TEACHING ALGORITHMS BY EDUCATIONAL DIGITAL GAME PROGRAMMING

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ABSTRACT: The researches conducted by scientific community shows that student spare more time on games than activities like reading books, watching television. The popularity of computer games, which caused huge addiction on people since the day they were introduced, is increasing day by day. Educational computer games are developed in order to create a better teaching environment by benefiting from people's interest in computer games. Through educational computer games, students have the opportunity to have fun while learning. Researches prove that learning through educational computer games becomes more persistent on students. In addition, students can learn complex and hard to learn concepts in an easier way. The history of computer games begins from 1960s. Formerly the games used to be composed of simple screen images, they are now have gained 3 dimensional and more realistic display. Educators began to consider computer games as a tool that can be used in education, after their achievements in 1980 and 1990s (Mayer et al., 1999). As a result of these studies, concepts as Computer Aided Education (CAE), Game Based Learning (GBL), and Digital Game Based Learning (DGBL) have emerged. Software/Algorithm development courses are fundamental courses for computer science related departments. Besides, among these courses, students usually consider issues as decision-control structures and loop structures rather hard to learn. An educational computer game is designed in order to teach students these subjects with the help of computer aided interactive digital games. Kodu Game Lab, a commonly used application in the market, is used to design the game. In the game, it is aimed that students to learn the topic in a persistent and entertaining way with the use of three-dimensional graphics.

Key words: Digital game based learning, game programming, kodu game lab

INTRODUCTION

Use of technology also became widespread in parallel with the rapid advancements in technology. There have been some changes in our lifestyle due to widespread technology. The expectation of society from individuals is also altered due these changes. Sınce one of the objectives of education is to train individuals with respect to society's expectations, it is now mandatory to train students that are compatible to information age (Kurbanoğlu and Akkoyunlu, 2003).

Talking about technology, the first technological product comes to our mind is computers. Computers are now usable in all fields due to advancing technology. At home, at school, at work, at grocery stores, shortly in every field and place that occurs to us, computers are used effectively.

Use of computers for education and teaching is named as computer aided education (CAE) in general. One of the sub branch of computer aided learning is educational computer games. Computer games composes the infrastructure of educational computer games. Computer games emerged with the diffuse of computers and became an indispensable aspect of our lives by getting popular in time. Educators began to consider computer games as a tool that can be used in education, after their achievements in 1980 and 1990s (Mayer et al., 1999).

Considering the developments in computer technologies and games, students interest in computer games and computers becoming a part of our daily lives; the use of computer games in education became a subject that should be emphasized on and utilized. Wıth the studies on this direction, the dullness of education performed through traditional methods will be overcome and education process will be joyous for students and a more persistent learning will be achieved (Tüzün and Bayırtepe, 2007).

Computer Games

What is a Computer Game?

In simple, computer games are a kind of software that are used via computers and played for entertainment purposes. Computer games may be defined through various technical terms. The most fundamental of these definitions is the definition goes as; computer game is an electronic interaction process where player sends electronic commands through user interface in order to get visual responses through a screen (Smed and Hokenen, 2003).

What is Digital Game Based Learning?

The use of electronic devices such as computers, tablet computers, smart devices in the education and training process that allows students to recognize their insufficiencies and performance, get control of their learning through feedbacks; be more involved in courses with the help of graphics, sounds, animations and images by means of interaction may be shortly defined as Digital Game Based Learning.

History of Computer Games

History of computer games goes back to 1960s. Computer games made a great progress since those dates to this date and now became an indispensable aspect of our day. Originally the game used to be composed of a simple screen image, it now converted to three dimensional (3D) more realistic structure.

History of Computer Games in The World

When mentioning computers games, the first name appears in minds is William Higinbotham. William Higinbotham formed the basis of computer games by developing a simple tennis simulation in 1960. Later in 1961, Steve Russell, Martin Graetz and Alan Kotok developed another game. This game is Spacewar, a space war game having two players option and a feature that allows players to launch torpedoes.

