Girls, Computer Science, and Games

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ABSTRACT

An innovative week long mini-course for girls has successfully used video game development as the main motivation by teaching related computer science topics at the same time. Students split their time between creating their own game in the lab and learning about game design, usability, graphics, and artificial intelligence. They became more comfortable with the subject and say they are more likely to pursue computer science in high school because of this course.

Categories and Subject Descriptors

K.3.2 [Computers and Education]: Computer and Information Science Education – Computer science education

General Terms

Human Factors

Keywords

computer science fluency, middle school girls, games, project-based course

1. INTRODUCTION

Recent trends show that the number of women graduating from computer science programs has been declining for some time, as discussed in [2, 9]. Many initiatives have been developed to help promote interest in the subject for younger girls with the hope that some may take a second look at pursuing computer science in high school or university, including [2, 4, 5, 6, 8, 11, 13]. New and innovative ways to capture the interest of these girls should continuously be explored, as no one solution will suit every region or culture.

Earlier this year, there was an opportunity for the author to deliver a week-long course to a group of twelve girls in grades eight and nine. This course was one of fifty offered to gifted students from Ottawa area middle and high schools at Carleton University as part of the Enrichment Mini-Course Program[1]. Because instructors were given the freedom to develop new content for their courses, video games were chosen as the main subject.

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[1]http://www.emcp-pmce.org/

Others have reported success when using games to introduce girls to information technology [13], but they had several weeks to work with. The shorter time frame of one week forced the need for creativity in designing the course, especially since the main goal was not to teach the girls how to create a video game. Rather, games would be used as a motivator for learning basic concepts of computer science, and thereby help the girls become comfortable enough with the subject to consider pursuing high school or even post secondary level classes in this area later on.

In the second section of this paper, the actual course, entitled 'Computer Science and Games: Not Just for Boys!', will be described, followed by a discussion evaluating its success. The paper will conclude with some thoughts on where to go from here.

2. COMPUTER SCIENCE AND GAMES: NOT JUST FOR BOYS!

This week-long mini-course was the result of pairing the following two main objectives. First, it was important to teach the girls some basic concepts of computer science so they saw what the field was about, and that they were capable of understanding it. Second, these concepts had to appeal to the girls in a way that negative stereotypes of the field might be dispelled, and computer science might be deemed 'cool.' It is for these reasons that games were chosen as the main focus.

There is some debate about whether games provide an appropriate tool for teaching computer science. For example, some of the potential issues cited in [12] include the fact that girls are often uninterested in competitive games, that talking too much about games may give the impression they comprise a larger part of the field of computer science than they actually do, and that too much classroom time could end up being spent working with graphics. On the other hand, the same article points out the positives, such as the motivation of having seen several games before, the entertainment value associated with them, and the fact that they provide a relatively simple focal point for discussion. These points were encouraging enough to give it a try, and as will be seen, there are ways to avoid the potential pitfalls.

With this in mind, it was necessary to select an appropriate piece of software for use during the course.

The final choice needed to conform to several key requirements, including ease of use for middle school students, familiarity to the instructor(s), and ability for students to create a simple video game in less than a week. Carnegie Mellon's Alice software has been used for a similar one week camp [2], and was considered as a possibility. However, this software is better suited for the creation of 3D movies and requires direct instruction of programming concepts, neither of which were desirable. Instead, Game Maker by YoYo Games[2] was chosen. It has a friendly, drag and drop graphical interface that abstracts programming concepts further than Alice does. A simple game, such as those found in the freely available tutorials on the official website, can easily be made by a beginner within a week. It is easy to create 2D graphics for the games, and students can even scan their own drawings to use. Finally, Carleton's School of Computer Science uses Game Maker for their first year game development course, so several faculty members are familiar with it.

Course Content

The course was intended to introduce basic concepts of computer science in addition to allowing students to create their own video game. Each day of the week was split up into classroom lectures and lab time. Depending on the availability of the computer lab, lectures were in the morning and lab time in the afternoon, or vice versa.

