LEARNING MATHEMATICS WITH EDUCATIONAL DIGITAL GAME PROGRAMMING

Şakir TASDEMİR
Selcuk University, Turkey

İnayet Hakkı ÇİZMECİ
Alaaddin Keykubat University, Turkey

Davut ALAN
Selcuk University, Turkey

ABSTRACT: Game may help those who play to acquire spiritual and cognitive skills. Acquiring these spiritual and cognitive skills stems from educational power of game because game educates while it is being played. It has a certain purpose. Persons try various ways for achieving this purpose. Each way experienced teaches persons' new things. Thus, the game may help to acquire spiritual and cognitive skills. Variety of game has increased by technological advancement. The first thing that comes to mind is digital games anymore. Such an increase in digital games seems to decrease concern of students for lessons. Associating lesson with game is aimed in this study in order to turn this situation into advantage. Thus, it has been considered that motivation and education of students would be easier. A model application has been created for this. Mathematics has been selected for this application which is the most difficult lesson for students. A game has been designed by the software named Scratch which was developed by Massachusetts Technology Institute (MIT). The game designed includes four operations. The game starts with addition, subtraction, multiplication or division that is chosen by student. Fishes with different colors drop according to the operation selected. Penguin eats these fishes dropped. Student is required to give correct answer to the operation asked in order that penguin eats the fish. Therefore he/she may increase the total point as score. Thanks to this application it has been seen that concern of students for lessons was increased and education became easier. Furthermore, total points may feedback teacher regarding to what extent the students comprehend the operation selected. These examples may be raised and brought in compliance with all lessons.

Key words: Scracth, Game programming, Enjoyable mathematics

INTRODUCTION

What is Game?

It can be said that game concept is an activity that improves cognitive and spiritual skills and made by people entertainingly, in a suitable period of time, within periods other than that of interests of people (Erkan, 2012). When describing the game as articles;

- *Game is an out picture of joy in life.*
- Game is a fact that attributes its existence to life.
- *It is a very serious interest for children.*
- *It is the most natural environment for learning. Because game is a laboratory environment in which children test and try what they heard and experienced; reinforce what they learned.*
- *It is realm of freedom. Game reflects inner world of children and dominates that world. It sets up rules itself and may change these rules.*
- *It is an environment in which children improve their skills.*

Game, in brief; may be classified as an activity that no one can have idea about end of it, based on will and is far away from external constraints and stress (Anonym, 2015). Activities as reading book or watching film are not active actions as active as playing computer games. Computer game is a virtual world in which you can animate your choices in games, designs in our minds and characters in games (Bostan and Tingoy, 2015). Games of such a virtual world have considerably drawn interest as advancements in technology. It is possible to say that the studies on improving and designing these games have increased.

It led to changes in quality of game, fun and spare time activities, as well. The fact which humankind uses to fill in time and to communicate each other has been influenced by changes. Change of game concept has led to some problems and implied some seeking for solutions to these problems as well.

Difference of Digital Game from Other Games

Digital game refers to adaption of a story system including a scenario by coding with visual elements and adding voice. Television and game console which is called as video control system presents various aspects to user. This case enables users to manage with bringing them into forefront (Yengin, 2012).

When we look at progress of digital games, it appears to have been advanced with entertainment purposes. It started to be used, over time, with education purposes not only with entertainment purposes. This case has increased gradually. Thus educational digital game concept has come into our lives. This concept may be described as game which includes cognitive, social, behavioral and emotional dimensions for a certain purpose and is prepared with technology and provides learning (Cetin, 2015).

Digital games have a different structure among other games. That being a software product is the primary difference. Cultural differences and age criterion is not taken into consideration for being a software product. This case gives rise to psychological problems. It also became an important issue to enable classification system according to age groups in order to remove these problems (Ozhan, 2012).

Issues to be Regarded While Developing Game?

Target group that will play the game is the first to be taken into consideration because this group gives imaginary opinions to game designer about how to design the game (Lobão and et al, 2008). We frequently hear educational game concept among education and learning concepts in an improving and changing world. When considering educational theories, it seems that educational games promote these theories. For example, according to cognitive educational theory, designer educators used strategies which particularly facilitate learning, stimulate prior knowledge, enable learning by setting cognitive links and gather attention (Simsek, 2009). Games which target entertainingly learning and are established connections with learning must be advanced by planning (Anonym (1), 2015). Therefore, it is critical to prepare educational game by considering properties of platforms which are used during design of educational games, the things that game motor to be selected can do and properties of platforms that it supports (Coban and et al, 2011).

