Educational Game Design for Kids: A Case Study with Python Maze Game

KEMAL GOKHAN NALBANT[a], MEHMET DOGANCAN KAYGUSUZ[b], DEVRAN TUNC[c]
Software Engineering,
Istanbul Beykent University,
TURKEY

[a]ORCiD: 0000-0002-5065-2504
[b]ORCiD: 0009-0009-0983-8903
[c]ORCiD: 0009-0007-8544-9999

Abstract: - The development process of an educational mobile game is examined, supported by statistical data and research findings, in order to develop children's problem-solving, logical thinking, and various cognitive skills. The game, a complex level-based maze game was created using the Pygame library of the Python programming language. Our game, titled "SIU Robot and Mind Maze" takes a unique approach compared to other maze games in the industry, aiming to enhance children's attention, memory, logical reasoning, and mathematical skills. The development process is presented with a detailed explanation of the algorithms used, accompanied by code snippets and visual materials that support the game's structural design. The study is grounded in a thorough literature review on educational games, highlighting their significant role in boosting children's learning motivation and engagement.

Key-Words: - Python Game Development, Pygame, Mobile Game, Educational Game Development, Maze Game, Mobile Game for Kids.

Received: April 15, 2024. Revised: February 19, 2025. Accepted: April 22, 2025. Published: July 24, 2025.

1 Introduction

Games go beyond being just a leisure activity and support personal development, enabling the user to develop in areas such as problem-solving and reasoning. In this study, we decided to make a puzzle game. Puzzle games attract attention, especially with their logical thinking and problem-solving structures. Games like Tetris are examples of puzzle games.

In this study, the design and development process of our mobile game called 'SIU Robot and Mind Maze', which was designed to help children develop their learning skills while having fun by playing games, was developed using Python programming language and Pygame library. Unlike traditional maze games, our game not only aims to find the right path but also aims to develop children's intellectual and problem-solving skills with a level-based progression system, different difficulty levels in each level, various puzzles, and other tasks placed between levels, actions such as resource collection and strategic decision-making. In short, it is intended as an educational game where children can learn many things while playing this game. Many aspects of the game, such as its user interface, music, background images, messages at all levels, and graphic design, have been designed to attract the attention of children and enhance their motivation. It is aimed to have a structure that can be adopted by both parents and educators.

Educational games are programs that define the user in a certain context, assign him certain roles, and see the results of the decisions made by the user by taking a certain amount of responsibility, [1]. Educational games are accepted to have effects that increase children's motivation, [2]. The problem-solving process includes basic features such as structuring the problem, developing alternative solutions, and reaching the unknown result, as well as factors such as chance, race, and competition, [3]. Computer games are software that has the shortest learning curve among computer programs. Additionally, players learn by directly playing the game and gaining experience, rather than reading help files or following instructions, [4]. The first educational computer game for students was produced by the MECC research center in 1971, called the Oregon Trail. In 1973, a project called Plato was developed in which

educational computer games were used for mathematics education. The computer game developed within the scope of this project was tested on students. As a result, positive effects were observed on mathematics achievement and student attitudes towards mathematics. In a study investigating the relationship between computer games and strategic and logical thinking skills, it was determined that games had a positive effect on students' strategic and logical thinking skills, [3]. While educational games enable students to take more risks, they also contribute to risk-taking students being more persistent in their tasks in the game. This helps further improve students' learning performance, [5]. Mobile games are the most popular activity for children from the age of two, [6]. Since these parts attracted particular attention while scanning the literature, it was thought that it would be useful to make an educational mobile game. Because these types of games can motivate players and make the learning process more fun, while also improving cognitive and social skills. The positive effect of educational games on children's learning motivation is a subject frequently emphasized in the literature. In the existing literature, topics such as educational games and the examination of children's cognitive development have mostly been examined. There are a limited number of mobile games that improve skills. This study aims to address this gap in the literature.

Research on the mobile gaming industry shows that users' game-playing time is increasing every year. According to statistics from sources such as Newzoo and Statista, puzzle games were one of the most downloaded mobile game types in 2023. Additionally, the article will present statistical data on the mobile gaming industry and focus on the size of the industry and its effects on children.

In this context, this article discusses in detail an educational mobile game that contributes to the cognitive development of children. It provides a general evaluation of the game's development process, the technologies used, and its potential effects in education, and the mobile game industry. In the future; the game's graphics, sound effects, and user interface can be improved to make it even better and up-to-date. By using artificial intelligence, the difficulty level of the game can be customized for each player according to the players' performance. In this way, the game can better meet the needs of each player and each player will have a different experience. This article emphasizes once again the importance of educational games and emphasizes that studies in this field should be supported.

2 Literature Review

There is extensive literature in the field of educational mobile games. This article aims to create an educational mobile game for children as much as possible. In this section, topics such as mobile games, educational games, and statistical data on the mobile game industry will be presented and the size of the sector will be discussed. Information will be given from previous studies and what contribution this article will make and what will make it different from other articles will be discussed.

Mind games are expressed as games and in-game activities that positively affect mental development. While mind games can enable the user to have fun and a good time, they can also be used to increase reasoning, strategic thinking, and logical thinking abilities, to comprehend what is explained more quickly, and to improve brain functions, [7]. Factors such as intelligence games, and problem-solving, problem solving require children to try different ways and evaluate their meaningful and analytical thinking skills. Thus, it supports children's different ways of thinking, [8].

