Review Paper

Educational Computer Game for Earthquake

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ABSTRACT

Earthquakes are the movements of the earth's crust that originate in the ground, and they are one of the natural disasters that frighten people because they occur suddenly and often cause great loss of life and property. Earthquake natural disaster is the reality of Turkey and it is important to raise public awareness on this issue. Thanks to the sound effects, realistic animations and three-dimensional virtual environments used in the development of computer games developed in today's technologies, they attract more attention from the players. Digital computer games are used for educational purposes in various fields, enabling learners to increase their motivation towards the relevant subject. It is important to develop educational digital games using up-to-date technologies and present them to young people in accordance with learning. In this study, an educational three-dimensional computer game describing what to do before, during and after the earthquake was developed using the Unity game engine and C# coding language. It is thought that the features of the earthquake educational computer game will attract the attention of everyone from seven to seventy with its three-dimensional virtual environment and educational content, and it can be used for educational purposes in order to increase their motivation for gaining knowledge and experience about earthquakes.

INTRODUCTION

The game is an entertainment activity that people who start with the history of humanity have a good time in their spare time. Thanks to the innovations offered by technology in the digital age, people spend their free time in virtual environments. These virtual environments are social media, news sites, video channels as well as digital games. Although digital games are a favorite leisure activity for adults, young people are more likely to spend time with digital games. The educational-themed preparation of games, which are currently indispensable leisure time activities for young people, enables them to learn while having fun (Kader et al., 2019).

When educational games are used independently of the classroom environment, they ensure the successful transfer of course content (Garris et al., 2002; Turner et al., 2018). Gee (2003) argued that the principles of learning can be embodied with games, and claimed that the theory of learning is embedded in computer games. In pioneering studies on games, it has been found that students can develop more than one way of thinking about the problems they encounter while playing games (Pivec et al., 2004) and that games provide students with a problem-solving experience (Squire, 2005; Pusey, 2018; Shi et al., 2019).

Thanks to the sound effects, realistic animations and three-dimensional virtual environments used in the development of computer games developed in today's technologies, they attract more attention from the players. Studies on the effect of educational computer games on student achievement are current technologies such as augmented reality (Hwang et al., 2016a; Hsu, 2017), mobile software (Tlili et al., 2015; Hwang et al., 2016b; Cheung, 2018), virtual reality glasses (Hu et al., 2016; Sternig et al., 2018) are discussed with three-dimensional games (Bontchev, 2015; Koivisto et al., 2017).

It is important to develop educational digital games using up-to-date technologies and present them to young people in accordance with learning. With this awareness, a three-dimensional educational game with an earthquake theme was developed in the research. Earthquakes are the movements of the earth's crust that originate in the ground, and they are one of the natural disasters that frighten people because they occur suddenly and often cause great loss of life and property (Özdogan, 1993). The aim of this study is to show and enforce the measures that can be taken against earthquakes, which is one of the biggest problems of our country. It tells what to do before, during and after an earthquake.

METHOD

In this research, the developmental research method, which is one of the design-based research method derivatives, was used. With design-based research, tools that will facilitate learning are designed (Brown, 1992). There are two types of developmental research product or program development, which is a derivative of the design-based research method, and researching the educational aspect of the developed material (Richey et al., 2003). In this research, information is given about the development of an earthquake educational computer game.

Unity Game Engine was used for game development, and C# was used as the coding language in the game, and in Turkish. Game mechanics is a system that includes game rules, game control, interaction between players, story transfer, player experience, game equipment, and player emotions during a game (Lundgren & Björk, 2003). Flow Theory, which was introduced by Chickszentmihalyi in 1990, is explained as the ability of the player to challenge and solve the situation in the game. The actor must be successful in order to enter the theoretical flow (Prensky, 2001; Quoted by Facer, 2004). Playing the developed earthquake educational computer game in a three-dimensional environment increases the desire of the users to respond correctly to the situations they encounter and their motivation to complete the tasks. The game was developed over a period of 9 months on a computer with the following features; CPU: Intel i5-8265U, RAM: 8GB, STORAGE: 256GB, SSD Display: 15.6" FHD, OS : Windows 10 Home

The game story was written by an academic and a game programmer, using AFAD (Disaster and Emergency Management Authority in Turkey) earthquake documents. After the game story was completed, it was revised by taking the opinions of the students who took the game programming course at Isparta University of Applied Sciences Computer Programming. The opinions of the students about the game story were taken in the online lesson, and the number of people who attended the lesson was 52. After the game was completed, the same students were asked their opinions about the game and the game was appreciated by the participants.

