \overline{Y}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

Before calculating the “*T*” value, we should identify our hypotheses. In this study, we can state the null hypothesis in the form that the difference between the two population’s means is equal to each other and the alternative hypothesis that the population mean of the experimental group is greater than the population mean of the control group. The mathematical representations of these hypotheses are shown as follows:

$$H_0: \mu_1 = \mu_2$$

$$H_a: \mu_1 > \mu_2$$

In order to calculate “*T*” value and accept one of the above hypotheses, we have used Minitab program by entering the numerical data, which illustrate the differences of pre and post-tests scores for both groups (Table 8).

When we have chosen the value of significance level, which is demonstrated by  $\alpha$ , as 0.05 and assuming the variances as equal to each other, “*T*” value is calculated as 3.45 and “*P*” value is calculated as 0.001. According to *t*-Table (see Appendices II), the critical value is equal to 1.675, which is shown in Figure 30, by selecting the number of population as 52 ( $v = N_1 + N_2 - 2$ ).

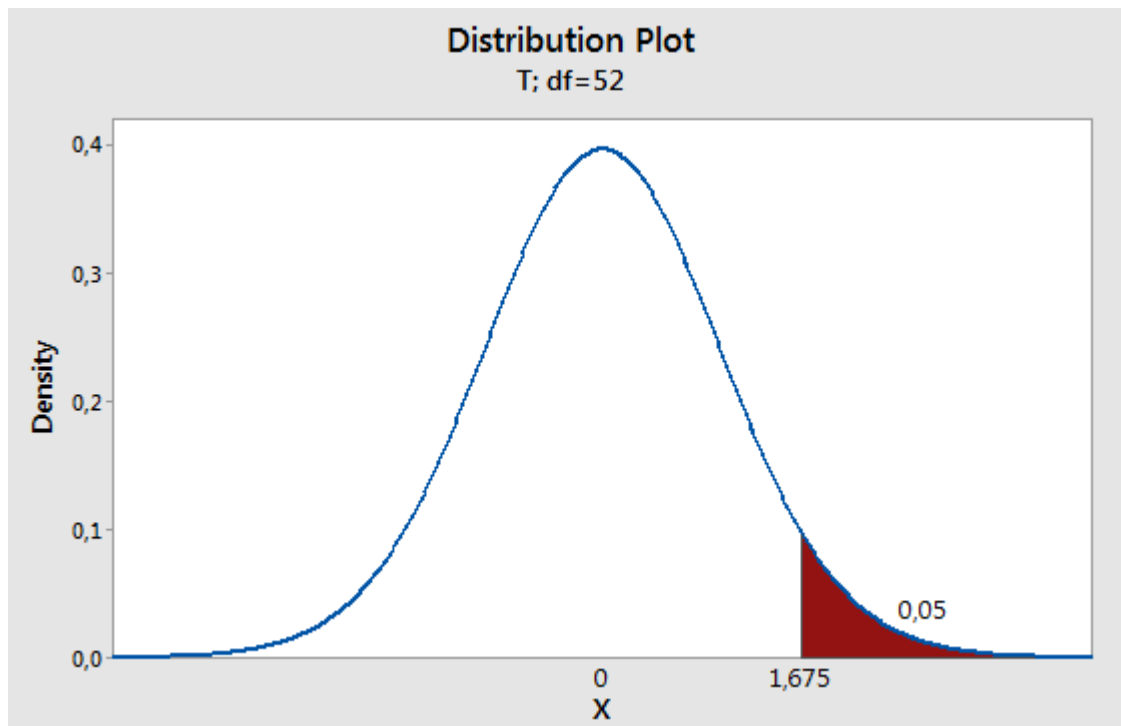
There can be made 2 interpretation by using these numerical results. First of all, our *p* value, which is equal to 0.001, shows that we reject the null hypothesis, because, if the *p* value is smaller than 0.05, the statistic directs the researchers to reject the null hypothesis. Secondly, our test statistic value ( $T = 3.45$ ) is greater than the critical value ( $t = 1.675$ ). Hence, the statistic indicates that if the test statistic value is greater than the critical value, the null hypothesis is rejected. According to this information, we reject our null hypothesis within 99.5 percentage of confidence level. Thus, our alternative hypothesis, which determines that the population mean of the

experimental group is greater than the population mean of the control group, is accepted statistically.