LITERATURE SURVEY ABOUT EDUCATIONAL GAME

Fırat S., in his master's thesis, has examined effect of mathematical education by way of computer driven educational games on cognitive learning concerning some probability concepts. Pretest and posttest comparison, that is to say, quasi-experimental research model was used. Pretest and posttest comparison was used in order to come to a conclusion. The notion was reached that generalizing the use of computer driven educational games in mathematical learning is suggestible (Firat, 2011).

Kebritcki and Hirumi (2010) studied effects of computer games on mathematic success and motivation of students. İnitially, computer knowledge, English grammar and mathematic knowledge of students were examined. A group of student received their learning in ordinary class environment, while another group received their learnings with computer in laboratory environment. It has been observed that motivation of those with computer driven learning was better (Kebritcki and et al, 2010).

In the paper published by KULA A. et al. in 2005, they reveal effect of educational computer games on progress of basic arithmetic operation skill. Pretest and posttest comparison were applied fır 4^{th} and 5^{th} class students. Change was examined in tests. Looking at the change, some positive results were obtained regarding motivator and educative effect of game (Kula and Erdem, 2005).

In Çankaya S. master's thesis, some studies were conducted about primary education students regarding effects of educative computer games, which were designed for ratio and proportion, on students. A questionnaire was prepared and applied to students for this study and a positive relation between educational computer games and mathematical learning was observed (Cankaya, 2007).

In study of Erman Yükseltürk and Serhat Altıok, education game design was focused by using Scracth program of preservice teachers of information technologies. Examining the games prepared, it has been seen that it applies to the subjects in math class and games designed are reasonably good and very well (Yukselturk and Altiok, 2016).

Marina Papastergiou (2009), in a study, researched effects of digital game database on education effectiveness and student motivation. Students were observed during playing. A feedback questionnaire was made at the end of the playing out of observation. It has been observed that motivation of students regarding learning increased (Papastergiou, 2009).

An article was made, in 2015, in order to establish effect of game driven education environments on student success and views. Experimental and control groups were set up within the research. Educational games on vitamin education portal supported by Ministry of National Education were used. They were evaluated according to the criteria determined by researcher and compared with views of teacher. It has been observed that it influenced learning positively according to the evaluation. However, it was of the opinion that games must be improved by considering imperfections of learning (Akin and Atici, 2015).

Ron Owston et al., made some studies concerning advancement of computer game in order to learn pedagogical and literacy activities. Students were divided into 2 groups as developer and control group. Control group controlled the game that was designed after 10-week-period and finally positive effect of computer game on learning was found (Owston et al, 2007).

In article published by Bakar et al., views of students regarding used of educational computer game were revealed. Qualitative research methods were used with 6th class students for this view. As a result, it has been observed that the students appreciated educational game environment and motivation of them was increased (Bakar et al, 2008).

Model Application regarding Educational Digital Game

A game was developed in order to resolve the problems of children at elementary school regarding four operations and make learning enjoyable. Generally looking at the principal philosophy of this game, we can say that it improves skills of users on four operations.

When examining content of the game, it can be seen that the aim is to make students enjoy mathematics by both colored characters and game. An educational game has been developed for these operations through Scratch which is a web based programming language developed by Massachusetts Institute of Technology (MIT) (Anonym (2), 2015). So the games were enabled to reach the users quickly and easily. Furthermore, this game will contribute students to improve their skills regarding their hand-eye coordination.

Method and Procedure used in Education Digital Game

It is not an easy effort to develop game. Some stages should be completed to be able to develop game. These stages enable game to be playable, reach target group and reflect desirable features. Therefore, the stages must be carried out during developing the game in turn. This procedure consists of 5 stages.

Concept Creation

The aim, with developed game, is to make four operations in math enjoyable for primary school students. This aim constitutes fundamental philosophy of the game. Even though children are thought to play this game in parallel with this purpose, it enables persons with older ages to increase their achievements regarding four operations. This game leads to teachers to test what their students learned and to make lessons enjoyable.

Although each successful game is unique in itself, almost all of them will fall into a certain type. The game to be created is decided and other games of the same type are consulted (Anonym (2), 2015). Education game, as type of game, has been chosen within our study.

As to financial analysis, this game does not require a serious cost because software platform is presented to users free of charge.

Game design

Story creation should be a few pages. Story created will be heart of the game (Anonym (3), 2015). There is penguin character trying to eat fishes falling in our education game. The cause of choosing penguins and fishes is to attract attention of children to the game and identify difficult operations for children with favorite characters. User starts the game by choosing four operations. This character takes a standard point for each fish that it eats but if it tries to eat different colored ones among falling fishes, four operations are asked depending on chosen operation. If he

gives correct answer to the question, he takes ten points and continues the game but if he cannot know the question, the game ends. Moreover, the game also ends if different colored fishes are not caught. Thus, total scored points within the section of the game demonstrate to what extend he learned the subject.

