

An Educational Computer Game: The Secret in Nature

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Abstract

Modern computer games use realistic animations, sound effects, and three-dimensional virtual environments to attract the attention of players. Forestry education achieved using digital computer games, such as developing students' planting information. Through it, learners can increase their motivation towards relevant subjects in a variety of fields. Learning becomes more interesting and curious when educational digital games are developed using the latest technology. An educational three-dimensional computer game was developed using the Unity game engine and C# coding language to provide information about nature to young people. A virtual environment and educational content were developed and can be used for educational purposes.

Keywords: educational computer games, computer-based learning, design-based research, nature

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Introduction

Digital game is a leisure time activity where young people spend time. It has made the digital game industry even more important by changing the choice of children's leisure activities during the pandemic process (Küçükvardar & Türel, 2022; Şahin, 2021). There is research on meeting the digital game playing preferences of young people with educational games (Gee, 2012; Squire, 2011). In addition to making learning fun, these games also facilitate learning by appealing to different learning styles and encouraging active participation (Özcan & Eriş, 2021; Nadeem et al., 2023).

Educational computer games can be designed based on different learning theories. Some of the most commonly used learning theories include:

- **Behaviorism:** According to this theory, learning consists of relationships between stimulus and response (Filsecker & Bündgens-Kosten, 2012). Educational computer games can encourage learning by using behavioral reinforcements such as scoring, badges, and levels.
- **Cognition:** According to this theory, learning is an active mental process (Chou et al., 2023; Lin et al., 2024). Educational computer games can promote learning by providing cognitive activities such as problem solving, simulations, and virtual experiments.
- **Constructivism:** According to this theory, learning occurs by associating new information with existing knowledge structures (Chowdhury et al, 2024). Educational computer games can promote learning by providing constructivist learning experiences such as discovery, investigation, and project-based learning (Wang, 2020).
- **Social learning:** According to this theory, learning occurs through interaction with other people (Bakhanova et al., 2020; Gandolfi, 2022). Educational computer games can promote learning by providing social learning opportunities such as multiplayer modes, collaboration, and social interaction.

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The effectiveness of educational computer games may vary depending on the game design, learning objectives, and target audience. Games should be appropriate to learning objectives, engaging and easy to use. Additionally, it should be able to appeal to different learning styles and skill levels.

Educational computer games can be expensive to design and develop, may cause technical problems, may create distraction (Lang, 2020) and can lead to feelings of loneliness (Pallavicini et al., 2022). These situations are stated as disadvantages of educational computer games. However, many benefits of educational games in terms of education are included in the literature. Educational computer games have significant potential in education and training. When designed and used correctly, it can make learning more effective, fun and engaging. Also, educational computer games can be used as an effective learning tool (De Freitas, 2018). Increasing students' motivation towards the lesson with games (Hawlitschek & Joeckel, 2017; Sabirli & Çoklar, 2020), individual learning (Göbel & Mehm, 2013), developing active, experimental and problem-solving skills (Gros, 2007; Ishak, 2023; McLaren et al., 2022; Tay et al., 2022), developing critical thinking skills (Bakhsh, 2022), developing better results in the areas of managerial control, planning and reminders, improving the ability to multitask and predict (Coşkun & Akçay, 2018; Dörner et al., 2016), it is ensured that learning skills are developed (Baigi et al., 2022) due to solving the game by trying different approaches. It is important to create the stories of educational games (Noemí & Máximo, 2014) for learning and to develop these games on digital platforms (Yılmaz İnce & Sancak, 2022).

The educational use of computer games has been the subject of a lot of studies in the relevant literature (Kurniawan et al., 2022; Yılmaz İnce & Sancak, 2022). According to academic studies, one of the important contributions of games to learning is providing a fun environment. Thus, in this proposed study, “The Secret in Nature” computer game developed to inform the game users about:

- the importance of planting trees,
- interesting lives in nature,
- beneficial insects for the forest,
- the ecosystem in nature,
- how difficult it will be if the trees disappear,
- how to plant a tree.

Research Questions

Research questions about the development of The Secret in Nature prepared to develop the game's impact on environmental attitudes and its efficacy in fostering sustainable behaviors;

- What narrative elements enhance engagement and environmental awareness in educational games?
- Which game mechanics contribute most to sustaining user motivation and reinforcing environmental attitudes?

