Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 191 (2015) 1479 – 1482

Procedia
Social and Behavioral Sciences

WCES 2014

Learning Basic Programming Concepts By Creating Games With Scratch Programming Environment

Ibrahim Ouahbi[a]*, Fatiha Kaddari[a], HassaneDarhmaoui[b], Abdelrhani Elachqar[a], Soufiane Lahmine[a,b]

[a]*Sidi Mohamed Ben Abdellah University - Faculty of Science Dhar El Mahraz - Laboratory of Didactic, Innovation Pedagogy and Curricular, PO BOX: 1796 Atlas-Fez, Morocco*

[b]*AlAkhawayn University in Ifrane- Center for Learning Technologies, PO BOX:1497, Avenue Hassan II, Ifrane, 53000, Morocco*

Abstract

A number of researchers have documented several difficulties faced by learners of basic programming concepts. Among the suggested pedagogical solutions to overcome these difficulties is the use of serious games inthe learning process. In fact, these games are more likely to boost the motivation of students and allow them to develop their knowledge efficiently. Our study focuses on evaluating such usage and the resulting students' motivation towards programming. We've made students create simple games using the Scratch game environment in order for them to learn programming basics. The experiment was conducted with a group of 69 high school science major students. This group of students was arbitrarily chosen and divided into three sub-groups. With the first sub-group we experimented with our pedagogical method based on the creation of simple games using Scratch environment. With the other sub-groups we used a conventional method based on Pascal programming language. Two surveys were distributed at the beginning and at the end of the experimentation in order to identify the programming level of students, their gaming habits, their motivation and interest for programming in the future. The analysis of the surveys shows that using an environment for learning programming such as Scratch highly motivate students and empower them to pursue their studies in programming. In fact, when learners were asked about their desire to continue their studies in programming, 65% of students who have experienced with Scratch environment consider continuing their studies in programming whereas only 10.3% of students who used a standard programming environment showed some interest.

Selection and peer-review under responsibility of the Organizing Committee of WCES 2014

*Keywords:*Serious games; introductory programming, scratch, motivation

* Ibrahim Ouahbi. Tel: +212- 663161656.
E-mail address ibrahim.ouahbi@usmba.ac.ma

Selection and peer-review under responsibility of the Organizing Committee of WCES 2014
doi:10.1016/j.sbspro.2015.04.224

1. Introduction

This study constitutes a major part of a reflection we are carrying out about the teaching and learning processes of basic programming at the high school level in Morocco. The interest is particularly linked to the issue of teaching algorithms and programming concepts to first year science major at Moroccan high schools. Our literature study reveals that several difficulties arise during the learning process of basic programming concepts such as program construction (Lahtinen, Ala-Mutka, & Järvinen, 2005), loops manipulation (Ginat, 2004), structures control and algorithms (Seppälä, Malmi, & Korhonen, 2006) Other studies suggested that these difficulties are mainly due to poor teaching methodologies, low interaction levels with students in class and lack of interest (Barker, McDowell, & Kalahar, 2009; Coull, & Duncan, 2011) The lack of interest of novice students is usually attributed to the fact that these students find programming full of tedious theoretical concepts and techniques (Bennedsen, Caspersen, & Kölling, 2008). Among the solutions to overcome these difficulties aforementioned, there's a call to change the programming working environment for students (Kelleher, & Pausch. 2005). A number of studies have been conducted to investigate the potential of a number of suggested programming environments for beginners such as Scratch (Wu, Chang, & He, 2010; Malan, & Leitner, 2007), StarLogo (Klopfer, & Yoon, 2004), kodu (Stolee, & Fristoe, 2011), and Alice (Kelleher, Pausch, & Kiesler, 2007). Another proposed solution is the use of video games (Barnes, Richter, Powell, Chaffin, & Godwin. 2007; Chaffin, Doran, Hicks, & Barnes, 2009; Liu, Cheng, & Huang, 2011). In fact, these games are likely to increase students' motivation for programming and allow them to develop their knowledge. More than that, this new pedagogical methodology can bring this new digital cultured youth interested more to the educational system. Some other researches have supported the idea of relying on the creation of video games or serious games to offer motivating educational activities for the learners either in schools or as an extracurricular activity (Kafai, 1995; Overmars, 2004). In our research, we mainly aim to test the following hypothesis: "The creation of simple games by students using a suitable programming environment for novices can improve the motivation of first year science major high school students for programming". The experiment was conducted with a group of 69 students arbitrary selected from the first year science major high school students. This group was divided into three sub-groups. We've use a new pedagogical teaching approach with the first sub-group based on the creation of games by students using the Scratch environment. The remaining sub-groups were thought the same basic programming concepts using a conventional method based on Pascal programming language.

