EFFECTS OF SERIOUS GAMES ON TEAM BUILDING

IN A MULTI-USER VIRTUAL ENVIRONMENT

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Thesis Abstract

Aysun Bozanta, "Effects of Serious Games on Team Building in a Multi-User

Virtual Environment"

The aim of this study is measuring the effects of serious game on team building in a multi-user virtual environment. For this purpose serious game Zoom which has been used in real life for team building was adapted into online multi-user virtual environment. 43 people played the game as a group which consists of different number of participants. After comprehensive literature review, a questionnaire which consists of both closed-ended and open-ended questions was prepared in order to measure the effects of serious game on team building in a multi-user virtual environment. Participants declared their ideas about the serious game by filling this questionnaire. The responses to the close-ended questions were analyzed by using The Statistical Package for Social Sciences (SPSS) software, reliabilities were tested by Cronbach's Alpha analysis and hypotheses were tested by applying Regression and Multiple Regression analysis. In addition to this the responses to the open-ended questions were examined. Analysis of data gathered from close-ended questions shows that physical characteristics of the serious game environment and attitudes of participants toward serious game affect the team building success and these two relations are moderated by personality of the participants. As a result of examination of open-ended questions that participants described the serious game in a multi-user virtual environment as helpful, relevant, on purpose and entertaining. Also they stated that this game and the games similar to this can be used as an alternative to the face-to-face team building games.

Tez Özeti


Aysun Bozanta, "Çok Kullanıcılı Çevrimiçi Ortamlarda, Ciddi Oyunların Takım

Çalışması Üzerine Etkileri"

Bu çalışmanın amacı ciddi oyunların takım oluşturma üzerine etkilerini çok

kullanıcılı çevrimiçi ortamlarda ölçmektir. Bu amaçla hâlihazırda gerçek hayatta

takım oluşturma için kullanılan Zoom oyunu çok kullanıcılı çevrimiçi ortama

uyarlanmıştır. Farklı sayılarda katılımcılardan oluşan gruplar halinde toplam 43 kişi

bu oyunu oynamıştır. Derinlemesine yapılan bir literatür taramasının ardından, ciddi

oyunların takım oluşturma üzerindeki etkilerini çok kullanıcılı çevrimiçi ortamlarda

ölçmek için, açık ve kapalı uçlu sorulardan oluşan bir anket hazırlanmıştır.

Katılımcılar oyunla ilgili düşüncelerini bu anketi doldurarak belirtmişlerdir. Kapalı

uçlu soruların cevapları The Statistical Package for Social Sciences (SPSS) yazılımı

kullanılarak, güvenilirlik İç Tutarlılık Katsayısı Analizi uygulanarak, hipotezler de

Regresyon ve Çoklu Regresyon Analizleri kullanılarak test edilmiştir. Buna ek olarak

açık uçlu soruların cevapları da incelenmiştir. Kapalı uçlu soruların cevaplarından

elde edilen veriler göstermiştir ki; ciddi oyunların oluşturulduğu ortamların fiziksel

özellikleri ve katılımcıların ciddi oyunlara karşı tutumu takım oluşturma başarısını

etkiler ve katılımcıların kişilik özelliklerinin bu iki ilişkinin gücü ve yönü üzerinde

etkisi vardır. Açık uçlu soruların cevaplarının incelenmesi sonucu göstermiştir ki;

katılımcılar, çok kullanıcılı çevrimiçi ortamdaki ciddi oyunu yararlı, ilgili, amaca

hizmet eden ve eğlenceli bir oyun olarak nitelemişlerdir. Aynı zamanda bu ve bu gibi

oyunların yüz yüze oynanan takım oluşturma oyunlarının bir alternatifi olarak

kullanılabileceklerini ifade etmişlerdir.

# ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

Millions of people in the world play computer games to some extent. Especially the

number of subscribers to the Massively-Multiplayer Online Games has been

increasing aggressively. The chart below shows this increase in terms of total current

subscriptions by years (Woodcock, 2005).
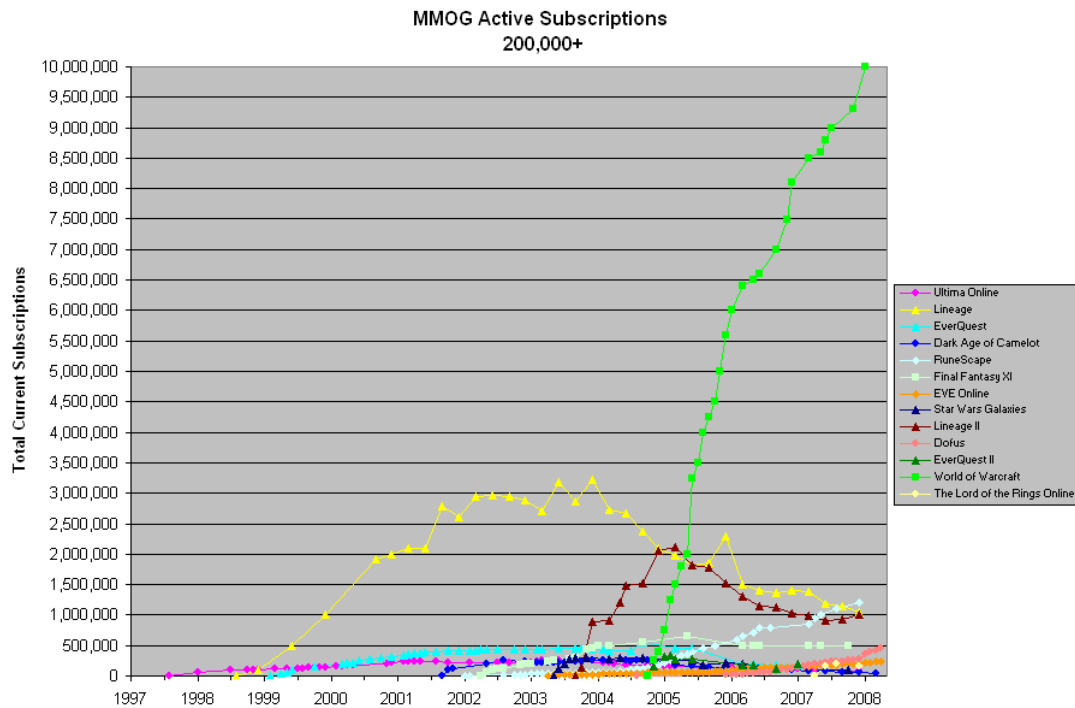


Figure 1. Total current subscriptions by year (Woodcock, 2005)

The sense of reality makes massively-multiplayer online environments more

attractive. Second Life is the most popular example of massively-multiuser online

environments. It has approximately 65,000 paying and 100,000 nonpaying

subscribers (Hemp, 2006). It is a brilliant idea to use these online environments and

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the games in order to practice real life cases. As a result of this use of serious games has also increased.

Serious games are based on some specific rules, played with a computer and use entertainment in order to teach some concepts in various areas like corporate training, education, health, public policy and strategic communication (Zyda, 2005). Serious games are different from ordinary teaching and practicing techniques and they have many advantages in this respect. First of all serious games are entertaining and also the necessary information is embedded in this entertaining content and people get this information by having fun. In addition to this, they help participants to develop various skills such as problem recognition and solving, social, cognitive, analytical and spatial, strategic, recollection, psychomotor, visual selective attention and self-monitoring (Graesser, Chipman, Leeming, Biedenbach, 2008; Hogue, 2010). Van Eck (2006) mentioned about their benefits on improving team building skills in his study. Team building is one of the concepts which can be practiced by using serious games.

Building effective teams is a vital necessity for today's competitive market. The projects require workers from various disciplines in order to be accomplished.

If there is a team synergy between two people they would mean a lot rather than when they are separate. In that point importance of team building emerges. Especially virtual teams are more disconnected than face-to-face teams because they can only communicate with communication and information tools to inform each other about project-based issues.

There are different ways that firms use in order to build more effective teams and warm up team members to each others. As it is mentioned previously, serious

games are one of these ways to build effective teams and warm up team members to each others.

This study is carried out to measure the effects of serious game on team building in a multi-user virtual environment. For this purpose, a serious game which is played in face-to-face environments, Zoom, was adapted to the multi-user virtual environments and it was played by 43 participants. After the game, a survey was conducted with the participants of the game. Proper analyses were applied to the survey results in order to measure the effects of serious game on team building in a multi-user virtual environment.

This thesis is composed of following chapters: Chapter I introduces the overall study. Chapter II includes literature review of serious game, team building, virtual teams and serious games used for team building. In Chapter III, theoretical model and hypotheses of the study will be proposed. Chapter IV presents the findings and the results of the study. Finally Chapter V contains the summary of findings, limitations of the study and suggestions for future researches.

CHAPTER 2

LITERATURE REVIEW


Serious Games


Definition of Serious Game


There are various definitions for the word "game". Philosopher Ludwig Wittgenstein (1953) defines the game as a play, rules and competition. Roger Caillois (1957) who is a French sociologist subsumed the game characteristics under six main headings which are; fun, separate, uncertain, non-productive, governed by rules, and fictitious. Chris Crawford (2003) who is a game designer defined game as a conversational, target-oriented activity played with active players against each other. Definition of word "game" is changed according to the perspective of researchers. Many definitions can be added to the existent ones.

Games can be grouped under the main headings like desk top games, video games, card games, paper and pencil games, etc. One of the main categories of the games is the serious games. Actually the term serious games is not only about computer and related technologies, it is an old term which is also used for other games than computer games. In 1970, Clark Abt mentioned the idea about serious game in his book "Serious Games". Abt (1970) defined the game in his book as; a game is played between more than two independent players who try to attain their

goals under some conditions. In other words game is a play with rules in which every player wants to win. Then he combined this definition with the serious game definition: serious games are apparently designed for educational purpose and are not aimed to be played primarily for entertainment. In 2002, Serious Games Initiative was established at the Woodrow Wilson Center for International Scholars in Washington.

As well various definitions have been made for the word game; miscellaneous definitions have been made for a serious game which is a category of the game. If we examine these definitions over the years we can find common and differing points. In 2005, Stokes described serious games as the games which captivate, educate, train the players and alter the behavior of players. One of the most important common points in the definition of serious games is defining serious game as a computer game. Zyda (2005) added more specific usage areas of serious games to his definition and he is one of the people who define serious game as a computer game; he said that serious games are based on some specific rules, played with a computer and use entertainment in order to teach some concepts in various areas like corporate training, education, health, public policy and strategic communication. Serious games include features of video and computer games. They provide fictitious environment in order to achieve predetermined goals from which participants gather experience and information (Freitas, 2006). On the other hand Kevin Corti (2006) who is the founder of PIXELearning Limited used the term game-based learning as a synonym of serious game and also mentioned about some advantages of serious games. According to him, game-based learning is part of the computer games that get players under its influence and make them to complete tasks, experience situations which are not possible to train in the real life because of logistical and safety reasons without unnecessary cost and time. Julian Alvarez and his friend (2012) were

impressed from Michael Zyda and Ben Sawyer who are the pioneers of serious games and wrote a book about serious games. In their book, they defined serious games as computer games designed to get together the learning and communication characteristics of video games.

It is important to understand that serious games do not just entertain the players, they also make them gain information and skills that can be used both in virtual and real worlds (Rankin, McNeal, Shute and Gooch, 2008). They combine both curricular content and computer game features (Wrzesien and Raya, 2009). In other words; they use elements of video games for educational purposes (Charsky, 2010). Serious game is an interdisciplinary term. It combines various disciplines such as computer engineering, pedagogy, game development technology. In addition to this it includes another subject which it aims to teach to the participants. It uses technology (e.g., sensors, computer graphics, multimedia, artificial technology) in order to create more reality. It makes people experience a situation and learn in this situation. After that, it analyzes human behavior during this process (Rüppel, 2011).

If it is needed to define serious game in the light of all these definitions: Serious game, unlike other games is not just for fun, it is a game that is also used for educational purposes and it has multidisciplinary content which consists of game development, computer technologies, pedagogy, and other disciplines which are issued in a game.

In the literature, we can find many synonyms for serious games as; educational games, computer games, video games, game-based learning, and instructional games (Guillén-Nieto and Aleson-Carbonell, 2011).

Advantages of Serious Games

Although serious games are used in many areas such as education, government, military, etc., the main purpose of using serious games is to teach or be experienced something to the participants. Since serious games are different from traditional way of teaching techniques and class environment, they have many advantages on educational context.

First of all serious games motivate younger people because of its contextual structure. Contextualized information is embedded in an environment of serious game and people get this information by exploring the environment (Bellotti, Berta, de Gloria and Primavera, 2010). As it is mentioned before, serious games are different from traditional methods; they are enthusiastic, motivational, learner-driven, incremental, contextualized, concentrated, interesting and identifiable. So they help participants to develop various skills such as problem recognition and solving, social, cognitive, analytical and spatial, strategic, recollection, psychomotor, visual selective attention and self-monitoring (Graesser, Chipman, Leeming and Biedenbach, 2009; Hogue, Bill and Pierce 2010). In addition to this they improve short-term and long-term memory (Hogue, Bill and Pierce 2010). Yet another example that serious games could improve is team-work skills (van Eck, 2006). Mike Zyda (2005) originated a new term "collateral learning" that is a concept that combines aspects of learning and fun in order to change attitudes and make learning easy. Serious games provide convenient environment for it (Forschauer, Arends, Goldfarb and Merkl, 2011).

On the other hand, serious games enable experiential learning. Participants can experience situations that are not possible in real life because of time, cost and safety issues (Corti, 2006; Hogue, Bill and Pierce 2010). Real tasks can be simulated

in serious games; it means lots of practices, immediate feedback, monitoring participants' behaviors in controllable environment (Carron, Marty and Heraud, 2008; Bulander, 2010; Haferkampf, Kraemer, Linehan and Schembri, 2011; Hogue, Bill and Pierce 2010; Rüppel and Schatz 2011).

Developers can create sense of reality in serious games with using computer technologies and also serious games have the fun components of video games so the issue that is handled in a serious game becomes more attractive. If social issues are handled in the serious games, public awareness and understanding of social issues can be increased (Rebolledo-Mendez, Avramides, de Freitas and Memarzia, 2009).

Finally it was proven that serious games are effective for supporting therapy. Since people can come together from different geographical areas in order to play serious games, the serious games increase intercultural communication, understanding of ethnic, religious and historical funded conflicts. Just because participants can play a serious game for many times and they can change their role in the game, they can get different perspectives on issues (Grappiolo, Cheong, Togelius, Khaled and Yannakakis, 2011).

<center>Use of Serious Games</center>

Contemporarily, various serious games have been designed for different uses. The most common usage areas can be grouped under the following headings: Management, manufacturing, finance, team building (collaboration, problem solving, and communication), education, health, simulation of real life experiences, technology and raising awareness to the social issues.