Methodology

Research Design

The aim of the study is to raise awareness of game users about nature, embedded in the game story. Based on game-based learning theories, game mechanics have been developed to keep users' motivation high. The developmental research method, which is a derivative of the design-based research method, was used in this study. With this method, educational tools can be developed to facilitate learning (Brown, 1992). The product or program development can be categorized into two types, which include designing a product or developing an educational program (Richey et al., 2003). In this study, both types are used by designing educational games and also development of this designed game.

Participants and Data Collection

We recruited participants for this study from the Department of Computer Technologies at Isparta University of Applied Sciences' Computer Programming program. 74 students who studied the Game Programming I and II courses offered so that they have sufficient knowledge and equipment to criticize the developed game. The participants' ($n = 74$) complaints of it were recorded on an internet platform, and the same students were subsequently polled.

Implementation

Unity Game Engine was used in the development of the game and C# was used as the coding language. The game was created in Turkish on the computer for a year. Thanks to the information contained in the "Sincap Forest Child Magazine" published by the General Directorate of Forestry of the Ministry of Agriculture and Forestry, an academician and a game programmer managed to create an instructive game story. In line with the feedback from the participants, changes were made to the scenario of the game. In addition, updates were made to the game taking into account user opinions, such as changing game mechanics.

Findings

The Secret in Nature starts with the start screen at first in the game. There is a button to go to the game menus, a button to the settings of the game and a button to exit the game (Figure 1). Brief information on how to interact is given on the settings page "Use E Key to Interact" and "Use N Key to Talk to Animals" is given (Figure 2). The first person character of the game is controlled with the W-A-S-D keys and mouse control.

Figure 1

Start Page

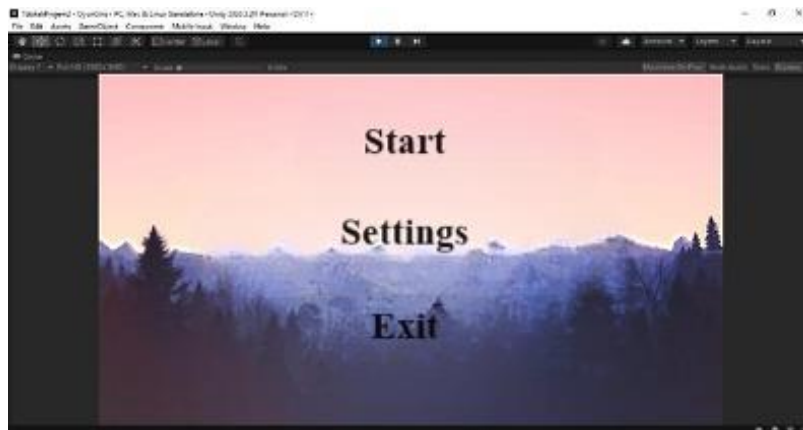


Figure 2*Settings Page*

When the game is first launched, it is written to the user that information about the secrets in nature is hidden in each level and that when the user succeeds in each level, user will learn all the secrets. Brief information about each level of the game is given at the beginning of the level.

The learning objectives of the game are to provide the user with information about the importance of planting trees, interesting lives in nature, insects beneficial to the forest and the ecosystem in nature, in an embedded and entertaining way within the game.

User performance evaluation in the game is provided by feedback given to the player on situations such as the number of golds collected and the success or failure of the in-game task.

Learn to Plant a Tree

When the start button is clicked, it goes to the game sections (Figure 3). In the “Learn to Plant a Tree” section, the squirrel welcomes the player, gives a little information about the tasks to be done and his own life, and then he will show us why trees are important to us (Figure 4).