Figure 1. An Image from spacewar game

In 1970, Computer Space game is launched to the market by Bushnell. Busnell transformed the game into a console application what works with token by adding a few features (Uysal, 2005).

Figure 2. Computer space game console

In 1975, with collaboration of Aclorn and Bushnell a brand-new step is taken in gaming world with the development of Home Pong which is a different version of pong game, a game which can be set up on televisions by a connection through antenna input.

Figure 3. Home pong game console

In 1980 a new era in computer world is created with the launch of Pacman by Japanese gaming company Namco. Users completely managed their character's features in this game. Besides, Nintendo Company made a solid ground for itself with the launch of the game Donkey Kong. With the hype of arcade games that emerged in 1980s, young people spent over a billion dollars to play these games.

Gaming sector gained pace with the release of Commodore 64 computers with a price tag of approximately $600 in 1982. New steps were taken in gaming sector with the game Tetris that has been developed by Alexey Pazhitnow in 1985. Tetris game won great recognition with its basic graphics.

In 1989 Nintendo Company released mobile gaming console Gameboy. A cutting-edge era in gaming world has begun with Gameboy. Gameboy Company sold about 115 million Gameboy in 12 years. With the game, Mario Bros 3 that has been offered in Gameboy console a brand-new hype has begun with the rush of Mario Bros 3.

Figure 4. Game boy gaming console

After 1990s gaming sector accelerated. Lots of companies rapidly began launching their gaming consoles or games. Wolfenstein in 1993, Doom in 1994 and Quake in 1996 are released to the market as the best games of their period (Yılmaz, 2004).

In 1998, Half Life game that stormed through the world has been released. This game was a movie adaptation and gained the favor of various crowds.

Year 2000 became a great milestone for gaming sector. Quite new steps were taken for gamers with consecutive announcements of gaming consoles. Sony (Playstation), Nintendo (Gameboy Advanced), Microsoft (Xbox) companies created a great wave of excitement with their new console application releases. With the release of Sims game in 2003, a great step was taken for simulation games.

Gaming sector then became a market where great revenues are made. The improvement that took place from simple games of early periods to 3 dimensional games of today cannot be negated. Today various companies and people compete each other to obtain a place in this sector.

History of Computer Games in Turkey

Turkey first met electronic games in 1980s. Turkey became acquainted with gaming sector through Atari that was quite popular those days. Also, lots of our citizens met Commodore 64 computer towards the middle of that period. By this means, games came into our houses from Atari saloons ever after.

In 1990s, the newly emerging Internet cafes made young people who want to play games come together. With the penetration of other console applications to Turkey, many of our young people began gaming on various platforms.

However, advancement in terms of game development took place rather slowly in Turkey. Although it is not known by users all around the world, some advancement took place in our country.

Keloğlan game that was released in 1989 by Byte Computer were played on Commodore 64 computers. As for year 1992, a game named Hançer narrating the foundation of Ottoman Empire was released. In 1995, the game named "Legends of Istanbul: Tulip Warriors" was released.

Mevlüt Dinç, one of the popular names among Turkish game producers moved to Turkey in 2000 and proceeded his works here. His latest game named Dual Blades is among the unforgettable games of game boy fans. Today many people can develop basic level games. Considering today's technology and advancements of games, gaming sector is a business that is costly but profitable as well.

Degign Tools Used for Educational Games

Adobe Flash

Educational software, games, simulations, animations can be developed using Adobe Flash software. Adobe Flash is suitable for developing software for various platforms. It is favored by many people for its 2D and 3D support for users. We may develop very good applications on education using Adobe Flash that have been even more strengthened by Action Script 3.0 programming language.

Figure 5. Adobe Flash CC screen

Unity 3D

Unity 3D is one of the most favored softwares. Games and animations that are compatible with various platforms may be created using Unity 3D. Especially 3D users mostly prefer it. It offers its users many advantages thanks to its powerful engine and physical attributes. We may develop various educational software easily using powerful features of Unity.

