# Work in Progress: Evaluating the Use of Mobile Game Development in Introductory CS Courses

Stan Kurkovsky
Department of Computer Science
Central Connecticut State University
New Britain, CT 06050

Delvin Defoe
Department of Computer Science and Software Engineering
Rose-Hulman Institute of Technology
Terre Haute, IN 47803

***Abstract*—Computer games have been accepted as an engaging and motivating tool in the CS curriculum. However, designing and implementing a playable game is challenging and is best done in advanced courses. Games for mobile devices offer the advantage of being simpler and, thus, easier to program for lower-level students. By exposing these students to a wide range of advanced topics, we can demonstrate to them that CS can be much more than coding. Here, we discuss our evaluation of a set of learning modules for introductory CS courses that use mobile game development as a motivational learning context.**

***Keywords-Games, mobile computing, introductory courses, motivation, engagement***

## I. INTRODUCTION

Computer games have been successfully applied to improve recruitment and retention in Computer Science (CS) courses and degree programs [10]. They have been shown to be a successful learning tool by leveraging students' enthusiasm towards computer games and their social relevance. Designing and implementing a playable game is a very challenging task, especially for lower-level students. Thus, this is best done in advanced CS courses where students already have sufficient experience in software development and exposure to other CS topics. Games for mobile devices, on the other hand, are simpler by nature and are thus easier to program [6]. This makes it more feasible for lower-level students to develop playable games as part of their classroom experience [4]. Mobile applications are often easy for students to relate to since mobile technology plays an increasingly important role in the lives of today's students. Thus, leveraging mobile game development as a motivational learning context has strong potential to improve student success in introductory CS courses and increase student motivation to stay in the major [8].

Creating engaging and feature-rich games requires a skillful integration of a wide range of techniques from many areas of CS; thus, computer games can be used at different points in the CS curriculum including in introductory courses. Using mobile devices as a learning context in these courses aims to provide a simple and elegant means to motivate students and communicate the diversity and power of many advanced CS areas in a manner that engages students in experiential education [9]. Moreover, research also shows that participatory learning methods such as those used in mobile game development can level the playing field for different types of students [1]. Research literature and our own experience demonstrate that most CS students seem to be very interested in computer game development, and introducing students to this topic early in the curriculum could serve as a good tool to increase student retention [1]. More broadly, current research literature indicates that students perform better when they find their course material relevant and motivating [2].

## II. DEVELOPMENT OF LEARNING MODULES

Supported by an NSF TUES/CCLI grant, we are working on a comprehensive set of eight learning modules consisting of laboratory projects and accompanying instructional materials for introductory CS courses taught using Java. Each learning module serves as a platform to introduce students to an advanced CS topic, such as algorithms, artificial intelligence, computer networking, computer security, computer systems, database management, human-computer interaction, or software engineering, as well as to practice a fundamental topic, such as arrays or inheritance. By demonstrating these and other non-programming and diverse aspects of the discipline to the students early, this approach may help dissolve a widely popular misconception that "CS is all about coding" [1].

Each learning module consists of a small laboratory project suitable for CS I and beyond. Each project focuses on a single mobile game, introduces one advanced topic, and reinforces one core concept. In addition to the project, deliverables for each module include a set of instructional and supplementary materials. These include an instructor's manual that provides a sample syllabus to go with each project and guidelines for the adoption and adaptation of the curricular material. Instructional materials consist of lecture notes, illustrations, references, and sample solutions, as well as supporting materials such as project source code and documentation.

## III. EVALUATION OF OUR APPROACH

We tested a few of the developed modules at Central Connecticut State University (CCSU) and Rose-Hulman Institute of Technology (RHIT) with a total of 161 students. In testing the modules highlighted above, we employed three assessment strategies: 1) student course grades and course completion, 2) the Classroom Survey of Student Engagement (CLASSE) administered at the end of the term, and 3) the Motivated Strategies for Learning Questionnaire (MSLQ) administered at the beginning and end of the term. The modules were used relatively late in the courses, during the last few weeks of the term.

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During the first year of the project, 161 students enrolled across eight sections of introductory CS courses at CCSU and RHIT, although the total number of students who completed each assessment varied. A total of 84 students were enrolled in a test section in which one or more curricular modules using mobile game development were used to convey basic concepts, and 77 students were enrolled in paired control sections of the same course. Not all students completed the courses, however; nor did all of those students who completed the courses participate in both administrations of MSLQ and the one administration of CLASSE. At both CCSU and RHIT, the courses were open to students of any major, as long as they met the courses' prerequisites.

According to the interim report [7], results from the first year of the assessment of the project yielded findings in various areas of interest. We highlight a few of these areas.

### A. Student Persistence

Persistence rates appear independent of administration of mobile game development curricular modules but were significantly different between the two institutions, with students at CCSU persisting at lower rates. The differences between universities in persistence rates very likely reflect the selectivity of the institutions, composition of the class population, and academic inputs of students taking the courses, with students at the less selective CCSU exhibiting lower persistence rates and lower levels of academic performances.

### B. Course grades

Student course grades were independent of the use of the curricular modules. This suggests that the mobile game development modules as administered at both institutions did not affect student performance on the assessments used by these instructors.

### C. Student engagement with course

Findings about student engagement in the course present a mixed bag of results that suggest limited positive effects of using the mobile game development modules in increased note taking, making connections across courses, and for the students at CCSU, whose academic preparation for college was not as strong as those at RHIT, perceptions of course difficulty decreased. Use of the mobile game development modules with the better prepared RHIT students, however, exhibited some negative effects in the area of instructor comfort and communication as well as student interest in the material. It is possible that these negative findings were a result of students who expected a more traditional classroom experience with these concepts or that the curricular modules did not fit seamlessly into the rest of the course taught at RHIT.

### D. Student motivation

Generally, motivation among students in CCSU computer science classes declined, but this decline was less pronounced in test sections than control sections. By contrast, RHIT student motivation stayed level or increased slightly over the course of the term for both the test group and the control group, with motivation gains among the control group slightly outpacing those in the test group.

## IV. Summary and Future Work

Evaluation results indicate that in each of the areas discussed above, the test groups did no worse than the control groups. As a matter of fact, students in the test groups were more engaged with the course in which the modules were presented and their motivation did not decline as much as the control groups. We will continue to refine the modules and adjust the points in the courses in which we use them. Allowing students more time to work with the modules and to apply what they learn to other topics may produce more positive results.

This project has a lot of potential. We believe that using mobile game development projects in introductory CS curricula will promote teaching and learning, help improve student experience in the critical introductory CS courses when student attrition is at its highest, and ultimately will help train outstanding computer scientists. We are currently in the process of making changes and finalizing the modules to address the concerns raised as a result of ongoing project assessment. We shared one of the modules with instructors at the 2011 ACM Special Interest Group on Computer Science Education (SIGCSE 2011) symposium and at several Consortium for Computing Sciences in Colleges (CCSC) conferences [5] and it was very well received. We are also working toward developing a web portal where we can share this and other modules with the wider community.

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