Math Edutainment Game for Girls Grades 1–6

Emily Clarke
Computer Systems Lab 2008–2009

April 1, 2009

Abstract

The purpose of this project is to create an engaging and educational game for girls in elementary school. This edutainment game will be driven by a comprehensive plot, a diverse cast of characters, and six different mini-games. Through an all-female cast of scientists, a feedback system, a stereotype–free presentation of science in the real world, and rewarding game play, this game will encourage girls to have higher confidence in their abilities as well as pursue higher-level math, science, and technology classes.

1 Introduction

Despite progress in recent years, girls as a whole are still behind in math and science enrollment and scores. Many girls feel unmotivated to continue their educations in math and science past the level required to graduate. As such, girls are underrepresented in college-level math, science, and technology classes ([3]). Many girls do not feel confident in their ability to perform math and, as such, avoid it whenever possible. Other girls find math impersonal, uncreative, and based in memorization alone([2]). This project is attempting to overturn these beliefs and behaviors and encourage girls in elementary school to have higher confidence in their abilities, a greater understanding of math and science, and continue their educations in math, science, and technology.

This project involves creating a web-based "edutainment" game – a piece of educational software that is meant not only to teach but also to keep the

student engaged, entertained, and interested in the subject – and making it available to elementary schools in Fairfax County. Students' beliefs before and after game play will then be compared. This game will implement a series of features to help counter several common problems with girls' beliefs, behaviors, education, and attitudes towards math.

2   Background

Many girls shy away from taking advanced science, math, and technology classes. Research done by the Girls, Math & Science Partnership states that despite recent advances boys still outperform girls in primary science, math, and technology classes. Girls are severely under enrolled in Advanced Placement Computer Science and Physics classes, and eighth grade boys typically have higher performances than girls in fractions, number sense, and the core sciences, in addition to a higher scientific confidence.

Concerned with this problem, several groups have created suggestions to help encourage girls both in the classroom and out. The Girls, Math & Science Partnership suggests making math more personal, helping girls appreciate math and science for its virtues instead of its utility in school; giving girls the feeling of control over their abilities in science and math; creating a "New Science Girl" archetype to break the "math is for geeks" stereotype; reminding girls that math and science can have rewarding, inspirational, elegant, and humanitarian aspects; and encouraging girls to explore what they can do with math and science. The Institute of Educational Sciences suggests teaching girls that their cognitive abilities are not fixed; giving girls specific feedback; providing strong female role models; linking math, science, and technology to unusual (non-stereotypical) and interesting careers and activities; creating opportunities for research; and providing spatial skills training. The Commission on Technology, Gender, and Teacher Education suggests implementing strategy, personal interactions, diverse and interesting characters, narrative plots, non-stereotyped creativity, and appropriate challenge into "edutainment" games.

3 Preliminary Testing and Analysis

To counter common problems in girls' math educations, this game will implement features based on several of the solutions suggested above. These include:

- Evolving, narrative plot and score tracking

- Feedback, suggestions, and the ability to "study"

- Cast of non-stereotyped female characters

- Presentation of female role models

- Links to interesting math, science, technology projects and activities

- Presentation of science in the real world

- Teach spatial skills through a game

- Engaging characters with social interactions

- Diverse cast and character customization

- Creative (but not in a stereotypical way) game

The plot is based around a research base on a fictional planet staffed by a multiethnic and diverse cast of female scientists. The player has arrived after an unusual and unexplained accident has caused several problems on the base. In order to return to Earth, the player must help the scientists fix the various problems. The more mini-games the player completes, the more the plot is revealed to the player, thus motivating students to complete the activities. After completing four initial mini-games, the player must activate an "artifact" through a fifth mini-game to make contact with an alien race on the planet and then complete the final mini-game to decode the aliens' language and form an alliance between the researchers and the aliens before returning to Earth. The plot will all be conveyed through simple cut scenes and character interactions. A score tracking system will also allow the player to see how much progress they have made at any time.