While the knowledge imparted during the lectures did not directly teach the students how to create their games, each topic discussed in the lectures still needed to have some connection in order to keep the students interested. The lecture topics, in order, were an introduction to computer science and women in the field, basic game design, usability and human computer interaction, computer graphics, and artificial intelligence. The course was originally going to include audio, but there was not enough time to cover it.

Girls tend to be focussed on the user's point of view when thinking about technology [7]. To make use of this fact, the introduction to computer science concentrated more on what it can *do* rather than what it *is*. For example, the connection to psychology, music, medicine, and, of course, games was discussed. This was followed by a presentation of the declining numbers of women in computer science and a brainstorming session on why it matters and what could be done about it. Several successful women in computer science and the game industry were profiled.

Game design is certainly a broad topic that could not be completely covered in one half-day lecture. Instead, a few of the key concepts from a comprehensive book on the topic [1] were presented with a focus on what makes games fun, particularly for the female audience. The stages of creating a game were also briefly discussed, providing an opportunity for the girls to begin developing an idea for their games.

The lecture on usability aimed to stimulate thought on what it means to have a good design, be it for a real life object or a computer program. Key concepts from a well respected book on the subject [10] were presented and applied to existing designs. Then these concepts were applied to games, using the suggestions from [1].

The first part of the graphics lecture focussed on what raster and vector drawings were, and free programs that could be used to create them. This was followed by the slightly more ambitious topic of 3D graphics. Basic concepts of transformations and projection were presented, as well as some graphics issues that can arise when developing games.

The last lecture, about artificial intelligence, began with the different ways AI is used in games. Finite state machines and the Turing test concluded the formal classroom content.

The first day of lab time consisted of the girls trying some tutorials for Game Maker, and then exploring the program and possibly starting their own game ideas. After that, all lab time was free, allowing the girls to work on their games and get help from the instructor.

Course Delivery

Just as important as the actual lecture content was the fashion in which it was delivered. In addition to keeping the interest of a group of young adults, it was important to make the subject seem 'cool' rather than nerdy or boring.
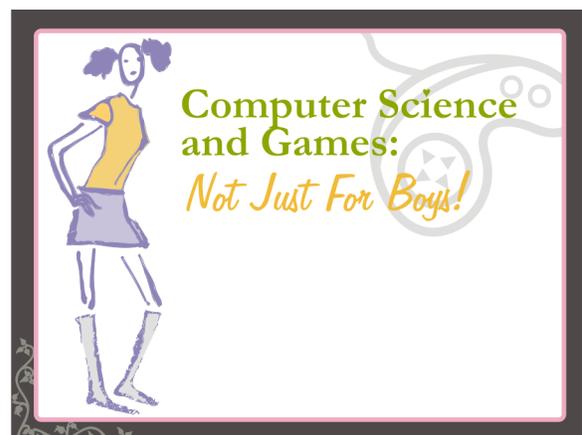
Figure 1 The look and feel of the material used during the mini-course lectures was created by the author, and was intended to be appealing to teenage girls.

The first step to accomplishing this was coming up with an appealing look and feel for the PowerPoint slides

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used during lectures. Figure 1 shows the background of title pages, where the subject of the lecture would appear in the while space below the main heading. The graphics used here were intended to convey the theme of girls and gaming, as well as be modern and fun.

Because time spent in the classroom could span two or three hours, an attractive slide design was not enough on its own to keep the attention of students in this age group. Therefore, making the material interactive was imperative. The slides contained little text, instead displaying an image and a short subtitle representing a particular topic. The instructor could give a brief presentation of basic information on a subject and then facilitate group discussions. More formal individual or small group activities were scattered through the lectures. These included brainstorming, reading relevant articles, and interactive demonstrations.

One of the most valuable resources for the group activities was Computer Science Unplugged (or CS Unplugged) [3]. As described on its website[3], "Computer Science Unplugged is a collection of activities designed to teach the fundamentals of computer science without requiring a computer. Because they're independent of any particular hardware or software, Unplugged activities can be used anywhere, and the ideas they contain will never go out of date." Activities for human computer interaction ("The chocolate factory"), finite state automata ("Treasure hunt"), and the Turing Test ("Conversations with computers") were used in the usability and artificial intelligence lectures.