This study aims to offer a new perspective by combining mobile games and educational games in the existing literature. This maze game developed for children is designed to support educational goals. In particular, the level-based design of the game and its inclusion of various puzzles allow children to improve themselves in many areas at different difficulty levels. Considering the deficiencies in the literature, an educational maze game was created by evaluating children's increased interest in mobile games, their interest in educational games, and the impact of these games. This project, developed with Python's Pygame library, contributes to the literature on issues such as offering a low-cost and accessible solution, being expandable, being a game for the future, and providing educational support to children. The fact that the game is open source allows other researchers to develop the game and develop their projects by being inspired by this project and adapting it from different perspectives in their projects.

This game, like every game, has many parts that can be improved. Future studies will undoubtedly offer new perspectives on the use and development of this game in different contexts.

Since this game is a maze game for children of a certain age range, it does not appeal to children of different age groups. It may feel too easy for them. Therefore, it can be adapted to the needs of children in that age group, considering children in other age groups. By analyzing in-game data, the effects on children's learning can be analyzed in more detail and the game can receive new updates accordingly. It is a multiplayer game and by increasing social interaction, more positive results can be achieved in the learning part. There may be different sections in the game for different lessons (social studies, science, geometry, etc.) or separate games can be designed for each lesson and questions can only be asked in the selected lesson category in that game. Many parts like these ensure that our game offers a structure open to development.

2.1 Educational Effects of Mobile Games

An educational game by definition; is a type of game that helps achieve the goals set during education and training, develops characteristics such as knowledge, skills, and thinking, and ensures the reinforcement and permanence of the learned knowledge, [9]. Educational games are defined as content developed for educational purposes that are played according to the rules and support the mental development of the child, [10]. The purpose of educational games is not only to win but also to ensure permanent learning by bringing together pieces of information within a certain plan, [11]. Educational games in the technology environment are also called digital educational games. In this context, in today's world where technology and game addiction are increasing, the digital design and integration of educational games with education emphasize that both game and education fields are important and the necessary effort should be made, [12].

2.2 Educational Games Children Play

Today, which is also described as the age of technology, children are included in an environment intertwined with technology as soon as they are born. Traditional education and training approaches will be inadequate to meet the vital expectations and educational needs of the new generation, which has been intertwined with technology since the moment they were born, [13]. Educational games ensure that the information learned through various methods and activities is reinforced and made permanent by going through mental processes as a part of the learning process. Educational games, which keep children's interest and motivation alive throughout the process, ensure that learning takes place in a more comfortable and entertaining environment and add diversity to the learning environment, [14]. Since educational games are interesting and fun for children, they help make learning permanent by increasing their motivation to learn. That's why educational games have emerged as the latest and most popular application areas in our country and the world. For this reason, scientific and technical studies on educational games in education are gaining importance, [12].

According to Statista (2023) data, the most downloaded learning applications by children in the USA in 2023 are shown in Figure 1.

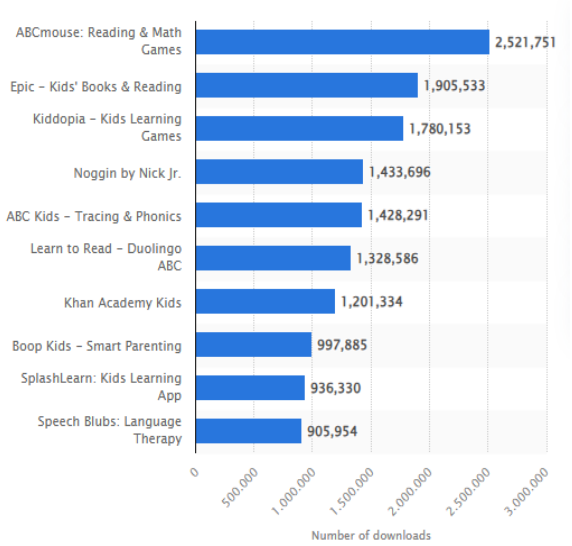

Fig. 1: The most downloaded learning apps by children in the USA, [15]

As shown in Figure 1, it can be seen how many million downloads various educational games have reached. In line with the data in Figure 1, the first 3 games were analyzed in detail and it was concluded that children are interested in learning through digital platforms. As a result of the analysis, the games were intended to attract children's attention by using simple designs and colorful visuals. It is aimed at the user to progress the game by asking basic-level questions on subjects such as mathematics and the alphabet. By using various animal figures, sounds, professional actors, and vehicles, it is aimed for children to achieve various gains in many areas. When these parts were taken into consideration and implemented, very high download numbers were achieved. As a result of the detailed analysis, we decided to design our educational game by using reading,

comprehension, mathematics, and various figures in educational applications for children.

2.3 Mobile Games Played by Children

The spread of mobile games among children leads to the development of games specifically for children in the gaming industry. In this regard, by examining the games played by children, we have seen the parts that can be added to our games and that we can pay attention to, and the parts that we will not overlook and attach importance to while developing our game have been clarified.

According to Statista 2023 data; the number of downloads of mobile games for children in the USA in 2023 is shown in Figure 2. Using this Figure, the basic building blocks of our game were created.

