Abstract — The aim of the project is to use serious games in multi user virtual environments for building teams at workplaces so that teams can develop better communication and collaboration skills, and put them into practice in a relax environment. 3D environments are more appropriate for this purpose because of their sense of reality. Avaya Engage platform is used as the multi user virtual environment with its functionalities such as; avatars, 3D spatial sound, and collaboration surfaces. The game “Zoom”, used for improving team building skills face-to-face, is adapted into this 3D environment. This game is based on picture books “zoom” and “re-zoom” by Istvan Banyai consisting 30 sequential pictures. The group activity within the game helps develop communication skills, perspective taking, and problem solving skills. The game is played with a total of 24 participants from different companies in Turkey and Canada. Participants filled a survey and answered open ended questions about the game and the environment at the end of the game. The results showed that participants liked the environment and the game. It can be concluded that face-to-face played serious games can be complemented by multi user virtual environments, and it is promising for the organizations that they can benefit from these environments.

Index Terms — Organization, serious games, team building, virtual environment.

I. INTRODUCTION

In recent years, teams have become a very important issue for both educational and institutional corporations especially for those working as project based which require teamwork rather than individual study. It is important to be aware of that being a team is more than working individually. Productivity and efficiency is a vital concern for companies, and one of the most significance factors for increasing them is building effective teams.

Team is a group of people who communicate with each other in order to achieve shared goals [1]. Another definition is that a team consists of at least two people who contact each other in order to accomplish predetermined, shared and valued goals [2]. Tanenbaum and his friends suggested that each member of the team must have specific roles and functions [3].

Team building is a concept that brings people together and makes them learn experientially by considering their values, and interpersonal dynamics to improve their skills in order to achieve predetermined objectives [4]. 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 it makes them to use all their resources for this purpose [5]. On the other hand Albenese 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 [6].

The content of team building is irregular because it can be used for different aims such as upgrading an existing team, building a new team, reforming of a team after reorganization, and improving relationships between several teams [4].

Woodcock and Francis argued that team building has four significant advantages [1]. First of all team managers and members gain experience from being a part of a team and this experience reflects to the operations. Second, teamwork is active, permanent and closely related to the team’s objectives. In relation to first benefit, also individuals can improve their skills and personal effectiveness. Lastly, team builders are appreciated that their efforts produce successful results.

Teams can be referred to as face-to-face teams or virtual teams depending on their communication types. Face-to-face teams consist of people who are in the same place and can communicate face-to-face. Virtual teams consist of people who are locally dispersed and they use telephone, teleconference, e-mails etc. for communication [7,8,9,10]. A virtual team is also defined as "geographically and/or organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task" [11].

Nowadays projects require people with different backgrounds in order to accomplish different tasks. It is important to fulfill this requirement without additional cost. People who are experts in their area join these project teams using telecommunication facilities and hence forming virtual teams. Virtual teams have replaced face-to-face teams to a larger extent. Many multinational companies cannot survive without virtual teams that have become a necessity for the efficient functioning of an organization. However, managing the performance of virtual teams is still a major issue [12]. Some researchers argue that the dysfunctions of face-to-face teams are amplified in the virtual context resulting in problems such as social loafing, role overload, role ambiguity, absenteeism, and lack of organizational commitment [9].
There exist many team building activities for co-located teams that designed specifically for teams to realize and appreciate the differences, understand the importance of the communication and trust among team members, and practice leadership skills. However, when it comes to virtual teams, team building activities are limited. It is difficult to find an online activity serving above objectives although the need is greater than the co-located teams. Games and especially serious games serve as an online activity to help team building.

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 augment it. In addition to this, successful projects require various disciplines since one person cannot contain know how of all of these disciplines, teams are indispensable. In order to make project successful one of the requirements is building 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 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 voice of 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.

Serious games are defined as games designed for educational purposes, based on specific rules, played with a computer, and use entertainment in order to teach many concepts [13,14,15].