FINDINGS

The EFM model proposed by Song and Zhang in 2008 got its name from the combination of the initials of the words effective learning environment, flow and motivation. The main purpose of the EFM model is to increase the aspiration throughout the flow. The EFM model aims to increase motivation and increase the level of learning by keeping the student in the flow. While developing the earthquake educational computer game, student motivation compatible with the EFM model was taken into account.

When the game starts, the player is asked "What is an Earthquake?", "What are the Earthquake Precautions?", "What Should Be Done in an Earthquake?" and "What to Do After the Earthquake?" information is provided. Missions appear on the left of the game screen (Figure 1).
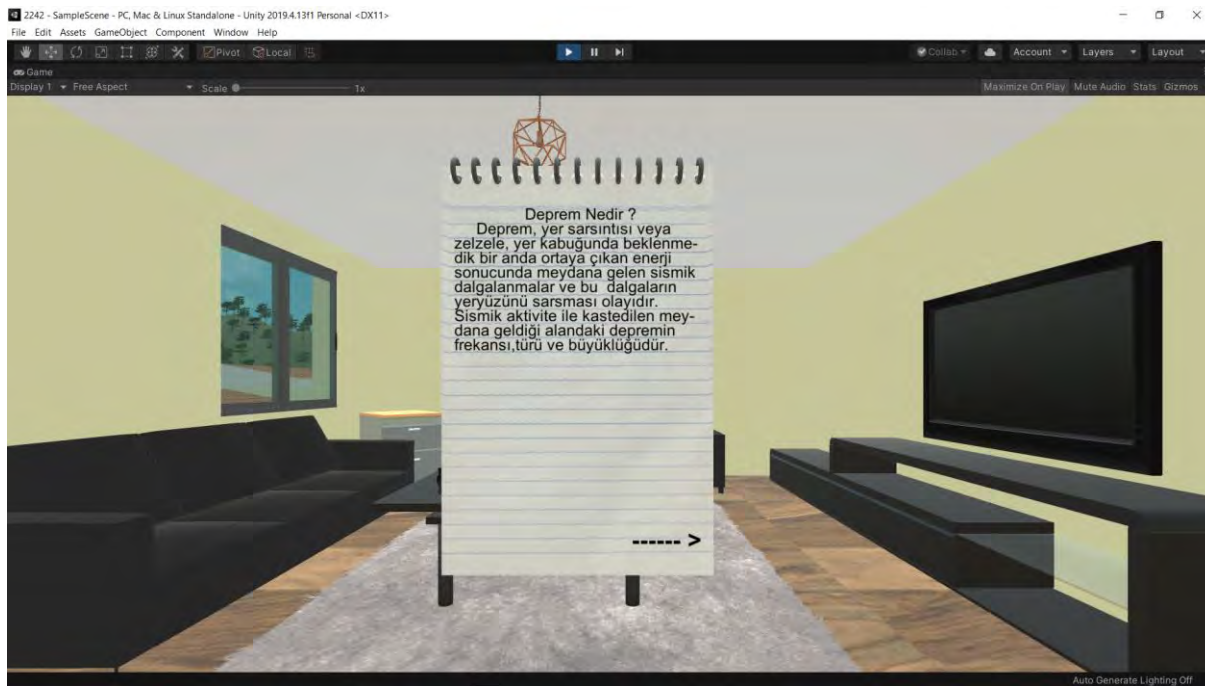

Figure 1. Giving earthquake notification to the player

For pre-earthquake precautions, the first task is for the player to turn on the television. The player cannot see and do other missions without doing this mission. When the TV is turned on, short videos that give information about two earthquakes and explain the earthquake are watched. The videos are taken from AFAD's youtube channel. After watching the videos, the tasks will be visible on the left (Figure 2).