<b>Experimental Group</b>	<b>Control Group</b>
4	6
12	4
10	6
8	0
12	6
12	12
16	6
10	0
8	6
12	8
10	8
12	4
28	14
6	4
4	8
6	4
4	6
20	14
14	2
10	8
24	2
8	2
16	10
4	6
8	4
12	10
8	12

**Table 8:** The Differences Between Pre-Test and Post-Test Results





**Figure 30:** Probability distribution plot

### 5.5 Validation Interviews

To fulfil the qualitative aspects of our study, we conducted a set of interviews with the football referees, who have joined our training program, to evaluate the results of our study. According to these interviews, they consider that our game platform increases the ability of making true comment about the positions, which have occurred during the football games and improve the self-confidence of themselves. In addition, the game platform creates a competition between the players to get higher position in overall ranking. Also, the questions in the platform help the football referees to remind the rules of the football game. When we consider the opinions of the participants, our game platform is beneficial tool to improve their knowledge level about the football game rules and their decision making skills.

## 5.6 Threats to Validity

Yilmaz [92] defines the “*threats to validity*” as the possible factors that can alter correctness, trust-ability and usefulness of the study in a bad way. In support, Fayter et al. [25] describe threats that the factors affect to get poor quality results.

There are some threats, which can be negatively affect the results of the study. These threats are listed as follows:

- A referee, who is in the experimental group, may share his user name and password to another referee, who are in the control group.
- A referee, who is in the experimental group, may solve the questions with another individual, who has experience in football refereeing.
- A referee, who is in the experimental group, may also study with FIFA book.
- A referee, who is in the control group, may also study with the training platform.
- The referees, who can be in both groups, may purposely give wrong answers to the questions, which were asked in the both tests.

Although we have tried to consider all conditions, which may negatively affect our study, the above threats may negatively affect the results of this study.

## CHAPTER 6

### CONCLUSION AND FUTURE WORK

The main objective of this study to propose a training framework for the football referees about the football game rules in an enjoyable way. In addition, this system aims to improve the decision making abilities of the football referees against the critical positions during football games. The secondary objective is to explore that game-based learning is more beneficial than traditional learning tools (e.g books) to educate the football referees about the football game rules. In order to provide these goals, we have illustrated how the game should be designed to support learning, we have indicated a set of factors, which should be considered when a game is designed. In addition, we conducted a literature review to seek similar studies. Our initial results show that such techniques are beneficial in learning area. Also, we have pointed out the importance of educating the football referees and the point of views of FIFA. Next, we have explained our research methodology, (*Mixed Research Methodology*), and why we have chosen this methodology type by comparing both “*Qualitative Research Methodology*” and “*Quantitative Research Methodology*”. After that, we have illustrated the requirements and design of our system. Finally, we have analysed the results of pre-test and post-test, which have been tested on the football referees. As a conclusion, our results suggest that our game platform is a beneficial tool about educating football referees about the football game rules by applying statistical tests. In addition to the results of statistical tests, we have conducted interviews to capture the football referees' experiences and opinions about the training platform in order to validate this conclusion. According to these interviews, we have indicated:

- The platform increases the ability of making true comment about the positions, which have occurred during the football games.

- It improves self-confidence of the participants, because, they have declared that after three or four game sessions, they have started to give true answers to the question. Hence, they have started to trust their knowledge level about the rules of the football game.
- In order to get higher place in the overall ranking, there is a competition between the football referees. This competition fosters them to play more games.
- The questions help the football referees to remind the rules of the football game.
- It is a beneficial and complementary tool for studying, especially before the real exams.
- The football referees have a chance to follow new positions, which have occurred during the matches played all over the world. In fact using the proposed system, more positions can be shown to the football referees to improve their decision-making skills.

Although the proposed tool meets the expectations, our aim is to develop and improve this system with additional properties in future works. In order to achieve this aim, we envision more methods that can improve the quality of the training of the football referees.

First of all, we plan to increase the number of questions for each question category. We have seen that when the user plays so many games, the questions start to repeat. Although, research suggests that repeating increases the learning process [77, 28, 78], it can be boring as the time passed. Hence, we have to improve the variety of questions in order to keep the system updated.

Secondly, we can categorize the questions according to their difficulty level. This system is designed to train the new football referees, however, we want to address the needs of the experienced football referees into our game platform. In order to do this, we should add new more challenging questions. For example, we could separate

the videos and show them according to users' experience levels. Thus, the novice football referees should not solve these questions.

Lastly, in the future we can create a new section, which consists of the materials of the LOG book of FIFA. As we mentioned above chapters, there are 17 football game rules, however some of them are more important and more used than the others. Thus, we have to determine the important rules. In order to determine this, we can make a survey the referees to get their opinions about which rules are more important than the others. After determining the important rules according to the referees, we will prepare the materials as a material consists of the information, which size is at most 1 page. Hence, these materials should not be long, but also it should be educative. Then, we will put the status of each material. Thus, a feedback system can be designed to explore referees' status about the related material with selecting one of the statuses. The materials, which should be solved by the user, will be determined by the system. To this end, we will code an algorithm that evaluates the user's situation about the materials. The materials, which are difficult to solve for the user, should repeat more than the materials, which are easy to solve for the user. In order to figure out whether the materials are difficult or not, we will consider some criteria such as status of material, answering time, similar materials in the same game rule etc. In this way, we aim to determine the missing points of the referees about the football game rules and to send them the materials, which help to remove these missing points.