One of the widespread usage areas of the serious games is to practice managerial issues. For instance, Infiniteams is a game that is played with teams in

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order to reveal leadership potential of participants (Kaplancalı and Bostan, 2010). It is a multi-player, team-based and online game. It was applied to 48 undergraduate students and results are fulfilling about online gaming experiences. Empirical study shows that transactional and transformational leadership behaviors are correlated with the multiplayer online game. Another example is Virtual U which was designed for management practices (Corti, 2006). British Telecom designed a serious game "Better Business Game". In this game, players become a CEO and try to manage social and environmental issues in a business (Corti, 2006). Learning Beans was designed by PIXELearning in order to provide practicing to participants on a detailed management scenario (Corti, 2006). It includes high volume manufacturing, sales, marketing, HR, finance, production, distribution, and export planning. Innov8 is another serious game which was created by IBM. Its main purpose is to practice modeling business processes (Bulander, 2010). Another serious game for business process management was designed by Marco Santorum (2011). Grappiolo and his friends (2011) made a single-player 3D serious game for resource management. Content generator of this mini game is operated by neural network by this means content is adapted to player's experience and behavior. PIXELearning studies on a retail game which was designed to help people who develop their careers in retail (Corti, 2006).

Another issue that serious games are used for and also closely related with management is team building. Team building has many components which will be explained comprehensively in team building part. Some of these components are collaboration, problem solving, and conflict resolution. Objectives of some serious games include these components. Ellis and his friends (2008) designed three games in Second Life; Crossing the Ravine, Tower of Babble and Castle Builder. Each one is more difficult than previous and they are designed for improving collaboration

between participants and team building skills. Another game for team building activity is GaMeTT which is a multi-user, online and 3D game (De Leo, Goodman, Radici and Secrhist, 2011). There are 30 numbered markers in an environment and there are two groups which consist of five people each. Aim of the game is stepping all numbers in a sequence as quickly as possible. This study shows that female participants have more positive senses about game. In addition to this, participants who are not tired and dizzy attained more sense of presence in the game. Hamalainen and his friends (2006) designed a game eScape which promotes collaboration. 24 people participated in the game and data was collected by using many methods such as questionnaires, video feed from each players, audio record of spoken dialogue, observation notes, etc. Results are promising that most groups reached the high level of collaboration. Another study of Hamalainen (2008) is Mustakarhu which is played by a team of 2-4 members. Participants design customized hotel rooms and based on the size of room, they calculate the cost of decorating each room. Finally participants write a final report to the customer. Total of 20 participants played the game and participants expressed that the game environment is more attractive and helpful than traditional class environment. Woodment is an online, multi-user, 3D game. It is for collaborative learning (Wendel, Babarinow, Hörl, Kolmogorov, Göbel and Steinmetz, 2010). Woodment players manage the company, encounter with unexpected events and try to solve conflicts, communicate with others via chat option. It is shown that 3D online gaming environment is useful for collaborative learning, results encourage future studies. Since components of team building and management skills encompass each other. Some serious games are used for improving both management and team building skills. Woodment and Infiniteams which are mentioned previously are two examples that are used for improving both team building and management skills.

Since serious games are more attractive than traditional class environment, they began to be used widely for educational purposes. One example is "Supercharged!" which is a serious game for teaching physics curriculum especially electromagnetism (Stapleton, 2004). Another example is The Monkey Wrench Conspiracy which is a first-person shooter game (Corti, 2006). It was created to teach 3D CAD software to the mechanical design engineers. Other game that was developed in an educational domain is Pedagogical Dungeon (Carron, Marty, Heraud, 2008). Learning activity is compared with the dungeon. Participants try to find out ways to get out of the dungeon; they also run after some hints or some information in order to learn something. It was applied to 15 students in the University of Savoie. Since it is totally different from normal learning period, students asked more questions to their teachers and teachers became overloaded. On the other hand since students take direct feedback from the system about their wrong answers, it is helpful for them. Another example is River City (Ketelhut and Schifter, 2011). Distinctive feature of River City that separates it from the other implemented games is examining its effects on teachers rather than students. It was applied to 25 teachers, results are versatile. Both negative and positive effects were observed. The last example of serious game that is used for educational purpose is ThIATRO which was designed to teach art history to the students (Froschauer, Arends, Goldfarb and Merkl, 2011). It is a 3D, multi-player, online game played by teams. Only test session was carried out with four people.

Health is another area that serious games have begun to use widely. There are many games for different roles such as patients, doctors or managers in the health sector. VR Phobias is a serious game used for the treatment of various phobias (Stapleton, 2004). Patients play a variety of video games in order to beat their phobia. Each video game was designed for different phobia like fear of driving, fear

of the dark, fear of spiders, fear of heights, fear of snakes, claustrophobia, and agoraphobia. It was implemented by the Virtual Reality Medical Center. Success rate of the games are 92%, and it varies among phobia with the rate of 4.5%. Packy and Marlon is another serious game that was designed in health sector (Corti, 2006). It is a video game used to reduce diabetes-related emergency. Another game Zipland Activity was designed for reducing negative effects of the divorced or separated parents on kids (Corti, 2006).

One of the most important advantages of the serious games is providing people some activities that could not be experienced in real life because of time, money and safety conditions. Especially dangerous and time loss activities are simulated in the serious games. Biohazard is one them which was designed for firefighters in order to simulate their act after the terrorist attack (Stapleton, 2004). Levee Patroller is another serious game that participant tries to construct levee toward unexpected flood (Harteveld and Bidarra, 2007). It is single player 3D first-person game. The most important aim of the game is to find the reason of the failure of levee and reporting it to the participant. The game has been applied in more than 10 workshops. Another simulation game is The Site Safety Game which was designed by PIXELearning (Corti, 2006). The game positions the participants as safety inspectors on a building site and makes them to find potential hazards. DRED-ED is the game for emergency management (Haferkamp, Kraemer, Linehan and Schembri, 2011). When an emergency situation arises such as flood or huge fire, each member has a specific role which is based on the roles of crisis units in the reality. Three to six people can participate to the game. It was applied to 20 people and results are sufficient for future studies. Another serious game Serious Human Rescue was designed for examining the effect of building conditions on human behavior during the evacuation process (Rüppel andSchatz, 2011). Serious Human

Rescue game was designed by the help of Building Information Modeling (BIM). With this system, it is not necessary to create new scenarios again and again because BIM provides different game scenarios, it is like game scenario basis. Serious games which try to simulate real life experiences are mostly used in military. America's Army and Foreign Ground are two examples of serious games that were designed for the military purposes. America's Army is a video game that simulates tasks in the War on Terror and it provides collective and individual training (Jackson, 2004). Foreign Ground was designed with Swedish Military in order to prepare soldiers for international missions (Frank, 2007).

CISCO designed Learning Game Triology which consists of three serious games for technological purposes; these are Rockin' Retailer, Network Defenders and SAN Rover (Corti, 2006). In addition to this INTEL made a game for IT security.

On the other hand, using serious games for raising awareness about social issues is a very effective way. UN/WPF- food force is an example of a serious game which was designed for raising awareness of world hunger (Corti, 2006). FloodSim is another example that was created for raising awareness of flooding issues (Rebolledo-Mendez, Avramides, De Freitas, and Memarzia, 2009).

Lastly, Insider is the financial game consisting of four part learning solutions by PricewaterhouseCoopers (Luppa and Borst, 2006). New auditors as users join the finance team and try to improve their financial skills.

Team Building

## Definition of Team

In recent years, team has become a very important issue for both educational and institutional corporations. It is important to be aware of that being a team is more than working separately. Productivity and efficiency are vital concerns for companies, and one of the most significant factors for increasing them is building effective teams.

In this point, it is essential to know what the team is. Team is a group of people who communicate each other in order to achieve shared goals (Woodcock and Francis, 1981). Another definition of team is that team consists of at least two people who contact each other in order to accomplish predetermined, shared and valued goals (Salas, 1993). Tanenbaum and his friends (1992) suggested that each member of the team has specific roles and functions.

## Definition of Team Building

Based on this information next step is to understand the ways of building successful teams. Team building is a concept that brings people together and makes them to learn experientially by considering their values, and interpersonal dynamics to improve their skills in order to achieve predetermined objectives (Liebowitz and De Meuse, 1982). Hanson and Lubin defined team building as an effort in which team members work together and remove all negative effects in order to solve problems and makes them use all their resources for this purpose (Hanson and Lubin, 1988 cited by Hardy, and Crace, 1997). On the other hand Albenese (1994) explained team

building as a project-focused process in which stakeholders come together in order to improve achievement of project by building trust between participants, solving problems and conflicts between each other.

The content of team building is changeable because it can be used for different aims such as upgrading an existing team, building a new team, re-forming a team after reorganization, and improving relationships between several teams (Liebowitz and De Meuse, 1982).

One of the most important purposes of team building is increasing productivity and efficiency. According to Beckhard (1972 cited by Hardy and Crace, 1997) there are four aims of the team building. First one is to set goals and priorities. Second one is based on capabilities of team members, and allocation of tasks. Third one is determination of the team processes and the last one is analyzing the relationship between team members. It is argued that team building provides a platform for individuals to examine their behaviors and change them if it is necessary so they can improve group effectiveness with this way (Baker, 1979 cited by Liebowitz and De Meuse, 1982). In other words, if team does not act in a proper way, team building concept tries to find problems, analyze them and makes the team work properly (Dyer, 1977 cited by Liebowitz and De Meuse, 1982).

Woodcock and Francis (1981 cited by Hardy and Crace, 1997) argued that team building has four significant advantages. First of all, team managers and members gain experience by being in a team and this experience reflects to the operations. Second, team-work is active, permanent and closely related to the team's objectives. In relation to the first benefit, individuals can also improve their skills and personal effectiveness. Lastly, team builders are appreciated that their efforts produce successful results. On the other hand Salas and his friends (2005) argued both advantages and disadvantages of team building. Team building improves

positive interaction among team members. If role clarification is determined successfully then it improves team functioning. It can be used in place of team training. One of the disadvantages of the team building research is being limited with white-collar management team. Generally team building is not based on a theory. It suffers from popular culture especially it is learnt from how-to books and exercises that consulting firms' offer. In addition to this, its effect on team effectiveness is modest. The influence of team building is not long-lived enough.

Team building process varies between team to team. Its reason is each team has different properties and experiences. It is crucial to find the right model for team building based on team characteristics.

Team Building Models

There are many different team building models which vary according to different group needs. Beer (1976 cited by Buller, 1986) argued that there are four main models for team building. These four models are also called as four components of team building. These are the goal-setting model, the interpersonal model, the role model, and the managerial grid model.

The purpose of the goal-setting model is to create shared goals for members of the team and make them accomplish these goals (Buller, 1986). These goals strengthen the motivation of team members (Salas, Priest, DeRouin, 2005). There are three assumptions in the goal setting model for team building. First one is that goals affect attitude of group and individuals. Second, goals affect group effort in a good manner. Third, if participants join the process of setting goals, commitment, and motivation to work increase (Beckhard, 1966, cited by Liebowitz and De Meuse, 1982). Goals can be defined as end results like productivity, sales, or profits and they

should be revised periodically in order to be sure that they are still valid and useful (Liebowitz and De Meuse, 1982).

Second model is the interpersonal model. It depends on strengthening interpersonal relations in the group so group members work coherently (Buller, 1986). It is necessary to lessen interpersonal conflicts and it is possible with the mutual trust, commitment, cooperation, and open communication (Liebowitz and De Meuse, 1982; Salas, Priest and DeRouin, 2005). As a result of this, team effectiveness and productivity will increase (Liebowitz and De Meuse, 1982).

In role model, each member has distinct roles (Buller, 1986). These roles determine expected behaviors which are to be acted by each distinct member (Liebowitz and De Meuse, 1982). By this model role expectations and tasks of team members are clarified. In this model, it is assumed that if all team members know and understand their roles, effectiveness will increase because there will be more time to perform the task rather than solving personal conflicts (Bennis, 1966; Lawrence and Lorsch, 1967 cited by Liebowitz and De Meuse, 1982).

The managerial grid model is an organizational development model which was found by Blake and Moutan (1964 cited by Liebowitz and De Meuse, 1982). It consists of six phases and second phase is team building. In team building, a manager tries to analyze tasks and interpersonal problems in the team (Buller, 1986). For this purpose employees fill a survey about individual and group problems. They also write their ideas about an ideal team. Based on this information, they try to move from present situation to ideal team (Liebowitz and De Meuse, 1982). The managerial grid model is different from these entire three models because it depends on standardized instrument rather than consultant help (Liebowitz and De Meuse, 1982; Buller, 1986).

In addition to these four models Buller (1986 cited by Salas, Priest and DeRouin, 2005) argued that there is also another component of team building – problem solving. In this approach team members try to accomplish objectives of above mentioned four models by problem solving tasks (Salas, Priest and DeRouin, 2005). Problem solving approach improves participants' critical thinking skills (Salas, Priest and DeRouin, 2005).

Steps of Team Building

Based on literature, there are many different approaches to the steps of team building. Also the number of steps varies according to these approaches.

One of the most widely used and oldest one is Tuckman's stages; forming, storming, norming, and performing (Tuckman and Jensen, 1977). First stage is forming. In this stage, team members try to know each other. They avoid personal conflicts and some important issues. They only try to perform routine tasks. Second phase is storming. In this phase; team defines its problems, conflicts and also team members examine how they work together and individually. In addition to this team tries to determine which leadership model they will accept. In this stage, team members listen to each other's ideas and perspectives. In order to be more effective in this stage they should be more tolerable to each other and supervisors should be more accessible for managing this stage. Third stage is norming. In norming stage, team members attempt to put shared goals and make a plan about how to move. In this stage, they should meet on a common ground. Last stage is performing, if team completes all the stages above without a problem, they can reach the performing stage and perform their tasks and plan. On the other hand they should turn the previous stages and solve their conflicts.

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In 1977, Tuckman and Jensen added fifth step to previous steps "adjourning". In this step, team completes its tasks and the team should be separated.

Virtual Teams

<u>Definition of Virtual Team</u>

Virtual teams consist of closely worked people who are separated by at least one of these components; space, time, and organizational barriers (Jennings, 1997; Johnson, Heimann and O'Neill, 2001). Members of virtual teams are located in different places and they use computer technologies in order to share their individual efforts (Peters and Manz, 2007). More specifically, virtual team's participants are group of people who are dispersed by geographically or organizationally and they try to accomplish organizational tasks with using information and telecommunication technologies (Yoo and Alavi, 1997; DeSanctics and Poole, 1997; Jarvenpaa and Leidner, 1998; Powell, Piccoli and Ives, 2004). Virtual teams may be formed in many different ways. For instance; members of virtual teams can be from "(1) same organization, same department, (2) same organization, different departments, (3) different organization, similar cultures, (4) different organization, different cultures, (5) different organization, different cultures and different nationalities" (Loughran, 2000, pp.2).

Virtual teams differ from traditional teams with their characteristics. First, while traditional teams are more organized, hierarchical and centralized, virtual teams are informal, flat and decentralized so they can easily embrace new ideas (Peters and Manz, 2007). Traditional team members in a company typically contact each other synchronously but virtual team members communicate with the

telecommunication technologies both synchronously and asynchronously. One of the advantages of virtual teams to the traditional teams is consisting of people who have specific expertise. Since there is no geographical and organizational boundary, it is easier to find these specific experts for virtual teams (Martins et al., 2004).