Video 1: https://www.youtube.com/watch?v=6k2QNfmN4mw

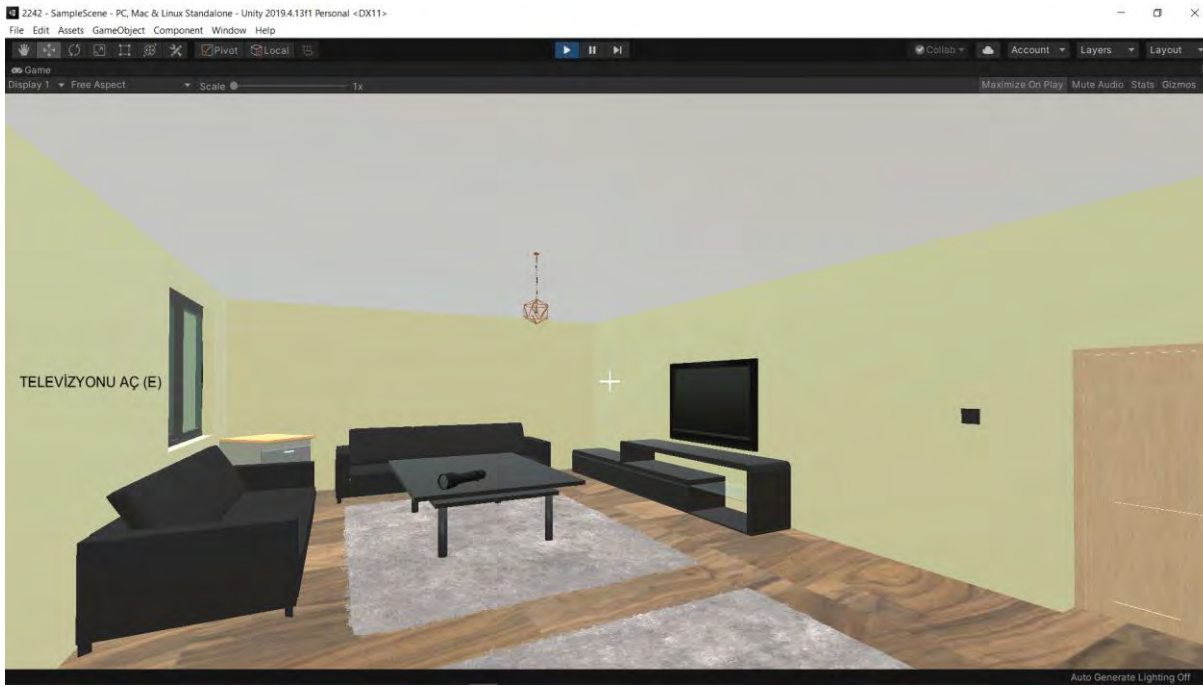Video 2: https://www.youtube.com/watch?v=xJ5tO8S2uzE

Figure 2. The player's task of watching television

Must do the tasks in the living room, kitchen and bedroom within a certain period of time. In order to see and perform the tasks in the rooms, it is necessary to be in that room. In the hall, the player is asked to fix the bookshelf, wire in front of the shelves and take the flashlight. If the library is not fixed, it will collapse in the event of an earthquake. If it is not pulled alone in front of the shelves, books may fall during an earthquake. He should take the flashlight as he has to put it in the earthquake bag (Figure 3).
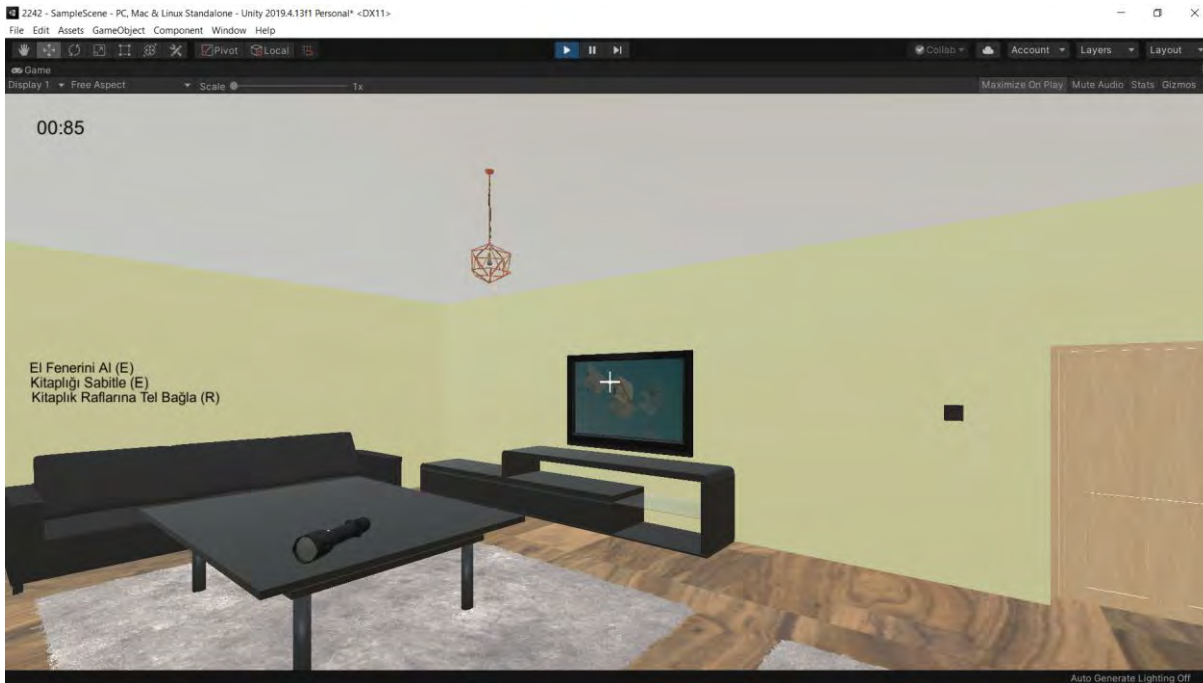

