



New Trends and Issues Proceedings on Humanities and Social Sciences



Volume 4, Issue 9, (2017) 17-21

www.prosoc.eu

ISSN 2547-8818

Selected Paper of 3rd World Conference on Science and Mathematics Education (SCI-MATH-2017), 28-30 August 2017,
Bahcesehir University Besiktas Campus Istanbul, Turkey

Digital game design on the subject of identities and expansions

Selcuk Alkan^{a*}, Mustafa Kemal University, Alahan District, Atay St. Tayfur Sokmen Kampusu, 31060 Alahan-Antakya, Hatay, Turkey

Tuba Ada^b, Anadolu University, Yesiltepe District, Yunus Emre Campus, 26470 Tepebasi, Eskisehir, Turkey

Suggested Citation:

Alkan, S. & Ada, T. (2017). Digital game design on the subject of identities and expansions. *New Trends and Issues Proceedings on Humanities and Social Sciences*. [Online]. 4(9), 17–21. Available from: www.prosoc.eu

Selection and peer review under responsibility of Assoc. Prof. Dr. Murat Tezer, Near East University, Nicosia, Cyprus

©2017 SciencePark Research, Organization & Counseling. All rights reserved.

Abstract

This study aimed to design a digital game used in the teaching of identities and expansions and provide modelling by students. This game was designed according to the eighth-grade math curriculum. Unity3d game engine was used in designing the game. The software required to run the game was written by researchers using C# and java script. At the stage of designing, initially, the game was introduced to five mathematics teachers and various arrangements were made according to their opinions. Then, the game was evaluated and given the final form by two instructors who were experts in the field of mathematics education. In general, problems was designed that can be solved by dividing the rectangle given by 2 dimensional and given one edge like $(ax + b)$ into the sub rectangles such as x^2 , $2x$ and 1 and by writing the final result of how many sub-rectangles formed the whole rectangle. The teachers who participated in the evaluation of the game stated that the game was suitable for education and the students would gain interest in the game during the course. Teachers have criticised the game only on visual matters. For education to be more effective, the number of such games and materials should be increased. For design of more effective and more interesting games, we must collaborate with the experts in the field of fine arts.

Keywords: digital game; game; expansions; mathematics education

* ADDRESS FOR CORRESPONDENCE: **Selcuk, Alkan**, Mustafa Kemal University, Alahan District, Atay St. Tayfur Sokmen Kampusu, 31060 Alahan-Antakya/ Hatay, Turkey.

E-mail address: salkan@mku.edu.tr / Tel.: +90 326 221 33 17

1. Introduction

The success rate of mathematics is quite low than the intended level (Akin, 2010). As Pisa's (2015) results are examined, it has seen that the mathematics average was quite low compared to other countries and other courses. Especially, algebra is one of the most challenging mathematical subjects for students. Students fail to comprehend the meaning of letter expressions used to represent unknown concepts, hence they fail in this course (Pearson, 1992). In particular, the identities have a special place in algebra. Identities are generally referred to equations that are correct for all real numbers given to variables within. As more mathematically expression, identities are inequations that solution set is all real numbers (Yenilmez & San, 2008). The subject of identities underlies learning of algebra because of this feature.

The subject of identities starts to be taught since the eighth grade and forms the fundamental of many mathematical topics from polynomial to integrals. Students have difficulty in learning the subject of identities and expansions as they do in other topics of algebra. The most basic reason for problems that students experienced in the teaching of this subject is that identities and expansions are tried to be taught by memorising them. Geometric meanings of algebraic expressions should be taught and appropriate visual materials should be designed in order for education to be effective (Ozdemir & Duru, 2005). Especially, blending algebraic identities with geometric information and cross-linking both of them will facilitate better learning. Identities can be correlated with many topics in geometry, yet when taught related to topics such as space and volume, they will enable students to advance appropriate mental models (Yenilmez & San, 2008). The relationship between geometry and identities can be best provided by visual materials. Ozer and San (2013), in their study on the subject of identities and factorisation, found that visual materials were effective in the teaching of this subject and observed that visual materials increased the academic achievement of students by 60%.