One of the widespread usage areas of serious games is to practice managerial issues. For instance, Infinitea is a game that is played with a teams in order to reveal leadership potential of participants [16]. It is a multi-player, team-based and online game. It was applied to the 48 undergraduate students and results are fulfilling to take reactions of participants about online gaming experiences. Empirical study shows that transactional and transformational leadership behaviors are correlated with the multiplayer online game.

Another issue that serious games are used for and also closely related with management is team building. Team building has many components such as collaboration, problem solving, conflict resolution etc. Van Eck argues that serious games could improve team-work skills [17].

Another game for team building activity is GaMeTT which is multi-user online and 3D game [18]. 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 designed a game eScape which promotes collaboration [19]. eScape is an adventure game which is played by four people. Participants try to solve a set of problems and escape from 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 to make teamwork.

Another study of Hamalainen is the game “Mustakarhu” [20]. The game is played with a team of 2-4 members and participants design customized hotel rooms and based on the size of room, they calculate the cost of decorating for each room. Finally participants write a final report to customer. Total of 20 participants played the game and participants expressed that the game environment is more attractive and helpful than traditional class environment. It was concluded that the game helped improving collaboration and cooperation skills among participants in a team.

Woodment is an online, multi-user, 3D game which is for collaborative learning [21]. 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 is mentioned previously are two of examples that are used for improving both team building and management skills.

The potential of immersive virtual games as team building environment especially for virtual team mentioned in paper written by Ellis et al. as well [22]. Ellis and his friends developed three games in Second Life; Crossing the Ravine, Tower of Babble and Castle Builder. These games were designed for improving collaboration between participants and team building skills. After testing serious games designed for team following is the observation they reported “Our observations to date tell us that the games enable role formation, cooperation, and communication between team members. In addition, our games elicit social behaviors from participants. Completion of games, especially when coupled with a high score, was often followed by spontaneous group celebrations such as dancing, drinking (virtual) champagne together, or animations such as cartwheels”.

The aim of this study is to measure the effect of serious games on team building in a multi-user virtual environment. For this purpose the team building game Zoom, which is generally played face-to-face, is adapted to the multi-user virtual environment Tipontia. These effects are measured by a survey which is filled by participants after the game.
II. METHODOLOGY

A. Serious Game: Zoom

Zoom is a team building game which was created by Istvan Banyai. Zoom depends on a picture book in which there are 30 sequential pictures within pictures. This game requires 20-30 minutes to play. It helps to develop problem solving, perspective taking and communication skills of team members.

Before the game starts, facilitator hands out one picture per person and warns them to hide their pictures from others. Each participant tells her/his picture and the team tries to put these pictures in a correct order.

For online version of the game, it was integrated in a multi-user virtual island “Tipontia” which was created by AvayaLive Engage. Camping area consisting of ten chairs and ten boards behind these chairs was built in Tipontia. Chairs were developed by using AutoDesk Maya which is 3D animation, design and engineering software and other components such as boards and campfire were developed in AvayaLive Engage platform (Fig. 1).

Maximum number of people that could play in the game is ten. In addition to this, a facilitator attends the sessions in order to observe and manage the team and the game.

Facilitator sends pictures to the participants via e-mail then the game starts. Each participant tells her/his picture one by one and the team tries to put these pictures in a correct order. After the team decides the order, they sit on the chairs based on this sequence. After that, all participants upload their pictures on the boards that are behind their chairs. Game ends here and then participants discuss the game process.

B. Theoretical Model

In this part of the study, theoretical model, variables in this model and hypotheses which are written by depending on the model will be explained (Fig. 2).

In the model, it is thought that there are two independent variables; physical characteristics of the serious game environment and the serious game itself, which affect dependent variable directly. Dependent variable is team building.

There are two hypotheses in the model:

- The physical characteristics of the serious game environment affect the success of the team building activity.
- Thoughts of participants about serious game itself affect the success of the team building activity.

