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Integrating Games to Teach a First Programming Course

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ABSTRACT: In the past few years, there has been an increased interest in game-based learning as a powerful tool to stimulate students' interest and promote their engagement in the learning process. In this paper, we discuss our experience in integrating gaming to teach a first programming course. The course is restructured and redesigned to allow teaching the basics of programming through games. Students actively use fundamental programming concepts learned to modify and create two dimension games using C# and XNA with .Net framework. This is an on-going work. Surveys and worksheets are developed to be used in assessing the effectiveness of the proposed approach.

1. INTRODUCTION

The education literature reports many works related to efforts dedicated to new methods for enhancing teaching in many areas (e.g. Patton 2004, Vuokko and Berg 2000). Game-based learning has lately emerged as a powerful tool for effective teaching (Jonnavithula and Kinshuk 2005). In computer science, this teaching strategy has been proposed for different courses such as software programming (e.g. e.g. Chen et al. 2008 and Long 2007) and computer programming (e.g. Leutenegger and Edgington 2007, Eagle and Barnes 2008, Ceder and Yergler 2003, Miles 2008). The intent is to motivate students and increase course enjoyment (Cliburn 2006). These efforts are aimed at improving retention levels at computer science departments that tend to be low (Carver et al. 2007). This objective is particularly important when looking at national statistics about students' enrolment in computer science majors. According to the National Sciences Foundation statistics for 2006, only 1.6 % of all freshmen intended to major in Computer Sciences compared to 5.2% in 2000 (NSF). Moreover, the percentage of African American freshmen who intended to major in Computer Sciences that year was 14% only. This is a decrease compared to 2005 when this percentage was 17.4% (NSF).

Game-based learning also helps enhancing first-year students' performance in programming courses which is not at its best (McCracken 2001). This is achieved by stimulating students' interest and promoting their engagement in the learning process since the use of technology and digital graphic tools are an integral part of the millennium student's life.

2. TARGETED POPULATION

The first programming course offered in the department of Computer Science & Engineering at Johnson C. Smith University is restructured and redesigned to allow teaching the basics of programming through games. Students who take this course have typically no previous knowledge of programming. The course is a multiple sections course with typically a maximum class size of 20. Female students typically represent thirty to fifty five percent of total students in each section.

3. METODOLOGY

Our proposed methodology seeks to take advantage of the gaming features such as graphics and user interaction in order to reinforce fundamental programming concepts. Using graphical objects for example, makes it easier for students to visualize their logical errors and realize that the compiler does not notice them contrary to their syntax counterparts. Thus gaming is used as a supporting resources rather than a major learning outcome. The challenge is to find a good trade-off between core programming notions to deliver and gaming functionalities needed such as creating sprites or loading fonts. In our methodology, games are first used to motivate students and stimulate their curiosity to learn more about the concepts behind them. Students then use fundamental programming concepts learned to modify and create two dimension games using C# and XNA with .Net framework. Some detailed examples are given in the following.

A game can be executed at the beginning of the course to motivate students and roughly introduce them to basic notions of object-oriented programming such as classes, objects, etc... The link between classes and objects can be easily explained and demonstrated by running an empty game which is a class where no attributes are specified.

Simple games can also be used to introduce data types, variables, values and to explain and demonstrate the difference between these last two. This can be achieved for example by giving students a simple game where a sprite is standing at a given location on the screen and

asking them to change the location of the sprite, change the sprite itself or change the background color.

Simple games can also be used to reinforce single selection instructions and their use. Stopping a moving sprite when it reaches a given position on the screen is an example which can be used to this end. This example also exposes students to using arithmetic operations necessary to moving the sprite.

Introducing double selection instructions can also be enhanced through a game that displays a smiley face if the player's answer to a simple arithmetic operation is right or an angry face, otherwise.

As the course material advances, students are given assignments where they are asked to apply the programming concepts learned to create simple games. Students are encouraged to be creative and to work in groups of two members. Promoting creativity helps students building their own knowledge, developing their critical thinking and reflection skills; and fostering their problem solving abilities. On the other hand, collaborative learning promotes peer-learning which has been proven to be effective in improving students' engagement and facilitating their learning process.

4. CONCLUSION

In this paper we present our experience in integrating gaming to teach a first programming course. The course is restructured and redesigned to allow teaching programming concepts through games. The proposed approach takes into account the trade-off between core programming concepts to deliver and gaming functionalities needed to use the gaming software. Current work is aimed at developing surveys and collecting data to assess the effectiveness of the proposed approach. Preliminary observations show that the redesigned course captivates students' interest and increases their participation in both in-class activities and homework assignments.

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