There are various benefits of virtual teams for both employees and employers. Benefits to the workers can be listed as follows: since virtual teams provide flexible working hours, workers can spend more time with their families (Baig and Dunkin, 1998; Johnson, Heimann and O'Neill, 2001). Physically challenged people can work in virtual teams using telecommunication technologies (Gould, 1999; Johnson, Heimann and O'Neill, 2001). As it is mentioned before it allows flexible working hours so people spend less time in offices. This means less office and parking space and also some costs such as electricity and heating are reduced. These are some of the benefits to the companies or employers. Another benefit to the company is reducing pollution (Johnson, Heimann and O'Neill, 2001). Since people don't have to go to the office, virtual teams provide money savings and time. Lastly, virtual teams remove cultural, geographical and organizational boundaries as a result of this more expert people can join to virtual team so team becomes more effective (Johnson, Heimann and O'Neill, 2001).

<u>Difficulties that Virtual Teams Encounter</u>

Virtual teams have different structure than traditional, face-to-face teams. There are many reasons that it is hard to construct this relationship in virtual teams, some of these are as follows:

Culture is one of the most important reasons that members of virtual teams cannot construct relation easily in a team. In virtual teams, there can be a participant from different nationalities. These nationalities have different histories, cultures and backgrounds (Loughran, 2000). These differences can cause conflicts in a group. This situation requires more effort to team building (Johnson, Heimann and O'Neill, 2001).

Communication is essential for all types of teams. Communication in virtual teams and face-to-face teams are different as it is mentioned previously. Virtual teams use telecommunication technologies. Having physical hitches is very probable when using these technologies. On the other hand, it is hard to show facial expressions and body language while using the telecommunication devices. Teleconferencing provides some opportunities but slow graphical refresh and low quality of display reduce advantages that we have in real time communication (Loughran, 2000). In addition to this, written communication is also problem for team members because sometimes team members send an e-mail and couldn't get a response back (Johnson, Heimann and O'Neill, 2001). Another disadvantage of written communication is that explaining something by writing is hard rather than speaking especially for sarcastic expressions (Gould, 1999 cited by Johnson, Heimann and O'Neill, 2001).

Other difficulties emerged depending on communication hitches can be perceived confusion, satisfaction, post discussion accuracy and long decision making process (Thompson and Coovert, 2002; Thompson and Coovert, 2003). Study of Thompson and Coovert (2002) revealed that computer-mediated teams have more confusion and less satisfaction on their discussion and they spend more time in order to reach a consensus than face-to-face teams. In 2003, Thompson and Coovert designed a study to test stepladder technique in order to improve decision making

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process. Results showed that face-to-face team participants felt that they were more effective on decision making process than counter-mediated team members regardless of decision technique (Thompson and Coovert, 2003).

Lack of trust is another issue for virtual teams. Face-to-face teams can see each other's not only in a working environment but also in social life. They can go to lunch together or take coffee breaks. They communicate more so they know and trust each other in short times. For this reason, the relation between team members is developed easier than virtual teams (Loughran, 2000).

Other difficulties can be technophobia, stress and lack of shared goals (Loughran, 2000; Johnson, Heimann and O'Neill, 2001). Despite the fact that people get used to technology, there are still people who cannot handle it (Johnson, Heimann and O'Neill, 2001). Since there are no boundaries in virtual teams, one result of it is that people can be assigned to more projects. This means more work and more stress for employees (Townsend and DeMarie, 1998 cited by Johnson, Heimann, O'Neill and 2001). Shared goal is one of the critical factors of a successful team. It is difficult to determine shared goals in virtual teams because each member may come with different goals and agendas (Loughran, 2000).

How to Overcome Difficulties that Virtual Teams Encounter

Virtual teams are indispensable in today's organizations. Therefore it is important to make them more effective and remove all obstacles that they face off. Since they cannot communicate face to face, new ways should be found to bring them together.

There are synchronous and asynchronous tools for strengthening virtual teams. Web sites can be used for information sharing in virtual teams. It is one of the

asynchronous tools for communication in virtual teams. These types of web sites are used for sharing relevant information for project and it encourages people to share more personal information. With this way people know each other more and it strengthens trust between team members (Loughran, 2000). Teleconferencing is one of the synchronous tools to communicate in virtual teams (Loughran, 2000). More sophisticated version of teleconferencing is 3D videoconferencing. 3D videoconferencing provides participants a virtual environment that participants can communicate in real time around shared table. It means participants can observe other's gestures and system provides correct eye contact (Kauff and Schreer, 2002). Group decision support system is a collaboration tool for the virtual teams (Huang, Wei, Watson and Tan, 2002). It is used for not only communication but also task support. It is both synchronous and asynchronous. Games are another effective tool for improving commitment, trust, communication and collaboration between virtual team members.

Multi-User Virtual Environment

Virtual environments are complicated systems in which people, artificial agents and environment itself have continuous interaction between each other. Multi-user virtual environments are 3D or animated online systems that are used for carrying real world to the computer systems in many sectors (De Freitas, 2008). Based on De Freitas report (2008), virtual worlds have following characteristics; learner control, collaboration, persistence, 3D or animated experiences, sharable and user-generated digital content, immersion and interactivity.

Multi-User Dimensions/Dungeons (MUDs) and Multi-Object Orientated MUDs (MOOs) can be said as ancestors of multi-user virtual environments except

their text-based structure (De Freitas, 2008). The first graphical visualization and avatars were used in "Habitat" which was created by Lucasfilm in 1985. Each participant accessed Habitat by using a computer, Commodore 64 (Benford and Fahlen, 1993). There has been rapid increase in the use of virtual worlds in the last ten years. The reason of this can be the increase in use of PCs and improvement in technical specification of PCs.

In the report of De Freitas (2008) based on usage purposes, multi-user virtual environments are grouped as; role play worlds, social worlds, working worlds, training worlds, and mirror worlds. Role playing games are widely known examples of virtual environments. Everquest, Guild Wars, Lineage, Lineage2, World of Warcraft, and Star Wars: The Old Republic are some of the most popular online role playing games. All around the world millions of people play these games. One of the main purposes of virtual worlds is providing alternative social world. It supports interaction between people and social networks. Active Worlds, Educational Universe, Second Life, and There.com are widely used examples. Another goal of virtual worlds is to support learning. In corporate business sector, virtual worlds are used especially for supporting group interaction and communication. Interactive videoconference system Project Wonderland is an example of virtual world which provides also voice and document sharing. As it is mentioned before training worlds are for practicing some real world situations which are not possible to practice in the real world because of cost and safety issues. Mirror worlds are exact reflection of the real world. Google Earth is the most well-known example for mirror worlds. Some other examples of mirror worlds are; Microsoft Virtual Earth, NASA World Wind, Unype.

Serious Games for Team Building in Multi-User Virtual Environment

Teamwork is very important for today's organizations because two people coming together would mean a lot rather than that they are separate. The sharing of information yields to augmentation. In addition to this, successful projects require various disciplines since one person cannot contain know how of all of these disciplines, therefore teams are indispensable. In order to make a project successful one of the requirements is building a successful team. Team building has several components such as communication, collaboration, commitment, cohesion, conflict resolutions, problem solving, goal sharing etc. In order to build successful teams, it is important to construct these components among team members. For this purpose games are very relevant and beneficial tools. Computer games can be preferred more rather than face-to-face games because of cost, time, safety and possibility to experience more than one. In order to make these games more realistic, massively multi-user virtual environments are very useful platforms. In these platforms, each person has an avatar that reflects their own image. Also gestures are allowed in these environments so people can express themselves more comparing to other video games. In addition to this, people use their own voices in these environments so others can comprehend hidden meanings from the voice of the person speaking. These facilities strengthen the sense of reality. There are studies in the literature that examine or develop serious games for team building in multi-user virtual environments.

Roberts and his friends (2003) designed the serious game Gazebo in order to support distributed teams with tasks that require collaborative moving of objects. Team members enter a garden with their avatars and take nearest tool in order to build a gazebo. There are some rules, for instance some parts are too heavy to lift

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alone so two or more people come together and hold those parts. In addition to this in fixing part of the game, while one team member holding the some part of gazebo, other one tries to fix or assemble it to another part. This game was applied between walk-in display devices at the University of Reading (UK), John Kepler University Linz (Austria), University College (London) and University of Salford. Interaction of users with objects in the environment was successful but some technical challenges occurred. Such as, it is difficult to users to interact with shared objects so this situation makes harder to build Gazebo. In addition to this communication problems occurred in the system. Based on the feedbacks, Gazebo was improved and applied again. Some limitations are added to the system. For example it is allowed for maximum three people to hold one part of the gazebo. In addition to this, tracking rate was reduced. Despite some progress, all of the defects could not be removed.

Hamalainen and friends (2006) created the game eScape in order to help students to solve problems collaboratively. eScape is the adventure game which is played by four people. Participants try to solve a set of problems and escape from the ancient prison. 6 groups – total of 24 people played this game and qualitative analysis was applied on data. Analysts examined the game observation notes, video of the game sessions, etc. Results showed that teams achieved high level of collaboration during the game. Participants reported that the game encouraged them for teamwork.

Mustakarhu is another serious game which was designed and applied by Hamalainen (2008). It is played by four people. It makes people decide together so it improves collaboration and cooperation skills among participants in a team. Participants in a team try to design a hotel room, calculate its areas and cost of the materials that are used during the design process. This game was applied to five groups which consist of 20 students. In order to gather data, interview was conducted

with the participants. Also video and audio records of the game and chat logs of the participants were collected in order to analyse. Students agreed that the game is more effective than traditional class environment since they can immediately observe the results of their work. Although collaboration level differed among groups, in most groups collaboration was obtained.

Ellis and friends (2008) developed three serious games for team building in the Second Life. These games are Crossing the Ravine, Tower of Babble and Castle Builder. These games have three common characteristics. First one is that each team member should participate to the game. Second, if team members do not work together than being successful becomes more difficult. Third, communication between team members is essential for finding a solution in the game. Crossing the Ravine is played by five people. There is a puzzle board which is embedded into the ground. There are five chairs with different colors and puzzle pieces in these colors. Each person sits different chairs so they can move only the puzzle pieces in the same color with their seats. Team members should communicate in order to decide on the correct place of the pieces. This game aims to improve communication between team members. Tower of Babble is similar with the board game "Blockhead!". Team members try to construct a tower with blocks as high as possible. Since next person's move is related with previous one, each team member should try to put blocks properly in order to help next person. This game's purpose is to improve collaboration among team members. Castle Builder is played with two groups; designers and builders. Designers design a castle and send their work to the builders and then by looking at this design builders try to build a castle. When the built castle is matched with the designed one then first phase of the game is completed. In the second phase designers become builders and vice versa. Each step is repeated. This

game's object is to improve communication, collaboration and empathy between team members.

Infiniteams is an online serious game in which participants are team members. It allows participants to understand group dynamics and improve team building skills. In addition to this, in the game each person is assigned as a leader randomly and at the end it a leader role in the team is figuredout. Kaplancali and friend (2010) applied this game to 48 people in order to measure the effect of multi-player online games on leadership development process. Results showed that there is a correlation between multi-player serious games and leadership development.

De Leo and friends (2011) developed a multi-player, online, virtual serious game "GaMeTT" which is a game for team training. In this team building activity there are 30 numbered markers on a ground and participants should tread on to them as quickly as possible in a sequential way. Aim of this study is measuring level of presence of participants in a multi-user virtual environment and figuring out which variable such as gender, age, knowledge of computer etc. has more influence on this level. This game was applied to two groups each consists of 5 people. Results showed that, there is no significant difference between age groups with respect to level of presence. There is significant difference among gender groups such as female participants felt more immersive in virtual environment than males. Also results revealed that computer knowledge affects level of presence. More knowledgeable people experienced more negative effects in the environment.

# CHAPTER 3

## THEORETICAL MODEL AND HYPOTHESES

### Theoretical Model
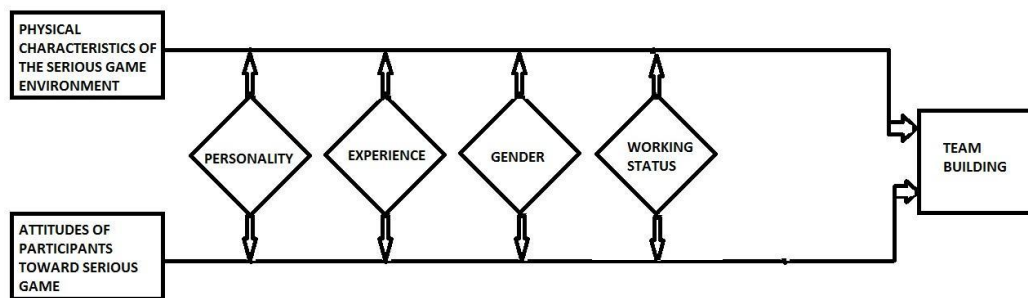


Figure 2. Theoretical model

In this part of the study, theoretical model is proposed. The variables that formed this model will be introduced in the following part. This model aims to explain effects of the serious game which was created on a multi-user virtual environment with team building context.

### Independent Variables

Physical characteristics of the serious game environment and attitudes of participants toward serious game are independent variables. They could be considered as components of serious game and used for explaining the effects of it. The scale physical characteristics of the serious game environment is prepared by asking to participants the characteristics such as graphics, sounds, places, animation, collaboration tools and  navigation of the game. After that, the views of participants

towards the game were asked. The difficulty and entertainment level of the game, the level of feeling comfortable while playing the game, how much they like the game and finally if they think that the game can improve their team building skills or not are the questions to be asked to determine attitudes of participants towards the game.

<p style="text-align:center"><u>Moderator Variables</u></p>

There are five moderator variables which are age, gender, working status, experience and personality. Moderator variables are variables that affect direction and strength of the relation between independent and dependent variables (Baron and Kenny 1986).

One of the moderator variables is age which was asked as categorical variable in the interval as follows: 18-24, 25-31, 32-38, 39-45, 46-52, 53-59, 60 and over so its measurement level is ordinal. Second moderator variable is gender which was asked as female or male so its measurement level is nominal. Third one is working status which consists of answers as worker and student so its measurement scale is nominal. Fourth one is experience, in that part questions were asked as a Likert scale. Experience scale consists of the questions that asks participants about their experiences of online environment and experiences of teamwork such as playing computer game, participating in a computer game as a team member, participating in an immersive environment, taking online course, taking part in a group work or collaborative projects face-to-face and taking part in a group work or collaborative projects online. Personality is the last moderator variable of theoretical framework of this study. Personality was also asked as a Likert scale. There are 12 questions in order to determine the tendency of participants for teamwork.

Team building is a dependent variable of this study. Team building scale was prepared as a Likert scale and 10 questions are asked in this scale in order to determine team building level of teams that play the serious game.

## Hypotheses

The hypotheses to be analyzed in this study are;

- Hypothesis 1: Physical characteristics of the serious game have a positive significant impact on a team building.

  o Hypothesis 1a: Personality is a moderator between physical characteristics of the serious game and team building.

  o Hypothesis 1b: Experience is a moderator between physical characteristics of the serious game and team building.

  o Hypothesis 1c: Impact of the physical characteristics of the serious game on team building varies by gender.

  o Hypothesis 1d: Impact of the physical characteristics of the serious game on team building varies by participants' working status.

- Hypothesis 2: Attitudes of participants toward serious game have a positive significant impact on team building.

  o Hypothesis 2a: Personality is a moderator between attitudes of participants toward serious game and team building.

  o Hypothesis 2b: Experience is a moderator between attitudes of participants toward serious game and team building.

