

# USING GAMES CREATED IN SECOND LIFE TO TEACH MIDDLE SCHOOL SCIENCE CONTENT\*

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Using games created within Second Life to teach science content excites middle school students like no other form of teaching. This paper focuses on the use of two games created during the second year of a three year grant which provides digital curriculum to middle school science students in rural Appalachian Ohio. The data collected in this ongoing research has shown significant improvements in students' scores from pre-test to post-test. When educating students through computer games in Second Life, the games must be created in a way to keep students interested and focused on their task since this environment can be distracting to learn in. This work was conducted through a National Science Foundation (NSF) grant in a project called Science and Technology Enrichment for Appalachian Middle-schoolers (STEAM). This project involved eight graduate students from Ohio University that worked with partner teachers to create games to teach middle school science concepts in a variety of mediums.

## 1. Introduction

In the STEAM Project our research has explored the benefits of using computer games created through a variety of mediums within the classroom. Previous work has shown evidence that computer games in the classroom provide many benefits which include increasing student's achievements, motivation, and concentration [1].

Teachers that participated within the STEAM project were excited about games that occurred within a virtual world because they can provide a more immersive environment than a 2-D game [2]. Virtual worlds provide a more interactive environment that students can explore and this motivates students to be more interested in the game [3]. This has proved to be true in the classroom when comparing student's reactions between the games in Second Life and games created through other mediums such as Adobe Flash based games.

Second Life was chosen as the tool for my games due to simple and quick object creation, networked 3-D world, and shorter development time to program games. Because Second Life is already a game in itself, creating games with educational content does not require as much work as creating entire games in other mediums. This allows more time to be spent on refining each game and the educational content presented within. Another convenient aspect of developing in Second Life is the ease of distributing new games at the school. Second Life can be executed from a shared networked drive making only one install required instead of having to install software on each lab computer. After the initial installation, no more installs or downloads need to be made when releasing a new game (except for client updates).

The games presented in this paper include the Fruit Fly Genetics Experiment and the Mystery School. Both games align to the Ohio standards for science content. The Mystery School game was designed to teach students the differences between observation and inference. Fruit Fly Genetics was created within an existing Interactive

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Science Lab where students have the opportunity to choose from three experiments. In the Fruit Fly Genetics Experiment students are taught about heredity and punnett squares while conducting their experiment.

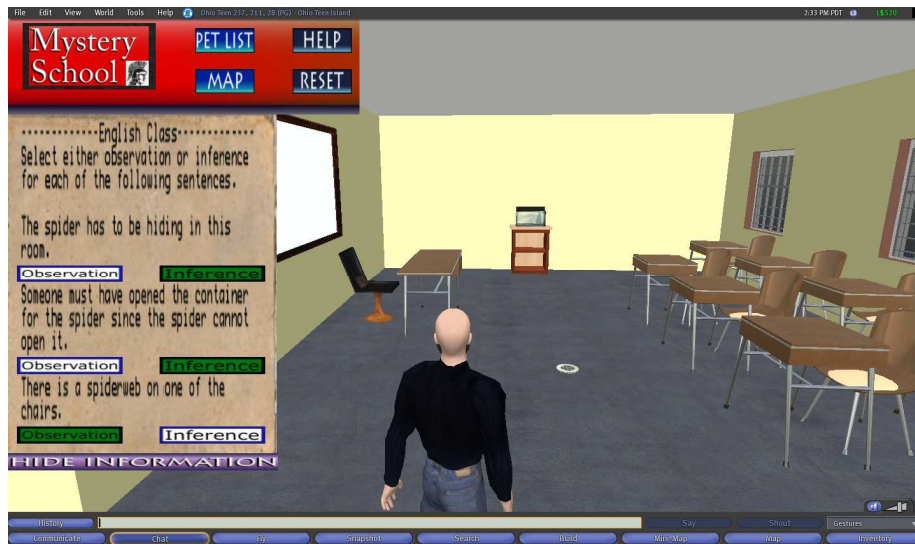


Figure 1: Screenshot of Mystery School

## 2. Game Design

Three games were created and used in the classroom prior to developing the games discussed in this paper. This previous work provided feedback and direction in refining the methods used for designing better games for use with the middle school students. Both games include a scoring system which is used with a high scoreboard to promote competition between the students and increase replay value of the games.