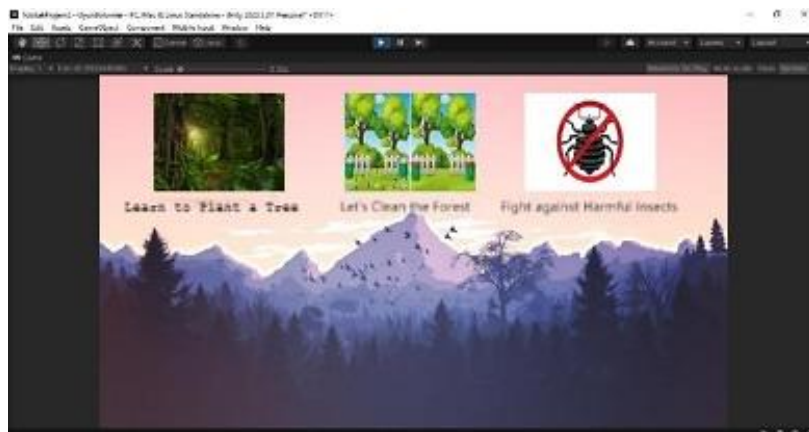
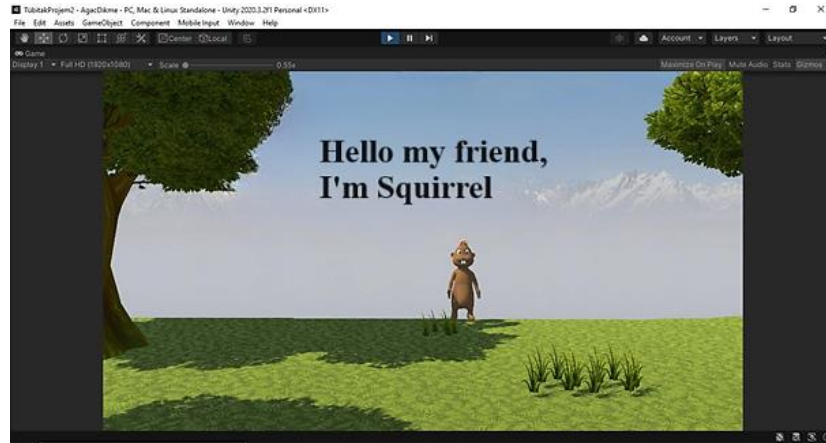
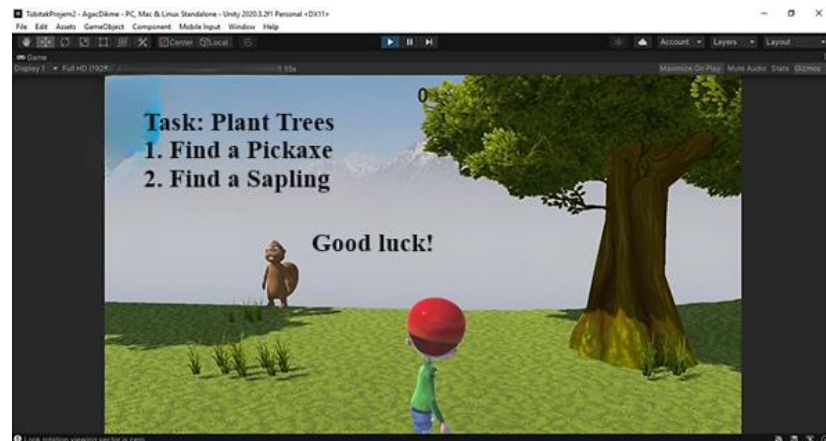
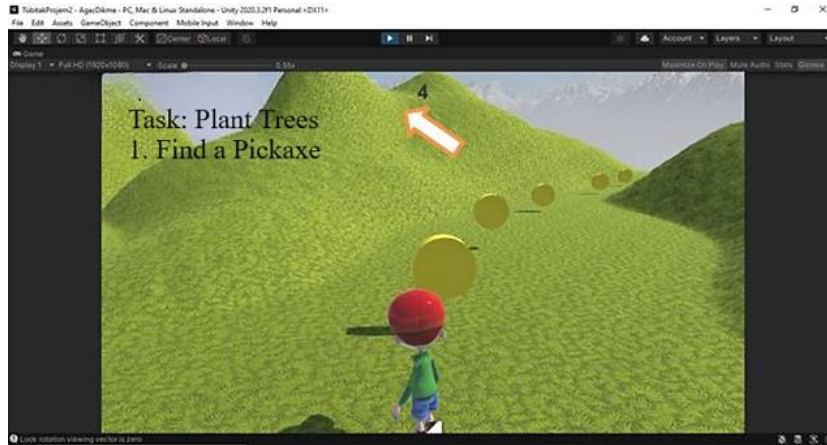
Figure 3*Menus Section*

