Computer Science Honours Project Proposal

An investigation into the benefits of contextualised learning in computer science

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2 The problem

Due to the high male participation in science subjects, it has been suggested that the actual course work and assessments have been developed with male bias (Clewell & Campbell, 2002). The early stages of computer science courses are usually focused on technical aspects of programming, with the development of multipurpose and useful systems being left until the later years of the degree (Margolis & Fisher, 2002). This results in the coursework appearing to be entirely removed from any real world-context. Sue Rosser, a feminist educator, believes that ensuring that science and technology courses are considered within their social context to be of paramount importance within education. She states that openly discussing the benefit of the course work in regard to the environment and other people is advantageous to both genders (Rosser, 1990). This contextualizes the information and raises its perceived importance. It has been shown that females tend to perform better with open-ended or essay type questions while males perform better when tested with multiple choice or short questions (Clewell & Campbell, 2002). If computer science is taught in smaller, disassociated chunks, it encourages male aptitude more than female. A computer science professor, Dianne Martin, suggested that an integrated approach to computer science, with greater value placed on the social impact and relevance of computer science fundamentals, would help redress the balance between genders (Margolis & Fisher, 2002).

3 Objective

The aim of this honours project will be to develop an application that will encourage interest and confidence in computer science students. The application will be an interactive, highly contextualized game that will both reveal the benefit of computer science and the enjoyment that can be derived from it. The game will aim to teach problem solving skills and algorithmic thinking, content currently already covered in Csc 112 lectures. A survey assessing the students' confidence and competence levels will be run before and after the usage of the application in order to gauge the impact. Shaw and Marlow found that though there was no obvious difference between the genders with regard to learning style, there was a significant difference in the level of comfort with using computers (Shaw & Marlow, 1999). Males felt much more at ease with new concepts and technology whereas females resisted moving away from what they were already comfortable with (Shaw & Marlow, 1999). In order to promote a feeling of comfort, the application will be encouraging and easy to use, trying to minimize the level of frustration felt by the students when learning new concepts. An emphasis will also be placed on enjoyment. If students have fun while using the application, they are more likely to play more than the required amount. Extended interest promotes learning as students are more like to explore and look for new ways to apply their acquired knowledge (Prensky, 2002).

4 History and background

In today's world, technology and information have become more widely used than ever before. The acknowledgment of a digital divide occurring between economic classes due to lack of access to technology happened many years ago (Lau & Yuen, 2010). However, another digital divide exists in our society that also requires attention, and this has occurred between genders (Lau & Yuen, 2010). Females are under-represented in the field of computer science, and this may be due to a male biased education system that does not adequately address female learning.

In most countries,there are more women than men pursuing tertiary education, however the opposite proves true within computer science university courses (Rev, 2009). A review of scientific achievement in the United States of America (Rev, 2009) revealed that more females were enrolling in high school science courses than males.However, men were on average performing better academically in science subjects (Gunn *et al.*, 2002). Lack of achievement could lessen the enthusiasm in female students towards pursuing further scientific study. Clewell and Campbell (2002) have also suggested that stereotypes have played a role in the gender divide. Stereotypes are also further enhanced by the lack of female role models in science and often results in women receiving less encouragement to pursue a science based career then an equivalent male student would receive (Rev, 2009). In a camp run to encourage female high school students to become developers, it was found that contextualized and relevant projects resulted in the student feeling more secure and confident in the field, resulting in more of the girls being enthusiastic about pursuing computer science at tertiary level than before (J.E. Burge & Davis, 2013). However, contextualizing concepts has been proven to improve understanding and interest in both genders. Holman

and Pilling found that teaching physics in a contextualized way raised the class average by over 10 percent (Holman & Pilling, 2004).

Contextualized teaching "may better promote an integrated view of analysis that includes both science and technology. Rather than presenting a simplistic view of scientific methodology, a contextualized approach can introduce students to the complex decision-making strategies needed to solve day-to-day problems... Context justifies and gives meaning to theory by demonstrating it in specific situations" (Koul & Dana, 1997, p 131).