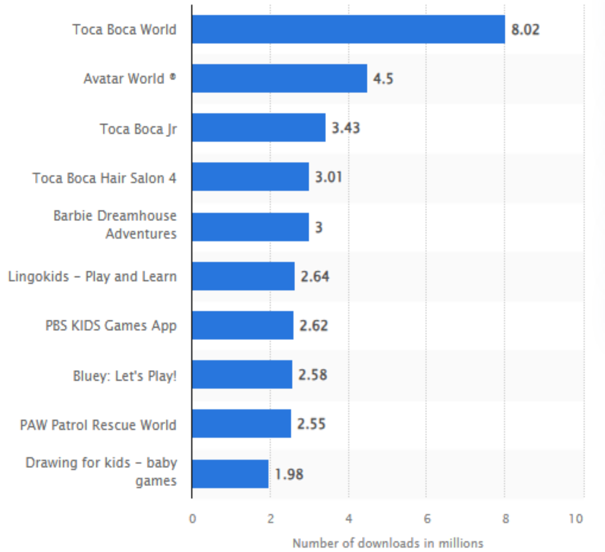

Fig. 2: The most downloaded mobile games by children in the USA, [16]

As shown in Figure 2, it is seen how many million downloads various games have reached. The most downloaded games include games such as Toca Boca World, Avatar World, Toca Boca Jr. In line with these download numbers, it has been observed that the most popular game has been downloaded almost twice as much as its closest competitor. In line with this data, it is seen that children play games not only for entertainment but also to contribute to their development. When we examine the games in Figure 2, they have simple mechanics; that will contribute to the development of many features such as careful thinking, strategic decision-making, planning, and quick decision-making. We chose a concept that will cover all games as a creativity development, and various experiments were made on the parts we could add to our game from this main idea.

2.4 Most Preferred Mobile Game Types

An in-depth literature review was conducted to identify the most suitable category for our game based on game type popularity. According to the five most downloaded mobile game types in the USA;

1. Hyper Casual (16.4 billion downloads)
2. Simulation (10.5 billion downloads)
3. Action (5.5 billion downloads)
4. Kids Games (4.3 billion downloads)
5. Puzzle Games (3.1 billion downloads)

When you look at our game in the puzzle category, it actually appears to be the game that ranks fifth. So, the best explanation for why we did not choose to make games from the first or second category will be made by using Figure 3.

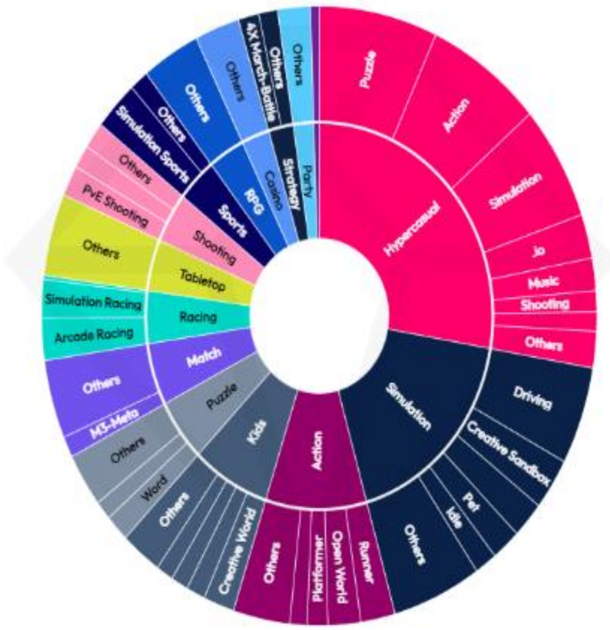

Fig. 3: Distribution of mobile games by type in the USA, [17]

As shown in Figure 3, you can see which types of games are in the categories and their size in the circle. The puzzle category does not seem to have a significant place in terms of size in gray color. However, hyper-casual games include puzzle games, and since our game is a game for children, it will also be included in the category of children's games. A game was developed to appeal to both of these categories. In other words, we wanted to point out that we will have a significant share not only in the puzzle category but also in both the

children's and hyper-casual categories. Such a variety of game types will attract the attention of children of different age groups. It allows each child to develop different skills and gain new perspectives. Based on Figure 3, one in every three games is in the hyper-casual genre and is divided into various categories within the hyper-casual category. With this perspective, since the hyper-casual genre includes many genres, our game should also be designed in the hyper-casual genre.

We wanted to look at some data from Turkey, and according to Statista 2023 data, the number of downloads of mobile games in Turkey according to their categories is examined in detail in Figure 4.