Figure 3. Flashlight acquisition and library tasks

In the kitchen, the player is asked to fix the refrigerator. If the player does not fix the refrigerator, the refrigerator will collapse during the earthquake (Figure 4). In order to put it in the earthquake bag, he must take the water from the table and the pocketknife from the counter.
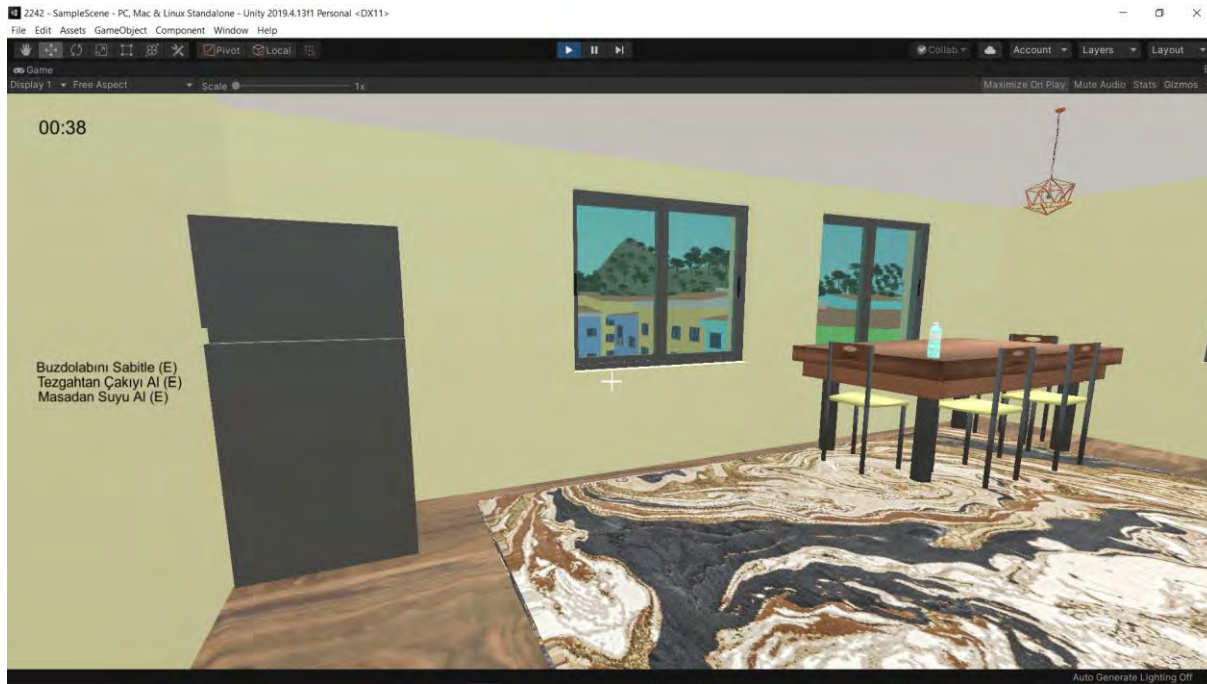
Figure 4. Earthquake precautions for the kitchen

