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A Proposed Framework for Simulation Based Learning of Inheritance

Abdelbaset Jamal Abdellatif  
Computer Science Department  
Queen’s University Belfast  
Belfast, UK  
aabdellatif01@qub.ac.uk

Barry MacCollum  
Computer Science Department  
Queen’s University Belfast  
Belfast, UK  
b.mccollum@qub.ac.uk

Abstract—Different types of serious games have been used
in elucidating computer science areas such as computer games,
mobile games, Lego-based games, virtual worlds and web-
based games. Different evaluation techniques have been con-
ducted like questionnaires, interviews, discussions and tests.
Simulation have been widely used in computer science as a
motivational and interactive learning tool. This paper aims
to evaluate the possibility of successful implementation of
simulation in computer programming modules. A framework
is proposed to measure the impact of serious games on enhancing
students understanding of key computer science concepts.
Experiments will be held on the EEECS of Queen’s University
Belfast students to test the framework and attain results.

Keywords—Simulation, Serious games, Computer Science, e-
learning, experiment.

I. INTRODUCTION

Electronic Learning (e-learning) is the practice of dis-
tributing knowledge and training via electronic formats like
text, audio, video, simulation, virtual classrooms, labs and
mobile phones [1]. The European commission defines e-
learning as using the Internet and multimedia to enhance the
quality of learning by enabling collaboration and offering
access to resources and services [2]. Schools, universities
and corporations have been widely using it for learning and training; moreover they have been investing significant
amounts of time and money for developing such alternative
for traditional way of learning which is limited to classroom
teaching [3]. Games have acquired an extensive fame in the
last years with a massive industry of 155 million users and
$22.4 billion per year in the US alone; however only small
percentage (5%) of the games acquired in the US where
developed for educational purposes[4]. Simulation is a great
example on educational games that could be applied in the
context of e-learning and has been defined as an “art and
science of creating a representation of a process or system
for the purpose of experimentation and evaluation” [5]. It
is the process of reproducing a procedure where learner can
apply his knowledge on with no risk and by saving time and
money. Simulation has been used in teaching and training
as part of e-learning due to its efficiency and effectiveness
[6]. It is applied on different disciplines such as medicine,
business, management, military, engineering and computer
science. Various serious games and simulations have been
conducted on computer science topics like software project
management, operating systems, computer assembly and
computer programming which attracted more interest over
the other topics because students and teachers confronted
different difficulties learning and teaching computer pro-
gramming [7]; furthermore students faced several problems
understanding the concepts of Object Oriented Programming
(OOP) like classes, objects, recursion and inheritance [8].

The organization of this paper is as follows; Simulation
Studies is discussed in section 2, proposed framework is
described in section 3, finally discussion and conclusion are
provided in section 4.

II. SIMULATION STUDIES

A. General Simulation Studies

The use of simulations and games has a significant
positive correlation in enhancing the students learning and
knowledge; moreover developing their skills such as team
working and communication [9],[10]. Despite the fact that
there is a future for simulation games, there is a need for
more corporation between industry and academia to create
that software, technical, institutional, personal and cultural
issues should be fully measured and resolved to be able to
achieve a successful e-learning system in developing coun-
tries. [13],[14] proved that simulation games embrace deeper
learning; however educational technology and educational
content is vital to achieve the educational goals. [15] stated
that simulation games became less effective the longer the
game was used which means trainees became bored over
time; nevertheless posing challenges in the game introduce
a competitive feature with the simulated game that enhanced
the students learning and eliminates the bored factor [16].