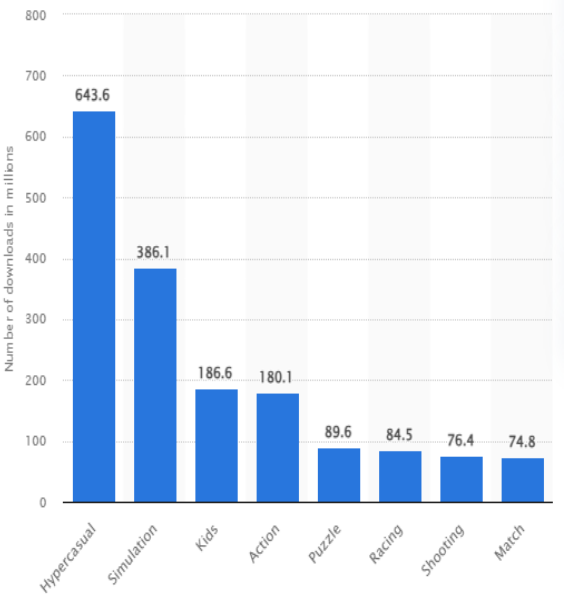

Fig. 4: Number of downloads of mobile games in Turkey, [18]

As shown in Figure 4, it can be seen that the most downloaded genres consist of genres such as hyper-casual, simulation, and children's games. When we look at Turkey, the puzzle category, which is the main category of our game, has reached a download number of 89.6 million. The hyper-casual category ranks first here, as in the US data, while children's games move up one place to rank third, with 180.1 million downloads. When we look at the USA and Turkey, we see that the data has changed only numerically and there is no big change based on categories. The interest in the hyper-casual category is visible in Turkey. It is observed that it has reached more than twice the number of downloads than its closest competitor in the simulation category.

Statista data shows the average daily time in minutes that U.S. children spent on mobile games from 2019 to 2023, as shown in Figure 5. This figure shows the average daily time spent by US children on mobile games.

As shown in Figure 5, according to the data, it is observed that the average duration has generally increased for most games until 2023. Also, it is observed that these games not only serve entertainment purposes for children but also use and develop many features such as instructiveness, creativity, and strategic thinking.

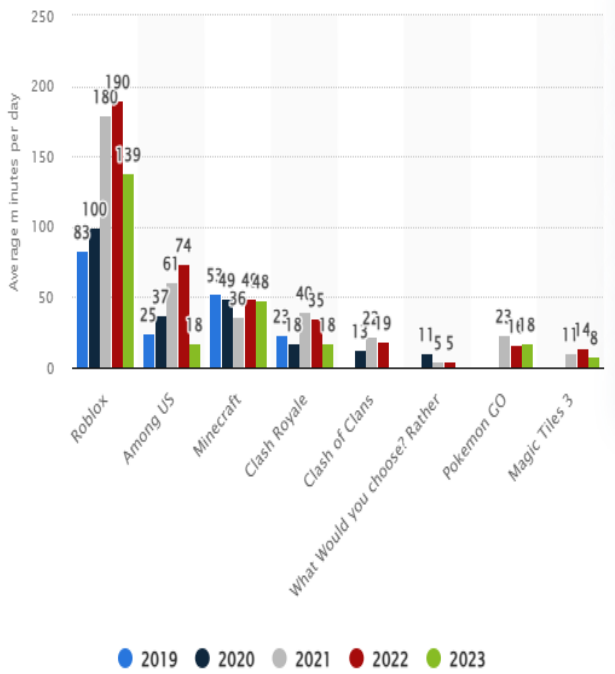

Fig. 5: Time spent by children in the USA on mobile games, [17]

It has been observed that the most popular Roblox game has been played for an average of three hours per day over the past three years. This extended playtime is attributed to the game's inclusion of numerous diverse modes, which differentiates it from other games. When we look at the time spent in these generally popular games, it is seen that there is a three or four-times difference between the game called Roblox and its closest rival every year. Based on this, Roblox will increase its popularity in four years. On the contrary, it continued to increase. This shows that it is a game that is sustainable, interacts with the user, and has a structure open to development. An analysis of the positive aspects of Roblox highlights the key design elements that should be considered in the development of our own game.

2.5 The Impact of Mobile Game Types on Generations

Mobile games are not limited to certain age groups; there are millions of different types of mobile

games that appeal to all age groups. There are distinct differences, with exceptions, between the types of mobile games played by each generation. Generally mobile games for children; are produced in genres such as problem-solving, language learning, entertainment, and memory strengthening. However, negative effects such as prolonged screen time and decreased social interactions are also observed. Youth; It tends towards more complex game types such as action, strategy, entertainment, sports, and role-playing games. Although young people's social ties are strengthened through the online environment, some types of games can cause negative consequences such as excessive stress, addiction, and conflicts within school and family. Adults generally play puzzles, casual games, and mobile games to relax in their spare time. Effects on generations; It varies due to factors such as predisposition and familiarity with technology and habits. Generation Z and Alpha are the generation that interacts with mobile games the most due to features such as playing, watching, and owning games, while Generation Y and previous generations interact with mobile games due to factors such as passing time and distraction. In conclusion; Mobile game types cause different effects in each generation, and these effects directly affect individuals' gaming experience, learning habits, and social interaction styles. Therefore, in mobile game design, developing content suitable for the target audience and then continuing the interaction with the user is of great importance. Educational games have a significant market share, and new game designs are being launched every day, and companies are introducing their new games to users. While designing educational games for children to increase the popularity of these new or upcoming games; The gaming habits of the target audience should be analyzed and paid attention to, better experiences should be offered to children by making use of popular categories, and the features to be used should be designed to be more interesting, instructive and beneficial in educational games.