In the bedroom, the player is asked to fix the wardrobe (Figure 5). If the player does not fix the wardrobe, the wardrobe will be destroyed during the earthquake. He should take the first aid kit and the whistle on his desk to put in his earthquake kit.
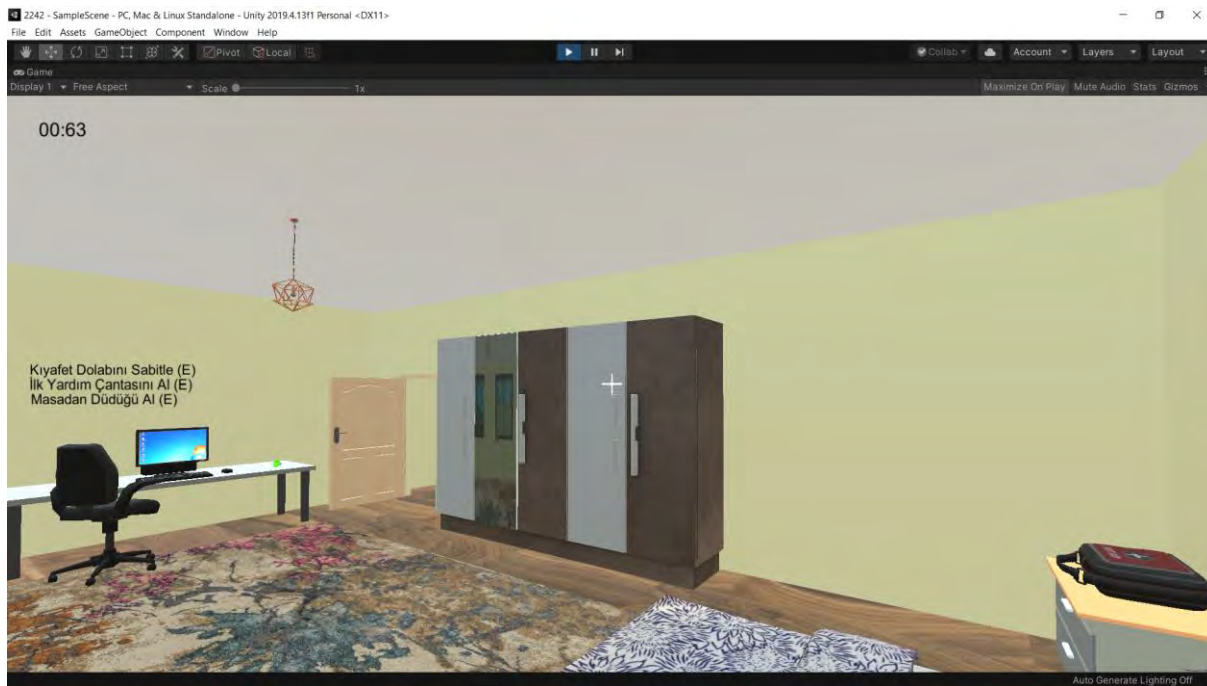

Figure 5. Bedroom earthquake precautions

During the earthquake, the scenario is started after the earthquake measures, after the time given to the player has elapsed, the earthquake takes place. When the earthquake starts, the player is presented with three options and asked to make a decision. These options are; "Skip Out The Window", "Escape From The Apartment", "Hide In A Safe Location" options. If he jumps from the window, the player quickly falls to the ground and the game is over (Figure 6). The player can see what will happen if he jumps out of the windows during an earthquake. If he tries to escape from the apartment, at the time of the earthquake, the character leaves the house and tries to escape. But since this should not be done in a real earthquake, the player fails and the game is over.
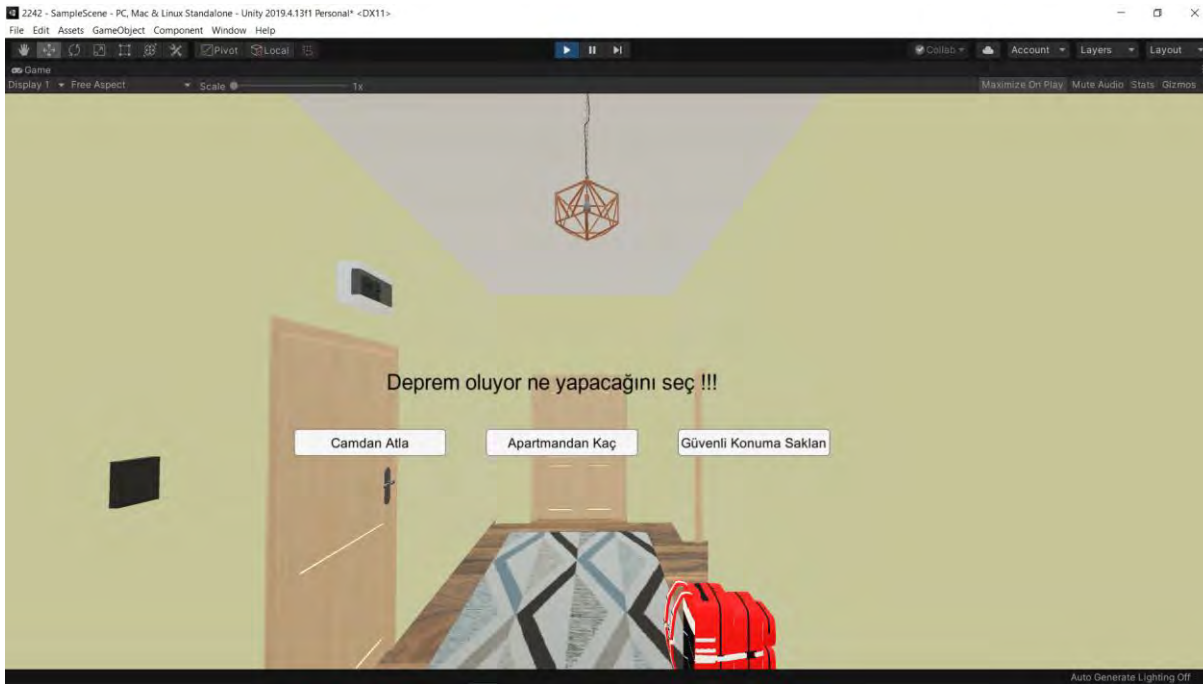
Figure 6. What to do during an earthquake