Figure 6. Unity 3D screen

Scratch

It is a web-based programming language that has been developed by Massachusetts Institute of Technology (MIT). It is the most favored software by especially elementary and secondary school students. Because this software allows users to develop new softwares without requiring any software skills. Coding in Scratch is performed using blocks. Users add the predefined blocks in its library into each other to complete the programming. Using Scratch which is also supported by Ministry of Education, we may develop especially 2 dimensional applications easily and rapidly.

Figure 7. Scratch screen

Kodu Game Lab

It is a software developed by Microsoft. Computer and Xbox games may be developed using this software. Its primary objective is to teach programming while playing games. We may design entertaining and instructional games using this software which allows people that does not even have any coding skill to develop games. In this software games are designed using if conditions. Users apply if conditions to specific characters and attributes to design games. It is especially used in foreign countries to teach the logic of software development to kids in elementary schools.

Figure 8. Kodu Game Lab Application screen

Literature Review on Educational Games

Kaplan (2004) designed an educational computer game that may be used for instructional purposes in his thesis. Using this game model which is similar to Quest Atlantis educational game, it is aimed to teach kids in an entertaining way.

Tollefsrud (2006) proposed an editor software to develop educational games in his thesis. This editor software aims to teach students topics like mathematics, physics, and chemistry in an easy way.

Bruhn (2007) researched the effects of learning through simulation games on student success in his master's thesis. In his study, he lectured some topics to students using simulation games that are developed for educational purposes and investigated the effect of these games on students' learning skills.

Allen (2007) designed an educational game that is built on 4th grade mathematics syllabus in his thesis. Using this online game that is built as a MMORPG genre, students learned mathematics in an entertaining way.

Hangül et al. (2008) developed a mobile game that is used to illustrate the physics topic of projectile motion using three dimensional graphic technologies in their published article.

Gökdal (2008) designed an educational game for instructing engineering faculty students in his master's thesis. Designed game aims subjects to be learned very well by lecturing the courses taken by engineering faculty students using computer games.

Doğusoy and İnal (2009) published an article analyzing multiplayer computer games and their contribution to learning environment.

Ünal and Bay (2009) published an article attempting to execute computer aided teaching of Java programming language using the game they designed.

Güneş (2010) designed an educational game in MMORPG genre using Elektrogame and The Mana World in his thesis study. He contributed to elementary school 4th grade students' informatics course with the game he designed.

Fırat (2011) taught mathematics concepts to students by using the computer games he designed with animation software Flash in his thesis study. He confirmed the positive contributions of educational games to students in his study.

Akgün et al. (2011) published an article developing a new educational design model by examining the literature of design models used for educational game design process.

Genç and Karakuş (2011) published an article examining the convenience introduced by designing games using Scratch that is used to design educational games and its effect on students' opinion.

Gürbulak (2013) wrote a thesis on teaching pre-school kids the concept of colors using educational software developed by himself. He prepared an educational game that has a rich visual quality using animation software Flash. Thus, he mentioned how positively computer aided education contributes.

Aslan (2014) taught elementary school mathematics subject of probability questions by the educational game designed using Scratch software in his master's thesis. The students well comprehended probability problems with the help of this game. It is also observed that the attention of students has increased that are having fun while learning increases.

Yechshzhanova (2014) developed an educational game to help vocational high school students understand geometry course better in her master's thesis. She provided a better understanding of geometry course subjects to students especially with the help of effective utilization of 3 dimensional objects in the game she developed using Unity 3D software.

Demirtaş and Aslan (2015) studied the effect of game aided teaching to student success on instructing 5th grade course, acquisition of basic geometrical terms and drawing, in their article study.