- Hypothesis 2c: Impact of the attitudes of participants toward serious game on team building varies by gender.

- Hypothesis 2d: Impact of the attitudes of participants toward serious game on team building varies by participants' working status.

CHAPTER 4

METHODOLOGY

This part describes the technical details of the game and the questionnaire designed

for this study. Definition of team building game Zoom and its benefits, adaptation of

Zoom to the multi-user virtual environment and application of Zoom will be detailed.

After the application of the game, participants filled a questionnaire. This part also

describes technical details of this questionnaire. Preparation of the questionnaire,

method and procedure of data collection, variables and measurement constructs, data

sampling and analysis approach will be handled in this part.

Team Building Game: Zoom

Zoom is a game for team building which was created by Istvan Banyai (1995). Zoom

is based on a wordless picture book which consists of 30 sequential "pictures within

pictures" which means each picture is zoom out version of the previous one. Also

there is a book Re-Zoom which is the reverse version of Zoom. In Re-Zoom pictures

are again sequentially positioned but in a reverse order which means each picture is

zoom in version of the previous one.

The game can be played with a group of up to 30 people but it can be done

with fewer people also. Total time requirement is 30 minutes; 5 minutes to set up and

brief the group, 15 minutes for active problem solving and 5-10 minutes for

debriefing.

Pictures are handed out so each participant has a picture and participants can not show their pictures to the others. Then, by explaining their pictures, they try to put pictures in an order that creates a unified story.

This group activity helps improving communication skills, perspective taking, and problem solving skills (Anonymous, 2009).

Adaptation of Zoom to the Multi-User Virtual Environment

Tipontia is a multi-user virtual island which was created by AvayaLive Engage group (Fig. 3, Fig. 4).



Figure 3. Tipontia island with female avatar
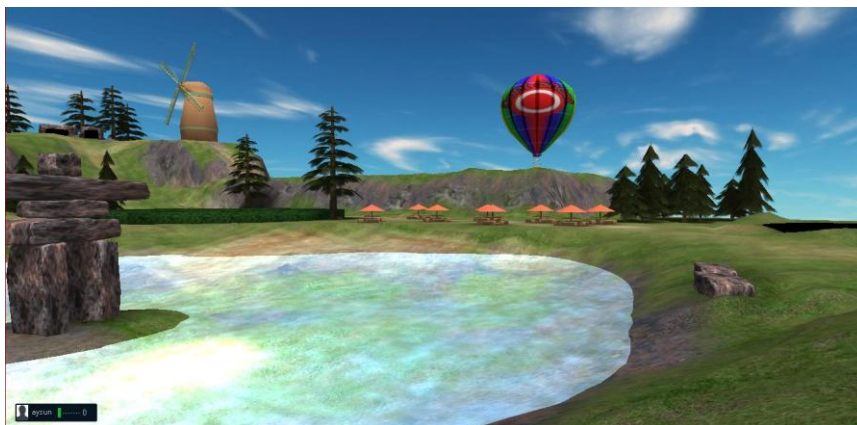


Figure 4. Tipontia island: lake and picnic area

A relaxing game environment was required in order to adapt the team building

activity Zoom to the virtual environment, so a camping area was built on Tipontia (Fig. 5).



Figure 5. Camping area

Camping area has been established between mountains and trees. It consists of 10 chairs, 10 boards and a campfire. Chairs were developed by using AutoDesk Maya which is a 3D animation, design and engineering software and other components such as boards and campfire were developed in AvayaLive Engage platform.

Zoom in virtual environment is played with a total of 10 people, including the facilitator. The facilitator joins the game and manages the course of the game.

Participants can access the island Tipontia by using any web browser from the web address of the game server (wa2844.avayalive.com). If the participant will join to the game for the first time, s/he should install a plug-in and run it. After that by using any nickname, s/he can connect to the game server. After connecting to the game, participant can change the appearance, clothing and profile of her/his own avatar. Before s/he begins to the game, first s/he should check audio settings in order to be sure that microphone and headset are working properly.

At the beginning, participants come to Tipontia and attend to the orientation. Firstly, they practice their gestures which are available on the system. Secondly, participants create a group that consists of 2 people and walk around the island. Their

purpose is to find the black cubes which are placed around the island Tipontia as many as possible in 5 minutes. After this ice-breaking activity, participants and the facilitator teleport to the camping area and the game Zoom begins. One picture is sent to each participant and participants don't share their pictures by the others. They explain their pictures one by one and try to put them in an order for creating a unified story. After participants decide that they put all the pictures in a correct order, they sit down to the chairs based on this order. Each participant uploads his/her own picture to the board behind his/her chair. After that, participants and the facilitator discuss the process, difficulties and entertaining part of the game.

## Game Application

### Pilot Application

Before we apply our game to a sample, we applied it on a pilot sample which consists of 10 people with a facilitator who managed the game session. The facilitator has been managed the serious games in a face-to-face environment before. After pilot application, open-ended questions were asked to the participants in order to learn their opinions about the game and the environment. Also facilitator stated his thoughts about the game and the environment.  Opinions of participants are in a positive way. They liked the game and believed that this game can help to improve their team building skills. In addition to this, the facilitator compared this environment with the face-to-face environment and expressed that since participants act in a similar way as face-to-face environment, this game and the virtual environment can be used as an alternative to the face-to-face environment.

Our sample consists of 44 people. One person left the game after the orientation part because of emergency situation in the work place. The sample consists of 19 students and 24 workers. Students are from mostly Boğaziçi University and Middle East Technical University. A group of worker which consists of 8 people is from IBTech which is a company that designs and develops software for core finance, credit cards and Internet banking. Second group of workers which consists of 6 people is a paramedic group from Canada. Third group of workers consists of 4 pilot candidates who work for Turkish Airlines. Last group of workers consists of 6 teachers from different schools in İstanbul.

## Structure of the Questionnaire

Aim of this questionnaire is to measure the effects of serious game on team building in a multi-user virtual environment. The questionnaire is prepared by using https://drive.google.com/. After participants played the game, they filled the survey online. This questionnaire consists of 8 close-ended and 4 open-ended questions. The questionnaire has 7 parts. These parts:

- Part1: Individual's demographics
- Part2: Individual's personality that measure the tendency for being a team
- Part3: Individual's experience about games, online environments and being a team
- Part 4: Perceptions of participants about the physical environment of the game

- Part 5: Attitudes of participants towards serious game Zoom

- Part 6: Perceptions of participants about being a team in the game

- Part 7: Open-ended questions about the whole experience

These parts will be explained in details in the following sections.

## Part 1: Individual's Demographics

The first part of the questionnaire consists of 3 close-ended questions about the demographics of the participants. These are:

- Gender

- Age

- Working Status

Participants choose their gender from drop down list as "Female" or "Male". Age is asked as a categorical variable and participants are allowed choosing one of these choices from drop down list: "18-24", "25-31", "32-38", "39-45", "46-52", "53-59" and "60 and over". For the questions Working Status, participants choose one of the choices from "Worker" or "Student".

## Part2: Individual's Personality that Measure the Tendency for Being a Team

In this part, there is 1 question which was asked as a 5-point agreement scale (Likert scale) and consists of 12 items. The questions were compiled from various sources which were referenced at Table 1.

These questions were asked in order to understand the level of tendency to being a team and to measure if this personality affects the relationship between

serious game in an online environment and team building.

Table 1. Sources of Questions about Personality

| Part 2 Scale Items | Reference |
|---|---|
| I would prefer to be a leader rather than a follower. | Adapted from Burger and Cooper (1979) |
| I prefer making plans thoroughly before I start any task. | Adapted from Burger and Cooper (1979) |
| I would rather not try something I'm not good at. | Adapted from Burger and Cooper (1979) |
| I like trying out new ways of doing things. | Adapted from Personality Test (http://www.teamtechnology.co.uk) |
| I can easily make new friends. | Adapted from Self Efficacy Scale (http://www.mytherapysession.com) |
| I am more comfortable alone than in social gathering. | Adapted from Self Efficacy Scale (http://www.mytherapysession.com) |
| I am confident that I can handle any challenge well. | Adapted from Self Efficacy Scale (http://www.mytherapysession.com) |
| I get frustrated when my teammates have conflict between each other. | Adapted from Personality Test (http://www.teamtechnology.co.uk) |
| I like doing practical things that have a tangible result. | Adapted from Personality Test (http://www.teamtechnology.co.uk) |
| I prefer solving the problems on my own. | Adapted from Personality Test (http://www.teamtechnology.co.uk) |
| I give up easily. | Adapted from Self Efficacy Scale (http://www.mytherapysession.com) |
| I like sharing my ideas with others. | Adapted from Self Efficacy Scale (http://www.mytherapysession.com) |

## Part 3: Individual's Experience about Games, Online Environments and Being a Team

In part 3, there is 1 question which was asked as Likert scale and consists of 6 items. In this part, participants state their frequency of playing a computer game, participating in an immersive environment, taking course online, working in a face-to-face group project and participating in collaborative online projects as a team member. Answers of participants to these questions show the experience of participants about online environments and teamwork.

These questions were asked in order to understand the experience level of participants about online environments and teamwork and to measure if this experience affects the relationship between serious game in an online environment and team building.

## Part 4: Perceptions of Participants about the Physical Environment of the Game

In part 4, there is 1 question which was asked as a 5-point-scale ("Very Bad", "Bad", "Neither Good or Bad", "Good, "Very Good") and consists of 6 items. In this part, participants state their ideas about physical environment of the game such as graphics, sounds, places, animation, collaboration tools and navigation. Answers show the appreciation level of participants for physical characteristics of the game environment.

These questions were asked in order to understand the appreciation level of participants for physical characteristics of the game environment. In addition to this they are useful for measuring the effects of physical characteristics of the serious

game environment on team building.

## Part 5: Attitudes of Participants towards Serious Game Zoom

In this part, there is 1 question which was asked as a 5-point agreement scale (Likert scale) and consists of 5 items. In this part, participants state their ideas about the game itself. They state the difficulty and the entertainment level of the game, the level of feeling comfortable while playing the game, how much they like the game and finally if they think that this game can improve their team building skills or not.

These questions were asked in order to understand the appreciation level of participants for the game itself. In addition to this, these questions are useful for measuring the relationship between the attitudes of participants towards the game and team building.

## Part 6: Perceptions of Participants About Being a Team in the Game

In this part, there is 1 question which was asked as a 5-point agreement scale (Likert scale) and consists of 10 items. The questions were compiled from various sources which were referenced at Table 2.

These questions were asked in order to understand the ideas of participants about being a team in the game. This scale was used as a dependent variable "Team Building" in the theoretical model and hypothesis.

Table 2. Sources of Questions about Team Building

| Part 6 Scale Items | Reference |
|---|---|
| I felt I was part of the team. | Adapted from Seashore (1954) |
| Team members got along together well. | Adapted from Seashore (1954) |
| Team members worked together well. | Adapted from Seashore (1954) |
| Team members helped each other. | Adapted from Seashore (1954) |
| Team members trusted each other sufficiently. | Adapted from Larson and LaFasto (1989) |
| Team members shared information completely. | Adapted from Larson and LaFasto (1989) |
| Team members embraced a common set of guiding values. | Adapted from Larson and LaFasto (1989) |
| The communication between team members was good. | Adapted from Gouran et al. (1978) |
| There was no team spirit in the team. | Adapted from Pearce et al. (1992) |
| Team members had confidence in one another. | Adapted from Pearce et al. (1992) |

Part 7: Open-Ended Questions

In order to obtain participant views about whole experience, four open-ended

questions were addressed to the participants:

1. Have you done any team building exercise before? How does this compare to

   that?

2. Do you think virtual environments have advantages on this exercise? If yes,

   what are these advantages?

3. Do you think virtual environments have disadvantages on this exercise? If

   yes, what are these disadvantages?

4. What did you like or dislike about the whole experiences including the environment, orientation and the game?

CHAPTER 5

ANALYSES AND FINDINGS

In this part of the study; descriptive statistics of the findings, reliability analysis of

the scales, regression analysis between independent and dependent variables and

multiple regression for moderator variables were conducted and results were

examined. IBM SPSS Statistics19 was used to test the hypotheses and provide the

findings. Since the survey is conducted online by Google drive, results were taken

directly from the application and copied to SPSS. In addition to this answers of the

open-ended questions were examined.

Descriptive Analyses were done for:

- Demographic characteristics

- Personality Scale

- Experience Scale

- Physical Characteristics of the Serious Game Environment Scale

- Attitudes of Participants Towards Serious Game Scale

- Team Building Scale.

Reliability of the survey items, personality scale, experience scale, physical

characteristics of the serious game environment scale, attitudes of participants

towards serious game scale and team building scale, has been analyzed by using

reliability analysis with Cronbach's Alpha.

Linear regression analysis has been performed to figure out the effects of physical characteristics of the serious game environment and attitudes of participants towards serious game on team building.

Multiple regression analysis was conducted in order to discover the moderator effects of gender, working status, personality and experience of participants on a relationship between independent variables (physical characteristics of the serious game environment and attitudes of participants towards serious game) and dependent variable (team building).

Finally, answers of participants to the open-ended questions were examined at the last part of the chapter.

Descriptive Findings

Demographic Profile of the Respondents

Table 3. Demographic Profile of Respondents

| Gender | | |
|---|---|---|
| | Frequency | Percent |
| Female | 17 | 39.5 |
| Male | 26 | 60.5 |
| Total | 43 | 100 |
| Age | | |
| | Frequency | Percent |
| 18-24 | 17 | 39.5 |
| 25-31 | 12 | 27.9 |
| 32-38 | 5 | 11.6 |
| 39-45 | 6 | 14 |
| 46-52 | 3 | 7 |
| Total | 43 | 100 |
| Working Status | | |
| | Frequency | Percent |
| Student | 19 | 44.2 |
| Worker | 24 | 55.8 |
| Total | 43 | 100 |

Table 3 shows that, 39.5% of the respondents are female and 60.4% of them are male.

The sample consists of mainly young people with 39.5% in the 18-24 range and early adults with 27.9% in the 25-31 range. The age range 32-38 follows them with 11.6 percent. 14% of respondents are between the ages of 39-45 and remaining 7% is between the ages of 46-52. So, 67.4% of respondents are between ages 18 and 31, who have relatively more tendency to play and like computer games.

44.2% of the respondents are students and 55.8% of them are workers from different sectors. Since we do not use sector as a search criterion, it is not important the working sectors of respondents.

Descriptive Statistics for Personality Scale

Table 4. Mean Values of Personality

| | N | Mean (Over 5) | Std. Deviation |
|---|---|---|---|
| a. I would prefer to be a leader rather than a follower. | 43 | 4.00 | 0.690 |
| b. I prefer making plans thoroughly before I start any task. | 43 | 4.07 | 0.704 |
| c. I would rather not try something I'm not good at. | 43 | 3.67 | 0.644 |
| d. I like trying out new ways of doing things. | 43 | 4.23 | 0.718 |
| e. I can easily make new friends. | 43 | 3.95 | 0.815 |
| f. I am more comfortable alone than in social gathering. | 43 | 3.21 | 1.013 |
| g. I am confident that I can handle any challenge well. | 43 | 4.28 | 0.591 |
| h. I get frustrated when my teammates have conflict between each other. | 43 | 3.28 | 0.984 |
| i. I like doing practical things that have a tangible result. | 43 | 4.12 | 0.544 |
| j. I prefer solving the problems on my own. | 43 | 2.98 | 0.938 |
| k. I give up easily. | 43 | 4.23 | 0.812 |
| l. I like sharing my ideas with others. | 43 | 4.16 | 0.531 |
| Valid N (listwise) | 43 | | |

This part of the questionnaire attempts to measure the tendency of respondent's personality to being a team. There are 12 items in the scale. Respondents were asked

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to answer the questions on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree). Items; "c, f, j and k" are reverse coded in the data because they were asked in a negative manner.