Each character in a game that we could direct and play is a player character. Our character in our game is penguin. Each character which interacts with player character during the game is given character name which is not player. If we look at the character not player in our game, it is possible to say that these are fishes within the game.

The platform chosen for developing game will considerably influence the development. Platform determines the game in a controlled way; smart phone games are generally used with touch and slope basis, PC games, particularly keyboard, mouse, console games and game pad (Anonym (3), 2015). It is a PC based game and played with keyboard and mouse.

Art design

It is design of environment and character appearances. Penguins and fishes are designed in various colors in this game. These designs are designed with Adobe Photoshop software.

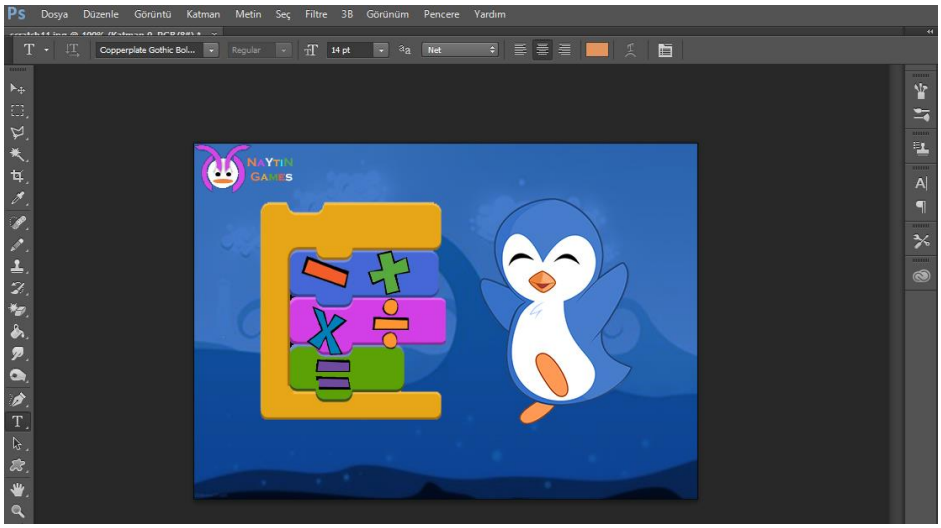

Figure 1. An appearance of game design

During adjusting voice and music, a voice is available that indicates eating action while penguin eats fishes. Also, there is another voice reporting wrong answer in the game.

Programing design

Scratch program was used in order to develop education game. This program can be downloaded from scratch.mit.edu.tr address. It has a design supporting forty-two foreign languages. Scratch was developed as a project supported by American National Science Institution in MIT University.

The project started in 2003 and completed in 2007. It aims to make youngsters who spend time in centers which operates in society, except for school in countries whose economic level is low, it means that it aims to increase technology use (Resnick et al, 2003).

When this new programming environment is being designed, following key features has been considered:
Programming with block structures: It has been provided that students can make program parts by swiping and dropping the graphically block structures.
Use of rich media as programmable: First activities in traditional programming teaching are structured on boring number, string and basic graphic processes. However, in this new programming environment, processes can be on the pictures, animations, film parts and sounds.

More shareability: Youngsters can share their projects and compare notes with their friends on web.
Integration with the real world: they can control machines in the real world also via some kind of hardware equipment which can be connected to computers.

Before forming the codes of our game, we prepare a flow diagram. This diagram will be helpful to us in encoding of our game. When diagram is observed, the significance of the choose process can be seen. Because in line with the chosen process, our game is directed.