The football rules are updated every year and there are lots of new positions, which need to be commented, in the matches. Hence, we should keep the system updated. The purpose of these additional properties is to increase the educational effects of this system with keeping it updated and interesting.

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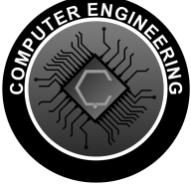
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APPENDICES A



**ÇANKAYA ÜNİVERSİTESİ  
BİLGİSAYAR MÜHENDİSLİĞİ BÖLÜMÜ VE TÜRKİYE  
FUTBOL FEDERASYONU ANKARA İL HAKEM KURULU  
BAŞKANLIĞI HAKEM EĞİTİM PROGRAMI ÖN TESTİ**



Ad Soyad	
Tarih	
İmza	



**TÜRKİYE  
FAAL FUTBOL HAKEMLERİ VE  
GÖZLEMCİLERİ DERNEĞİ**

## **1.BÖLÜM - ÇOKTAN SEÇMELİ SORULAR**

**1. A takımı rakip ceza alanı içinden serbest vuruş kullanmaktadır. 8 numaralı oyuncusu topun üstünden atlayarak barajdaki kaleciyi şaşırtmış ve 5 numaralı takım arkadaşının vuruşuyla top kaleye girmiştir. Hakem nasıl bir karar vermelidir?**

- a) Gol kararı vermelidir.
- b) Vuruşu tekrar ettirmelidir.
- c) 5 numaralı oyuncuya ihtar vermeli ve vuruş tekrar ettirmelidir.
- d) Kale vuruşu vermelidir.

**2. A takımı umut vadeden bir atakla rakip kaleye hücum etmektedir. 7 oyuncu ile oynayan B takımından bir oyuncu kasıtlı olarak oyun alanını terk etmiştir. Bu durumda hakem nasıl bir karar vermelidir?**

- a) Oyunu durdurmalı ve B takımındaki oyuncu sayısı 7'nin altına düştüğü için oyunu devam ettirmemelidir.
- b) Yapılan atağı beklemeli ve top oyun dışı olduğunda B takımı en az 7 oyuncu sayısına sahip değilse oyunun tekrar başlamasına izin vermemelidir.
- c) Oyunu durdurmalı ve oyunu kasıtlı olarak terk eden oyuncuyu oyun alanına davet etmelidir. B takımı en az 7 oyuncu sayısına sahip değilse oyunun tekrar başlamasına izin vermemelidir.
- d) Oyunu durdurmalı ve B takımının kaptanı aracılığıyla kasıtlı olarak oyun alanını terk eden oyuncuyu oyuna davet etmeli, oyuncu oyuna devam etmek istemezse oyunu başlatmamalıdır.

**3. Kendi ceza alanı içinde duran ev sahibi takımın 25 nolu oyuncusu ayakkabısını, ceza alanı dışındaki misafir takımın 16 nolu oyuncusuna aşırı kuvvet kullanarak atmıştır. Hakemin kararı ne olmalıdır?**

- a) İhraç, indirekt serbest vuruş.
- b) İhtar, penaltı.
- c) İhraç, direkt serbest vuruş.
- d) İhraç, penaltı.



**4. Bir kale vuruşunda, rakip oyuncu ceza alanı yan çizgisi üzerinde topa sahip oluyor, kale vuruşunu kullanan oyuncunun arkadaşı ceza alanı içinde, topa sahip olan oyuncuya karşı şiddetli harekette bulunuyor. Hakem nasıl bir karar vermelidir?**

- a) Penaltı vuruşu vermelidir.
- b) Kale vuruşunu tekrar ettirmelidir.
- c) Penaltı vuruşu vermeli ve şiddetli harekette bulunan oyuncuyu ihraç etmelidir.
- d) Kale vuruşunu tekrar ettirmeli ve şiddetli harekette bulunan oyuncuyu ihraç etmelidir.

**5. Başlama vuruşu yöntemi ile ilgili aşağıdaki ifadelerden hangisi yanlıştır?**

- a) Hakem işaret verir.
- b) Bütün oyuncular top oyuna girinceye kadar toptan 9.15 metre uzakta olurlar.
- c) Bütün oyuncular kendi yarı alanlarında bulunur.
- d) Vuruş yapan oyuncu top bir başka oyuncuya dokunmadan önce topa ikinci kez dokunamayacaktır.