As a result, respondents have tendency to be a team since their responses are higher than average values (Table 4).

<u>Descriptive Statistics for Experience Scale</u>

Table 5. Mean Values of Experience

|  | N | Mean | Std. Deviation |
|---|---|---|---|
| a. Played a computer game. | 43 | 3.37 | 1.113 |
| b. Participated in a computer game as a team member. | 43 | 2.51 | 1.316 |
| c. Participated in an immersive environment (in which people have avatars). | 43 | 2.30 | 1.264 |
| d. Taken a course online. | 43 | 2.26 | 1.217 |
| e. Taken part in group work or collaborative projects- face to face. | 43 | 3.53 | 1.032 |
| f. Taken part in group work or collaborative projects- online. | 43 | 2.37 | 1.196 |
| Valid N (listwise) | 43 |  |  |

This part of the questionnaire attempts to measure the experience level of participants' to play computer games and attend teamwork. Participants state their frequency of playing a computer game, participating in an immersive environment, taking course online, working in a face-to-face group project and participating in collaborative online projects as a team member. There are 6 items in the scale. Respondents were asked to answer the questions on a 5-point scale (1: Never, 2: Rarely, 3: Sometimes, 4: Often, 5: Always).

As a result, respondents' experience of playing computer games is slightly above the average level (Table 5). However their experience of playing computer

game as a team member is below this level. Also respondents' experience of participating in an immersive environment is at a low level. In addition to this, taking an online course level is below from the average. While respondents' experience level of attending face-to-face group work is above the average, experience level of attending online group work is below the average.

Descriptive Statistics of Perceptions of Participants About the Physical Environment of the Serious Game Scale

Table 6. Mean Values of the Physical Characteristics of the Serious Game

|  | N | Mean | Std. Deviation |
|---|---|---|---|
| a. Graphics | 43 | 3.70 | 0.914 |
| b. Sounds | 43 | 3.53 | 0.984 |
| c. Places (mountains, picnic area, etc.) | 43 | 3.98 | 0.771 |
| d. Animation (gestures such as waving, nodding, etc.) | 43 | 3.95 | 0.785 |
| e. Collaboration Tools (text chat, pdf surface, web renderer, file sharing) | 43 | 4.05 | 0.925 |
| f. Navigation (walk, run, finding locations using map) | 43 | 3.86 | 0.774 |
| Valid N (listwise) | 43 |  |  |

This part of the questionnaire attempts to measure the admiration of participants towards physical environment of serious game. There are 6 items in the scale. Respondents were asked to answer the questions on a 5-point scale (1: Very Bad, 2: Bad, 3: Neither Good or Bad, 4: Good, 5: Very Good).

As a result, since all values are above the average, respondents like physical environments of the serious game "Zoom" (Table 6).

Descriptive Statistics of Attitudes of Participants Towards Serious Game Scale

This part of the questionnaire attempts to measure the attitudes of participants

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towards serious game "Zoom". There are 5 items in the scale. Respondents were asked to answer the questions on a 5-point scale (1: Very Bad, 2: Bad, 3: Neither Good or Bad, 4: Good, 5: Very Good). Item "a" is reverse coded in the data because it was asked in a negative manner.

Table 7. Mean Values of Attitudes of Participants Towards Serious Game

|  | N | Mean | Std. Deviation |
|---|---|---|---|
| a. The game was difficult. | 43 | 3.91 | 0.648 |
| b. I was comfortable while playing the game. | 43 | 4.05 | 0.575 |
| c. The game was entertaining. | 43 | 4.12 | 0.697 |
| d. I liked the game. | 43 | 4.12 | 0.793 |
| e. This game can improve my team work skills. | 43 | 3.91 | 0.840 |
| Valid N (listwise) | 43 |  |  |

As a result, , since all values are above the average, respondents like the serious game "Zoom" (Table 7).

## Descriptive Statistics of Team Building Scale

Table 8. Mean Values of Team Building

|  | N | Mean | Std. Deviation |
|---|---|---|---|
| a. I felt I was part of the team. | 43 | 3.95 | 0.815 |
| b. Team members got along together well. | 43 | 4.16 | 0.574 |
| c. Team members worked together well. | 43 | 4.23 | 0.571 |
| d. Team members helped each other. | 43 | 4.21 | 0.514 |
| e. Team members trusted each other sufficiently. | 43 | 4.05 | 0.653 |
| f. Team members shared information completely. | 43 | 4.26 | 0.621 |
| g. Team members embraced a common set of guiding values. | 43 | 3.86 | 0.560 |
| h. The communication between team members was good. | 43 | 4.07 | 0.593 |
| i. There was no team spirit in the team. | 43 | 3.95 | 0.925 |
| j. Team members had confidence in one another. | 43 | 3.88 | 0.625 |
| Valid N (listwise) | 43 |  |  |

This part of the questionnaire attempts to figure out the ideas of participants about being a team in the game "Zoom". This scale attempts to measure team building level of participants. There are 10 items in the scale. Respondents were asked to answer the questions on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree). Item "i" is reverse coded in the data because it was asked in a negative manner.

As a result, we can understand that participants' thoughts about the team in the game are positive (Table 8). They stated that they applied the components of team building successfully.

## Reliability / Internal Consistency of the Survey Items and Scales

Reliability of the survey items including 5 scales have been checked by Cronbach's Alpha.

### Reliability Analysis for Personality Scale

First of all personality scale was checked and the value of Cronbach's Alpha was found as 0.608 which is smaller than 0.7. In order to increase this value, item8 which is the most effective item on this low value was deleted. Item8 is "I get frustrated when my teammates have conflict between each other." We thought that if a person has a tendency to be in a team, her/his answer to this question will be "agree". While we were preparing the survey we regarded another possible point of view of respondent who has tendency to be in a team. S/he may think that "I do not get frustrated and I strive to hold them together." Hence, the respondent who has this opinion may answer this item as "do not agree". Since there are two possible views

to answer this question, it is inconsistent. After deleting item8, Cronbach's Alpha became 0.655 which is still smaller than 0.7. The most effective item on this low value is item3 which is "I would rather not try something I'm not good at." Since this question is not related directly with being in a team, it was deleted. After that Cronbach's Alpha became 0.672 which is smaller than 0.7. The most effective item on this low value is item11 which is "I give up easily." Since this question is not related directly with being in a team, it was deleted. After that Cronbach's Alpha became 0.675 which is still smaller than 0.7. The most effective item on this low value is item1 which is "I would prefer to be a leader rather than a follower." Each person in a team does not have to have a characteristics of leadership so this item was also deleted and finally Cronbach's Alpha became 0.703 (>0.7). See Appendix B.1 for detailed information and SPSS results.

<center>Reliability Analysis for Experience Scale</center>

Cronbach's Alpha value of experience scale is 0.714 which is greater than 0.7. This result shows that items in this scale are consistent with each other for measuring experience of respondents. See Appendix B.2 for detailed information and SPSS results.

<center>Reliability Analysis for Perceptions of Participants About the Physical Environment
of the Serious Game Scale</center>

Cronbach's Alpha value of physical characteristics of the serious game environment scale is 0.797 which is greater than 0.7. This result shows that items in this scale are consistent with each other for measuring perceptions of participants about the

physical environment of the serious game. See Appendix B.3 for detailed

information and SPSS results.

<u>Reliability Analysis for Attitudes of Participants Towards Serious Game Scale</u>

Cronbach's Alpha value of attitudes of participants toward serious game scale is

0.672 which is smaller than 0.7. In order to increase this value, item1 which is the

most effective item on this low value was deleted. Item1 is "The game was difficult."

Since this question was asked in a reverse manner, it could confuse the respondents.

After deleting this item, Cronbach's Alpha became 0.782 which is greater

than 0.7. This result shows that items in this scale are consistent with each other for

measuring attitudes of participants towards serious game. See Appendix B.4 for

detailed information and SPSS results.

<u>Reliability Analysis for Team Building Scale</u>

Cronbach's Alpha value of team building scale is 0.887 which is greater than 0.7.

This result shows that items in this scale are consistent with each other. See

Appendix B.5 for detailed information and SPSS results.

Hypotheses Testing

<u>Regression Analyses</u>

Regression analysis was conducted in order to obtain the relationship between

continuous variables such as independent variables and dependent variable. For this

purpose, it is required to calculate the average values of scale. Team_av, game_phy_av, game_emo_av, pers_av and exp_av columns were added to the data.

Since all items of team building scale are consistent with each other and scale is reliable, average of all of the answers of team building items (1-5 Likert scale, 10 items) for each respondent were calculated and written in Team_av column.

Since all items of physical characteristics of the serious game scale are consistent in each other and scale is reliable, average of all of the answers of physical characteristics of the serious game items (1-5 Likert scale, 10 items) for each respondent were calculated and written in game_phy_av column.

In order to get sufficient Cronbach's Alpha value, item1 was deleted from the attitudes of participants towards serious game scale. After this process, average value of the scale was calculated with the remaining items and written in game_emo_av column.

In order to get sufficient Cronbach's Alpha value, item8, item3, item1 and item11 were deleted respectively from the personality scale. After this process, average value of the scale was calculated with the remaining items and written in pers_av column.

Since all items of experience scale are consistent with each other and scale is reliable, average of all of the answers of experience items (1-5 Likert scale, 10 items) for each respondent were calculated and written in exp_av column.

Hypothesis 1

Hypothesis 1 is "Physical characteristics of the serious game have a positive significant impact on team building." In order to test this hypothesis, linear regression analysis was conducted.

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Table 9. Model Summary for Hypothesis 1

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|---|----------|-------------------|----------------------------|
| 1 | 0.627[a] | 0.394 | 0.379 | 0.32942 |
| a. Predictors: (Constant), game_phy_av | | | | |

Model summary shows that R value is 0.627 and R square value is 0.394 which mean

regression result is satisfying but it is required to check significance levels.

Table 10. ANOVA Analysis for Hypothesis 1

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|-------|--|----------------|-----|-------------|---|------|
| 1 | Regression | 2.887 | 1 | 2.887 | 26.606 | 0.000[b] |
| | Residual | 4.449 | 41 | 0.109 | | |
| | Total | 7.336 | 42 | | | |
| a. Dependent Variable: Team_av | | | | | | |
| b. Predictors: (Constant), game_phy_av | | | | | | |

ANOVA Analysis result shows that significance level of predictor which is physical

characteristics of the serious game environment is under 0.05 so it is significant. This

means, there is a strong positive relationship between physical characteristics of the

serious game environment and the team building.

Table 11. Coefficients for Hypothesis 1

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|-------|--|-----------------------------|-----------|---------------------------|---|------|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.365 | 0.338 | | 6989 | 0.000 |
| | game_phy_av | 0.445 | 0.086 | 0.627 | 5.158 | 0.000 |
| a. Dependent Variable: Team_av | | | | | | |

From the coefficient table (Table 11), coefficient of physical characteristics of the

serious game environment is significant so physical characteristics of the serious

game environment (PCSGE) can be used in an equation as a predictor of team

building. Thus, hypothesis 1 is supported. Equation can be written as below:

Team Building = a + 0.627 PCSGE (Table 11)

Hypothesis 2 is "Attitudes of participants towards serious game have a positive significant impact on team building." In order to test this hypothesis, linear regression analysis was conducted.

Table 12. Model Summary for Hypothesis 2

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.662[a] | 0.439 | 0.425 | 0.31693 |
| a. Predictors: (Constant), game_emo_av | | | | |

Model summary shows that R value is 0.662 and R square value is 0.439 which mean regression result is satisfying but it is required to check significance levels.

Table 13. ANOVA Analysis for Hypothesis 2

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3.218 | 1 | 3.218 | 32.038 | 0.000[b] |
| | Residual | 4.118 | 41 | 0.100 | | |
| | Total | 7.336 | 42 | | | |
| a. Dependent Variable: Team_av | | | | | | |
| b. Predictors: (Constant), game_emo_av | | | | | | |

ANOVA Analysis result shows that significance level of predictor which is physical characteristics of the serious game environment is under 0.05 so it is significant. This means, there is a strong positive relationship between attitudes of participants towards serious game and the team building.

Table 14. Coefficients for Hypothesis 2

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.904 | 0.389 | | 4.892 | 0.000 |
| | game_emo_av | 0.536 | 0.095 | 0.662 | 5.660 | 0.000 |
| a. Dependent Variable: Team_av | | | | | | |

From the coefficient table (Table 14), coefficient of attitudes of participants towards serious game is significant so attitudes of participants towards serious game (APTSG) can be used in an equation as a predictor of team building. Thus, hypothesis 2 is supported. Equation can be written as below:

Team Building = a + .662 APTSG (Table 14)


### Multiple-Regression Analyses (Analysis of Moderation Effect)


Personality, experience, gender and working status are the moderator variables which are thought that they have effect on the direction and/or strength of the relationship between independent and dependent variables. In order to measure the moderation effect, Baron and Kenny's method (Baron and Kenny, 1986) is used. The figure below shows the framework of this method.
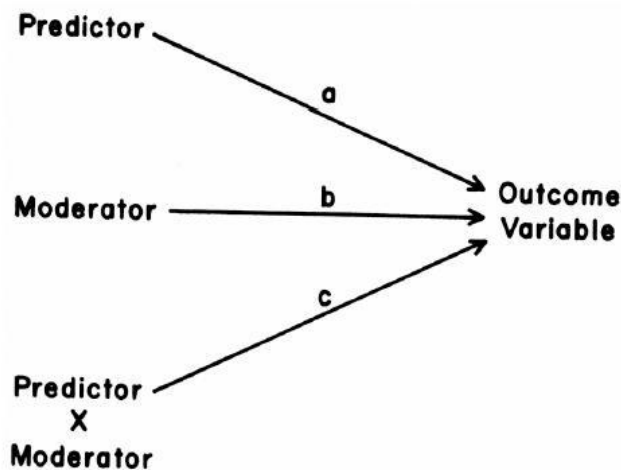


Figure 6. Moderator model (Baron and Kenny, 1986)

In this figure, predictor is an independent variable, moderator is a moderator variable, (predictor x moderator) is the product of independent and moderator variable, it is called as an interaction term as well, and outcome variable is a dependent variable. These three variables are run in a multiple regression analysis at

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the same time and for moderator effect path c should be significant. If the interaction term is significant then it can be said that there is a moderation effect. Also path a and b can be significant but they are not directly related with the moderation effect. Furthermore there should not be a correlation between moderator and dependent variable and moderator and predictor variable in order to get clear moderation effect (Baron, Kenny, 1986). Personality and experience are continuous variables and they were measured in an interval scale. Gender and working status are categorical variables so they were measured in a nominal scale. Independent variables; physical characteristics of the serious game environment and attitudes of participants towards serious game are continuous variables and they were measured in an interval scale. First we should center continuous variables and recode categorical variables, in order to use these variables together.