C. Sample

This game was applied to a total of 24 participants from different companies. All participants had worked as part of a project team previously. After participants had played the game, they filled a questionnaire which had been prepared in order to measure the effects of serious game on team building in a multi-user virtual environment.

D. Structure of Questionnaire

Aim of the 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 consisted of 5 parts; demographic questions, scale that measures physical characteristics of the serious game environment, scale that measures thoughts of participants about serious game itself, the team building scale and the open-ended questions.

The first part of the questionnaire consists of 3 close-ended questions about the demographics of the participants. These are: gender, age and nationality. Participants choose their gender from drop down list as a “Female” or “Male”. Age is asked as a categorical variable and participants allow 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”. Participants write their nationality in the box below the nationality question.

Second part was prepared to measure appreciation level of participants to the physical characteristics of the serious game. In this part, there is 1 question which is asked as an interval scale (“Very Bad”, “Bad”, “Neither Good or Bad”, “Good”, “Very Good”) and consists of 6 items.

Third part was prepared to measure appreciation level of participants for the game itself. In this part, there is 1
question which is asked as a 5-point agreement scale (Likert scale) and consists of 5 items. Participant state 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 this game can improve their team building skills or not.

In the fourth part of questionnaire, there is 1 question which is asked as a 5-point agreement scale (Likert scale) and consists of 10 items. These questions are prepared in order to examine the ideas of participants about team in the game.

In the last part, there are four open-ended questions. These are:

- Have you done any team building exercise before? How does this compare to that?
- Do you think virtual environments have advantages on this exercise? If yes, what are these advantages?
- Do you think virtual environments have disadvantages on this exercise? If yes, what are these disadvantages?
- What did you like or dislike about the whole experiences including the environment, orientation and the game?

III. RESULTS AND FINDINGS

Statistical analysis of the application of the game will be explained in this part. There will be three subheadings: descriptive statistics of the data, reliability analysis of the scales and regression analysis between independent and dependent variables. IBM SPSS Statistics19 was used to test the hypotheses and provide the findings.

A. Demographic Characteristics of the Participants

Table 1 shows that, 29.2% of the respondents are female and 70.8% of them are male.

The sample consists of mainly young adults with 41.7% in the 25-31 range. The ranges 32-38 and 39-45 follow them with 20.8% and 25.0%. Lastly, 12.5% of respondents are between the ages of 46-52. From the last part of the table, Turkish people are majority with the percent of 75 and others are Canadians.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic Characteristics of the Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENDER</td>
<td>Frequency</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
</tr>
<tr>
<td>Male</td>
<td>17</td>
</tr>
<tr>
<td>AGE</td>
<td></td>
</tr>
<tr>
<td>25-31</td>
<td>10</td>
</tr>
<tr>
<td>32-38</td>
<td>5</td>
</tr>
<tr>
<td>39-45</td>
<td>6</td>
</tr>
<tr>
<td>46-52</td>
<td>3</td>
</tr>
<tr>
<td>NATIONALITY</td>
<td></td>
</tr>
<tr>
<td>Canadian</td>
<td>6</td>
</tr>
<tr>
<td>Turkish</td>
<td>18</td>
</tr>
</tbody>
</table>

B. Descriptive Statistics of Physical Characteristics of Serious Game Environment

There are 6 items in the scale that measures physical characteristics of game environment. Respondents were asked to answer the questions on a 5-point interval scale (1: Very Bad, 2: Bad, 3: Neither Good or Bad, 4: Good, 5: Very Good). Table 2 shows that, respondents liked physical environment of the serious game “Zoom” because all values in the table are above the average.

C. Descriptive Statistics of Thoughts of Participants About Serious Game

Respondents were asked to answer the questions on a 5-point interval scale (1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree). Table 3 shows that, respondents liked the serious game “Zoom” because all values in the table are above the average.