Educational Digital Game Based Model Implementation

In this section, a simple game is designed using Kodu Game Lab software. The aim of this design is to teach students the "for loop" concept, which is one of the fundamentals of programming courses, hard to be comprehended by students and its mechanics is often confused in a simple manner. Our objective in the game that is developed simple enough to be understood by secondary school level vocational high school and upper secondary education students is to make them understand operating logic of two nested for loops.

When logged into the game, the robot character named Bilgin welcomes us. It is one of the main robot characters of the game that will assist us with annotations through the game.

Figure 9. The reception screen of the game

After the reception screen, the game begins once our character is directed to the castle using direction arrows of keyboard. Bilgin gives us information on for loop and its implementation before the game commences.
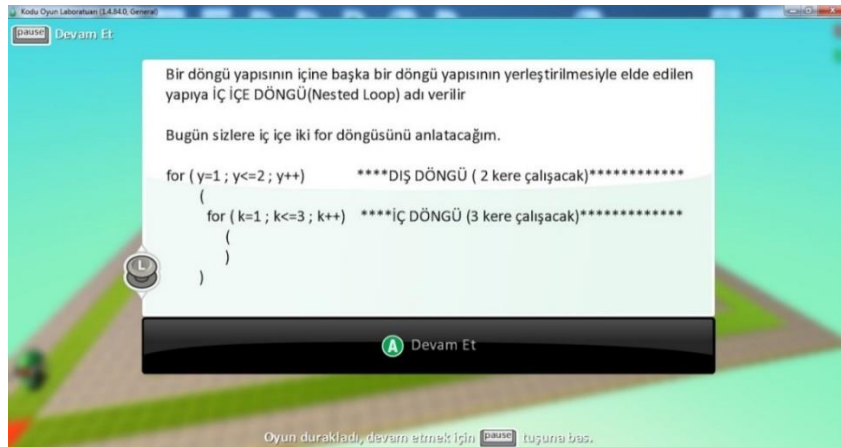

Figure 10. The moment of reaching the castle

Figure 11. For loop information display

After going through the information display, two robocycles and two tracks will appear on our screen. These tracks represent our outer and inner for loops. The track displayed in green represents our outer loop while the track displayed in orange represents our inner loop.
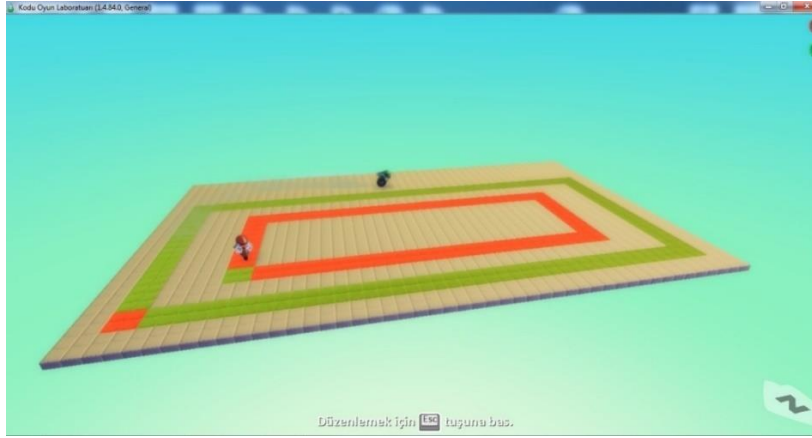
Figure 12. Game screen