Defining New Parameters

First we should center continuous variables. Centering means subtracting the mean of one variable from each element of that variable. Centering reduces correlation between independent variable and moderator variable (multicollinearity) so it makes regression effect clearer. Variables; phy_cent, emo_cent, pers_cent and exp_cent were calculated as centered values of variables; physical characteristics of the serious game environment, attitudes of participants towards serious game, personality of participants and experience of participants respectively.

Nominal variables (categorical variables) are required to be recoded in order to be included in a test for moderation. Gender was coded as 1 for female and -1 for male. Working status was coded as 1 for workers and -1 for students.

Then interaction terms were calculated in order to be used in a test of

moderation. First interaction term is phy_pers_cent which is the product of centered value of independent variable physical characteristics of the serious game environment and centered value of moderator variable personality. Second interaction term is phy_exp_cent which is the product of centered value of independent variable physical characteristics of the serious game environment and the centered value of moderator variable experience. Third interaction term is phy_gend_cent which is the product of centered value of independent variable physical characteristics of the serious game environment and recoded value of moderator variable gender. Fourth interaction term is phy_work_cent which is the product of centered value of independent variable physical characteristics of the serious game environment and recoded value of moderator variable working status. These are the interaction terms for independent variable physical characteristics of the serious game environment with each moderator variable.

In addition to this, interaction terms were calculated for independent variable attitudes of participants towards serious game and each moderator variable. First interaction term is emo_pers_cent which is the product of centered value of independent variable attitudes of participants towards serious game and centered value of moderator variable personality. Second interaction term is emo_exp_cent which is the product of centered value of independent variable attitudes of participants towards serious game and the centered value of moderator variable experience. Third interaction term is emo_gend_cent which is the product of centered value of independent variable attitudes of participants towards serious game and recoded value of moderator variable gender. Fourth interaction term is emo_work_cent which is the product of centered value of independent variable attitudes of participants towards serious game and recoded value of moderator variable working status.

Moderation Effect of Personality on a Relation between Physical Characteristics of the Serious Game and Team Building

Moderation effect of personality on a relation between physical characteristics of the serious game environment and team building was measured with multiple regression analysis. Independent (predictor) variable physical characteristics of the serious game environment, moderator variable personality and the interaction term were included in a multiple regression as independents and dependent variable team building was included as dependent and the analysis was performed.

Table 15. Multiple Regression Results for Hypothesis 1a

| Predictor Variable | Standardized Coefficient ($\beta$) | t-value (p-level) |
|---|---|---|
| Physical characteristics of the serious game environment (PCSGE) | 0.487 | 3.605 (0.001) |
| Personality | -0.053 | -0.441 (0.662) |
| PCSGE x Personality | -0.275 | -2.048 (0.047) |
| F (p-value) = 10.921 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.457 (0.415) | | |

Table 15 shows that standardized coefficient of interaction term is significant (<0.05) so it can be said that there is a moderation effect. Standardized coefficient of personality is not significant so it can be understood that there is no direct relationship between personality and team building so it is obvious that personality is

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a moderator variable. However this result is not enough to determine the direction of moderator because moderation should be measured in different levels. It should be measured at least as high, medium and low levels (Aiken and West, 1991). For this purpose the software ModGraph (Jose, 2008) was used.

Table 16. Moderation Effect of Hypothesis 1a

|  | low | med | high |
|---|---|---|---|
| **Personality** |  |  |  |
| **high** | 3.97 | 4.05 | 4.12 |
| **med** | 3.87 | 4.07 | 4.27 |
| **low** | 3.76 | 4.09 | 4.42 |
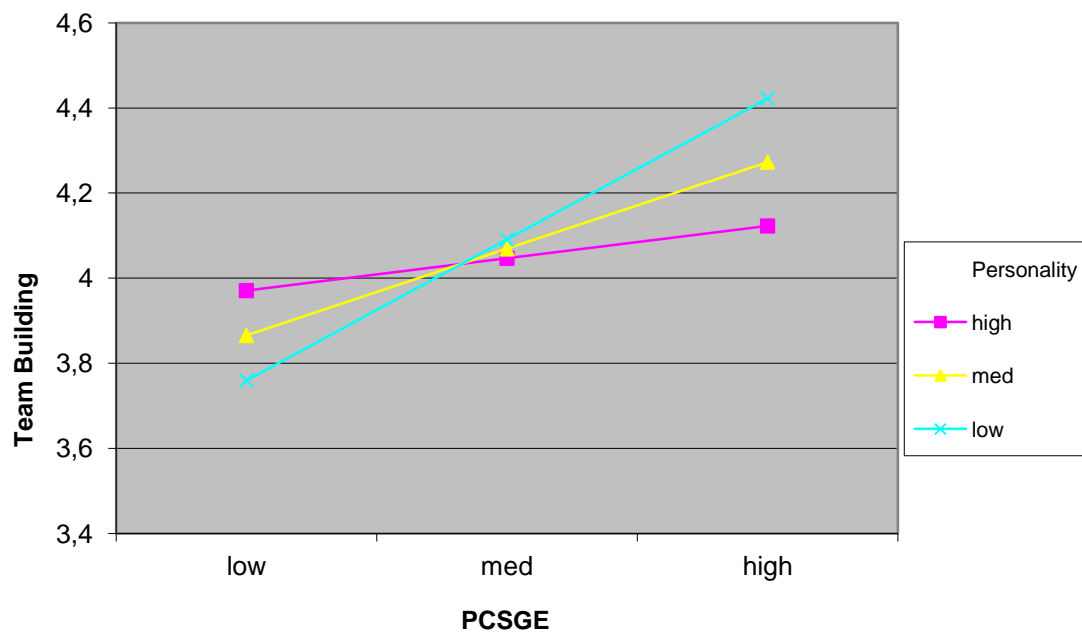


Figure 7. Graph of moderation effect of Hypothesis 1a

Table 16 and Figure 7 show that, moderation effect is in a positive direction for low level of physical characteristics of the serious game environment. In case of low level of appreciation for the physical characteristics of the serious game, personality has increasing effect on the relation between physical characteristics of the serious game environment and team building. When the appreciation level of participants for

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the physical characteristics of the serious game environment increases, moderator effect of the personality decreases and the appreciation of participants for the physical characteristics of the serious game environment becomes much more effective on team building success.

Moderation Effect of Experience on a Relation between Physical Characteristics of the Serious Game and Team Building

Moderation effect of experience on a relation between physical characteristics of the serious game environment and team building was measured with multiple regression analysis. Independent (predictor) variable physical characteristics of the serious game environment, moderator variable experience and the interaction term were included in a multiple regression as independents and dependent variable team building was included as dependent and the analysis was performed.

Table 17. Multiple Regression Results for Hypothesis 1b

| Predictor Variable | Standardized Coefficient (β) | t-value (p-level) |
|---|---|---|
| Physical characteristics of the serious game environment (PCSGE) | 0.626 | 5.005 (0.000) |
| Experience | 0.057 | 0.451 (0.654) |
| PCSGE x Experience | -0.181 | -1.469 (0.150) |
| F (p-value) = 9.654 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.426 (0.382) | | |

Table 17 shows that standardized coefficient of interaction term is not significant (>0.05) so it can be said that there is not a moderation effect at the alpha level 5%.

Moderation Effect of Gender on a Relation between Physical Characteristics of the
Serious Game and Team Building

Moderation effect of gender on a relation between physical characteristics of the
serious game environment and team building was measured with multiple regression
analysis. Independent (predictor) variable physical characteristics of the serious
game environment, moderator variable gender and the interaction term were included
in a multiple regression as independents and dependent variable team building was
included as dependent and the analysis was performed.

Table 18. Multiple Regression Results for Hypothesis 1c

| Predictor Variable | Standardized Coefficient (β) | t-value (p-level) |
|---|---|---|
| Physical characteristics of the serious game environment (PCSGE) | 0.631 | 4.772 (0.000) |
| Gender | 0.098 | 0.778 (0.441) |
| PCSGE x Gender | 0.085 | 0.660 (0.513) |
| F (p-value) = 9.082 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.411 (0.366) | | |

Table 18 shows that standardized coefficient of interaction term is not significant
(>0.05) so it can be said that there is not a moderation effect at the alpha level 5%.

Moderation Effect of Working Status on a Relation between Physical Characteristics of the Serious Game and Team Building

Moderation effect of working status on a relation between physical characteristics of the serious game environment and team building was measured with multiple regression analysis. Independent (predictor) variable physical characteristics of the serious game environment, moderator variable working status and the interaction term were included in a multiple regression as independents and dependent variable team building was included as dependent and the analysis was performed.

Table 19. Multiple Regression Results for Hypothesis 1d

| Predictor Variable | Standardized Coefficient ($\beta$) | t-value (p-level) |
|---|---|---|
| Physical characteristics of the serious game environment (PCSGE) | 0.676 | 5.093 (0.000) |
| Working Status | -0.134 | -1.012 (0.318) |
| PCSGE x Working Status | 0.046 | 0.371 (0.712) |
| F (p-value) = 9.106 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.412 (0.367) | | |

Table 19 shows that standardized coefficient of interaction term is not significant (>0.05) so it can be said that there is not a moderation effect at the alpha level 5%.

Moderation Effect of Personality on a Relation between Attitudes of Participants Towards Serious Game and Team Building

Moderation effect of personality on a relation between attitudes of participants

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towards serious game and team building was measured with multiple regression analysis. Independent (predictor) variable attitudes of participants towards serious game, moderator variable personality and the interaction term were included in a multiple regression as independents and dependent variable team building was included as dependent and the analysis was performed.

Table 20. Multiple Regression Results for Hypothesis 2a

| Predictor Variable | Standardized Coefficient ($\beta$) | t-value (p-level) |
|---|---|---|
| Attitudes of Participants toward Serious Game (APSG) | 0.648 | 6.288 (0.001) |
| Personality | -0.211 | -2.051 (0.047) |
| APSG x Personality | -0.320 | -3.115 (0.003) |
| F (p-value) = 18.969 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.593 (0.562) | | |

Table 20 shows that standardized coefficient of interaction term is significant (<0.05) so it can be said that there is a moderation effect. However this result is not enough to determine the direction of moderator because moderation should be measured in different levels. As it is mentioned before, it should be measured at least as high, medium and low (Aiken and West, 1991). For this purpose the software ModGraph (Jose, 2008) was used again.

Table 21. Moderation Effect of Hypothesis 2a

| | low | med | high |
|---|---|---|---|
| personality | | | |
| high | 3.75 | 4.02 | 4.29 |
| med | 3.76 | 4.10 | 4.43 |
| low | 3.78 | 4.18 | 4.58 |
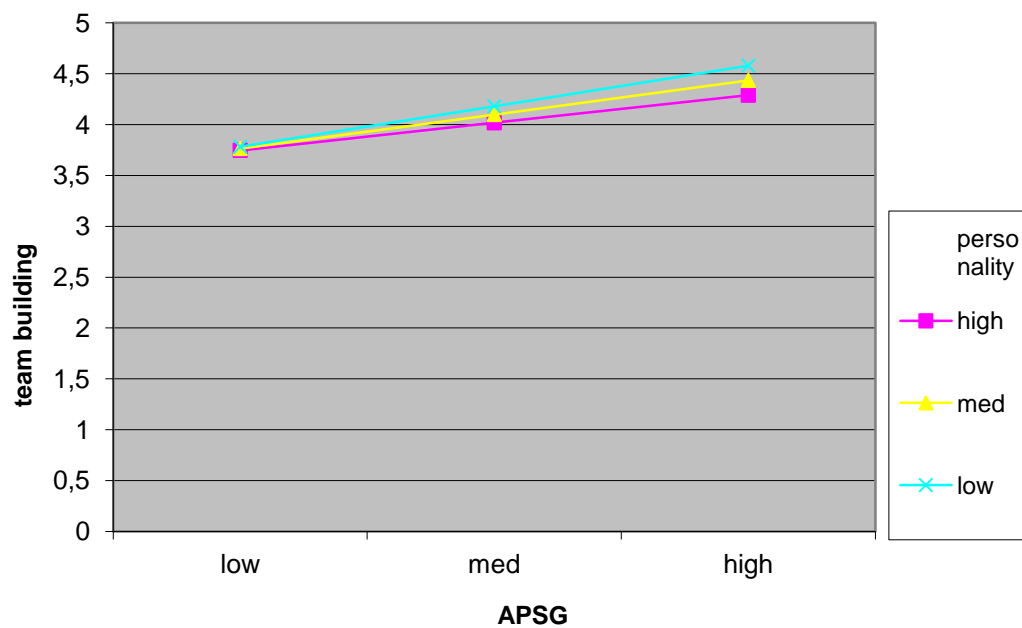


Figure 8. Graph of moderation effect of Hypothesis 2a

Table 21 and Figure 8 show that, as appreciation level of participants for the serious game increases, the effect of personality on the relation between attitudes of participants towards serious game and team building increases but in a negative manner. This situation can be explained as follows; appreciation level of participants who have no tendency to be a team in the game affect team building success much more than participants who have tendency to be a team. It means there is more possibility that person who has no tendency to be a team can be influenced by a serious game and s/he can help to improve team building success.

Moderation Effect of Experience on a Relation between Attitudes of Participants

Towards Serious Game and Team Building


Moderation effect of experience on a relation between attitudes of participants

towards serious game and team building was measured with multiple regression

analysis. Independent (predictor) variable attitudes of participants towards serious

game, moderator variable experience and the interaction term were included in a

multiple regression as independents and dependent variable team building was

included as dependent and the analysis was performed.

Table 22. Multiple Regression Results for Hypothesis 2b

| Predictor Variable | Standardized Coefficient ($\beta$) | t-value (p-level) |
| --- | --- | --- |
| Attitudes of Participants toward Serious Game (APSG) | 0.642 | 5.306 (0.000) |
| Experience | -0.111 | -0.934 (0.356) |
| APSG x Experience | -0.084 | -0.690 (0.494) |
| F (p-value) = 11.072 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.460 (0.418) | | |

Table 22 shows that standardized coefficient of interaction term is not significant

(>0.05) so it can be said that there is not a moderation effect at the alpha level 5%.

Moderation Effect of Gender on a Relation between Attitudes of Participants

Towards Serious Game and Team Building

Moderation effect of gender on a relation between attitudes of participants towards serious game and team building was measured with multiple regression analysis. Independent (predictor) variable attitudes of participants towards serious game, moderator variable gender and the interaction term were included in a multiple regression as independents and dependent variable team building was included as dependent and the analysis was performed.

Table 23. Multiple Regression Results for Hypothesis 2c

| Predictor Variable | Standardized Coefficient ($\beta$) | t-value (p-level) |
|---|---|---|
| Attitudes of Participants toward Serious Game (APSG) | 0.641 | 5.138 (0.000) |
| Gender | 0.068 | 0.548 (0.587) |
| APSG x Gender | -0.038 | -0.314 (0.755) |
| F (p-value) = 10.379 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.444 (0.401) | | |

Table 23 shows that standardized coefficient of interaction term is not significant (>0.05) so it can be said that there is not a moderation effect at the alpha level 5%.