3 Methodology

A research design based on educational development for children was adopted. During the research, a comprehensive literature review was carried out, incorporating academic articles, theses, and diverse data sources concerning educational games. Current and abstracts were evaluated in line with the information obtained and the design features of the most functional parts were integrated among these scopes. Python and its game development library Pygame were preferred as the programming language. This choice was made considering Pygame's free and open-source structure, easy learning, and the possibilities that allow simple but functional games for files to be developed with rapid prototypes. The encryption and data sources used in the research process are detailed below.

3.1 Research Design

Our main goal is to develop an educational mobile game that offers children both fun and learning opportunities. It is aimed at developing children's various personal characteristics while playing the game. For this purpose, the parts we paid the most attention to in the literature review were; games played by children, educational games, and mobile games for children. During the literature review, both the article written and the game-made content were quite few. We gave extra importance to the article and game we will make to increase this number. The questions of the article and the parts we paid attention to are listed:

- For which audience will we make the game and what will be the category of the game?
- Do educational games have a positive effect on children?
- Do mobile games cause children to waste time?
- Do educational games increase children's learning speed?
- Do games improve children's motivation to learn or do they have a positive contribution?

3.2 Data Collection and Analysis

Data Sources: In the study, data were collected regarding children's gaming experiences, the number of times mobile games were played, and the mobile games most played by children. In this context, the data we found consists of data collected from different countries, different years, and generally with the participation of children. These data are generally based on studies conducted with the direct participation of children. The sources used include different parameters such as year, region, and age range, and this diversity adds depth to the analysis process.

Analysis Process: The data collected will be used to analyze which type of games children play more, and children's learning processes related to games. In addition, factors such as which learning styles

children adopt while playing games and changes in their motivation levels were also evaluated.

4 Application

This section describes the design and development processes of the mobile game "SIU Robot and Mind Maze". The methods used in the design, development, and implementation stages of the game also include software tools. The game was developed with an educational approach to ensure that children learn while having fun. The development process progressed step by step using the Python programming language and the Pygame library; elements such as the game's user interface, graphic design, and game mechanics were designed in this process. It is aimed to develop this application in future studies. Among these goals, many features such as developing leveled versions of the game according to different age groups, monitoring children's in-game development with parent and teacher control panels, adding artificial intelligence-supported personalization modules to the game, and providing content appropriate to the child's level are important in terms of both children playing the game more safely and providing a sustainable game.

4.1 Environment and Tools

Python programming language and Pygame library were used during development. During the programming language selection, Python was preferred due to the game's flexibility, extensibility, and ease of learning. Visual Studio Code, an easily accessible, user-friendly, popular code editor, was used during the development of the game. It was preferred because it facilitates the processes of writing code and debugging. Various free sources were used for visual designs, music, and sound effects. For the user to save the game and continue where he left off, his data is saved in JSON type files, thus enabling him to continue the game at any time. Below are the code lines for the save game function and the function for loading the saved game.

As shown in Figure 6, the aim is to save the game from where the player left off while playing the game. The JSON type file type will be used to save. The player's last location, last level, items in his inventory, and score will be preserved thanks to this function. Saving will be done automatically for many things such as every move, every score increase, etc., rather than manually.

```python
DOSYA_KAYDET = "game_save.json"

def oyunu_kaydet():
    bilgi_kaydet = {
        "mevcut_level": mevcut_level,
        "oyuncu_poz": oyuncu_poz,
        "envanter": envanter,
        "skor": skor,
        "dogru_cevap": dogru_cevap,
        "yanlış_cevap": yanlış_cevap,
    }
    with open(DOSYA_KAYDET, "w") as file:
        json.dump(bilgi_kaydet, file)
```

Fig. 6: Save Game Function

```python
DOSYA_KAYDET = "game_save.json"

def kayıtlı_oyunu_yukle():
    global mevcut_level, oyuncu_poz, envanter, skor, dogru_cevap,
yanlış_cevap, labirent
    if os.path.exists(DOSYA_KAYDET):
        with open(DOSYA_KAYDET, "r") as file:
            bilgi_kaydet = json.load(file)
            mevcut_level = bilgi_kaydet["mevcut_level"]
            oyuncu_poz = bilgi_kaydet["oyuncu_poz"]
            envanter = bilgi_kaydet["envanter"]
            skor = bilgi_kaydet["skor"]
            dogru_cevap = bilgi_kaydet["dogru_cevap"]
            yanlış_cevap = bilgi_kaydet["yanlış_cevap"]
            labirent = levels[mevcut_level]
        print("Kaydedilmiş oyun yüklendi!")
    else:
        print("Kaydedilmiş bir oyun bulunamadı.")
```

Fig. 7: Saved Game Loading Function

As shown in Figure 7, the aim is for the player to continue the game from where he left off. For this, after Figure 6 works first, Figure 7 will be able to work correctly. If there is no saved game, an error message will be given to the user. The necessary information is taken from the json type file where the game is saved, and when the player opens the game again, Figure 7 runs and the game continues from where it was left off.

4.2 Game Design and Development Process

The basic structure of the game is based on maze-solving mechanics, and mini-puzzles that improve children's logical thinking and decision-making skills are placed at each level. Game mechanics are designed to attract children's attention, nourish their imagination, and make the learning process fun. The progression system in the game is designed to include different difficulty levels and different

tasks encountered in each level, increasing in difficulty as the levels are passed, and each level has been tested. The aim was to increase motivation by providing success messages after completing each level. The visual design was aimed to attract children's attention with a child-friendly interface, colors, and icons that would attract children's attention. At the same time, fun music and sound effects suitable for the game atmosphere were used. Scoring system; To monitor the success of the children and increase their motivation, the player earned points with the resources collected during the movement in the maze at each passing level.