If player prefers to hide in a safe location, the character moves to a location that is as open as possible, where there are no objects that could fall on him. In this position, the player cannot move for 5 seconds. At the end of 5 seconds, new tasks are given to the player in order to prevent the dangers that may occur after the earthquake (Fig. 7).
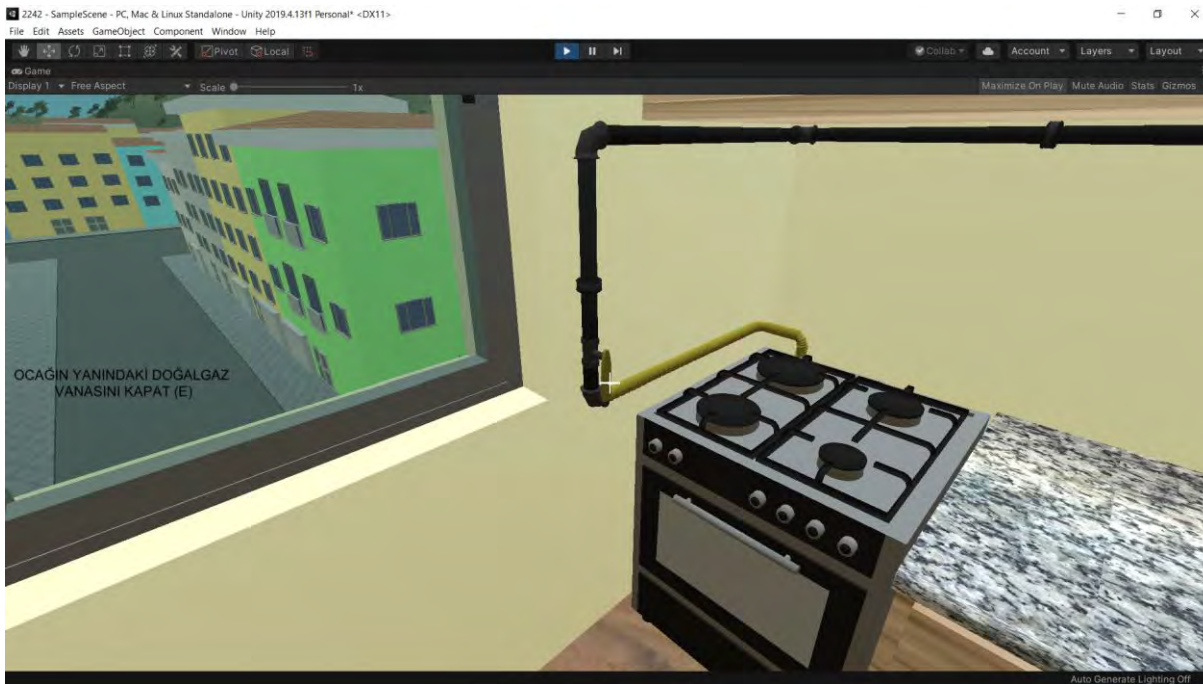