2. Method

This study was designed based on the Digital Game Development model described by Kapp, Blair and Mesch (2014). According to this model, digital game design consists of two different stages. The first is the pre-production stage and the second is the production phase. The pre-production stage is the stage at which the educational objectives and the ideas about the structure of the game emerged. In educational objectives, which concepts will be taught and the approaches used in teaching these concepts, the contexts that will allow students to develop mental model for these concepts and the dimensions such as the target audience are determined. In the structure of the game, the dimensions such as the game story, levels and mechanics of the game are determined. The game was produced and teacher views about the game were collected in the second stage of the game.

2.1. Designing of the game

It was decided to use geometric shapes and the most suitable models for teaching the subject of identities. This model was used to solve the equations with two unknowns by ancient mathematicians like Harezmi in history. In this model, it was asked how many squares; one edge is x unit, one edge is 1 unit and rectangle one edge is x and 1 unit need to cover the area of square which edge is $x + b$ unit. Squares and rectangles are the expansion of the equation with two unknowns. Later, students are asked to write the number of square and rectangles in the box in game. The target group of the game is eighth-grade students because according to Ministry of education curriculum, the identity is eighth-grade subject.

Unity3d game engine was used to design the game. The reason for selection of Unity3d is its easy usage, and there are many resources that can be used during making process. C # and JavaScript were used as the code writing language of the game. The structure of the game was determined based on

levels. Accordingly, one who is successful at one level has the right to solve the question at the other level. Scoring is done in order to motivate the students, and each question is worth 10 points. Feedback and reinforcement are not given to prevent the interaction between the teacher and the student, as the game is planned to be played with the teacher in the classroom environment. Instead of this, there are information boxes saying that the answer is correct and wrong.

The second stage of the model defined by Kapp et al. (2014) is the production of game. This stage consists of writing codes for producing the game, production of game objects and trying and resigning of the game. Moreover, the trying of the game by the users is done in this stage after the design of the game. For this purpose, the effectiveness, playability and understandability of the game by the students were first shown to the teachers and opinions of them were taken.

2.2. Participants

Five middle school mathematics teachers working in Hatay/Antakya participated in evaluating the game. Teachers' demographic information is provided in Table 1.

Table 1. Demographic traits of teachers

	Gender	Years of experience
Teacher 1	Male	10
Teacher 2	Female	7
Teacher 3	Male	8
Teacher 4	Male	11
Teacher 5	Female	12

2.3. Collection of data

Teachers were introduced to the game before the data were collected. The game was also played by researchers and teachers. Then, the teachers were interviewed about the game and four questions were asked. Interviews were recorded using a voice recorder. The questions asked in the interview are as follows:

- Do these games contribute to students in terms of education, how?
- Do you use this game in class?
- What are the missing points you saw in this game?
- What can be done to develop the game?

3. Findings

Findings related to the first interview question: All the teachers said yes to the question 'Do these games contribute to students in terms of education, how?' Three teachers emphasised that the concept of identity is abstract and therefore usage of visual materials is significant in teaching this topic. Three teachers mentioned the existence of materials made of cardboard and paper, but two teachers mentioned that the materials were not useful and could not be used in classrooms.

Teacher 1: 'They already have concrete material on this topic. When we use them students learn better. However, we cannot use much since we do not time in class'.

Teacher 2: 'We are doing these kinds of activities using blocks, but it would be more rational if there will be the program in this way'.

Findings related to the second interview question: Four teachers said yes to the question 'Do you use this game in class?' One teacher stated that the use of the game in class is inadequate. This

teacher said that he/she could give as homework. Smart boards have been said to be available for this purported material. It has been said that smart boards can be used for such materials.

Teacher 3: 'I can use it in a classroom with smart board'.

Teacher 4: 'I think activities with paper and cardboard are more beneficial than these kind of materials'.

Findings related to the third interview question: Each teacher has given a specific answer to the question 'What are the missing points you saw in this game?' Especially, they have criticised in terms of image and shape, but these criticisms do not cause a great change in game.

Teacher 2: 'The type sizes of the edges of the square and rectangle edges given in the math game can be further enlarged'.