B. Computer Science Simulation Studies

[17] conducted an experiment on university students,
where they played a Massive Multiplayer Online Role Play-
ing Game (MMORPG) named CMX to learn programming
arrays in C programming language. The study showed that
students have increased their understanding and knowledge
levels by playing the game. In Addition the majority of
the students stated that they want to use other educational
games in learning programming, due to enjoying the way
of learning and because they felt motivated in doing the
required tasks. In agreement with this [18] conducted a
test on students after taking a game called Java Ninja
which is a game to help students understand inheritance in OOP. All the students enjoyed the game and want it to be involved in covering other concepts in learning. Also the study concluded that most students showed significant improvement. [19] conducted a study on computer science university students, where students have used Sifteo Cubes as a technological resource that offers interaction with tangible user interaction to learn C# OOP. The findings of the study showed that students showed a higher interest level and felt more motivated. In line with [20] conducted a study on students in Taiwan who played a problem-based educational game for teaching knowledge of computer assembly named Boom Room. The results were that the game is useful for learning and fulfil learners with its design elements; however the results showed that the usability of the game require enhancement. Furthermore the authors stated that adding challenges to the game may increase the acceptance of the game.

III. PROPOSED FRAMEWORK

Robocode is a short for "Robot code" and it is an Open Source project, it is a Java programming game, where the goal is to code a robot battle tank to compete against other robots in a battle arena. The player is the programmer of the robot, who will have no direct influence on the game. Instead, the player must write the artificial intelligence (AI) of the robot telling it how to behave and react on events occurring in the battle arena by overriding the Super-class methods. Battles are running in real-time and on-screen. In this study, Robocode game will be used as a tool to measure the impact of simulation games on enhancing students learning. The first phase of this study will be a competition between Year 1 students of Electronics, Electrical Engineering and Computer Science (EEECS) in Queen’s University Belfast. This paper suggests a six stages framework to measure the impact of serious games on enhancing students understanding of key computer science concepts, Figure 1 shows the proposed framework. The Stages are:

- Stage 1: Students will get an induction about the game and how to develop and customize their own tanks.
- Stage 2: Pretest will be held on students to evaluate their understanding of Inheritance.
- Stage 3: Students will be given a period of one week to develop and prepare their tanks and they can friendly battle against each other.
- Stage 4: A session of one hour will take a place, where competitors will be chosen through a draw, then the battle will start and the player who gets three out of five will be the winner, because the starting position of the tanks will be randomly generated each battle.
- Stage 5: Post test will took a place to measure the game impacts on students understanding.
- Stage 6: Competition might be repeated based on the results of the post test.

Further, the second phase will be the evaluation of the competition results (comparison of students results between pre and post tests). Previous studies have used the same evaluation technique of pre and post tests to measure simulation impact on students [21]. According to the evaluation the proposed framework might be modified and expanded to address any issues that might arise during the first phase. The final phase will extend the proposed framework to be used in further experiments on different classes and different levels (year 1, year 2, year 3) and maybe broaden to postgraduate students who are taking a conversion Computer Science master’s degree due to their work experience to measure their experiences with simulation games.

Figure 2 shows a screen-shot of the battlefield where pre-programmed tanks face and fire at each other, until one tank dies. Figure 3 shows the code of a basic tank, where students will implement and override the Super-class Robot methods, to customize their own tank, in terms of movement, offence and defense.
IV. DISCUSSION AND CONCLUSION

[21] concluded that the use of simulation is a money saver which increase the use of simulation; conversely [22] stated that using simulation requires high cost due to the need to develop a specific system to match the training course needs. Furthermore [23] highlighted other limitations of using simulation rather than the high development cost, such as: eliminating face-to-face communications, limitation of students assessment and feedback and the need of suitable infrastructure along with high bandwidth. Nevertheless the study stated that using simulation enhance group collaboration, save travel cost and time for students and will offer a free time and place access. This study aims to measure the impact of simulation and serious games in teaching computer science, a six stages framework was introduced. According to the proposed framework the experiment is assessed in two areas:

- Quality of the experiment, assesses the merit of the usage of simulation in a certain computer science concept.
- Potential for adoption, assesses the factors that may prevent or encourages the adoption of simulation.

At this point we are in the process of taking approvals from the EEECS committee to run out the experiment during the second period of the Spring semester 2015-2016. It is expected that the experiment results from the proposed framework will affirm the positive impact of using simulation in computer science teaching. Further experiments will be conducted and analyzed to gain precise and reliable results. Additionally this framework must be tested so that it could be generalized into other disciplines and to identify the possibility of integration between simulation and other technologies.

REFERENCES