**6. Aşağıdakilerden hangisi ceza alanı içinden ve dışından yapılan serbest vuruşların ortak bir özelliğidir?**

- a) Top, vuruş yapıp hareket ettiği anda oyundadır.
- b) Bütün rakip oyuncular top oyuna girinceye kadar ceza alanı dışında kalmalı ve toptan en az 9,15 m. uzakta bulunmalıdır.
- c) Serbest vuruş ihlalin yapıldığı yerden yapılmalıdır.
- d) Vuruş yapılırken top hareketsiz durmalı ve vuruşu yapan oyuncu başka bir oyuncu dokunmadan önce topa dokunmamalıdır.

**7. Serbest vuruş veriliyor ve oyuncu bu vuruşu hızla kullanıyor. Topa 9.15 metreden daha yakında bulunan bir rakip oyuncu topa sahip oluyor. Hakemin kararı ne olmalıdır?**

- a) Hakem, oyunun devam etmesine izin verir.
- b) Hakem, vuruşu tekrar ettirir.
- c) Vuruş tekrar edilir. 9.15 metreden daha yakına giren oyuncuya ihtar verir.
- d) Hakem vuruşu tekrar ettirir. Her iki oyuncuya da ihtar verir.

**8. Serbest vuruşla ilgili ařağıdaki tanımlamalardan hangisi doğrudur?**

- a) Eęer bir direkt serbest vuruşta top, doğrudan doğruya takımın kendi kalesine girerse kale vuruşu verilir.
- b) Eęer bir endirekt serbest vuruşta top, doğrudan doğruya rakibin kalesine girerse köşe vuruşu verilmelidir.
- c) Kale alanı içinde, hücum eden takım lehine verilen direkt serbest vuruşta, rakip oyuncuların kale çizgisi üzerinde durmaları 9,15' in açtırılması açısından yeterlidir.
- d) Serbest vuruşlar, her zaman ihlalin yapıldığı yerden kullanılmaz.

**9. Sakatlanmalarla ilgili ařağıdaki ifadelerden hangisi yanlıştır?**

- a) Bir yaradan dolayı kanaması olan bir oyuncu, oyun alanını terk etmelidir.
- b) Top oyunda olduğunda, sakatlanan oyuncu tekrar oyun alanına taç çizgisinden girmelidir.
- c) Eęer hakemin görüşüne göre, bir oyuncu hafif şekilde sakatlanmış ise, top oyun dışı oluncaya kadar oyunu devam ettirir.
- d) Topun oyunda olup olmadığına bakılmaksızın, sakatlanan bir oyuncunun tekrar oyun alanına girmesine izin verme konusunda sadece 4. hakem yetkilidir.

**10. Hakemler avantaj uygulamak veya oyunu durdurmak kararını verirken ařağıdaki hangi durumu göz önüne almamalıdır?**

- a) İhlalin yapıldığı dakika.
- b) İhlalin ciddiyeti.
- c) İhlalin yapıldığı yer.
- d) Maçın atmosferi.

**11. Bir oyuncu köşe vuruşunu kullanmış; ancak top kale direğine çarparak aynı oyuncuya gelmiştir. Bu oyuncunun ceza alanına gönderdiği toptan takımı bir gol kaydetmiştir. Hakemin kararı ne olmalıdır?**

- a) Gol geçersiz, topa ikinci kez vurduğu yerden aleyhine endirekt serbest vuruş. İlgili oyuncuya ihtar.
- b) Gol geçerlidir.
- c) Gol geçersiz, topa ikinci kez vurduğu yerden aleyhine endirekt serbest vuruş.
- d) Köşe vuruşu tekrar edilmelidir.

**12. Bir ofsayt ihlali meydana geldiğinde kullanılacak endirekt serbest vuruşun yeri ile ilgili aşağıdaki ifadelerden hangisi doğrudur?**

- a) Kendi takım arkadaşı tarafından atılan topa bulunduğu veya buluşabileceği yerden.
- b) Top, kendi takım arkadaşı tarafından en son oynandığında ihlali yapan oyuncunun bulunduğu yerden.
- c) Sondan ikinci savunma oyuncusunun bulunduğu yerden.
- d) Son savunma oyuncusunun bulunduğu yerden.

**13. Aşağıdaki bilgilerden kaç tanesi direkt ve endirekt serbest vuruşun ortak özelliğidir?**

- Bir serbest vuruştan top, doğrudan doğruya kendi kalesine girerse rakip takım lehine bir köşe vuruşu verilir.
- Bir serbest vuruş yapılırken top hareketsiz durmalı.
- Bir serbest vuruş yapıldıktan sonra vuruşu yapan oyuncu başka bir oyuncu dokunmadan önce topa dokunmamalı.
- Savunan takımın kendi ceza alanı içinden kullandığı bir serbest vuruşta bütün rakip oyuncular top oyuna girinceye kadar ceza alanı dışında kalmalı.