All games created take advantage of using a Heads Up Display (HUD) for interacting with and controlling the games [4]. The HUD is capable of displaying dynamic text to allow different gameplay scenarios each time the game is played. The HUD is connected to a questions database backend which is used for integrated pre-tests and post-tests. Teachers are then able to edit the questions that are used in the game through a web interface. When the students answer the pre and post test questions in the game, their responses are automatically sent to the database which allows the teacher to see real time results.

The goal of the Mystery School game is to explore a school to find out which classroom pet is not missing from the school. As the students enter each room, a list of clues is displayed on the HUD and the students must label them as either an observation or inference. The clues provided are then used to discover which of the classroom pets have not disappeared. The HUD also provides students with a map for easier exploration of the school to the rooms they have not visited previously. After labeling all three clues in each of the eight rooms, the HUD directs the students outside to a garage where they can receive a reward. The reward consists of allowing the students to ride one of four different vehicles depending on how many clues they labeled correctly. They also have the option of returning to the school in order to correct their answers and receive a better reward.

Fruit Fly Genetics is a simulation based game where students step through the experiment with their HUD. Previous research points out that simulation based games within Second Life provide instructional benefits in the classroom through real world situations [5]. Providing simulations such as the Fruit Fly Genetics Experiment in a virtual world allows students to conduct an experiment that is not normally used at school [4].

In Fruit Fly Genetics, students begin by choosing colors to use as the traits of their fruit fly's body and eyes [4]. Then a set of dynamically defined offspring is created based off of the traits of two heterozygous flies. The students then analyze these flies in a dividing tray and count the number of flies with each individual trait. Their ability to quickly and accurately count the traits is used in determining their score for the experiment. The HUD will then display a graph of the actual results and students will compare these to their predicted results which are calculated on an accompanying worksheet.

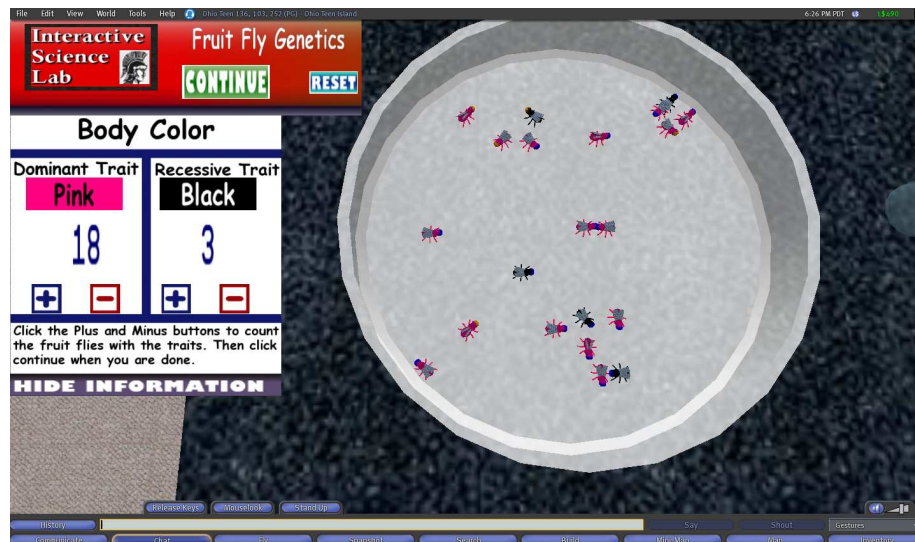


Figure 2: Screenshot of Fruit Fly Genetics [3]

Second Life provides many distractions which cause students to lose focus such as chatting, flying, and exploring the 3-D world. To minimize these distractions games must be built in a manner to keep the students focused. Methods such as requiring the student's avatar to stay seated to play the game can eliminate distractions even though it takes away some of the fun. Providing a reward incentive to the students who successfully complete the game provides an end goal which drives the students to take on the educational part of the game. In order to discourage chatting about off-topic subjects students are logged through a chat logger in the games. The students are aware of the chat logger while using the games and this keeps unnecessary chat to a minimum. They are encouraged to ask questions and talk about the game they are playing during chat which benefits the students and makes the virtual world more fun to be in.