There exists a danger of allowing the use of gender to result in an overly simplistic comparison of students, when many other factors, such as socio-economic or culture, can effect academic performance (Gunn *et al.*, 2002). Ultimately, there should be an effort to redefine the discipline of computer science to be more gender inclusive (Margolis & Fisher, 2002). Excluding women from the field not only results in an inequality, but it effects what is being produced by the industry. Margolis and Fisher make the observation that "women must be part of the design teams who are reshaping the world, if the reshaped world is to fit women as well as men" (2002, p 3). By attempting to make a more inclusive educational system and debunking the stereotypes of women in computer science, a more comprehensive and holistic future for computer science is possible.

5 Approach

To establish whether a contextualized approach to teaching programming logic will encourage students to become more interested in computer science, I will develop a themed game to teach the fundamentals currently taught in CSc112 programming logic. It will consist of multiple challenges based on the basic programming concepts covered in lectures. Each level will have a task. When the task is completed, the student will advance onto the next level. If a level is failed three times in a row, the concept needed from the lectures to complete the task will be revealed. If the player fails another time, an explanation of the concept will be displayed. Hopefully this will help students understand how the concepts they are being taught can be applied to problems. The free platform game template platformer by XNA Game Studio is easily adaptable and extendable (pla, n.d.). This would allow me to focus my time on developing the system instead of graphics. Three surveys will be run within the class: one at the beginning of the entire course, one at the beginning of the logic course and the final one after the use of my application. The survey run before and after the use of the application is meant to act as an indicator of how much of a contribution the system has made to the students learning. Each survey will be anonymous but will require the student to enter their gender. The initial survey will ask the students to rate:

- their ability of using a computer
- their attitude towards computers
- their confidence in their ability to problem solve
- do they enjoy problem solving
- their attitude towards programming

- whether they intend on pursuing a career in computer science
- have they done any programming before the course

After a few weeks of exposure to the computer introduction course, the second survey will try to gauge whether this is attracting or repelling students to computing. The students will have been generally introduced to the computing concepts of functions and algorithms. I would like to ascertain whether the current way computer use is being taught is sparking any interest in the students. I also want to judge whether there is a different rate of change in the responses of men or women.

- their attitude towards programming
- their attitude towards learning programming
- their confidence in their ability to problem solve
- whether they intend on pursuing a career in computer science
- do they enjoy problem solving
- have they done any programming before
- do the lectures cater to their way of learning

Once the survey is completed the students will be exposed to the developed application. They will be encouraged to play through the levels, gaining skills along the way. Afterwards, they will be given a follow up query asking them to rate:

- their attitude towards programming
- their confidence in their ability to problem solve
- whether they enjoyed using the application
- did they find using the application more useful than the lectures
- did the application help show them the possibilities learning programming would open up
- did the application affect the way they interpreted lectures

6 Requirements

The application will have to be able to run on multiple Windows 7 machines (the current jac lab set up). I will develop in C# using Visual Studios so I can take advantage of of image libraries like XNA and the platformer templates.

7 Projected Timeline

Date	Event
6 March 2014	Practice Seminar
11 March 2014	First Seminar
17 March 2014	Finalise application parameters
21 April 2014	Create project website
21 April 2014	Submit draft of department wide survey
28 April - 5 May 2014	Away for the week
12 May 2014	Submit draft of literature review
14 May 2014	Run survey throughout department
21 May 2014	Begin application development
30 May 2014	Submit literature review and plan of action
6 - 20 June 2014	Exams
9 July 2014	Submit draft of initial survey for CSc112 class
13 - 18 July 2014	Field trip to Cape Town
21 July 2014	Run initial survey in CSc112
29 July 2014	Second Seminar Part 1
5 August 2014	Second Seminar part 2
12 August 2014	Second Seminar part 3
18 August 2014	Trial run of application to receive feedback and test
10 September 2014	Submit draft of second survey for CSc112 class
19 September 2014	Submit draft of third survey for CSc112 class
22 September - 10 October 2014	CSc112 Programming Logic course
22 September 2014	Run second survey in CSc112 Programming Logic course
22 - 26 September 2014	CSc112 use application
29 September 2014	Follow up survey with CSc112
13 October 2014	Submit draft of short paper
17 October 2014	Submit final short paper
27 - 29 October 2014	Final Seminar
31 October 2014	Thesis Hand-in
7 November 2014	Website complete
19 November 2014	Research oral exam

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