- a) 4                      b) 3                      c) 2                      d) 1

**14. Kural 11 ile ilgili aşağıdaki ifadelerden hangisi yanlıştır?**

- a) Ofsayt kararı veren yardımcı hakemler, kararın doğru ve biraz geç olmasının, hızlı ve yanlış olmasından daha iyi olduğunu bilmelidir.
- b) Yardımcı hakemin, bayrağı oyun alanına yakın elinde tutması ve hareket yönünü değiştirdikçe bayrağı tuttuğu elini de değiştirmesi tavsiye edilir.
- c) Yardımcı hakeme daha iyi görüş çizgisi sağlayacağından, bayrak sol el kullanılarak kaldırılmalıdır.
- d) Ofsayt kararı için bayrak işareti verilirse ve bu işaret hakem tarafından hemen görülmezse; yardımcı hakem işaret tam olarak görülene kadar ya da top tamamen savunmadaki takımın kontrolüne geçene kadar işareti göstermeye devam etmelidir.

**15. “Başlama vuruşu” ile ilgili aşağıdaki ifadelerden hangisi doğrudur?**

- a) Para atışı yapılır. Atışı kazanan takım başlama vuruşunu yapar.
- b) Para atışı yapılır ve atışı kazanan takım ikinci yarıda başlama vuruşunu yapar.
- c) Para atışı yapılır ve atışı kaybeden takım ikinci yarıda başlama vuruşunu yapar.
- d) Para atışı yapılır ve atışı kazanan takım topu veya kaleyi seçer.

**16. Bir oyuncu ta atışını kendi kalesine doęru yapıyor, kaleci topa dokunamıyor ve bir takım arkadaşı, kaleye girmekte olan topa eliyle vurarak, topu, kale direęinin yanından oyun alanı dıřına atıyor. Hakem nasıl bir karar vermelidir?**

- a) Penaltı vuruřu vermeli ve oyuncuya da sportmenlik dıřı davranıřı nedeniyle ihtar vermelidir.
- b) Ke vuruřu vermeli ve oyuncuyu, bariz gol řansını engellemekten oyundan ihra etmelidir.
- c) Penaltı vuruřu vermeli ve oyuncuyu, bariz gol řansını engellemekten oyundan ihra etmelidir.
- d) Ke vuruřu vermeli ve oyuncuya da sportmenlik dıřı davranıřı nedeniyle ihtar vermelidir.

**17. I- Kale vuruřu**

**II- Ta atıřı**

**III- Ke vuruřu**

**Yukarıdakilerden hangisinden veya hangilerinden doęrudan doęruya ofsayt olmaz?**

- a) Yalnız I
- b) Yalnız I ve II
- c) Yalnız II ve III
- d) I, II ve III

**18. Bir kaleci ta atıřı yaptıktan sonra, top bařka bir oyuncuya dokunmadan nce, rakip ceza alanı iinde, topa eliyle dokunursa, hakem nasıl bir karar vermelidir?**

- a) Kalecinin topa eliyle dokunduęu yerden, rakip takım lehine endirekt serbest vuruř vermelidir.
- b) Ta atıřını tekrar ettirmelidir.
- c) Kalecinin topa eliyle dokunduęu yerden, rakip takım lehine direkt serbest vuruř vermelidir.
- d) Penaltı kararı vermelidir.

**19. A takımının yedek oyuncusu oyun oynanırken oyun alanı iindeki bir rakibine ayakkabısını fırlatıyor. Oyunu durduran hakem oyunu tekrar nasıl bařlatmalıdır?**

- a) Rakibin bulunduęu yerden rakip takım lehine endirekt serbest vuruř ile.
- b) Topun bulunduęu yerden rakip takım lehine direkt serbest vuruř ile.
- c) Rakibin bulunduęu yerden rakip takım lehine direkt serbest vuruř ile.
- d) Topun bulunduęu yerden rakip takım lehine endirekt serbest vuruř ile.

**20. Kalecinin yaptığı kale vuruşunda top, rakip kaleye doğrudan girmeden önce, ofsayt pozisyonunda olan takım arkadaşı topa dokunmuştur. Hakem nasıl bir karar vermelidir?**

- a) Ofsayt kararı vermelidir.
- b) Kale vuruşu kararı vermelidir.
- c) Gol kararı vermelidir.
- d) Yukarıdakilerin hepsi yanlıştır.