2. Materiel and methods

2.1. Scratch environment:

Several introductory programming environments were designed to avoid common beginners' mistakes in programming such as syntax errors and logic. Therefore, instead of typing commands, most of these revolutionary environments use programming languages based on blocks. In this context, each block or brick is an element of the programming language: a control structure, an operator, a variable, or a function etc. These elements can be combined with "drag and drop" in an intuitive way according to a certain planned logic to form a computer program. In our study, we used the Scratch environment (http://scratch.mit.edu), developed by the Lifelong Kindergarten research group at the MIT Media Lab. This area is known for its educational and entertaining vocation. In addition to that, Scratch is a free and open source. It facilitates the creation of interactive stories, cartoons, games, musical compositions, and numerical simulations. More than that, it allows learners to share their creative work on the Web. Up to now, Scratch has a creative learning community of over two million registered users with 4,361,284 projects shared.

2.2. Course of the experiment:

This experiment was conducted with three sub-groups of common core scientific high school students in the city of Nador located in the north-east of Morocco. The experiment was carried out during the second semester of the 2012-2013 academic year. It was mainly introduced to test the hypothesis that the creation of games using a programming environment for novices can improve students' motivation to learn the algorithmic and programming

module.

A sample of 69 scientific common core students was chosen arbitrary. The procedures carried out are summarized in the following table:

Table 1: The experiment design

Sub-Group A	Sub-Group B	Sub-Group C
20 students	20 students	29 students
(13 females and 7 males)	(08 females and 12 males)	(17 females and 12 males)
A Method based on the creation of games using the Scratch environment with the computer studies teacher (P1) at the high school Abdelkarim Elkhattabi in the city center of Nador (L1).	A conventional method with the computer studies teacher (P1) at the high school Abdelkarim Elkhattabi in the city center of Nador (L1).	A conventional method with the computer studies teacher (P2) at the high school Nador Al Jadid in the city center of Nador (L2).
The multimedia room includes 10 computers and a video projector.		The multimedia room includes 10 computers and a video projector

A questionnaire was distributed to all students before teaching the module of algorithms and programming to determine their programming level and to identify their gaming habits. Throughout the learning sessions which we conducted with group “A”, we first presented the Scratch environment and had them develop simple games with this environment. Furthermore, several practical sessions have been introduced to create small programming pieces by using the suggested blocks. The learners intended to make games, animations, and stories. Then the students were asked to develop these small pieces of codes at home to design more sophisticated games with less functional scores and options. As for sub-groups “B” and “C”, a conventional method was used. This conventional method is based on Pascal programming language. These sub-groups had also conventional practical work sessions to learn the basics of programming. At the end of the algorithms and programming module, a questionnaire was distributed to test the students' motivation to pursue studies in algorithms and programming. The questionnaire targeted also learners’ opinion about the modules studied. It should be stressed here that before answering the questionnaires, students indifferent sub-groups were given a brief explanation of key terms used in the survey such as: creativity, fun, interesting , cooperative ...etc.

3. Results :

The objective of the questionnaire before the experiment was to identify the students’ level in programming. Among the 69 participants, 95% had no experience in programming whatsoever; the other 5 % had only a limited exposure to basic programming concepts. Concerning the effect of the programming environment on students’ interest in programming, 85% of students in sub-group “A” installed Scratch programming environment in their home computers against 17.2 % in the other groups for the Pascal programming environment. Only15% of students from sub-groups “A” found that programming with the Scratch environment is boring but in the other sub-groups “B” and “C”, 79.3 % of students found it monotonous and boring to program with a conventional environment. We also noticed that the creation of games and stories to learn the programming basics can empower students and make them more creative and autonomous. 90 % of students in sub-group “A” thought and/or tried to make games on their own with Scratch whereas only 37.9% of the students in the other sub-groups intended to create their program with the conventional environment. We should also mention here the positive reactions of students in sub-group “A” at the end of each experiment in the practical work sessions. They were enthusiastic and applauded each other about their achievements. They were eager to watch each other creations and work. One student in sub-group A made the following comment to express his fulfilment: "This is great; we are really playing and learning". Other students have presented their own achievements to other school friends. There was really an interesting exchange and an apparent dynamism in the work of pairs that was totally absent in sub-groups “B” and “C”.