Teacher 3: 'The control panel may be in a more visible place'.

Teacher 4: 'The $x + 1$ (by showing edge) found here can be misinterpreted by the students. Therefore it is required to make clear that the whole edge is $x + 1$ '.

Findings related to the fourth interview question: The question 'What can be done to develop the game?' was asked and two teachers responded to this question. Especially, the first teacher emphasised the importance of the context.

Teacher 5: 'If you can put the game in a context like problems, the students will arouse more students' interest and the game will be more functional. It is even better if there is a problem that they encountered in daily life'.

Teacher2: 'It is more effective for students to find the edge of the big square themselves'.

4. Discussion and Conclusion

In many studies, it is seen that students have difficulty in understanding and comprehending the subjects of identity and two unknowns. Therefore, using of visual materials have been proposed in the teaching of these topics in many studies since especially the use of visual materials made easier to learn identities and solutions of equations with two unknowns (Akin, 2007; Flusser & Francia, 2000; Ozdemir & Duru, 2005; Ozer & San, 2013). Similarly, in this study, teachers who participated in the study emphasised that the materials facilitated the learning of the students and therefore the number of digital materials such as game should be increased.

Students achieve mathematical knowledge in learning environments where materials are used, and communication between students are achieved (Galindo, 1995). Fidan (2008), in his study, found that all teachers thought that materials were an important tool to reach mathematical knowledge, but they did not use them at the desired level. Moreover, teachers generally have positive attitudes towards technology. Utilisation of digital games compatible to smart board games will increase the use of in-class materials as they are easy to use and time-saving.

5. Suggestions

- Teachers generally liked educational digital games and found them valuable in terms of education. Therefore, the number of these kind of studies should be increased
- Taking the opinions of students in such studies and playing games together with the students can cause emerging of new ideas about the game.

- Five teachers participated in this study. However, increasing the number of teachers in such studies and using them in the classroom environment can lead to development of more successful digital game.
- Although there is need for engineering skills such as coding in digital game design, artistic skills such as colour match and design of object are also required. Therefore, it is essential to find researchers who have been trained in Fine Arts.

References

- Akin, M. F. (2007). *Ozdeslik konusunun ogretiminde yapilandirmaci ogrenme yaklasiminin ogrenme urunlerine etkileri* (Yayinlanmamis yuksek lisans tezi). Dicle Universitesi Fen Bilimleri Enstitusu, Diyarbakir, Turkey.
- Fidan, N. K. (2008). Teachers' view with regard to the use of tools and materials in the primary level. *Journal of Kuramsal Egitimbilim. AKU Education Faculty*, 1(1), 48–61.
- Flusser, P. & Francia, G. A. (2000). Derivation and visualization of the binomial theorem. *International Journal of Computers for Mathematical Learning*, 5, 3–24.
- Galindo, E. (1995). Visualization and students' performance in technology-based calculus. In *Proceedings of the 17th Annual Meeting of the International Group for the Psychology of Mathematics Education, Columbus, OH, 21–24 October 1995* (pp. 321–327).
- Kapp, K. M., Blair, L. & Mesch, R. (2014). *The gamification of learning and instruction fieldbook*. San Francisco, CA: Wiley.
- Ozdemir, M. E., Duru, A. & Akgun, L. (2005). Iki ve uc boyutlu dusunme: iki ve uc boyutlu geometriksel sekillerle bazi ozdesliklerin gorsellestirilmesi. *Kastamonu Egitim Dergisi*, 13(2), 527.
- Ozer, M. N. & San, I. (2013). Gorsellestirmenin ozdeslik konusu erisisine etkisi. *The Journal of Academic*, 6(1), 1275–1294.
- Tas, U. E., Arici, O., Ozarkan, H. B. & Ozgurluk, B. (2016). *PISA 2015 ulusal raporu*. Ankara, Turkey: MEB.
- Yenilmez, K. & San, I. (2008). Dokuzuncu sinif ogrencilerinin ozdesliklerin gorsel modellerini tanima duzeyleri. *Journal of Qafqaz University*, (24).