Figure 4*Learn to Plant a Tree*

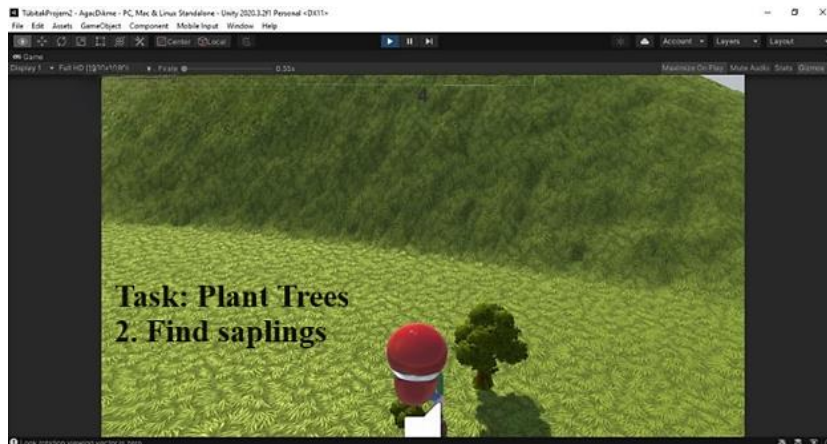
Squirrels plant many trees in their lifetime, so they grow the forest. It also gives the player small tasks such as finding a pickaxe and finding saplings to learn the materials needed for planting trees. The player will dig the ground with Pickaxe, then again engage in dialogue with the squirrel and find a sapling. After bringing the sapling and planting it, the tasks will be completed (Figure 5).

Figure 5*Assignment*

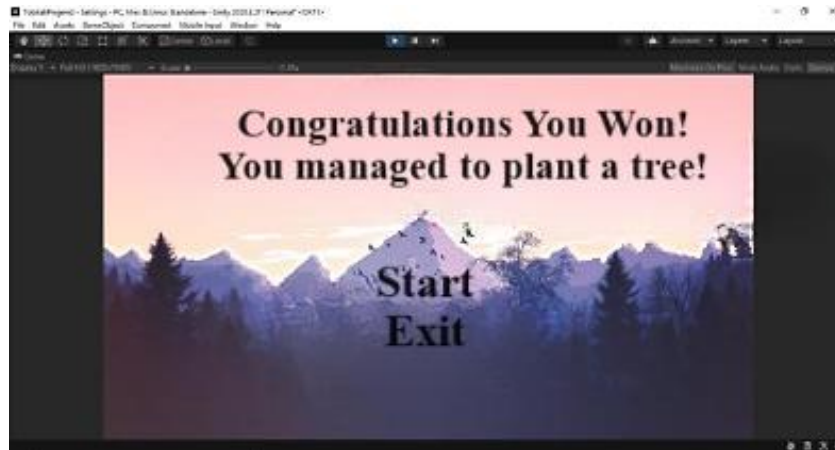
At the same time, there are gold coins on the way to find direction in the forest, by collecting this gold, a score is obtained, and the character will not get lost in the forest. When collecting gold, the information on how many golds he collected is also shown at the top (Figure 6).

Figure 6*Collecting Gold*

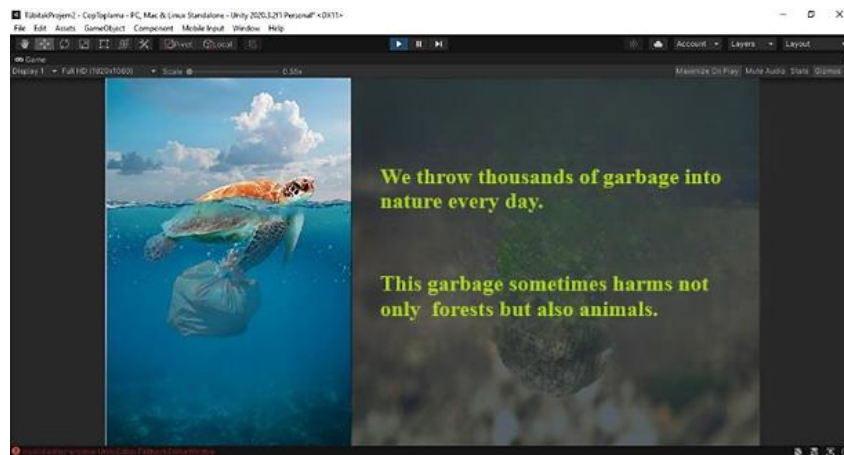
Then the character will collect the gold and go to the place where the pickaxe is located. When you pick up the pickaxe, the "take pickaxe quest" will turn green in the quest bar, which means that the quest has been completed. Using the "E key", the soil is dug, and a new task bar is opened for the sapling and the sapling is taken by collecting gold, just like picking up the pickaxe (Figure 7).