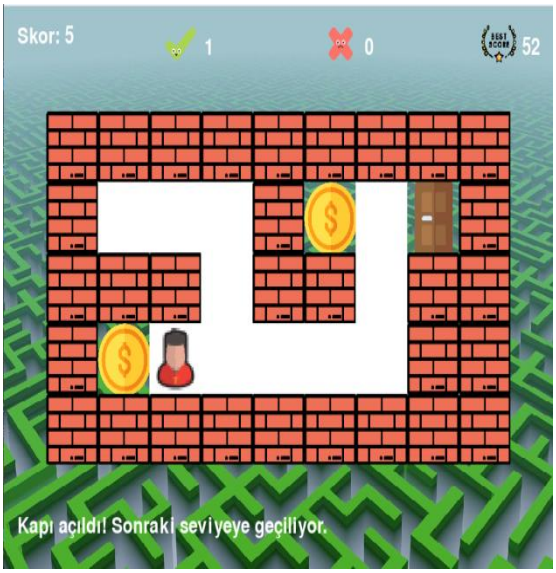

Fig. 8: In-Game Visual 1 of the game second level

As shown in Figure 8, in the second level of the game, there is the character managed by the player, the resources to be collected, the walls of the maze, the door that allows access to the next level, the score, the number of correct and incorrect answers, the highest score value, the background image and the messages given to the user at the bottom. The player faces a simpler level in the 2nd level compared to the following levels. As the levels are passed, the difficulty level of the maze will increase. As the game progresses, the structure of the mazes becomes more complex and the aim is to improve the problem-solving skills of the player. While playing the game, the user is informed with continuous background music, a sound effect when resources are collected, and a sound when the level is completed and the next level is completed. With this design, simple, as entertaining visuals and sounds as possible were used, as the user will immediately understand what to do, will easily understand the mechanics of the game, and the main aim is to improve himself.

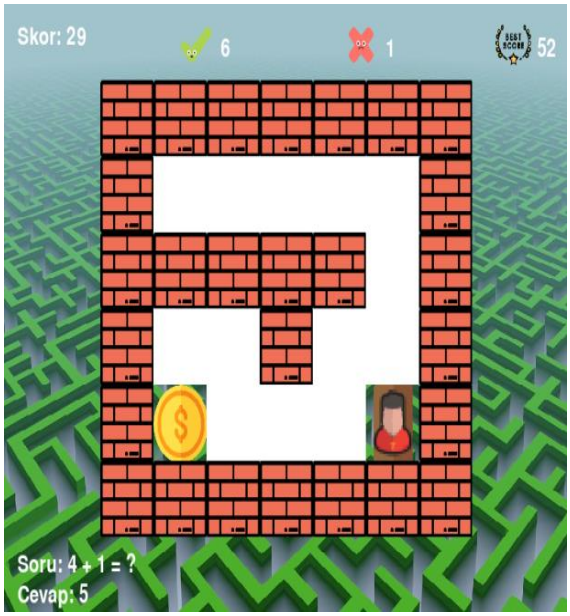

Fig. 9: In-Game Visual 2 of the game eighth level

As shown in Figure 9, a more complex maze structure is presented compared to previous levels, and the player's problem-solving skills are improved. Some of the resources that need to be collected have been collected and the player has reached the door to move on to the next level. Since the player is at the door, the system has asked the user a question at the bottom of the game screen, and the answer is awaited. If the player answers the question correctly, the next level will pass; if the answer is wrong, another question will be asked by the system. The system will continue to ask different questions until the player answers any question correctly. The questions that can be asked consist of mathematical operations and logic questions. The score, correct and incorrect answer numbers, and the best score value are located at the top of the screen. The highest score value automatically changes every time the player exceeds his highest score. With this difficulty level, the gaming experience becomes more immersive and educational, and it is aimed to develop the player's analytical thinking and problem-solving skills.

4.3 Goal of Mobile Game

It aims to help children develop problem-solving and logical thinking skills in a fun way. At the same time, it offers a useful resource for both parents and educators as an educational game that makes children's learning process fun. Unlike other educational games, the gaming experience is

enhanced with more immersive, engaging, educational puzzles and cross-level rewards. The main purpose of the game is to both support children's learning processes and encourage them to use technology as an educational tool. In-game goals include collecting resources and increasing your score, successfully passing mazes and moving on to other levels, and solving puzzles from the fields of mathematics and logic.

There are some basic deficiencies in the educational mobile game genre. Since some educational games generally focus on a specific topic, players may find the content in the game repetitive and boring after a while. Therefore, it is of great importance to design the game considering a dynamic model. Lack of connection to real-life applications, lack of feedback and evaluation, and excessive amount of advertising content are common deficiencies in today's educational games. The educational mobile game we developed was designed with care and attention, taking into account these common deficiencies in other educational mobile games. Repetitive content is avoided by constantly asking the user new and interesting questions. Additionally, difficulty levels are adapted according to the players' progress, providing a personalized experience. Thus, it is aimed to minimize common deficiencies while maximizing the advantages offered by educational games.