Finally, when the learners were asked about their desire to continue their studies in programming, 65% of students in sub-group A consider continuing their studies in programming while only 10.3 % of students in the other sub-groups do.

4. Conclusion

In this article, we presented motivation results of our use of Scratch environment in teaching basic programming at the high school level. Scratch allowed beginners to implement animations and games. They became familiar with the fundamentals of programming without worrying about syntax. Our results show that the use of Scratch environment for learning programming can motivate the students and empower them to continue their studies in programming. In this context, we propose to use the Scratch environment in an introductory course of programming for first year high school students.

Acknowledgements

We acknowledge the help and assistance of Mr. Mohamed BOUGHARDAIN in conducting some of the experiments related to this work. We're thankful to him.

References

Barker, L. J., McDowell, C., & Kalahar, K. (2009, March). Exploring factors that influence computer science introductory course students to persist in the major. In *ACM SIGCSE Bulletin* (Vol. 41, No. 1, pp. 153-157). ACM.

Barnes, T., Richter, H., Powell, E., Chaffin, A., & Godwin, A. (2007, June). Game2Learn: building CS1 learning games for retention. In *ACM SIGCSE Bulletin* (Vol. 39, No. 3, pp. 121-125). ACM.

Bennedsen, J., Caspersen, M. E., & Kölling, M. (Eds.). (2008). *Reflections on the Teaching of Programming: Methods and Implementations* (Vol. 4821). Springer.

Chaffin, A., Doran, K., Hicks, D., & Barnes, T. (2009, August). Experimental evaluation of teaching recursion in a video game. In *Proceedings of the 2009 ACM SIGGRAPH Symposium on Video Games* (pp. 79-86). ACM.

Coull, N. J., & Duncan, I. M. (2011). Emergent requirements for supporting introductory programming. *Innovation in Teaching and Learning in Information and Computer Sciences*, *10*(1), 78-85.

Ginat, D. (2004). On novice loop boundaries and range conceptions. *Computer Science Education*, *14*(3), 165-181.

Kafai, Y. B. (1995). *Minds in Play: Computer Game Designs as a Context for Children's Learning*. Routledge.

Kelleher, C., & Pausch, R. (2005). Lowering the barriers to programming: A taxonomy of programming environments and languages for novice programmers. *ACM Computing Surveys (CSUR)*, *37*(2), 83-137.

Kelleher, C., Pausch, R., & Kiesler, S. (2007, April). Storytelling alice motivates middle school girls to learn computer programming. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 1455-1464). ACM.

Klopfer, E., & Yoon, S. (2004). Developing games and simulations for today and tomorrow's tech savvy youth. *TechTrends*, *49*(3), 33-41.

Lahtinen, E., Ala-Mutka, K., & Järvinen, H. M. (2005, June). A study of the difficulties of novice programmers. In *ACM SIGCSE Bulletin* (Vol. 37, No. 3, pp. 14-18). ACM.

Liu, C. C., Cheng, Y. B., & Huang, C. W. (2011). The effect of simulation games on the learning of computational problem solving. *Computers & Education*, *57*(3), 1907-1918.

Malan, D. J., & Leitner, H. H. (2007). Scratch for budding computer scientists. *ACM SIGCSE Bulletin*, *39*(1), 223-227.

Overmars, M. (2004). Teaching computer science through game design. *Computer*, *37*(4), 81-83.

Seppälä, O., Malmi, L., & Korhonen, A. (2006). Observations on student misconceptions—A case study of the Build–Heap Algorithm. *Computer Science Education*, *16*(3), 241-255.

Stolee, K. T., & Fristoe, T. (2011, March). Expressing computer science concepts through Kodu game lab. In *Proceedings of the 42nd ACM technical symposium on Computer science education* (pp. 99-104). ACM.

Wu, W. Y., Chang, C. K., & He, Y. Y. (2010, May). Using Scratch as game-based learning tool to reduce learning anxiety in programming course. In *Global Learn Asia Pacific* (Vol. 2010, No. 1, pp. 1845-1852).