Figure 7*Buying Saplings*

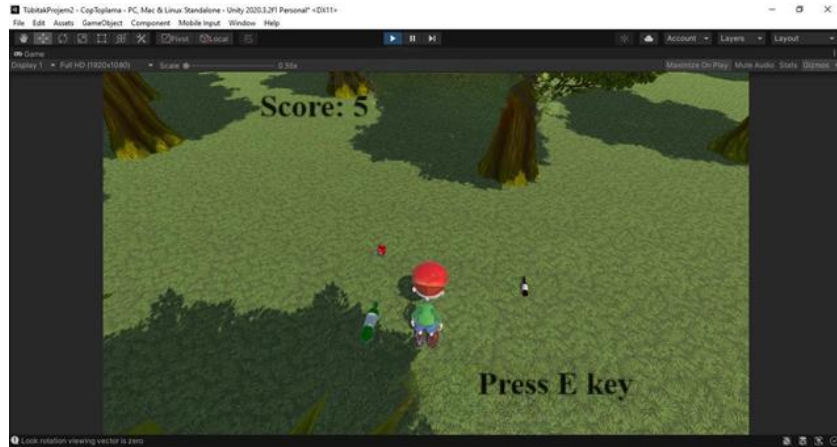
After getting the sapling, it goes to the excavated soil and planted again with the "E key", and when successful, the congratulatory message is received in the game (Figure 8). If desired, you can click the exit button to exit the game or choose the start option to play another game from the other menus.

Figure 8*Congratulatory Message***Let's Clean the Forest**

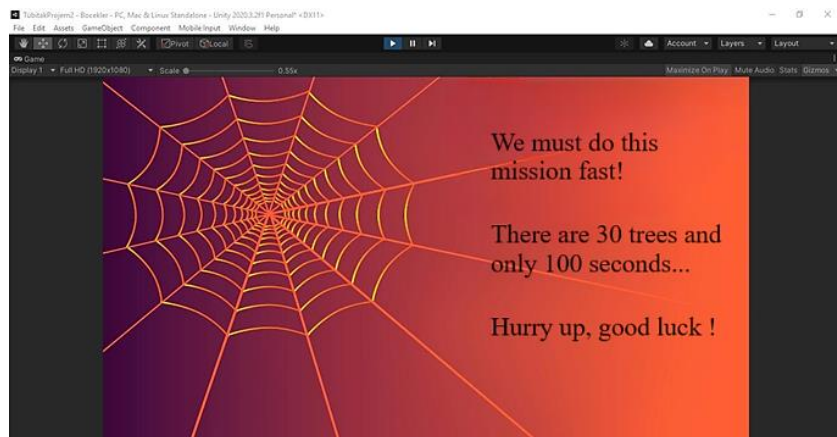
In the section "Let's Clean the Forest", it is explained how harmful the garbage thrown to nature is (Figure 9). It has been explained how harmful garbage can be to animals, and even forest fires can cause thousands of animals to disappear because of garbage. At the same time, it was mentioned that the ecosystem may be destroyed by forest fires and reach a level that cannot be recovered.

Figure 9*Let's Clear the Forest Section*

After the information is passed, our game starts. There are trash cans and glass bottles on the ground in the game. The player must take the glass bottles on the ground with the "E key" and take them to the trash, considering the garbage score that will be collected on the top (Figure 10).

Figure 10*Garbage Collection***Fight against Harmful Insects**

In the fight against harmful insects, the game was started by talking about the damage done by red spiders to the trees (Figure 11). In this section, he must clear the spiders from 30 trees in 100 seconds. The character has pesticide in his hand and will use this spray to clean the spiders.

Figure 11*Controlling Pests***Participants' Feedback about the Game**

The version described in the findings section relates to the final version of the game after changes were made as a result of participants' feedback about the game. The first version of the game was experienced by students in the computer programming program game programming course. The participants provided feedback about the game immediately after experiencing it. User feedback was noted, constructive criticism was taken into account, and the game scenario and game mechanics were revised, to enhance engagement narrative elements and environmental awareness in educational games and to develop game mechanics to sustain user motivation and strengthen environmental attitudes. In table 1, categories and feedback codes are given.

Table 1*Participants' Feedback about the Game*

Categories	Feedback Codes
storytelling	engagement and environmental context emotional connection
effectiveness of game mechanics	motivation and engagement feedback and assessment balancing entertainment and education

At the beginning of the game levels, it was suggested by the participants that information sharing aimed at developing environmental awareness related to the level be added to the game. This revision can significantly enhance engagement by providing environmental context and purpose to the learning activities.