Whenever the robocycle on the green track completes one round, the green counter on the top right corner of the screen increments by one. After green robocycle completes its round, Bilgin robot re-brief us again.
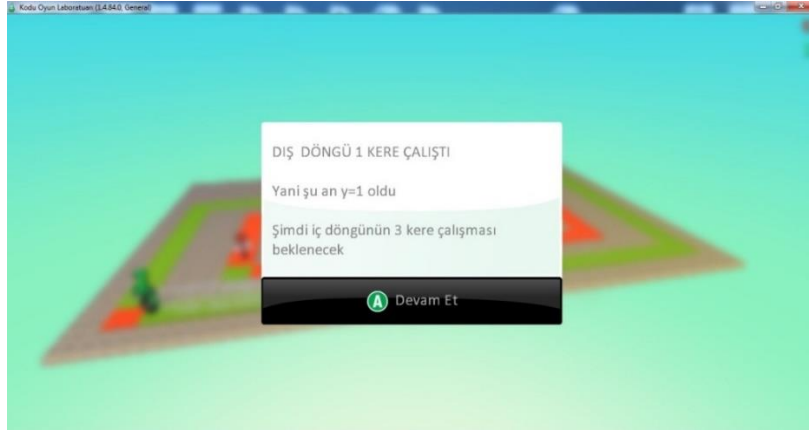

Figure 13. Outer loop information display

Green robocycle completing its first round indicates the first step of our outer cycle done its work. After the green robocycle stops, now our orange robocycle will begin moving and complete 3 rounds on its own track. Namely, our inner loop will function three times. The counter of our inner loop which is again on the top right corner of the screen will increment by one at the end of each round and when the counter hits 3, orange robocycle will stop.
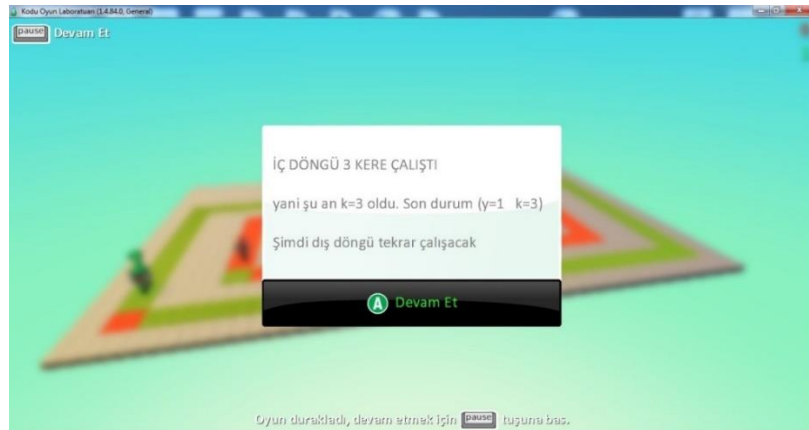

Figure 14. Inner loop information display

Inner robocycle will stop after completing three rounds and the green robocycle representing outer loop will once again begin its movement on its own track. Once the loop is completed, the counter representing outer loop will increment to two and green robot will stop again.
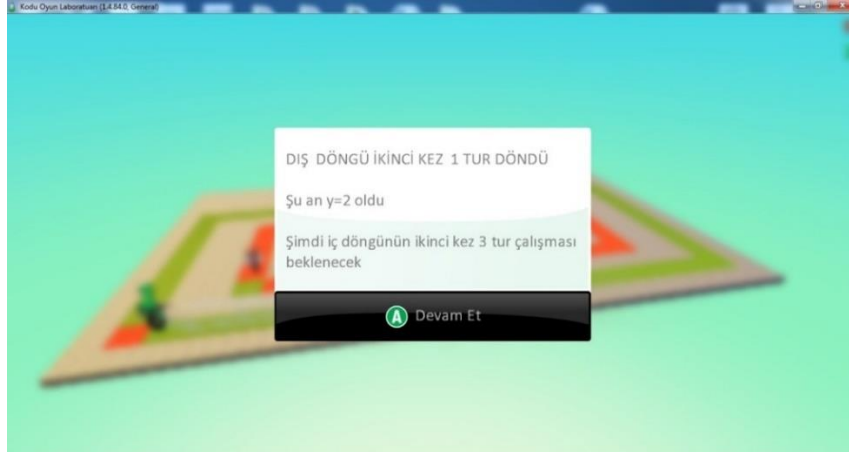
Figure 15. Outer loop information display 2