**21. Serbest vuruşlarla ilgili aşağıdaki ifadelerden hangisi doğrudur?**

- a) Eğer bir direkt serbest vuruş doğrudan doğruya takımın kendi kalesine girerse bir gol atılmış olur.
- b) Eğer bir direkt serbest vuruş doğrudan doğruya takımın kendi kalesine girerse bir kale vuruşu verilir.
- c) Eğer bir indirekt serbest vuruş doğrudan doğruya takımın kendi kalesine girerse bir köşe vuruşu verilir.
- d) Eğer bir indirekt serbest vuruş doğrudan doğruya rakip takımın kalesine girerse bir köşe vuruşu verilir.

**22. Eğer bir savunma oyuncusu rakip oyuncuyu ofsayt pozisyonuna düşürmek amacıyla kendi kale çizgisinin arkasına adımını atarsa hakem aşağıdakilerden hangisini yapmalıdır?**

- a) Oyunu durdurmalı, söz konusu savunma oyuncusuna sportmence olmayan davranışı nedeni ile ihtar vermelidir.
- b) Söz konusu savunma oyuncusunun bu hareketi bir ihlal olmadığı için oyunun devamına izin vermelidir.
- c) Hakem pozisyonu ofsayt olarak değerlendirmeli ve oyunu durdurmalıdır.
- d) Hakem oyunun devamına izin vermeli ve top oyun dışı olduğunda hakemin izni olmadan kasıtlı olarak oyun alanı dışına çıktığı için savunma oyuncusuna ihtar vermelidir.

**23. Hakem atışı ile ilgili aşağıdakilerden hangisi yanlıştır?**

- a) Herhangi bir oyuncu topu kazanmak için hakem atışına katılabilir (kaleci dahil).
- b) Hakem atışı esnasında top yere değmeden hakeme çarparsa atış tekrar edilmelidir.
- c) Hakem atışına katılma konusunda gerekli en az veya en çok oyuncu sayısı yoktur.
- d) Hakem, bir hakem atışına kimin katılacağına karar veremez.

**24. Kalecinin yaptığı kale vuruşunda top ceza alanının dışına çıkıyor ancak bir başka oyuncu dokunmadan kuvvetli rüzgârla geri dönüyor. Kaleci, geri gelen bu topu eliyle kontrol ederek tekrar oyuna sokuyor. Hakem bu durumda nasıl bir karar vermelidir?**

- a) Kale vuruşunu tekrar ettirmelidir.
- b) Rakip takım lehine endirekt serbest vuruş vermelidir.
- c) Rakip takım lehine endirekt serbest vuruş ve kaleciye ihtar vermelidir.
- d) Kale vuruşunu tekrar ettirmeli ve kaleciye ihtar vermelidir.

**25. Ofsayt değerlendirmesinde "rakibe müdahale"nin anlamı, aşağıdakilerden hangisini içermez?**

- a) Bariz bir şekilde rakibin görüş çizgisini engellemek,
- b) Rakibin hareketini engellemek,
- c) Ofsayt pozisyonundayken kale direklerinden dönen topla oynamak,
- d) Hakemin düşüncesine göre rakibi aldatici veya oyalayıcı hareketler yaparak rakibin topla oynamasını önlemek.

**26. Sakatlık nedeni ile oyun alanı dışına çıkmış bir oyuncu hakemden izinsiz oyun alanına girerek takım arkadaşına bir yumruk vurmıştır. Bunun üzerine oyunu durduran hakemin kararı ne olmalıdır?**

- a) Oyuncu ihraç - takımı aleyhine topun bulunduğu yerden endirekt serbest vuruş.
- b) Oyuncu ihraç - takımı aleyhine ihlalin olduğu yerden direkt serbest vuruş .
- c) Oyuncu ihraç - ihlalin olduğu yerden takımı aleyhine endirekt serbest vuruş .
- d) Oyuncu ihraç - topun olduğu yerden hakem atışı.

**27. Aşağıdakilerden hangisi hakemin kanaatince dikkatsiz, kontrolsüz veya aşırı güç kullanılarak yapıldığında direkt serbest vuruşla cezalandırılması gereken ihlallerden birisidir?**

- a) Rakibini tutarsa.
- b) Rakibin üstüne sıçrarsa.
- c) Rakibe tükürürse.
- d) Topu kazanmak için ayakla müdahale ederken topa dokunmadan önce rakibe dokunursa.