D. Descriptive Statistics of the Team Building Scale

This scale attempts to measure team building level of participants.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Physical Characteristics of Serious Game Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Graphics</td>
<td>Mean (N=24)(Out of 5)</td>
</tr>
<tr>
<td>b. Sounds</td>
<td>3.71</td>
</tr>
<tr>
<td>c. Places (mountains, picnic area, etc.)</td>
<td>4.21</td>
</tr>
<tr>
<td>d. Animation (gestures such as waving, nodding, etc.)</td>
<td>4.00</td>
</tr>
<tr>
<td>e. Collaboration Tools (text chat, pdf surface, web renderer, file sharing)</td>
<td>4.08</td>
</tr>
<tr>
<td>f. Navigation (walk, run, finding locations using map)</td>
<td>4.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Thoughts of Participants About Serious Game</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The game was difficult.</td>
<td>Mean (N=24)(Out of 5)</td>
</tr>
<tr>
<td>b. I was comfortable while playing the game.</td>
<td>4.08</td>
</tr>
<tr>
<td>c. The game was entertaining</td>
<td>4.08</td>
</tr>
<tr>
<td>d. I liked the game.</td>
<td>4.08</td>
</tr>
<tr>
<td>e. This game can improve my team work skills.</td>
<td>3.88</td>
</tr>
</tbody>
</table>
Table 4: Team Building Scale

<table>
<thead>
<tr>
<th></th>
<th>Mean (N=24)(Out of 5)</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. I felt I was part of the team.</td>
<td>3.96</td>
<td>1.042</td>
</tr>
<tr>
<td>b. Team members got along together well.</td>
<td>4.21</td>
<td>0.588</td>
</tr>
<tr>
<td>c. Team members worked together well.</td>
<td>4.17</td>
<td>0.637</td>
</tr>
<tr>
<td>d. Team members helped each other.</td>
<td>4.08</td>
<td>0.504</td>
</tr>
<tr>
<td>e. Team members trusted each other sufficiently.</td>
<td>4.13</td>
<td>0.680</td>
</tr>
<tr>
<td>f. Team members shared information completely.</td>
<td>4.33</td>
<td>0.637</td>
</tr>
<tr>
<td>g. Team members embraced a common set of guiding values.</td>
<td>3.92</td>
<td>0.584</td>
</tr>
<tr>
<td>h. The communication between team members was good.</td>
<td>4.00</td>
<td>0.511</td>
</tr>
<tr>
<td>i. There was no team spirit in the team.</td>
<td>4.08</td>
<td>0.881</td>
</tr>
<tr>
<td>j. Team members had confidence in one another.</td>
<td>3.96</td>
<td>0.550</td>
</tr>
</tbody>
</table>

E. Reliability Analysis of the Scale

Reliability of the survey items including 3 scales was checked with the Cronbach’s Alpha values. All values are above 0.7, so multi-item scales used in the study are reliable measures (Table 5).

F. Regression Analysis

Regression analysis was conducted in order to figure out relationship among independent and dependent variables.

First hypothesis is: “The physical characteristics of the serious game environment affect the success of the team building activity.” Linear regression analysis was performed in order to measure effect of physical characteristics of the serious game environment on a success of the team building activity. Table 6 shows that overall model is statistically significant (<0.05) and explains 65.7% of the team building success with the thoughts of participants about serious game itself, therefore Hypothesis I is accepted. Coefficient for physical characteristics of the serious game environment is statistically significant and its sign is also in the positive direction as it was expected.

Second hypothesis is: “Thoughts of participants about serious game itself affect the success of the team building activity.” Linear regression analysis was performed in order to measure effect of thoughts of participants about serious game itself on a success of the team building activity.