Figure 7. Tasks to be done in the kitchen after the earthquake

The first of these tasks is to close the gas valve. After closing the natural gas valve, the player is asked to take the earthquake bag (Figure 8). The earthquake bag is on the escape route in front of the exit door so that it does not waste time during the escape. Before leaving the house, the player is asked to turn off the electrical fuses located above the exit door (Fig. 9). After performing these duties, he should close the water valve located outside the door and on the right when leaving the house. He is then asked to leave the apartment.
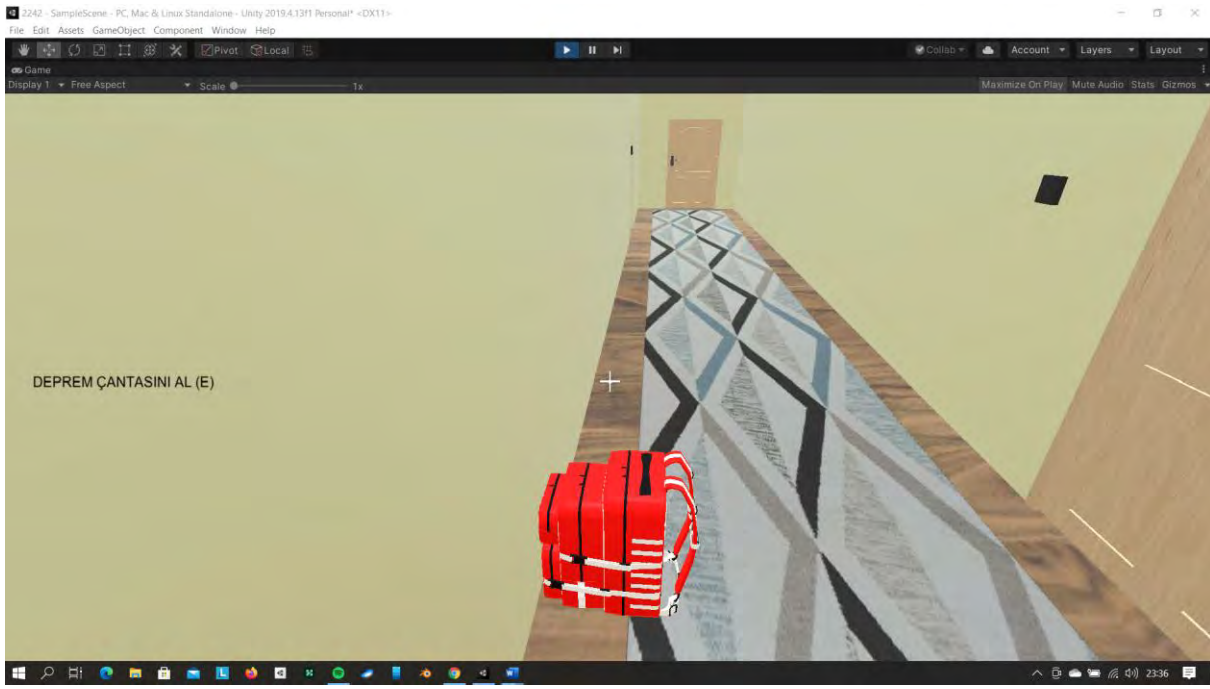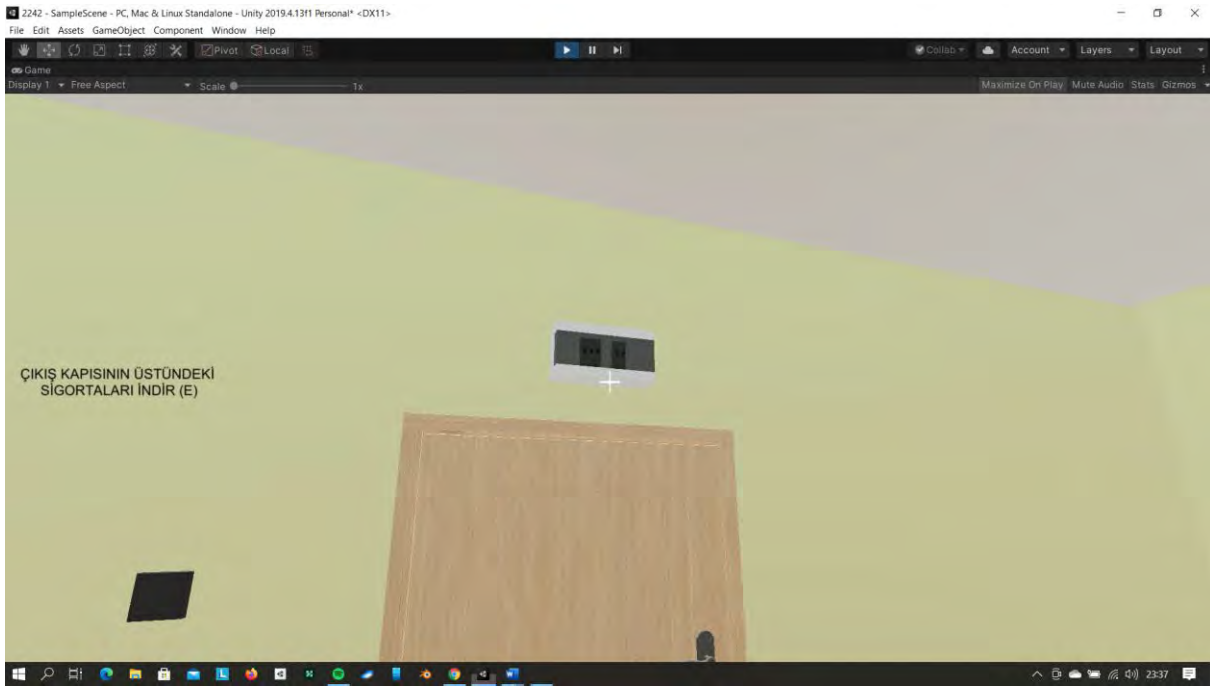
Figure 8. Earthquake bag picking task

Figure 9. Electrical fuse duty

After leaving the apartment, he has to go to the assembly area (Figure 10). One building opposite the assembly area collapsed in the earthquake (Figure 11). One person could not escape from the destroyed building. It is visibly suspended.