**28. Bir oyuncu kalecisine bilerek ayağıyla pas vermiştir. Kaleci topun boş kaleye girmekte olduğunu görüp kural ihlali yapmış ve topu eli ile kornere atarak bir gol olmasını engellemiştir. Hakemin kararı ne olmalıdır?**

- a) İhraç - endirekt serbest vuruş
- b) Endirekt serbest vuruş
- c) İhrac köşe vuruşu
- d) Köşe vuruşu

**29. Aşağıdakilerden hangisi yanlıştır?**

- a) Kale vuruşunda vuruşu yapan oyuncu hariç diğer oyuncular ceza alanı dışında duracaklardır.
- b) Kale vuruşu oyunu tekrar başlatma yöntemidir.
- c) Kale vuruşundan doğrudan doğruya rakip kaleye bir gol atılabilir.
- d) Kale vuruşundan doğrudan doğruya topu alan oyuncu ofsayt olarak değerlendirilmez.

**30. Aşağıdaki ihlallerin hangisi şiddetli harekete verilecek örneklerden birisi değildir?**

- a) Topsuz alanda rakibe dirsek vurmak.
- b) Bir takım görevlisine yumruk vurmak.
- c) Topu takım arkadaşının yüzüne fırlatmak.
- d) Topun üzerinden rakibin kaval kemiğine şiddetli tekme vurmak.

**31. Bir takım lehine kendi ceza alanında endirekt serbest vuruş veriliyor. Vuruşu yapan oyuncu topu ceza alanındaki bir takım arkadaşına çarpıyor ve top kaleye giriyor. Hakemin kararı ne olmalıdır?**

- a) Gol kararı verilir.
- b) Gol iptal edilir. Oyun kale çizgisine paralel kale alanı çizgisi üzerinden yapılacak bir endirekt serbest vuruşla başlatılır.
- c) Gol iptal edilir. Oyun kale çizgisine paralel kale alanı çizgisi üzerinden yapılacak bir hakem atışıyla başlatılır.
- d) Top, ceza alanının dışına çıkmadığı için oyunda değildir, vuruş tekrarlanır.

**32. A takımın kalecisi, hakeme haber vermeden devre arasında 2 nolu savunma oyuncusu ile yer deđiřtiriyor. Bir hücum sırasında rakip 5 nolu oyuncu, bariz gol řansı ile ilerleyen bu kaleciyi ceza alanında kural dıřı bir řeklide durduruyor. Oyunu durduran hakem ne yapmalıdır?**

- a) Savunan takımın 5 nolu oyuncusunu ihraç etmeli, kaleciye ve 2 nolu oyuncuya ihtar vermeli, oyunu penaltı vuruđu ile bařlatmalıdır.
- b) 5 nolu savunma oyuncusunu ihraç etmeli, oyunu penaltı vuruđu ile bařlatmalıdır.
- c) Kaleciye ve 2 nolu takım arkadasına ihtar vermeli, oyunu bir hakem atıřı ile bařlatmalıdır.
- d) Hücum oyuncusu ve kaleciye ihtar vermeli, oyunu bir hakem atıřı ile bařlatmalıdır.

**33. Bir oyuncu ikinci ihtarını alarak oyundan ihraç edilmiřtir. Oyun tekrar nasıl bařlar?**

- a) Kale vuruđu ile
- b) Direkt veya indirekt serbest vuruđu ile
- c) Taç atıřı ile
- d) Hepsisi olabilir

**34. Hakemin izniyle oyun alanı dıřında bulunan A takımının 5 nolu oyuncusu, hakemden izin almadan oyun alanına giriyor ve sportmenliđe aykırı bir řekilde topu eliyle tutuyor. Buna sinirlenen rakip 9 nolu oyuncu, bu oyuncuya bir yumruk vuruyor. Hakemin kararı ne olmalıdır?**

- a) 9 nolu oyuncu ihraç, 5 nolu oyuncu ikinci ihtarlık hareketinden oturu ihraç, 5 nolu oyuncunun takımı aleyhine topa eliyle müdahale ettiđi yerden direkt serbest vuruđu.
- b) 5 nolu oyuncuya ihtar, rakip 9 nolu oyuncu ihraç, 5 nolu oyuncunun takımı aleyhine indirekt serbest vuruđu.
- c) Rakip 9 nolu oyuncu ihraç, 5 nolu oyuncuya ihtar, 9 nolu oyuncunun takımı aleyhine indirekt serbest vuruđu.
- d) 9 nolu oyuncu ihraç, 5 nolu oyuncu ihtar, 5 nolu oyuncunun takımı aleyhine topun bulunduđu yerden direkt serbest vuruđu.