As soon as green robocycle stops, the orange robocycle representing inner loop will begin moving for the second time and complete its movement after taking three rounds. After completion of the rounds, our robot named Bilgin will step in again and will give brief information on processes conducted.
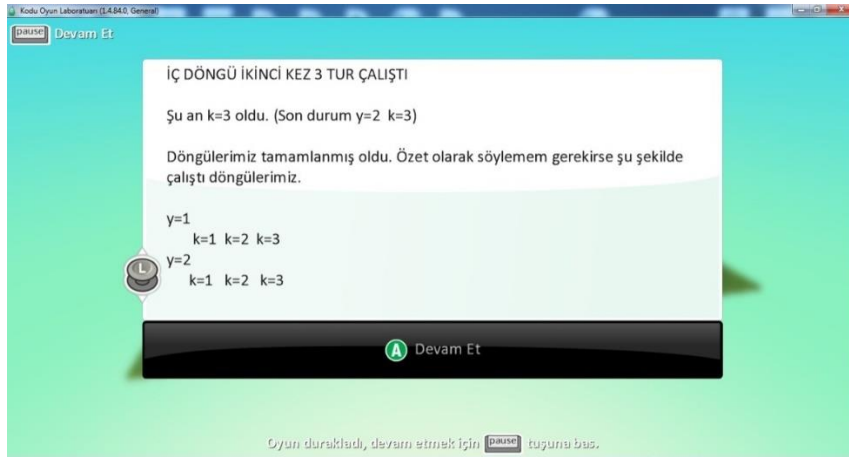

Figure 16. Summary screen

Finally, our robot will thank us and thus the game will be completed.
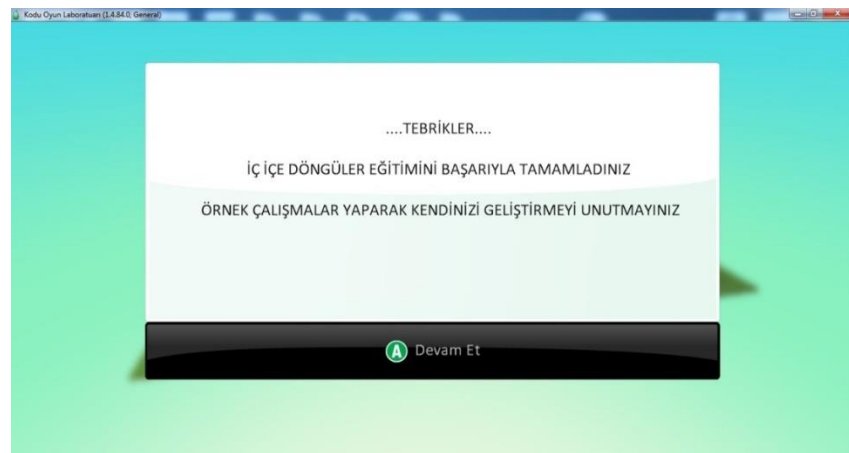

Figure 17. Game ending screen

With this designed game, visual illustration of the For-loop subject to students is intended. Its objective is to make students comprehend the subject better. The students will learn nested for loop concept in an entertaining way while playing a game.

CONCLUSION AND RECOMMENDATIONS

Researches show that in terms of education, successful and efficient results in students' academic achievement and development of positive attitude against courses among students are accomplished by game aided education. As a result of the point that technology reached these days, there is always a computer or smart phone with us, at home, at school, shortly in every moment of our life. In todays world where computers and mobile devices are widespread and every user now runs processes through computers, perceiving the idea of game aided learning as learning through digital media is a more appropriate opinion.

Based on this requirement, by teaching students the subject of decision loop structures, which is one of the main subjects of computer programming and its operating logic is usually confused by students, with the aid of educational digital games, absorption of this subject by students in a manner that is entertaining as well as it is persistent is aimed. Our game will be developed in further stages and will be a guide for teaching processes of other computer programming courses' subjects with the aid of educational digital games

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