The design and development process of the educational mobile game was examined in detail. While the game improves children's cognitive skills such as problem-solving, logical thinking, and attention, it also provides an entertaining experience. By using tools such as Python and Pygame, the game has been ensured to have a structure that is both technically sound and user-friendly. In the future, improvements may be added, such as porting the game to different platforms, larger labyrinth levels, adding more complex puzzles, and time restrictions based on the difficulty of each level.

5 Findings

The findings regarding the educational maze game developed within the scope of this research are presented below.

- It has been observed that mathematics-based questions are answered faster and more accurately than other question types.
- It has been determined that repetitive question types reinforce learning, but can become boring for players after a point.
- Many resources in the game, such as questions asked, maze difficulty levels, visuals and sounds, are designed to suit children.
- The difficulty level of the game increases linearly as the levels progress. It has been determined that this structure positively affects the fluency and playability of the game.
- It has been determined that the majority of children prefer mobile devices as the primary platform for playing games.
- Educational games that are linked to real life are preferred.
- It has been observed that background music and sound effects increase the player's loyalty to the game.
- It has been determined that more variety should be added to the levels for mobile games that increase learning motivation.

6 Discussion

The effects of the educational maze game developed within the scope of this study on user experience and learning process were evaluated. The findings revealed the development of educational mobile games on children and offered suggestions for future studies.

6.1 Comparison with Literature

The contribution of educational mobile games to the learning process has been emphasized in various previous studies. Educational games are considered to have positive effects on players' motivation, [2]. In this research, many resources such as the questions asked to increase the player's motivation, the difficulty levels of the mazes, visuals, and sounds were designed to be suitable for children. This finding was found to be compatible with similar studies in the literature.

Educational games, which keep children's interest and motivation alive throughout the process, ensure that learning takes place in a more comfortable and entertaining environment and add diversity to the learning environment, [14]. In this research, repetitive question types were avoided. The aim is to enable children to learn in a fun way. This finding coincides with similar studies in the literature.

6.2 Significance of Findings

The findings of this study show that educational mobile games for children enable them to develop skills such as problem-solving, logic, analysis, memory development, and learning by trial and error, revealing what they can improve.

In particular, it is thought that the linear increase in the difficulty level of the game enables children to gradually encounter more complex levels and question types, thereby improving their skills. It has been determined that the reward system, increase in scores, increase in the number of correct answers, and level-up mechanics increase children's motivation to continue playing the game.

6.3 Application

The findings reveal some important points that should be taken into consideration during the development of educational mobile games. In this context, the following practices are recommended:

- The variety of questions should be increased to improve skills such as problem-solving and analysis. In this way, game content can be made more effective.
- Various mechanics can be added to encourage children to learn collaboratively, such as multiplayer modes, competing with friends, adding a leaderboard, and increasing competition. In this way, the game is both more fun and can positively affect various features such as social learning and teamwork.
- In order to follow the children's learning process, children's performance reports can be presented specifically to parents or teachers. With this system, it can help personalize education by providing a detailed performance report by showing various characteristics of children, such as which subjects they have difficulty in, which subjects they are better at.

These suggestions are considered as the three most important design elements for educational mobile games to be fun and instructive.

6.4 Future Work

This study examined the contribution of educational mobile games to the learning process through a specific game structure. Future studies may expand the scope of the research by focusing on the following areas:

- The learning process can be supported with different game mechanics. In this research, a maze-based mobile game was made. The learning process can be addressed more comprehensively by choosing genres such as simulation and role-playing games and developing mechanics.
- The effect of play on children's success can be measured. The academic success of children who play this game for a certain period can be compared with the success of children who do not play this game.
- The game can be developed for other age groups. In this study, an educational mobile game was made for children. In future research, educational games can be designed to be suitable for different age groups.
- Educational games can be developed to suit different subjects. In addition to puzzles such as mathematics and logic, educational games can be developed for many different subjects such as science, geometry, and history. In this way, educational games can be evaluated by comparing their effects on different subjects.

These recommendations will contribute to future studies. In this way, it will enable many issues to be addressed, such as developing educational games in an effective, instructive, efficient and suitable way for everyone.

7 Conclusion

In this study, the potential of educational mobile games to contribute to the learning process was examined and the effects of the developed maze-based educational mobile game were evaluated. According to the findings, educational mobile games can be an effective tool in increasing children's motivation to learn. Math-based questions were generally easier to answer than others. It has been observed that linearly increasing the difficulty level of the game maintains the interest of the players, improves the player's experience with various visuals and sounds, and increases motivation to learn.

7.1 Contributions of the Study

This research contributes to determining the factors that should be taken into account in educational game design by revealing the role of educational games in learning processes, addressing the deficiencies in the literature, and eliminating the deficiencies, in some parts compatible with the existing studies in the literature. Developing children's various skills such as analysis, problem-solving, and reasoning helps them achieve significant improvements in both their education and private life. It has been determined that mobile game contents that are linked to real life are

preferred more by children, and it has been concluded that game content should be integrated more strongly with the learning process.