Moderation Effect of Working Status on a Relation between Attitudes of Participants

Towards Serious Game and Team Building

Moderation effect of working status on a relation between attitudes of participants

towards serious game and team building was measured with multiple regression analysis. Independent (predictor) variable attitudes of participants towards serious game, moderator variable working status and the interaction term were included in a multiple regression as independents and dependent variable team building was included as dependent and the analysis was performed.

Table 24. Multiple Regression Results for Hypothesis 2d

| Predictor Variable | Standardized Coefficient ($\beta$) | t-value (p-level) |
|---|---|---|
| Attitudes of Participants toward Serious Game (APSG) | 0.628 | 5.191 (0.000) |
| Working Status | 0.099 | 0.847 (0.02) |
| APSG x Working Status | 0.130 | 1.073 (0.290) |
| F (p-value) = 11.258 (0.000) | | |
| $R^2$ ($R^2$ adjusted) = 0.464 (0.423) | | |

Table 24 shows that standardized coefficient of interaction term is not significant (>0.05) so it can be said that there is not a moderation effect at the alpha level 5%.

## Examination of Responses to Open-Ended Questions

Have you done any team building exercise before? How does this compare to that?

- 17 of the participants have done team building exercise before. Only 3 of the participants who have done a team building exercise before, practiced these exercises in virtual environment.

- 5 of the participants who have done a team building exercise face-to-face before stated that this one is different from face-to-face experience, it is a little bit harder and it is required getting familiar with environment. Remaining 12 stated that this activity is similar to face-to-face team building activities.

- Since other participants haven't done any team building exercise before, they could not compare their experiences.

- All participants express that this serious game is really entertaining.

- Most of the participants stated that this serious game and environment is successful, social, to the point and helpful.

Do you think virtual environments have advantages on this exercise? If yes, what are these advantages?

- 17 of the participants expressed that it is easier to come together in virtual environments, there is no need to go somewhere physically, so time, money and energy saving can be obtained.

- 10 of the participants stated that the virtual environment makes people feel more comfortable and relax, especially they emphasized that camping area strengthens these feelings. Thus, people can communicate with people they haven't known before and can share their ideas with them easily. In addition to this, some of the participants pointed that this relaxing environment can remove hierarchical relations between people.

- Almost all participants said that both the game and the environment are really entertaining. They stated that they felt more like in a game environment than a work environment.

- 7 of the participants compared this environment with the teleconferencing environments and found virtual environments more successful. Avatars are especially attractive for participants because avatars are always good-looking.

- Some of the participants found file sharing feature of the environment as very relevant.

Do you think virtual environments have disadvantages on this exercise? If yes, what are these disadvantages?

- The most conspicuous disadvantage is technical hitches. 10 of the participants stated that internet speed or quality and hardware quality such as microphone, headset, computer etc. cause some problems during the game.

- Another disadvantage is getting familiar with the virtual environment and learning to control the avatar. 5 of the participants said that it could be a disadvantage for people who haven't played computer games before.

- Missing gestures are also important for participants. 5 of the participants expressed that missing gestures in the game damage the communication between team members.

- 4 participants told that people may easily lose concentration because of real life stimuli.

- 9 of the participants said that there is no disadvantage of the virtual environment.

What did you like or dislike about the whole experiences including the environment, orientation and the game?

- Almost all participants liked the whole experience and found it very relevant with team building.

- They found game as social, new, and entertaining.

- They liked having an avatar and nicknames.

- They really complained about the technical problems.

- Also they have problems about the control of avatar and gestures.

Final Model
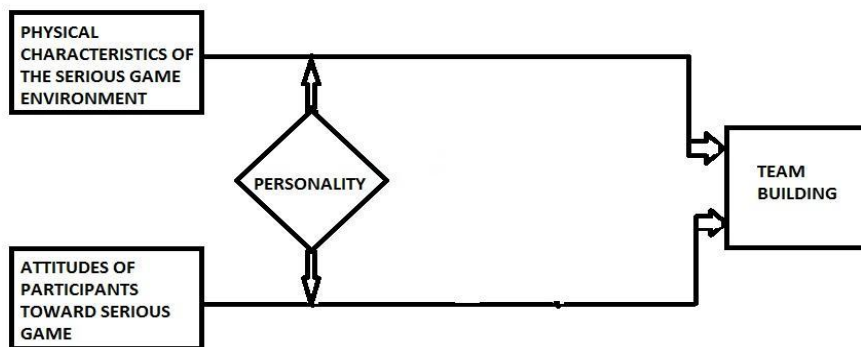


Figure  9. Final model of the study

Based on the regression analysis physical characteristics of the serious game environment and attitudes of participants towards serious game can be used as the

predictors of the team building success. In addition to this personality has a moderator effect on this relation. However working status, age and experience of the participants have not a moderator effect on the relation between independent variables and dependent variable. Supported on the information given above the final model of the study was shaped as shown in Figure 9.

CHAPTER VI

CONCLUSION

Effective team as well as successful team building is a vital concern for today's organizations; which is also obvious from literature. Also recent researches in the literature show that serious games have been used for various purposes and they are really to the point and successful. Team building is one of the intended uses of serious games and there are examples of serious games for team building in the literature. However there is no such a research that tries to measure the effects of serious game and its components on team building success.

Aim of this study is to measure the effects of serious game on team building in a multi-user virtual environment. For this purpose serious game Zoom which has been used in real life for team building purposes was adapted to the multi-user virtual environment. Zoom is the game that is helpful for improving perspective taking, communication and problem solving skills of team members. Participants visit the camping area in the multi-user virtual environment. There are pictures which are in a sequential order. Before the game begins, facilitator sends a picture to each participant randomly. Participants should not share their photos with others. Then each participant tells their own picture and they try to find a correct sequence of the picture group. After they decide the order, participants sit down to the chairs that are positioned around the campfire based on this order. Each participant uploads her/his picture to the board which is behind his/her chair.

This game was applied to 43 participants. After the game sessions, a survey was filled by the participants. The survey consists of 6 parts. In the first part there are questions about demographic characteristics of the participants. In the second part, there is 1 question which is asked as a 5-point agreement scale (Likert scale) and consists of 12 items. The questions are compiled from various sources. These questions are asked in order to understand the level of tendency of participants for being a team and to measure if personality affects the relation between serious game in an online environment and team building. In part 3, there is 1 question which is asked as a Likert scale and consists of 6 items. Answers of the participant to these questions show the experience of the participant about online environments and teamwork. In part 4, there is 1 question which is asked as a Likert scale ("Very Bad", "Bad", "Neither Good or Bad", "Good, "Very Good") and consists of 6 items. In this part, participants state their ideas about physical environment of the game. In part 5, there is 1 question which is asked as a 5-point agreement scale (Likert scale) and consists of 5 items. In this part, participants state their ideas about the game itself. In sixth part, there is 1 question which is asked as a 5-point agreement scale (Likert scale) and consists of 10 items. The questions are compiled from various sources. These questions are asked in order to understand the ideas of participants about being a team in the game. In order to obtain participant views about the whole experience, four open-ended questions were asked at the last part.

Hypothesis 1 which is "Physical characteristics of the serious game have a positive significant impact on team building." was tested by regression analysis and results show that physical characteristics of the serious game environment explains 62.7% of the team building success in the multi-user virtual environment. Hypothesis 2 which is "Attitudes of participants towards serious game have a positive significant impact on team building." was tested by regression analysis and results show that

attitudes of participants towards serious game explains 66.2% of the team building success in the multi-user virtual environment.

Personality, experience, gender and working status of participants were defined as the moderator variables and they were tested if they have an impact on the relation between independent and dependent variables. Multiple regression analysis was used in order to measure this impact. Results show that experience, gender and working status have no significant impact on the relation between physical characteristics of the serious game environment and team building. Also, experience, gender and working status have no significant impact on the relation between attitudes of participants towards serious game and team building. Personality is the only moderator that affects both relations.

Answers of participants to the open-ended questions show that; 17 of the participants have done team building exercise before. Only 3 of the participants who have done a team building exercise before practiced these exercises in virtual environment. 5 of the participants who have done a team building exercise face-to-face before stated that this one is different from face-to-face experience, it is a little bit harder and it required getting familiar with the environment. Remaining 12 stated that this activity is similar to face-to-face team building activities. Since other participants haven't done any team building exercise before, they could not compare their experiences. All participants expressed that this serious game is really entertaining. Most of the participants stated that this serious game and the environment is successful, social, to the point and helpful.

Answers of participants to the second and third open-ended questions show that; multi-user virtual environments have both advantages and disadvantages on this exercise. 17 of the participants expressed that it is easier to come together in virtual

environments, there is no need to go somewhere physically, so time, money and energy savings can be obtained. 10 of the participants stated that the virtual environment makes people feel more comfortable and relax, especially they emphasized that camping area strengthened these feelings. Thus, people can communicate with people they haven't known before and can share their ideas with them easily. In addition to this, some of the participants pointed that this relaxing environment can remove hierarchical relations between people. Almost all participants said that both the game and the environment are really entertaining. They stated that they felt not in the business environment for work but in the game environment for fun. 7 of the participants compared this environment with the teleconferencing environments and found virtual environments more successful. Avatars are especially attractive for participants because they are always good-looking. Some of the participants found file sharing feature of the environment as very relevant. On the other hand they also stated the disadvantages of the environment. The most conspicuous disadvantage is technical hitches. 10 of the participants stated that internet speed or quality and hardware quality such as microphone, headset, computer etc. cause some problems during the game. Another disadvantage is getting familiar with the virtual environment and learning to control the avatar. 5 of the participants said that it could be a disadvantage for people who haven't played computer games before. Missing gestures are also important for participants. 5 of the participants expressed that missing gestures in the game breaks the communication between team members. 4 participants told that people may easily lose concentration because of real life stimuli. 9 of the participants said that there is no disadvantage of the virtual environment.

Almost all participants liked the whole experience and found it very relevant with team building. They found the game as social, new, and entertaining. Especially

they stated that they liked having an avatar and nicknames. On the other hand, they really complained about the technical problems. Other problems are controlling the avatar and missing gestures.

Limitations and Future Research

There are a few limitations of this study; these limitations could be directions for future research.

First of all, this study investigates the effects of serious game on team building activity in a multi-user virtual environment. However, the effect of just one serious game was measured in this study. More games for team building should be developed and applied in a multi-user virtual environment.

Second, even it is online; bringing people together is difficult for the studies like that. This game could be applied to only 43 people. Number of total participants can be increased and hypotheses can be tested again.

Third, survey which was conducted after the game application can be revised or changed. Therefore, with new or revised variables hypotheses can be written and tested again.

QUESTIONNAIRE

Survey about Team Building Activities in Virtual Environments

This questionnaire is being performed in the concept of Boğaziçi University, Management Information Systems Department master's student Aysun Bozanta's master's thesis which has a topic as "EFFECTS OF SERIOUS GAMES ON TEAM BUILDING IN MULTI-USER VIRTUAL ENVIRONMENTS" with consultation of Prof. Dr. Birgül Kutlu Bayraktar. It will take approximately 10 minutes to answer this questionnaire. Your answers will be completely anonymous. Thank you for taking the time.

* Required

Nickname: *(It could be anything)

I. Please answer the following questions about yourself.

a. Gender: *

b. Age: *

c. Working Status: *

☐ Worker

☐ Student

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| d. I am confident in speaking English. | ○ | ○ | ○ | ○ | ○ |

II. Please indicate the level of your agreement for the below statements related to your personality.
*

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| a. I would prefer to be a leader rather than a follower. | ○ | ○ | ○ | ○ | ○ |
| b. I prefer making plans thoroughly before I start any task. | ○ | ○ | ○ | ○ | ○ |
| c. I would rather not try something I'm not good at. | ○ | ○ | ○ | ○ | ○ |

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| d. I like trying out new ways of doing things. | ○ | ○ | ○ | ○ | ○ |
| e. I can easily make new friends. | ○ | ○ | ○ | ○ | ○ |
| f. I am more comfortable alone than in social gathering. | ○ | ○ | ○ | ○ | ○ |
| g. I am confident that I can handle any challenge well. | ○ | ○ | ○ | ○ | ○ |
| h. I get frustrated when my teammates have conflict between each other. | ○ | ○ | ○ | ○ | ○ |
| i. I like doing practical things that have a tangible result. | ○ | ○ | ○ | ○ | ○ |
| j. I prefer solving the problems on my own. | ○ | ○ | ○ | ○ | ○ |
| k. I give up easily. | ○ | ○ | ○ | ○ | ○ |
| l. I like sharing my ideas with others. | ○ | ○ | ○ | ○ | ○ |

III. Please indicate the level of your experience for the followings:
*

| | Never | Rarely | Sometimes | Often | Always |
|---|---|---|---|---|---|
| a. Played a computer game. | ○ | ○ | ○ | ○ | ○ |
| b. Participated in a computer game as a team member. | ○ | ○ | ○ | ○ | ○ |

|  | Never | Rarely | Sometimes | Often | Always |
|---|:---:|:---:|:---:|:---:|:---:|
| c. Participated in an immersive environment (in which people have avatars). | ○ | ○ | ○ | ○ | ○ |
| d. Taken a course online. | ○ | ○ | ○ | ○ | ○ |
| e. Taken part in group work or collaborative projects- face to face. | ○ | ○ | ○ | ○ | ○ |
| f. Taken part in group work or collaborative projects- online. | ○ | ○ | ○ | ○ | ○ |

IV. Please rate the below components for the environment of the game.
*

|  | Very Bad | Bad | Neither Good or Bad | Good | Very Good |
|---|:---:|:---:|:---:|:---:|:---:|
| a. Graphics | ○ | ○ | ○ | ○ | ○ |
| b. Sounds | ○ | ○ | ○ | ○ | ○ |
| c. Places (mountains, picnic area, etc.) | ○ | ○ | ○ | ○ | ○ |
| d. Animation (gestures such as waving, nodding, etc.) | ○ | ○ | ○ | ○ | ○ |
| e. Collaboration Tools (text chat, pdf surface, web renderer, file sharing) | ○ | ○ | ○ | ○ | ○ |
| f. Navigation (walk, run, finding locations using map) | ○ | ○ | ○ | ○ | ○ |

V. Please indicate the level of your agreement for the below statements related to the game.

*

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| a. The game was difficult. | ○ | ○ | ○ | ○ | ○ |
| b. I was comfortable while playing the game. | ○ | ○ | ○ | ○ | ○ |
| c. The game was entertaining. | ○ | ○ | ○ | ○ | ○ |
| d. I liked the game. | ○ | ○ | ○ | ○ | ○ |
| e. This game can improve my team work skills. | ○ | ○ | ○ | ○ | ○ |

VI. Please indicate the level of your agreement for the below statements related to your team in the game.
*

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| a. I felt I was part of the team. | ○ | ○ | ○ | ○ | ○ |
| b. Team members got along together well. | ○ | ○ | ○ | ○ | ○ |
| c. Team members worked together well. | ○ | ○ | ○ | ○ | ○ |
| d. Team members helped each other. | ○ | ○ | ○ | ○ | ○ |
| e. Team members trusted each other sufficiently. | ○ | ○ | ○ | ○ | ○ |
| f. Team members shared information completely. | ○ | ○ | ○ | ○ | ○ |
| g. Team members embraced a common set of guiding values. | ○ | ○ | ○ | ○ | ○ |

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| h. The communication between team members was good. | ○ | ○ | ○ | ○ | ○ |
| i. There was no team spirit in the team. | ○ | ○ | ○ | ○ | ○ |
| j. Team members had confidence in one another. | ○ | ○ | ○ | ○ | ○ |
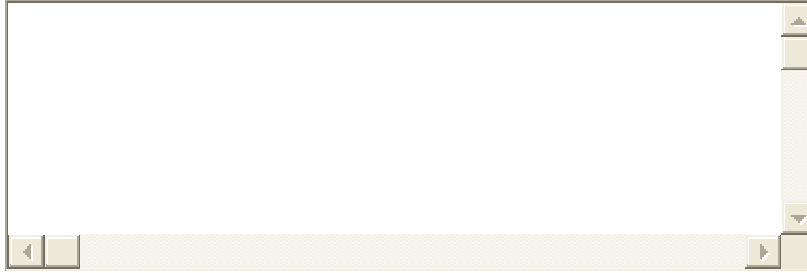
VII. Please briefly give your comments for the below questions.

a. Have you done any team building exercise before? How does this compare to that? *

b. Do you think virtual environments have advantages on this exercise? If yes, what are these advantages? *

c. Do you think virtual environments have disadvantages on this exercise? If yes, what are these disadvantages?*

d. What did you like or dislike about the whole experiences including the environment, orientation and the game? *

Thank you for your participation.