When the player answers a problem incorrectly, the character running that mini-game will provide suggestions to the player (such as "Try writing
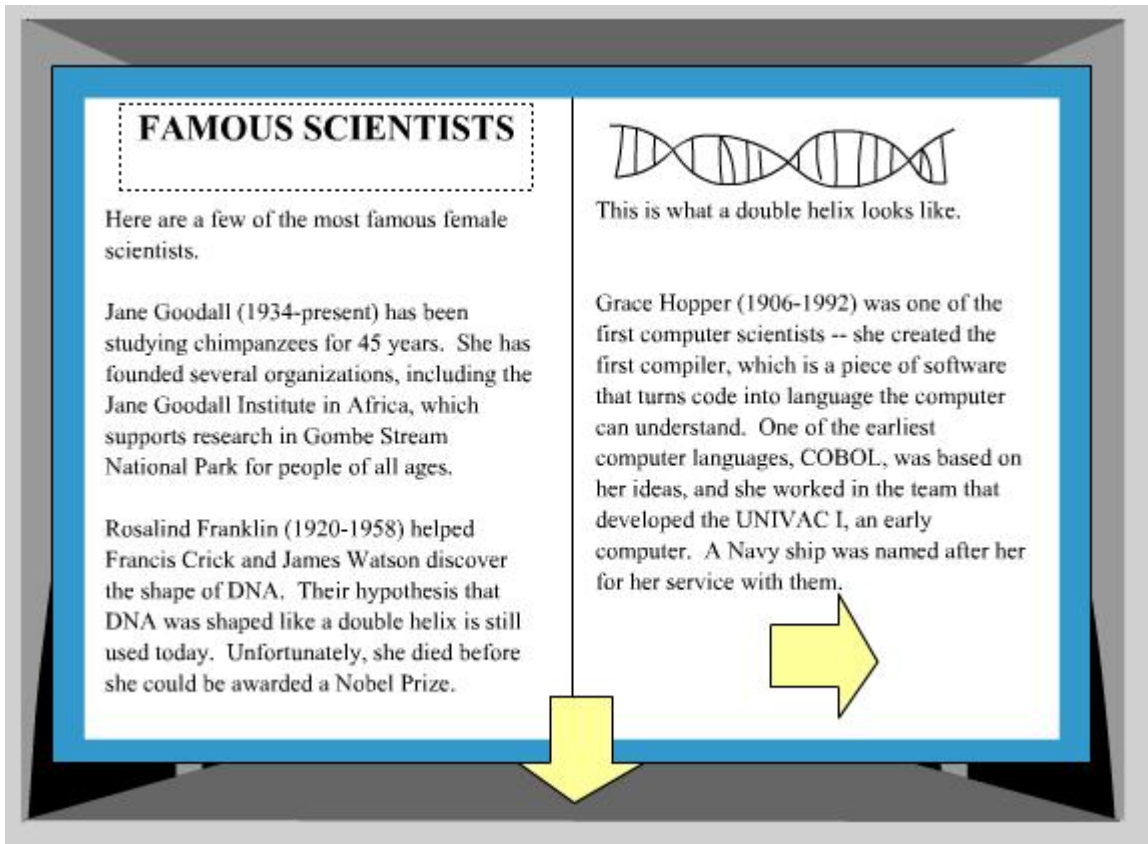
FAMOUS SCIENTISTS

Here are a few of the most famous female scientists.

Jane Goodall (1934-present) has been studying chimpanzees for 45 years. She has founded several organizations, including the Jane Goodall Institute in Africa, which supports research in Gombe Stream National Park for people of all ages.

Rosalind Franklin (1920-1958) helped Francis Crick and James Watson discover the shape of DNA. Their hypothesis that DNA was shaped like a double helix is still used today. Unfortunately, she died before she could be awarded a Nobel Prize.

This is what a double helix looks like.

Grace Hopper (1906-1992) was one of the first computer scientists -- she created the first compiler, which is a piece of software that turns code into language the computer can understand. One of the earliest computer languages, COBOL, was based on her ideas, and she worked in the team that developed the UNIVAC I, an early computer. A Navy ship was named after her for her service with them.

Figure 1: Engineer's Notebook

it down on paper" or "Look at the tips in the Engineer's Notebook for more help"). Although this is not terribly specific feedback, it is more helpful than the ever-present "Try again" or "Better luck next time". The player will also have resources for "studying" and additional information through the afore-mentioned "Engineer's Notebook". One character will have an interactive "book" that will provide common math tips and tricks, information about famous female scientists , a look at popular jobs in science and math, and links to interesting science, math, and technology activities. Through this feature girls will be provided with not only female role models but also infor-mation on science outside of the classroom and opportunities for continued research and experimentation.
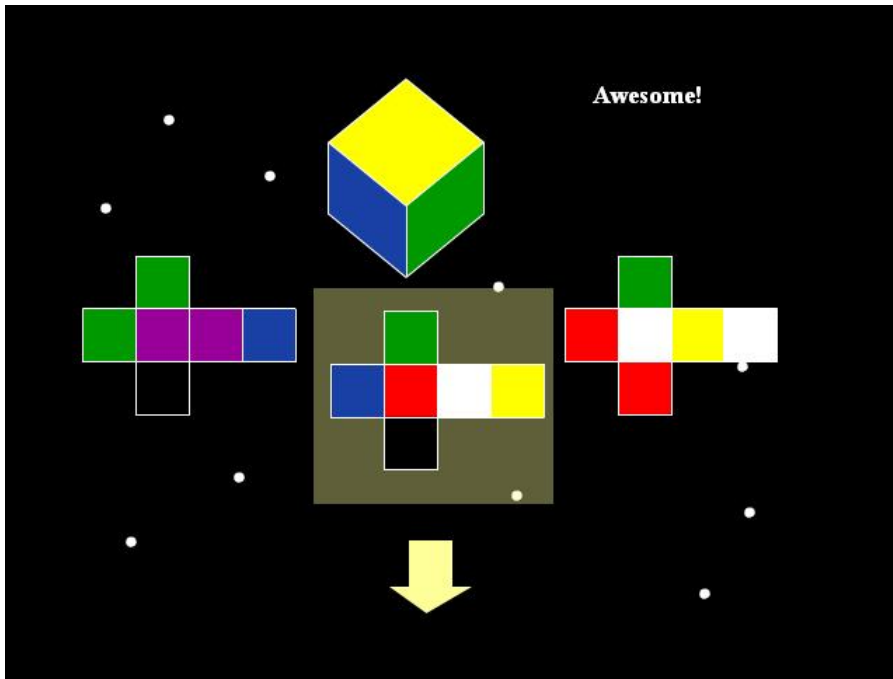
4

