A Proposed Framework for Simulation Based Learning of Inheritance

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***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 conducted 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 distributing 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 programming [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 better simulation products [11]. In addition [12] concluded 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 countries. [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 Playing 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.

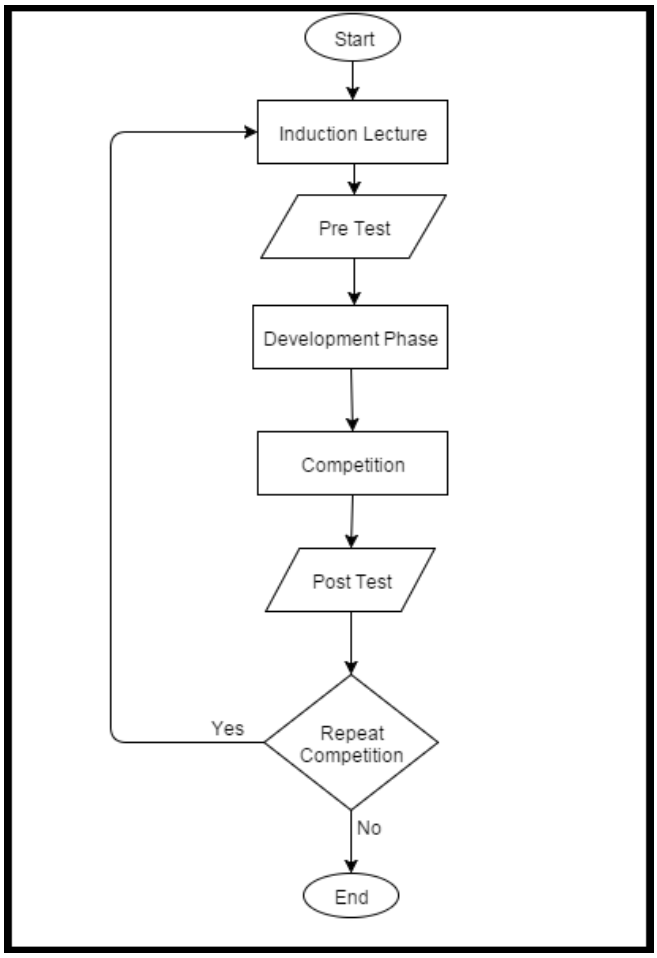

Fig. 1. Proposed framework.

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.

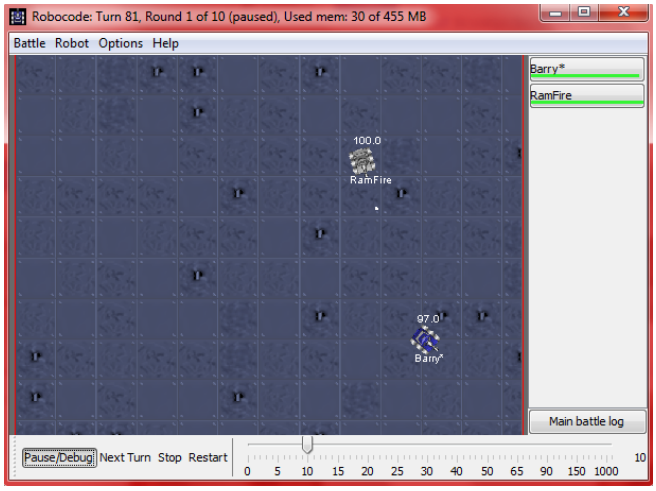

Fig. 2. Battlefield screen-shot.

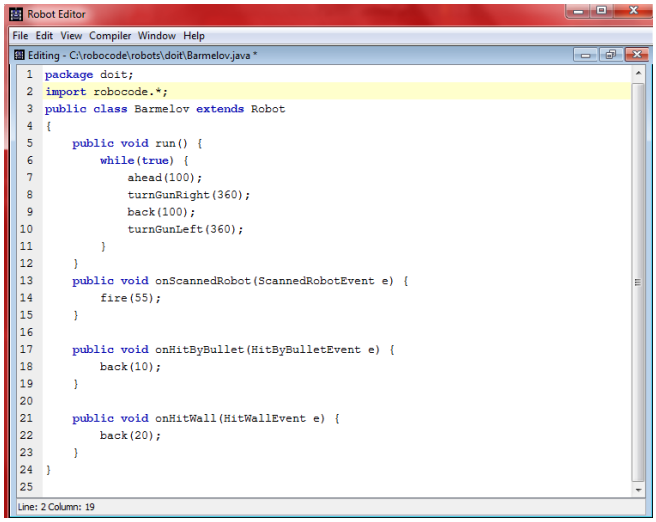

Fig. 3. Simple Tank code

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

[1] Digwo, U., Oderinde, D., and Brown-Huston, M., (2010) 'Leveraging e-learning in organizations: challenges, benefits and models for adoption'. UK Academy for Information Systems Conference Proceedings 2010. Paper 17.