“Stories can stimulate emotions and increase learning and recall; a mascot should be used in the game” said one participant. Considering this suggestion, the General Directorate of Forestry Squirrel Forest Children Magazine mascot, the squirrel, was used in this game. Due to the ability of squirrels to store seeds throughout their lives, they ensure that many trees are planted, and the forest grows, which has caused squirrels to be forest-friendly. The players were given game directions by the squirrel, allowing them to connect to the story.

For motivation and engagement, a participant expressed her views as "The challenge could be improved a little more, I can do the tasks quickly, the garbage collection task you give me finishes very quickly, this task is below my skills." Increased the number of game target garbage and added rewards to balance challenge with skill and therefore maintain the flow.

Two participants criticized that the game score should be constantly visible on the screen. In the first version of the game, the score was presented at the end of the game. The game score was constantly reflected on the screen to provide players with timely and relevant feedback on their performance.

Participants stated that the information texts between the sections were too long. The information texts were shortened and some environmental information that needed to be given to the user was presented within the game, thus providing a balanced presentation of education and entertainment.

Conclusion

The game “The Secret in Nature” was carried out in order to instill a love of nature in young people and to raise their awareness on environmental awareness and forest protection. “The Secret in Nature” computer game suggested in this study informs the game users about the importance of planting trees, interesting lives in nature, beneficial insects for the forest, the ecosystem in nature, how difficult it will be if the trees disappear and how to plant a tree. The game environment developed for this purpose is presented to the user in a fun 3D environment. In the development of the game, the contents of the “Squirrel Forest Child Magazine” prepared by the Ministry of Agriculture and Forestry General Directorate of Forestry were used. Initial user feedback suggests the game has potential to raise environmental awareness, but further evaluation is needed to confirm its effectiveness.

Game mechanics is a system that includes game rules, game control, interaction between players, story transfer, player experience, game. The Secret in Nature, an educational computer game developed in a three-dimensional environment, increases the desire of users to react correctly to situations and their motivation to complete the tasks they encounter, thanks to its game mechanics. It is thought that game elements (rules, controls, storytelling) will have an impact on users' behavior or knowledge acquisition. The game version discussed in the findings section is the last version of the game following modifications brought about by participants' feedback. Participants' feedback about the game categorized as storytelling and the effectiveness of game mechanics. Storytelling has been expressed with two different codes as engagement and environmental context and emotional

connection. The effectiveness of game mechanics category has been expressed with motivation and engagement, feedback and assessment and balancing entertainment and education feedback codes.

As limitations, this study provides insights into game development, it does not directly measure environmental attitude change.

The Secret in Nature educational computer game developed in this research, suggestions for future studies;

- In order for the game to be in demand from international users, adding other languages option to the game,
- Conducting longitudinal studies to assess learning retention.
- Comparing different storytelling techniques to see which is most effective.
- Presenting this educational game to students in cooperation with educational institutions, such as piloting the game in a controlled educational setting, collecting data, or refining the game, educational feedback

It is estimated that, thanks to the game content, graphics, story and motivation given to the user, it will increase the love and knowledge of nature in the users.

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Code of Ethics

The ethical consent was obtained from Scientific Research and Publication Ethics Committee at Isparta University of Applied Sciences on 28.11.2022 with the approval decision number 127 (Number of decision: 9).

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Eğitici Bilgisayar Oyunu: Doğadaki Sır

Öz.

Modern bilgisayar oyunları, oyuncuların dikkatini çekmek için gerçekçi animasyonlar, ses efektleri ve üç boyutlu sanal ortamlar kullanmaktadır. Ormancılık eğitimi, dijital bilgisayar oyunları kullanarak öğrencilerin bitki ekimi bilgilerinin geliştirilmesi gibi amaçlarla gerçekleştirilir. Bu sayede öğrenciler çeşitli alanlardaki ilgili konulara yönelik motivasyonlarını artırabilirler. Eğitsel dijital oyunlar son teknoloji kullanılarak geliştirildiğinde öğrenme daha ilginç ve merak uyandırıcı hale gelmektedir. Bu çalışmada, gençlere doğa hakkında bilgi vermek amacıyla Unity oyun motoru ve C# kodlama dili kullanılarak üç boyutlu eğitici bir bilgisayar oyunu sunulmuştur. Eğitim amaçlı kullanılacak sanal ortam ve eğitim içeriği geliştirilmiştir.

Anahtar kelimeler: eğitsel bilgisayar oyunları, bilgisayar tabanlı öğrenme, tasarım tabanlı araştırma, doğa.