Figure 2: Spatial skills game

Several of the mini-games will be created to address specific problems. One of these is a game designed to train the player's spatial skills. In this game, the player will be shown a folded cube and asked to match it with one unfolded cube out of three. Originally a mini-game where the player was asked to add components to a robot to carry out a mission was planned to give the player an opportunity for creativity. However, it was removed from the game later on due to the fact that very little progress had been made on it.

The characters are also a very important part of the game. In order to help the player better identify with the characters in the game, the player creates a character of their own in the very beginning. This character is relatively simple but presented free of stereotypes and has an option of various ethnicities.

At the end of the first quarter, about a fourth of the project is completed. I have all the menus, the loading bar, character customization, interactive characters, two mini-games, and the notebook feature in various stages of completion. In second quarter I plan to finish the other five mini-games,
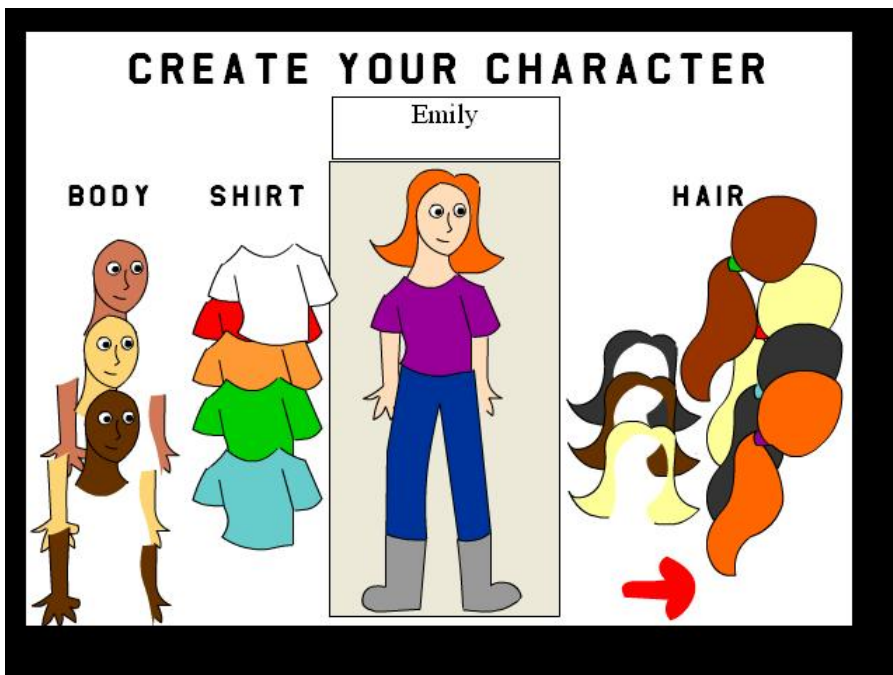
Figure 3: Character customization

animate a few cut scenes, and flesh out the notebook feature with some common math tips and links to my research and a few girls in math and science websites. To test my program at these stages, I (or another student) will play through the game to make sure that all games can be completed and all scenes can be accessed.

In second quarter, I have completed over half of the project. In addition to the features mentioned above I have completed two more games (the fifth game is in the debugging stage), two more menus, two more interactive characters, score tracking, a name feature as part of character customization, and about one quarter of the notebook feature's content. I have also created a website at TJHSST.edu to host my project. My testing methods are the same in second quarter as they were in first. In the third quarter I plan to complete the last three games and animate the cut scenes. I believe there will be four cut scenes – one before the title screen, one after the first give games, one after game six, and one final cut scene. If I have time before the end of the third quarter, I might also try and flesh out character interactions.

In the third quarter, this game has almost reached completion. Although the fifth game was removed from the project, the sixth and seventh were completed successfully. There were minor fixes on previously undetected bugs, character identities, and menus completed as well. I have almost completed the Notebook feature and simply need to finish inputing the information. Unfortunately, I was not able to get any animation done; however, that will be my main goal for the fourth quarter.

References

[1] "Encouraging girls in math and science:IESpractice guide", Institude of Educational Sciences, 2007.
http://www.braincake.org/files/EncouragingGirls_IES2007–03.pdf
(September 10, 2008)

[2] "Girls' beliefs", Girls in Math and Science Partnership, 2004.
http://www.braincake.org/files/RE_GirlsBeliefs.pdf (September 10, 2008)

[3] "GMSP stats and data", Girls in Math and Science Partnership, 2007.

http://www.braincake.org/files/GMSP_StatsData.pdf (September 10, 2008)

[4] "Tech-savvy: educating girls in the new computer age", Commission on Technology, Gender, and Teacher Education, 2000.
http://www.aauw.org/research/upload/TechSavvy.pdf (September 15, 2008)