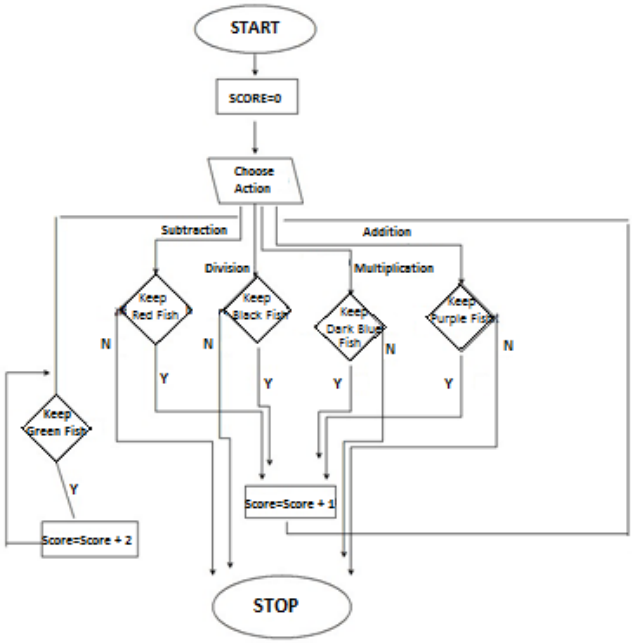

Figure 2. Algorithm of the game

When we come to encoding of our game we created our coding due to blocks in the Scratch Program. Thanks to those code blocks, we prepare ready codes in place of writing code by code. You can see some code blocks belonging to this game in Figure 3.

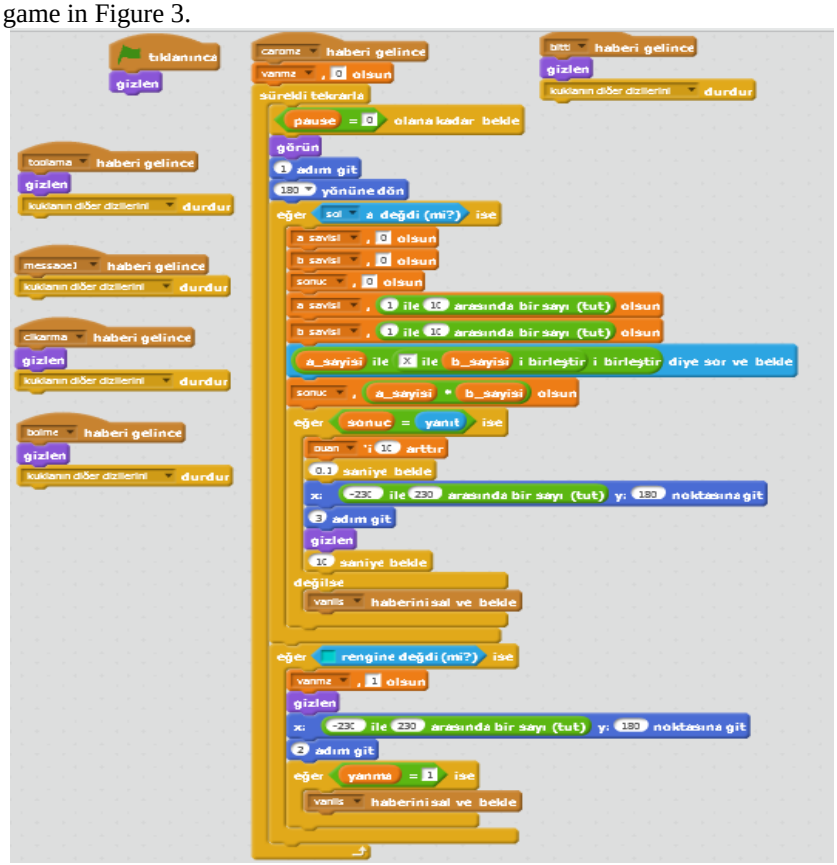

Figure 3. A sample from encoding of the game

RESULT AND RECOMMENDATIONS

Educational game can be defined as the most appropriate device for learning. With educational game, individuals can learn concepts which told to them more easily and those concepts are not erased from the memory in very long time. It can be said that the learning is healthy and clear because the learning was realized by entertaining (Anonym (4), 2015). In educational games, the individual faces with a goal and it is required to achieve this goal. The goal may be overpassing a certain point, completing the mission in a certain period etc.

Most children have a prejudice against math course. In order to break this prejudice, with educational computer games, it is provided that students create a positive concept. With this developed educational game it is understood that students move off from negative thinking by entertaining. It is observed that this game which is not limited with just students, helps reinforcing of four operations subjects learnt by elderly individuals. It also provides that teachers can take feedback of the taught subject from students. The achieved score may inform the teacher about how much of the taught information is learnt. In this way, it is provided that both reinforcing and feedback processes are realized by entertaining.

Our developed game will be able to help in learning and reinforcing of challenging subject by developed. Moreover, in the context of learning of all subjects, use of computer games will increase the quality of education.

CONTACT

Corresponding author: İnayet Hakkı ÇİZMECİ, E-mail: ihcizmeci@akdeniz.edu.tr

REFERENCES

Akın, F., Atıcı, B., (2015), Oyun Tabanlı Öğrenme Ortamlarının Öğrenci Başarısına ve Görüşlerine Etkisi, Turkish Journal of Educational Studies, Vol: 2 (2), Page:75-102.