Students often like to have something to take home with them after a course like this. The obvious choice is to help them bring the games they made in the lab to show their friends and family. But the course's other main goal was to have the students walk away with some knowledge of computer science and a desire to learn more. Their games alone would probably not accomplish this. Thus, a special CD containing PDF copies of all the notes used in lectures was prepared. It also included links to helpful resources and installers for all the free software discussed during class (such as Game Maker). A copy of the contents of this CD are available on the author's website[4].

3. EVALUATION

The course ran remarkably well for its first iteration, with no major problems to correct for the future. Following is a discussion of how well the course was received as observed by the author, and then the results of an online survey conducted after the course was over.

The twelve girls registered in this course began the

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[3]http://www.csunplugged.org/

[4]http://gailcarmichael.com/work/minicourse.htm

week feeling rather shy. After the formal opening of the course, during which an introductions activity was conducted, the girls became more comfortable and participated heavily in group discussions.

Most activities were received well, though the students were not always sure how certain topics related to computer science. For instance, while they were interested in the topic of usability, they asked several times what this had to do with computer science or games. After the CS Unplugged activity for this topic was finished, they seemed to feel more comfortable with the connection, particularly because of the discussion included in the activity.

The course was run by only one instructor. This was not a problem during the lectures, but it would have been beneficial to the students to have more people to turn to for help during the lab time. In the future, it may be possible to find some volunteers who would like to learn Game Maker and help the girls solve their problems.

When working on making the games in the lab, it was the original intention to have the girls work in pairs or groups of three. However, the girls asked to be allowed to work on their own, and it was allowed. Interestingly, the benefits of working in a team were not lost because the girls were very good about helping each other out. It would seem that they simply wanted to have a game of they could call their own, not that they preferred to work in isolation.

After the course was over, nine of the twelve girls participated in an online survey intended to collect feedback that would help improve next year's course. Eight of these students were in grade eight, and one was in grade nine. The responses were quite positive.

The first set of questions were intended to determine how beneficial it was to have a course just for girls. Eight out of the nine respondents said that this course was their first choice, but only three said they would not have signed up if it was going to be a mixed class. When asked whether they were glad the course was just for girls, however, only one said she didn't care; the other eight said they were glad, or that they were happy so long as they weren't the *only* girl there (half each).

There were several comments for the question of why each person signed up that further suggested that offering an all-girls' course may have caused more students to give it a try. For example:

> I enjoy working with computers, and I enjoy video games, so I thought this course would be perfect. Also the fact that it's a girls only course got me interested because there would be no boys who know everything about computers, making me feel dumb.

> The fact that it was all girls and the fact that we got to make our own computer games!!! Designing computer games is generally not thought of as acessible [sic] so it

looked really cool that we would be able to make and take home our own game.

In addition to this, the girls were asked to rank how much they agreed or disagreed with various statements. The first set was aimed at determining which lecture topics were well received. Aside from game design, the most popular topic was computer graphics, followed by artificial intelligence. This shows that there is no need to stick to the easier subjects, as students seem to appreciate the opportunity to learn something more difficult.

The next set of statements were about Game Maker. Four people strongly agreed and the other five agreed with the statement "I thought that Game Maker was a good choice of software to use for making my own video game." Six of the girls strongly agreed that they would like to use Game Maker again in the future, while two agreed and one had no opinion. These responses suggest that Game Maker was a successful choice in terms of the software used to make the games.

Finally, the girls were asked to rank the statement "I am more likely to try computer science in high school after taking a course like this." Five girls said they strongly agreed, while two each said they agreed or had no opinion. While these responses are not quite as strongly positive as for some of the other questions, they are still very encouraging. It seems that being exposed to computer science in a way they could understand the subject has made the girls feel confident enough to pursue it further.

4. CONCLUSIONS AND THE FUTURE

With such a positive first attempt at this course, it would definitely be a good idea to try to hold it again in future years. Beyond this, it may be possible to borrow some content from the course to use in shorter outreach activities for high school students. Overall, combining computer science concepts with the application of video games appears to work quite well for teaching young girls about the subject and making technical topics seem 'cool' again.

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