7.2 Applications and Recommendations

In line with the findings, some important points that should be taken into consideration in the design of educational games are revealed. The diversity of questions in educational game content can contribute to children's development of different skills. Different types of educational games can be designed, the learning process can be discussed more comprehensively, and newer and more detailed educational games can be designed for other platforms. Educational games suitable for other age groups can be designed and educational games can be compared according to age groups. Rather than just sticking to one subject, questions suitable for different subjects can be added from many fields such as science, geometry, social studies, and geography, or educational games can be designed to be specific to each field.

7.3 Limitations of the Study

In this research, an educational mobile game specific to children in a certain age group was designed, but no educational mobile game specific to other age groups was designed. The impact of children's play experience on long-term learning and development has not been evaluated. Since it is a mobile game, it will not be available on other platforms. For these reasons, it is recommended to evaluate educational game content for different age groups in future studies, examine the long-term effects on children, and design educational games that will take place on different platforms.

7.4 Sharing of Source Codes

The source codes of the educational maze game developed to increase the developability of this study were shared on the GitHub platform. Thus, developers can contact us and review the codes of this game to contribute to the development process or use it as a reference in similar projects, [19].

References:

[1] Hazar, M. (1996). *Education with games in physical education and sports.* Ankara: Tubitay Ltd.

[2] Malone, T. (1981). What makes computer games fun? *Byte,* 6(12), 258-277.

[3] Bottino, R., Ferlino, L., & Travella, M. O. (2006). Developing strategic and reasoning abilities with computer games at the primary school level. *Computers & Education,* 49(4), 1272–1286. https://doi.org/10.38015/sbyy.1031058.

[4] Siang, A. C., & Rao, R. K. (2003). Theories of learning: A computer game perspective. In *Proceedings of the IEEE Fifth International Symposium on Multimedia Software Engineering (ISMSE '03)* (pp. 239–244). IEEE.

[5] Lee, O., Eichinger, D. C., Anderson, C. W., Berkheimer, G. D., & Blakeslee, T. D. (1993). Changing middle school students' conceptions of matter and molecules. *Journal of Research in Science Teaching,* 30(3), 249–270.

[6] NPD Group. (2007). *The amount of time kids spend playing video games is on the rise.* New York: NPD Group.

[7] Turkish Think Tank – TBT. (2014). 1st Level Beginner Intelligence Games Instructor Training Book. Istanbul: Turkish Think Tank.

[8] Demirel, T. (2015). Evaluation of the cognitive and affective effects of using intelligence games in Turkish and mathematics lessons on secondary school students. (Unpublished doctoral thesis). Ataturk University, Erzurum.

[9] Çankaya, S., & Karamete, A. (2008). The effect of educational computer games on students' attitudes towards mathematics courses and educational computer games. *Mersin University Faculty of Education Journal,* 4(2), 115-127. https://doi.org/10.1016/j.sbspro.2009.01.027.

[10] Schumann, B. R. (2004). Effect of child-centered play therapy and curriculum-based small-group guidance on the behaviors of children referred for aggression in an elementary school setting (Unpublished doctoral dissertation). University of North Texas, Denton.

[11] Wells, D. (2012). Games and mathematics: Subtle connections. Cambridge: Cambridge University Press.

[12] Noraddin, E., & Kian, N. T. (2015). Three learning potentials in digital games: Perception of Malaysian university teachers. *Journal of e-Learning and Knowledge Society,* 11(2), 143-160.

[13] Prensky, M. (2008). Students as designers and creators of educational computer games: Who else? *British Journal of Educational Technology,* 39(6), 1004-1019.

https://doi.org/10.1111/j.1467-8535.2008.00823_2.x.

[14] Bayat, S., Kılıçaslan, H., & Şentürk, Ş. (2014). Examining the effect of educational games on the academic achievement of seventh-grade students in science and technology classes. *Abant İzzet Baysal University Faculty of Education Journal*, 14(2), 204-216. https://doi.org/10.17240/aibuefd.2014.14.2-5000091535.

[15] Statesman. Most popular U.S. learning apps for children. Statesman, [Online]. https://www.statista.com/statistics/1339244/most-popular-us-learning-apps-children/ (Accessed Date: December 26, 2024).

[16] Statesman. Most popular U.S. gaming apps for children. Statesman, [Online]. https://www.statista.com/statistics/1339232/most-popular-us-gaming-apps-children/ (Accessed Date: December 26, 2024).

[17] Udonis. Mobile gaming statistics. Udonis, [Online]. https://www.blog.udonis.co/mobile-marketing/mobile-games/mobile-gaming-statistics (Accessed Date: December 26, 2024).

[18] Statesman. Turkey: Top mobile game genres by downloads. Statesman, [Online]. https://www.statista.com/statistics/1449766/turkey-top-mobile-game-genres-by-downloads/ (Accessed Date: December 26, 2024).

[19] Kaygusuz, D., & Tunç, D. (2025). Educational Maze Game Source Code. GitHub, [Online]. https://github.com/dogancankaygusuz/LabirentOyunu-Pygame (Access Date: January 26, 2025).

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed in the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Creative Commons Attribution License 4.0 (Attribution 4.0 International, CC BY 4.0)

This article is published under the terms of the Creative Commons Attribution License 4.0 https://creativecommons.org/licenses/by/4.0/deed.en_US