Anonym, Access Date: 19.12.2015, http://yasamgucu.org/oyun-nedir-ve-turleri/

Anonym (1), Access Date: 19.12.2015, http://web.firat.edu.tr/icits2011/papers/27762.pdf

Anonym (2), Access Date: 17.12.2015, https://scratch.mit.edu/

Anonym (3), Access Date: 19.12.2015, http://www.wikihow.com/Make-Your-Own-Video-Game

Anonym (4), Access Date: 19.12.2015, http://www.egitseloyunlar.net/egitsel-oyun-nedir

Bakar, A., Tuzun, H., Cagiltay, K., (2008), Öğrencilerin Eğitsel Bilgisayar Oyunu Kullanımına İlişkin Görüşleri: Sosyal Bilgiler Dersi Örneği, Hacettepe University Journal of Education, Vol: 35, Page: 27-37.

Bostan, B., Tıngoy, O., (2015), "Dijital Oyunlar: Tasarım Gereksinimleri ve Oyuncu Psikolojisi", *AJIT-e: Online Academic Journal of Information Technology*, Vol: 6 -Num: 19.

Cankaya, S., (2007), "Oran- Orantı Konusunda Geliştirilen Bilgisayar Oyunlarının Öğrencilerin Matematik Dersi ve Eğitsel Bilgisayar Oyunları Hakkında Düşüncelerine Etkisi", *Master Thesis*, Balıkesir University, Institute of Science in Computer Education and Instructional Technology Department, Balıkesir- Turkey.

Cetin, E., (2013), Tanımla ve Temel Kavramlar**,** Mehmet Akif Ocak(Ed.), *Eğitsel Dijital Oyunlar Kuram, Tasarım ve Uygulama*, (s.2-6). Ankara: Pegem Academia.

Coban, M., Yıldırım, O., Goktas, Y., (2011), "Eğitsel Oyunların Tasarlanmasında Kullanılan Oyun Motorlarının Değerlendirilmesi", *5th International Computer & Instructional Technologies Symposium*, Fırat University, Elazığ-Turkey.

Erkan, U., (2012), "İşlem Oyununun Yapay Zeka Destekli Simülasyonu", *Master Thesis*, Gaziosmanpaşa University of Institute for Science and Mathematics Department, Tokat-Turkey.

Fırat, S., (2011), "Bilgisayar Destekli Eğitsel Oyunlarla Gerçekleştirilen Öğretimin Kavramsal Öğrenmeye Etkisi", *Master Thesis*, Adıyaman University, Institute of Science in Elementary Education Department, Adıyaman-Turkey.

Kebritchi, M., Hirumi, A., Bai, H., (2010), The Effects of Modern Mathematics Computer Games on Mathematics Achievement and Class Motivation, *Computers & Education*, Volume 55, Issue 2, September, Pages 427-443.

Kula, A., Erdem, M., (2005), Öğretimsel Bilgisayar Oyunlarının Temel Aritmetik İşlem Becerilerinin Gelişimine Etkisi, *Hacettepe University Journal of Education*, Vol: 29, Page: 127-136.

Lobão, A., Evangelista, B., Farias, J., (2008), "*Beginning XNA 2.0 Game Programming: From Novice to Professional*", The United States of America: Apress.

Owston, R. D., Wideman, H. H., Lotherington, H., Sinitskaya Rhonda, N., & Brown, C. (2007). Computer game development as a literacy activity. (Institute for Research on Learning Technologies Technical Report No. 2007-3). Toronto: York University.

Ozhan, S., (2012), "Dijital Oyunlarda Değerlendirme ve Sınıflandırma Sistemleri ve Türkiye Açısından Öneriler", Aile ve Toplum, Vol: 7, Num: 25.

Papastergiou, M., (2009), Digital Game-Based Learning in high school Computer Science Education: Impact on Educational Effectiveness and Student Motivation, *Computers & Education,* Vol: 52, Issue 1, Pages 1-12.

Resnick, M., Kafai, Y., Maloney, J., Rusk, N., Burd, L., & Silverman, B., (2003), "A Networked, Media-Rich Programming Environment to Enhance Technological Fluency at After-School Centers in Economically-Disadvantaged Communities", Proposal to National Science Foundation.

Simsek, A., (2009), *Öğretim Tasarımı*, Ankara: Nobel Press.

Yengin, D., (2012), *Dijital Oyunlarda Şiddet,* Istanbul: Beta Basım A.Ş.

Yukselturk, E., Altıok, S., (2016), Investigation of Pre-Service Information Technology Teachers Game Projects Prepared with Scratch, *SDU International Journal of Educational Studies,* Vol: 3, Num: 1, Page 59-66.