**35. Ceza alanında bir hakem atışı yapılırken, henüz top yere değmeden daha önce ihtar almış olan A takımının 9 nolu oyuncusu topa dokunmuş, bunun üzerine kaleyi savunan B takımının 3 nolu oyuncusu bu oyuncuya tekme vurmıştır. Hakemin kararı ne olmalıdır?**

- a) Her iki oyuncuyu da ihraç edip hakem atışını tekrar etmelidir.
- b) A takımının 9 nolu oyuncusunu ihraç etmeli, B takımının 3 nolu oyuncusuna ihtar vermeli, hakem atışını tekrar etmelidir.
- c) A takımının 9 nolu oyuncusunu ihraç edip, hakem atışını tekrar etmelidir.
- d) B takımının 3 nolu oyuncusunu oyundan ihraç ederek hakem atışını tekrar etmelidir.

## **2.BÖLÜM – VIDEO SORULARI**

### **1. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar
- b) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar
- c) Direkt serbest vuruş ve kart yok
- d) Direkt serbest vuruş ve dikkatsiz hareketten dolayı ihtar

### **2. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar
- b) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç
- c) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç
- d) Direkt serbest vuruş ve dikkatsiz hareketten dolayı ihtar

### **3. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç
- b) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç
- c) Direkt serbest vuruş ve dikkatsiz hareketten dolayı ihtar
- d) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar

### **4. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar
- b) Endirekt serbest vuruş ve hakemi aldatmaya yönelik hareketten dolayı ihtar
- c) Direkt serbest vuruş ve umut vadeden atağı kesmekten dolayı ihtar
- d) Direkt serbest vuruş ve kart yok

**5. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç
- b) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç
- c) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar
- d) Direkt serbest vuruş ve dikkatsiz hareketten dolayı ihtar

**6. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Herhangi bir ihlal bulunmamaktadır
- b) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar
- c) Direkt serbest vuruş ve kart yok
- d) Direkt serbest vuruş ve bariz gol şansını engellemekten ihraç

**7. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar
- b) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar
- c) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç
- d) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç

**8. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve kart yok
- b) Herhangi bir ihlal bulunmamaktadır
- c) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar
- d) Direkt serbest vuruş ve umut vadeden atağı kesmekten dolayı ihtar

**9. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar
- b) Direkt serbest vuruş ve umut vadeden atağı kesmekten dolayı ihtar
- c) Direkt serbest vuruş ve bariz gol şansını engellediği için ihraç
- d) Direkt serbest vuruş ve kart yok

**10. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç
- b) Direkt serbest vuruş ve umut vadeden atağı kesmekten dolayı ihtar
- c) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç
- d) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar

**11. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş tekrarı ve kart yok
- b) Direkt serbest vuruş tekrarı ve sportmenlik dışı hareketten dolayı ihtar
- c) Direkt serbest vuruş ve kart yok
- d) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar

**12. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş tekrarı ve kart yok
- b) Direkt serbest vuruş ve umut vadeden atağı kesmekten dolayı ihtar
- c) Endirekt serbest vuruş ve hakemi aldatmaya yönelik hareketten dolayı ihtar
- d) Direkt serbest vuruş ve sportmenlik dışı hareketten dolayı ihtar

**13. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Penaltı ve bariz gol şansını engellemekten dolayı ihraç
- b) Endirekt serbest vuruş ve hakemi aldatmaya yönelik hareketten dolayı ihtar
- c) Penaltı ve kart yok
- d) Penaltı ve sportmenlik dışı hareketten dolayı ihtar

**14. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve dikkatsiz hareketten dolayı ihtar
- b) Direkt serbest vuruş ve kontrolsüz hareketten dolayı ihtar
- c) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç
- d) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç

**15. Görüntüdeki pozisyonla ilgili kararınız nedir?**

- a) Direkt serbest vuruş ve şiddetli hareketten dolayı ihraç
- b) Endirekt serbest vuruş ve şiddetli hareketten dolayı ihraç
- c) Direkt serbest vuruş ve ciddi faullü oyundan dolayı ihraç
- d) Endirekt serbest vuruş ve ciddi faullü oyundan dolayı ihraç

Sınav sona ermiştir. Katılımınız için teşekkür ederiz...

## APPENDICES B

**t Table**

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	<b>0.50</b>	<b>0.25</b>	<b>0.20</b>	<b>0.15</b>	<b>0.10</b>	<b>0.05</b>	<b>0.025</b>	<b>0.01</b>	<b>0.005</b>	<b>0.001</b>	<b>0.0005</b>
two-tails	<b>1.00</b>	<b>0.50</b>	<b>0.40</b>	<b>0.30</b>	<b>0.20</b>	<b>0.10</b>	<b>0.05</b>	<b>0.02</b>	<b>0.01</b>	<b>0.002</b>	<b>0.001</b>
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.876	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
<b>Z</b>	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	<b>Confidence Level</b>										