Table 5: Reliability Analysis of the Survey Scales

<table>
<thead>
<tr>
<th></th>
<th>Number of Items</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Characteristics of Serious Game Environment</td>
<td>6</td>
<td>0.860</td>
</tr>
<tr>
<td>Thoughts of Participants About Serious Game</td>
<td>5</td>
<td>0.747</td>
</tr>
<tr>
<td>Team Building</td>
<td>10</td>
<td>0.932</td>
</tr>
</tbody>
</table>

Table 7 shows that overall model is statistically significant (<0.05) and explains 65.7% of the team building success with the thoughts of participants about serious game itself, therefore Hypothesis II is accepted. Coefficient for thoughts of participants about serious game itself is statistically significant and its sign is also in the positive direction as it was expected.

The responses to open ended questions can be summarized as follows:

Have you done any team building exercise before?
- 9 participants have attended team-building activity like that in face-to-face environment before.
- 1 participant has attended team-building activity like that in virtual environment.
- All participants agree that this activity is really fun and entertaining.
- Participants who have attended face-to-face activity before found this activity as a little bit different and they stated that it is required getting used to.

Advantages of virtual environments on the exercise:
- No need to attend physically so money and time saving.
- More tolerance, more fun.
- Avatars are always presentable.
- Easier to focus to the tasks than teleconferencing.
- Makes feel that people are in the same room.
- Decrease hierarchical relations.

Disadvantages of virtual environments on the exercise:
- Losing concentration because of real life stimuli.
- Sometimes real gestures are needed.
- Required getting used to move and control the avatar.
- Internet connection and/or hardware problems.

What did you like about the whole experience?
- Avatar appearance and nicknames.
- Comfortable environment.
- Entertaining, social and new activity.
- Original map design.
- Improves team building and communication skills.
What did you dislike about the whole experience:

- Missing gestures.
- Hard to control avatar.
- Huge environment causes communication breaks.

IV. CONCLUSION

In this study, in order to measure the effect of serious games on a team building in a multi-user virtual environment, a research model was developed. In this model, physical characteristics of the serious game environment and thoughts of participants about serious game itself were used as independent variables and team building success is dependent variable. Results show that physical characteristics of the serious game environment has a significant effect on a team building success and explains 57.1% of the team building success. In addition to this, results also show that beliefs of participants about serious game itself has a significant effect on a team building success and explains 65.7% of the team building success.

Answers to the open-ended questions show that, participants liked the environment, avatars, nicknames and the team building game. They stated that the activity helps saving money and time, and it decreases the hierarchical relations between workers. On the other hand, participants expressed the disadvantages of the environment as; interruption by real life stimuli, need for real gestures to explain hidden meanings, hard to control avatars for inexperienced participants, and problems caused by bad internet connections or inadequate hardware.

The comparison of virtual and face-to-face environment is elucidated best by the facilitator’s statement “Many of the exact behaviors, actions, and solutions that teams use and discover in face to face quickly became apparent and used in the virtual world”.

Besides limitations of small sample size and having only participants’ views as measurement method, it can be concluded that multi user virtual environments can successfully be used for team building activities. This is far more promising for organizations depending on virtual teams.

ACKNOWLEDGMENT

Authors would like to thank Avaya Engage team for the use of the tool along with IRCP (International Roundtable on Community Paramedicine) and IBTech (International Business Technologies) groups for their participation.

REFERENCES


AUTHORS

Birgul Kutlu is with the Management Information Systems Department, Bogazici University, Istanbul, TURKEY (e-mail: birgul.kutlu@boun.edu.tr).

Aysun Bozanta is with the Management Information Systems Department, Bogazici University, Istanbul, TURKEY (e-mail: aysun.bozanta@boun.edu.tr).

Nuket Nowlan is with 3D Virtual Crafting, Ottawa, CANADA (e-mail: nuket.nowlan@gmail.com).

Manuscript received 13 March 2013. This work was supported in part by Bogazici University Scientific Research Projects Fund (Project #: 6724). Published as submitted by the author(s)