# APPENDIX B

## RELIABILITY ANALYSIS OUTPUTS

1. Reliability Analysis of Personality Scale

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .608 | 12 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| personality1 | 42.19 | 15.203 | .035 | .626 |
| personality2 | 42.12 | 13.439 | .375 | .565 |
| personality3 | 42.51 | 15.351 | .020 | .626 |
| personality4 | 41.95 | 13.093 | .435 | .553 |
| personality5 | 42.23 | 13.802 | .232 | .593 |
| personality6 | 42.98 | 11.071 | .559 | .504 |
| personality7 | 41.91 | 13.753 | .403 | .566 |
| personality8 | 42.91 | 14.991 | -.012 | .655 |
| personality9 | 42.07 | 13.876 | .419 | .566 |
| personality10 | 43.21 | 12.265 | .415 | .549 |
| personality11 | 41.95 | 14.426 | .127 | .614 |
| personality12 | 42.02 | 14.452 | .281 | .587 |

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .655 | 11 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| personality1 | 38.91 | 13.801 | .139 | .662 |
| personality2 | 38.84 | 12.997 | .296 | .635 |
| personality3 | 39.23 | 14.278 | .061 | .672 |
| personality4 | 38.67 | 12.558 | .377 | .621 |
| personality5 | 38.95 | 12.236 | .367 | .621 |
| personality6 | 39.70 | 10.406 | .544 | .574 |
| personality7 | 38.63 | 12.620 | .482 | .608 |
| personality9 | 38.79 | 13.122 | .399 | .623 |
| personality10 | 39.93 | 12.114 | .306 | .636 |
| personality11 | 38.67 | 13.415 | .154 | .664 |
| personality12 | 38.74 | 13.433 | .328 | .633 |

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .672 | 10 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| personality1 | 35.23 | 13.230 | .114 | .686 |
| personality2 | 35.16 | 12.187 | .325 | .650 |
| personality4 | 35.00 | 12.143 | .323 | .650 |
| personality5 | 35.28 | 11.396 | .403 | .633 |
| personality6 | 36.02 | 9.785 | .547 | .594 |
| personality7 | 34.95 | 11.807 | .523 | .620 |
| personality9 | 35.12 | 12.439 | .402 | .641 |
| personality10 | 36.26 | 11.719 | .261 | .668 |
| personality11 | 35.00 | 12.476 | .199 | .675 |
| personality12 | 35.07 | 12.685 | .346 | .649 |

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .686 | 9 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| personality2 | 31.16 | 10.949 | .384 | .655 |
| personality4 | 31.00 | 11.000 | .360 | .660 |
| personality5 | 31.28 | 10.682 | .354 | .661 |
| personality6 | 32.02 | 8.642 | .598 | .595 |
| personality7 | 30.95 | 11.045 | .468 | .644 |
| personality9 | 31.12 | 11.486 | .393 | .658 |
| personality10 | 32.26 | 10.576 | .291 | .679 |
| personality11 | 31.00 | 11.714 | .154 | .703 |
| personality12 | 31.07 | 11.685 | .347 | .665 |

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .703 | 8 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| personality2 | 26.93 | 9.685 | .350 | .683 |
| personality4 | 26.77 | 9.564 | .368 | .680 |
| personality5 | 27.05 | 9.522 | .304 | .696 |
| personality6 | 27.79 | 7.074 | .670 | .592 |
| personality7 | 26.72 | 9.920 | .388 | .677 |
| personality9 | 26.88 | 10.058 | .395 | .678 |
| personality10 | 28.02 | 8.880 | .349 | .690 |
| personality12 | 26.84 | 10.092 | .397 | .678 |

2. Reliability Analysis of the Experience Scale

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .714 | 6 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| experience1 | 12.98 | 14.452 | .638 | .618 |
| experience2 | 13.84 | 12.806 | .696 | .585 |
| experience3 | 14.05 | 14.188 | .557 | .638 |
| experience4 | 14.09 | 17.658 | .191 | .750 |
| experience5 | 12.81 | 19.060 | .107 | .760 |
| experience6 | 13.98 | 14.738 | .536 | .647 |

3. Reliability Analysis of the Physical Characteristics of the Serious Game

   Environment Scale

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .797 | 6 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| game_phy1 | 19.37 | 8.763 | .685 | .732 |
| game_phy2 | 19.53 | 8.779 | .610 | .752 |
| game_phy3 | 19.09 | 10.086 | .536 | .770 |
| game_phy4 | 19.12 | 9.962 | .550 | .767 |
| game_phy5 | 19.02 | 9.738 | .470 | .786 |
| game_phy6 | 19.21 | 10.360 | .471 | .783 |

4. Reliability Analysis of the Attitudes of Participants Towards Serious Game
   Scale

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .672 | 5 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| game_emo1 | 16.19 | 5.203 | -.020 | .782 |
| game_emo2 | 16.05 | 3.950 | .560 | .577 |
| game_emo3 | 15.98 | 3.642 | .539 | .570 |
| game_emo4 | 15.98 | 3.261 | .584 | .539 |
| game_emo5 | 16.19 | 3.203 | .550 | .556 |

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .782 | 4 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| game_emo2 | 12.14 | 3.885 | .435 | .797 |
| game_emo3 | 12.07 | 3.066 | .676 | .685 |
| game_emo4 | 12.07 | 2.638 | .751 | .634 |
| game_emo5 | 12.28 | 2.968 | .528 | .769 |

5.  Reliability Analysis of the Team Building Scale

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .887 | 10 |

**Item-Total Statistics**

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|
| team1 | 36.67 | 15.511 | .804 | .861 |
| team2 | 36.47 | 17.493 | .731 | .869 |
| team3 | 36.40 | 17.816 | .663 | .874 |
| team4 | 36.42 | 18.059 | .689 | .873 |
| team5 | 36.58 | 17.249 | .675 | .872 |
| team6 | 36.37 | 18.382 | .482 | .885 |
| team7 | 36.77 | 18.468 | .531 | .882 |
| team8 | 36.56 | 18.014 | .589 | .878 |
| team9 | 36.67 | 16.653 | .507 | .892 |
| team10 | 36.74 | 17.338 | .693 | .871 |

APPENDIX C

REGRESSION ANALYSIS OUTPUTS

1. Physical Characteristics of the Serious Game Environment and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,627[a] | ,394 | ,379 | ,32942 |

a. Predictors: (Constant), game_phy_av

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 2,887 | 1 | 2,887 | 26,606 | ,000[b] |
| 1 | Residual | 4,449 | 41 | ,109 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), game_phy_av

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2,365 | ,338 | | 6,989 | ,000 |
| | game_phy_av | ,445 | ,086 | ,627 | 5,158 | ,000 |

a. Dependent Variable: Team_av

2. Attitudes of Participants Towards Serious Game and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,662[a] | ,439 | ,425 | ,31693 |

a. Predictors: (Constant), game_emo_av

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3,218 | 1 | 3,218 | 32,038 | ,000[b] |
| | Residual | 4,118 | 41 | ,100 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), game_emo_av

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1,904 | ,389 | | 4,892 | ,000 |
| | game_emo_av | ,536 | ,095 | ,662 | 5,660 | ,000 |

a. Dependent Variable: Team_av

# APPENDIX D

## MULTIPLE REGRESSION ANALYSIS OUTPUTS

1. Moderation Effect of Personality on a Relation between Physical Characteristics
   of the Serious Game Environment and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,676[a] | ,457 | ,415 | ,31973 |

a. Predictors: (Constant), phy_pers_cent, pers_cent, phy_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3,349 | 3 | 1,116 | 10,921 | ,000[b] |
| | Residual | 3,987 | 39 | ,102 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), phy_pers_cent, pers_cent, phy_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4,069 | ,050 | | 81,455 | ,000 |
| | phy_cent | ,346 | ,096 | ,487 | 3,605 | ,001 |
| | pers_cent | -,057 | ,130 | -,053 | -,441 | ,662 |
| | phy_pers_cent | -,561 | ,274 | -,275 | -2,048 | ,047 |

a. Dependent Variable: Team_av

2. Moderation Effect of Experience on a Relation between Physical Characteristics of the Serious Game Environment and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,653[a] | ,426 | ,382 | ,32855 |

a. Predictors: (Constant), phy_exp_cent, phy_cent, exp_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 3,126 | 3 | 1,042 | 9,654 | ,000[b] |
| 1 | Residual | 4,210 | 39 | ,108 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), phy_exp_cent, phy_cent, exp_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 4,072 | ,052 | | 78,786 | ,000 |
| 1 | phy_cent | ,444 | ,089 | ,626 | 5,005 | ,000 |
| | exp_cent | ,031 | ,069 | ,057 | ,451 | ,654 |
| | phy_exp_cent | -,175 | ,119 | -,181 | -1,469 | ,150 |

a. Dependent Variable: Team_av

3. Moderation Effect of Gender on a Relation between Physical Characteristics of

   the Serious Game Environment and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,641[a] | ,411 | ,366 | ,33278 |

a. Predictors: (Constant), phy_gen_cent, gender_coded, phy_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3,017 | 3 | 1,006 | 9,082 | ,000[b] |
| | Residual | 4,319 | 39 | ,111 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), phy_gen_cent, gender_coded, phy_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4,092 | ,053 | | 76,514 | ,000 |
| | phy_cent | ,448 | ,094 | ,631 | 4,772 | ,000 |
| | gender_coded | ,042 | ,053 | ,098 | ,778 | ,441 |
| | phy_gen_cent | ,062 | ,094 | ,085 | ,660 | ,513 |

a. Dependent Variable: Team_av

4. Moderation Effect of Working Status on a Relation between Physical Characteristics of the Serious Game Environment and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,642[a] | ,412 | ,367 | ,33260 |

a. Predictors: (Constant), phy_work_cent, phy_cent, worker_coded

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3,022 | 3 | 1,007 | 9,106 | ,000[b] |
| | Residual | 4,314 | 39 | ,111 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), phy_work_cent, phy_cent, worker_coded

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4,090 | ,055 | | 74,113 | ,000 |
| | phy_cent | ,480 | ,094 | ,676 | 5,093 | ,000 |
| | worker_coded | -,056 | ,055 | -,134 | -1,012 | ,318 |
| | phy_work_cent | ,035 | ,094 | ,046 | ,371 | ,712 |

a. Dependent Variable: Team_av

5. Moderation Effect of Personality on a Relation between Attitudes of Participants
   Towards Serious Game and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-----|----------|-------------------|----------------------------|
| 1 | ,770[a] | ,593 | ,562 | ,27657 |

a. Predictors: (Constant), emo_pers_cent, pers_cent, emo_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|-------|-----------|----------------|-----|-------------|--------|-------|
| | Regression | 4,353 | 3 | 1,451 | 18,969 | ,000[b] |
| 1 | Residual | 2,983 | 39 | ,076 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), emo_pers_cent, pers_cent, emo_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|-------|---------------|------|------------|------|--------|------|
| | | B | Std. Error | Beta | | |
| | (Constant) | 4,099 | ,042 | | 96,983 | ,000 |
| 1 | emo_cent | ,524 | ,083 | ,648 | 6,288 | ,000 |
| | pers_cent | -,228 | ,111 | -,211 | -2,051 | ,047 |
| | emo_pers_cent | -,560 | ,180 | -,320 | -3,115 | ,003 |

a. Dependent Variable: Team_av

6. Moderation Effect of Experience on a Relation between Attitudes of Participants Towards Serious Game and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,678[a] | ,460 | ,418 | ,31873 |

a. Predictors: (Constant), emo_exp_cent, exp_cent, emo_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 3,374 | 3 | 1,125 | 11,072 | ,000[b] |
| 1 | Residual | 3,962 | 39 | ,102 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), emo_exp_cent, exp_cent, emo_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 4,091 | ,049 | | 84,160 | ,000 |
| 1 | emo_cent | ,520 | ,098 | ,642 | 5,306 | ,000 |
| | exp_cent | -,060 | ,065 | -,111 | -,934 | ,356 |
| | emo_exp_cent | -,080 | ,115 | -,084 | -,690 | ,494 |

a. Dependent Variable: Team_av

7. Moderation Effect of Gender on a Relation between Attitudes of Participants

   Towards Serious Game and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,666[a] | ,444 | ,401 | ,32342 |

a. Predictors: (Constant), emo_gen_cent, gender_coded, emo_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 3,257 | 3 | 1,086 | 10,379 | ,000[b] |
| | Residual | 4,079 | 39 | ,105 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), emo_gen_cent, gender_coded, emo_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4,101 | ,053 | | 78,067 | ,000 |
| | emo_cent | ,518 | ,101 | ,641 | 5,138 | ,000 |
| | gender_coded | ,029 | ,053 | ,068 | ,548 | ,587 |
| | emo_gen_cent | -,032 | ,101 | -,038 | -,314 | ,755 |

a. Dependent Variable: Team_av

8. Moderation Effect of Working Status on a Relation between Attitudes of

   Participants Towards Serious Game and Team Building

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,681[a] | ,464 | ,423 | ,31751 |

a. Predictors: (Constant), emo_work_cent, worker_coded, emo_cent

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 3,405 | 3 | 1,135 | 11,258 | ,000[b] |
| 1 | Residual | 3,932 | 39 | ,101 | | |
| | Total | 7,336 | 42 | | | |

a. Dependent Variable: Team_av

b. Predictors: (Constant), emo_work_cent, worker_coded, emo_cent

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| | (Constant) | 4,084 | ,049 | | 83,748 | ,000 |
| 1 | emo_cent | ,508 | ,098 | ,628 | 5,191 | ,000 |
| | worker_coded | ,041 | ,049 | ,099 | ,847 | ,402 |
| | emo_work_cent | ,105 | ,098 | ,130 | 1,073 | ,290 |

a. Dependent Variable: Team_av

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