[2] Dominici, G. and Palumbo, F., (2013), How to build an e-learning product: Factors for student/customer satisfaction. Business Horizons, 56 (1), 87-96.

[3] Wang, Y., Wang, H., and Shee, D., (2005) 'Measuring e-learning systems success in an organizational context: Scale development and validation'. Computers in Human Behavior, Vol. 23 No. 4.

[4] Hollins, P., Westera, W. and Manero, I. B., (2015), "Amplifying applied game development and uptake", Paper accepted at ECGBL 2015.

[5] Gogg, T. J. and Mott, J. R. A., (1993), Web-based simulation: some personal observations. Paper presented at the Proceedings of the 28th conference on Winter simulation.

[6] Vogel, J.J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K. and Wright, M., (2006), Computer gaming and interactive simulation for learning: a meta-analysis. Journal of Educational Computing Research, 34(3), 229-243.

[7] Ragonis, N. and Ben-Ari, M., (2005), A long-Term Investigation of the Comprehension by Novices. Computer Science Education, Vol. 15, No. 3, 203-221.

[8] Yan, L., (2009), Teaching object-oriented programming with games. In Paper presented at the ITNG 2009 6th international conference on information technology: New generations, 969-974. Las Vegas, Nevada.

[9] Loon, M., Evans, J. and Kerridge, C., (2015) "Learning with a strategic management simulation game: A case study", The International Journal of Management Education 13, pp 227-236.

[10] Slotte, V. and Herbert, A., (2008) "Engaging workers in simulation-based e-learning", Journal of Workplace Learning Vol. 20 No. 3, pp. 165-180.

[11] Pongpanich, Ch., Krabuanrat, T. and Tan, K., (2009) "Educator insight on simulations and games: a comparative study between business schools in Thailand and the UK", On the horizon, VOL. 17 NO. 4 2009, pp. 323-329.

[12] Farid, S., Ahmad, R., Niaz, A.I., Arif, M., Shamshirband, S. and Khattak, D.M., (2015) "Identification and prioritization of critical issues for the promotion of e-learning in Pakistan", Computers in Human Behavior 51, pp 161-171.

[13] Navimipour, J.N. and Zareie, B., (2015) "A model for assessing the impact of e-learning systems on employees' satisfaction", Computers in Human Behavior 53, pp. 475-485.

[14] Nguyen, N.T., (2015) "Motivational Effect of Web-Based Simulation Game in Teaching Operations Management", Journal of Education and Training Studies Volume 3 No. 2.

[15] Garris, R., Ahlers, R. and Driskell, J.E. (2002) "Games, Motivation, and Learning: A Research and Practice Model", Simulation and Gaming No. 33, pp.441-467.

[16] Misfeldt, M., (2015) "Scenario Based Edcation as a Framework for Understanding Students Engagement and Learning in a Project Management Simulation Game", The Electronic Journal of e-Learning Volume 13 issue 3, pp 181-191.

[17] Malliarakis, C., Satratzemi, M. and Xinogalos, S., (2014), "CMX: Implementing an MMORPG for Learning Programming", Proceeding of the European Conference on Games-based Learning, 1, 346-355.

[18] Zhang, J., Caldwell, R.E. and Smith, E., (2013), "Learning the Concept of Java Inheritance in a Game", The 18th International Conference on Computer Games.

[19] Corral, R.M.J., Balcells, C.A., Estvez, M.A., Moreno, J.G. and Ramos, F.J.M., (2014), "A game-based approach to the teaching of object-oriented programming languages",Computers & Education 73, 8392.

[20] Hou, H.T. and Li, M.C., (2014) "Evaluating multiple aspects of a digital educational problem-solving-based adventure game" Computers in Human Behavior 30, pp 29-38.

[21] Zhang, J., Caldwell, R. E. Atay, M. and Jones, J. E, (2012), "Learning the Concepts of Classes and Objects in a Game", Proceeding of the 8th International Conference on Frontiers in Education: Computer Science and Computer Engineering .

[22] Schmitt, J. P., Agarwal, N. and Prestigiacomo, J. C., (2012), "From Planes to Brains: Parallels Between Military Development of Virtual Reality Environments and Virtual Neurological Surgery", World Neurosurgery, 78, 214-219.

[23] Borrajo, F., Bueno, Y., Pablo, I., Santos, B., Fernandez, F., Garcia, J. and Sagredo, I., (2010), "SIMBA: A simulator for business education and research", Decision Support Systems, 48, 498-506.

[24] Talebian, S., Mohammadi, M. H. and Rezvanfar, A., (2014), "Information and communication technology (ICT) in higher education: advantages, disadvantages, conveniences and limitations of applying e-learning to agricultural students in Iran", Social and Behavioural Sciences, 152, 300-305.