Jonathan Tow

Dr. Stuver

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A Proposal for Virtual Reality Based Learning of Object Oriented Programming

The following is a proposal to conduct a study on the effectiveness of Virtual Reality (VR) video game based learning for introductory object oriented programming (OOP). With the recent increase in the development of VR gaming (e.g., Oculus Rift and Playstation VR), it has come to attention the existence of new potential educational environments. This study intends on integrating a VR gaming system with introductory OOP teaching and examining the outcomes on a group of new OOP learners. It will be performed primarily for university level professors and/or curriculum designers belonging to their respective computer science departments.

In the past decade, the ubiquitous use of OOP languages have seemingly forced academia to accommodate computer science curricula around this programming paradigm. For the computer science departments that cater to industry demands, this means designing an introductory course with emphasis on objects. Such courses must ensure that first year students understand the rudimentary object oriented concepts and quite notably must do so under the assumption that the class will be the first encounter a student has with programming in general. Therefore an introductory OOP course is a fundamental part of today's computer science education.

How to teach this paradigm has been somewhat troubling, as computer science retention rates can attest to this statement. It appears as though the traditional forms of teaching OOP are not the most adequate.

Looking to acquire a more progressive approach to teaching OOP, Cooper, Lurie, and Moskal's landmark study, Effectiveness of a New Instructional Approach, has provided a new look into successfully educating new university level students on OOP via computer gaming environments. In particular, the team designed a 3D computer video game where object oriented concepts were at the forefront of the player's progress. For example, players learned the concepts of classes by roaming an animated world and searching for objects of a certain class and could not continue onto more abstract concepts, such as inheritance, until a certain level of understanding classes was met. Furthermore, subsequent studies have shown a positive correlation between increased test scores and learning with video games. Sharad Sharma's study on computer game-theme based instructional modules for teaching OOP introduced an affective way of designing educational OOP based teaching games. The idea is that each OOP concept is broken into a game-module wherein gameplay leads users to an understanding of the concept. This was a great success in Sharma's introductory computer science course at Bowie University.

From alike studies, we are safe to assume that educational computer games facilitate students' introduction to OOP. But note that all previous studies on the effectiveness of video games on OOP teaching and learning, have been conducted with games designed for traditional 3D computer video games. By exploring other platforms, it is possible to provide even greater help to new learners. This study intends on

extending the aforementioned works by incorporating a more visual and tactile exposure to the concepts of OOP by way of virtual reality gaming platforms.

In order to conduct this study, the well documented educational game design techniques created by Sharma in his study will be used to implement the desired VR specific game. This game will be particularly written for the Oculus Rift VR system. Note that each core concept of OOP (Classes, Encapsulation, Inheritance, etc.) will have a gaming module tailored for helping users learn the material. The study will be conducted in two different universities, Stony Brook University and the University of California Berkeley. For each university's required introductory programming course, respectively CSE 114 (Intro to Computer Science I) and CSE142 (Computer Programming I), 60 random subjects will be chosen out of the total course population. A control group of 30 random students will take part in their course's traditional teaching methods with their usual weekly computer only labs. Whereas the other 30 randomly selected students will be part of the treatment group receiving VR-game only labs. At the end of the semester letter grades will be averaged to find the central values of the two groups. A fitted linear model will be constructed via linear regression between scores and lab methods to analyze the correlation between failure/success of the methods.

The overall costs for the study will be determined as follows. $35,000 for the 60 Oculus Rift consoles (individual price of $598) necessary for both treatment groups in the SBU and UCB courses. A further $10,000 for game design costs and $1,000 for time spent on the final analysis. The overall cost estimate is roughly $46,000.

In the pursuit of discovering the most optimal object oriented teaching methods, this VR game based innovation provides a possible shift in university teaching styles for

the most prominent programming paradigm in the world today. Past pedagogical methods have shown not to be the most adequate, but with recent studies on game based teaching styles resulting in positive student performances, the gap between successfully teaching and learning OOP can be narrowed significantly. VR is worthy of a study in this area as it immerses users in a virtual 3D spatial environment that emulates real world perceptions. This gives students a near tangible experience with the content they are learning that is otherwise abstracted in text.

Works Cited

Moskal, Barbara, Deborah Lurie, and Stephen Cooper. *Evaluating the Effectiveness of a New Instructional Approach. ACM* SIGCSE Bulletin 36.1. 2004.

Arwa Al-Linjawi, and Hana Al-Nuaim. *Using Alice to Teach Novice Programmers OOP Concepts.* Journal of King Abdulaziz University-Science 22.1. 2010.

Sharad Sharma. *GameTheme Based Instructional Module for Teaching Object Oriented Programming.* 2015 International Conference on Computational Science and Computational Intelligence (CSCI). 2015.

Wong Yoke Seng, and Maizatul Hayati Mohamad Yatim. *Computer Game As Learning and Teaching Tool For Object Oriented Programming in Higher Education Institution* Procedia - Social and Behavioral Sciences 123. 2014.

Jose Maria Rodriguez Corral, Anton Civit Balcells, Arturo Morgado Estevez, Gabriel Jimenez Moreno, and Maria Jose Ferreiro Ramos. *A Game-based Approach to the Teaching of Object-Oriented Programming Languages.* Computers & Education 73. 2014.