Figure 10. The task to go to the assembly area

Figure 11. A view outside after the earthquake

When the player approaches the gathering area, he sees the tents inside and other people in front of the tents. When he enters the assembly area, a short article about the precautions he took and the importance of the earthquake bag is shown on the screen and the game is over.
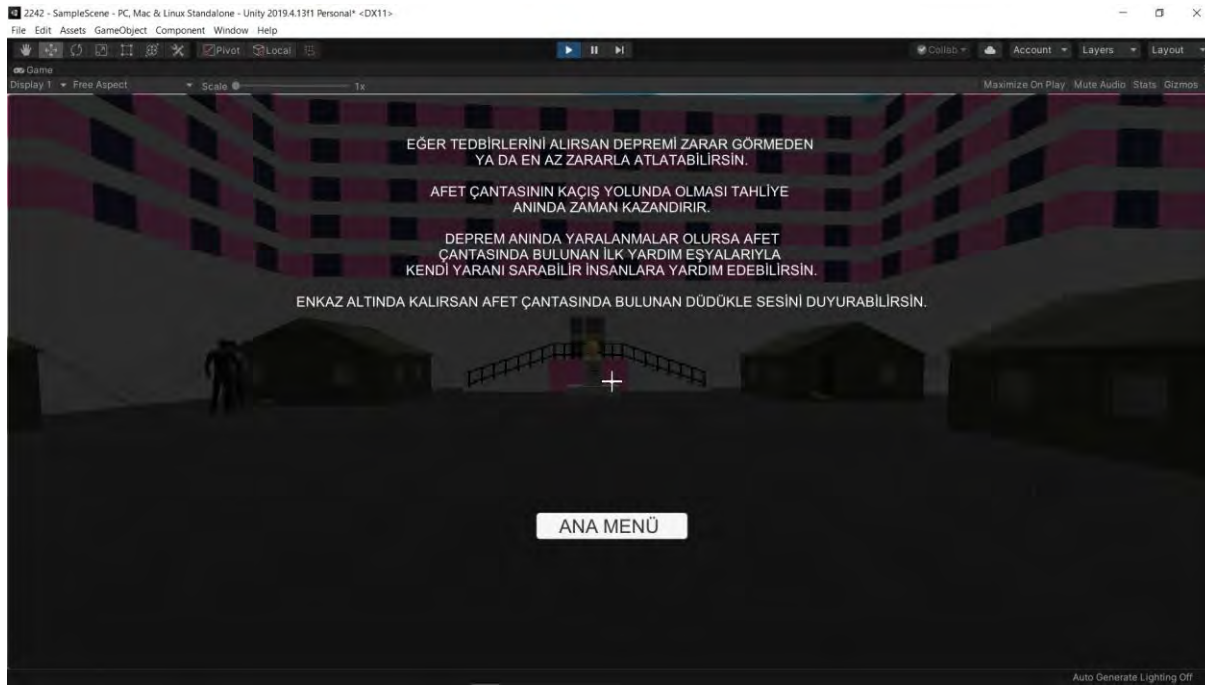
Figure 12. Incoming notifications when players enter the gathering area

CONCLUSION AND RECOMMENDATIONS

In this study, which was carried out with the awareness of the necessity of the development of educational games, the earthquake educational computer game is an interactive game with educational content, which was developed in a three-dimensional virtual environment and includes what needs to be done before and after the earthquake process as a task.

Thanks to the transfer of educational content to the user with three-dimensional and mobile games in current academic studies, there are findings of creating a desire to learn in students, student success and motivation towards the course. It is thought that the features of the earthquake educational computer game will attract the attention of everyone from seven to seventy with its three-dimensional virtual environment and educational content, and it can be used for educational purposes in order to increase their motivation for gaining knowledge and experience about earthquakes.

The earthquake educational computer game was developed in this research, suggestions for future work;
- Development of new levels of the existing game,
- Adding English language option to the current game,
- Developing educational games for all disasters,
- Presenting this educational game to the user through bilateral cooperation with educational institutions and evaluating user opinions.

Ethics and Consent: Ethics committee approval is not required as it does not involve clinical researches on humans as well as it does not contain Retrospective studies in accordance with the Law on Protection of Personal Data.

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