Second Life can sometimes provide confusion to novices who are new to games within a 3-D world. This can take away from users receiving educational benefit because they are more focused on trying to learn how to play the game rather than learning educational topics. The HUD is a key tool in preventing this confusion while playing the games. All directions and most of the controls to interact with the game were integrated into the HUD. Mostly if a student has a question the answer would be in their HUD which makes the game a lot simpler to play.

### 3. Gaming in the Classroom

Introducing middle school students to Second Life in a classroom environment can be a tedious process. The usual method within the STEAM project involved allowing the students to spend one computer lab day receiving an introduction to Second Life. In this introductory session, students will learn the process of signing into Second Life to allow them to explore and learn the controls. Most students learn the controls quickly even if they have not had prior experience with 3-D computer games. In their first session students are told to explore the island in order to find the Interactive Science Lab where they will conduct a short experiment called the Sugar and Water Solubility Experiment. Other introductory sessions by STEAM graduate fellows have included tasks such as allowing students to customize their avatar. Having a dedicated class spent on customizing your avatar can be beneficial. Usually once students know they can customize their avatar they will always become distracted from the current task. Therefore students in our classroom are typically not permitted to customize their avatar unless extra time is available at the end of class.

Students typically worked in pairs while playing these games. This allows one student to work the controls while the other would be a navigator giving out directions. Even though the HUD included all the directions, students would mostly ignore them until they came to a confusing part of the game. This results from the students wanting to quickly explore the game without reading the directions. For this reason, these games provide an interactive way to learn by exploring and not solely through reading text.

After the first few lab visits students will become familiar with Second Life and the typical process of playing the games. This is when games within Second Life become even more rewarding because students are

not as concentrated on learning how to play Second Life and are instead more focused on the game. Teachers have more time to relax because the number of questions about Second Life and the game drop dramatically.

#### 4. Results

Each game created utilizes pre-test and post-test questions to evaluate the effectiveness of the educational content. Two methods of pre-test and post-test evaluations have been used within the STEAM project's research. Method A consists of games being evaluated with a pre-test before playing the game and a post-test after the game. A more revised research Method, B, involves two rounds of playing the game. Students are divided into two randomly selected groups. Before the science content covered in the game is taught, one group takes the pre-test, plays the game, and then takes the post-test. The second group only takes the post-test before playing the game. After the science content in the game is taught in the classroom, the game is played again with both groups taking the pre-test before the game and the post-test after the game.

Mystery School was evaluated only once using Method A. Due to time restriction issues only 33 results were completed. Tests consisted of five multiple-choice questions on both the pre-tests and post-tests and they were presented to the students in the game through the HUD. Student's scores improved 3.0% on the post-test but due to the small number of responses and questions asked I feel that further research is required to prove the effectiveness of the Mystery School game. Testing the students through using the HUD provokes more students to game the system by clicking through the questions instead of taking time to properly answer them. In future research a method of recording the response time has been implemented in the question database system so that we will be able monitor who is gaming the system by responding to questions too quickly.

While using the Fruit Fly Genetics Experiment, Method B was used to evaluate the game [6]. An overall improvement of 16% from pre-test to post-test was found. Each test contained nine multiple choice questions and one short answer using pencil and paper tests. The following tables show the results obtained from both runs of playing the game on a total of 95 students.

Table 1: Average scores from 1st run [6].

	Pre-test Grade	Post-test Grade	Post-test Grade
Group 1	24%		44%
Group 2		44%	

Table 2: Average scores from 2nd run [6].

	Pre-test Grade	Post-test Grade
Group 1	48%	62%
Group 2	54%	73%

Between the two games tested, more students appeared to have more fun while playing the open ended Mystery School game. Mystery School is also a simpler game that doesn't require as much direction to play and learn. Fruit Fly Genetics contained more detailed directions and more complicated topics than the Mystery School game. Trying to teach too many concepts within the game can cause confusion and make the game less enjoyable and could hinder learning.

#### 5. Conclusions

Using Second Life as a medium for creating games for middle school students has shown to be an effective method. Students respond very well to the games and research so far has shown educational benefits. Development time for games created within Second Life is shorter than development times in creating other 3-D games. More testing should clearly show the benefits of using the games that we have created for middle school science students to teach educational content.

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**References**

- [1] Rosas, R., Nussbaum, M., Cumsille, P., Marianov, V., Correa, M., Grau, V., Lagos, F., Lopez, X., Lopez, V., Rodriguez, P., & Salinas, M. (2003). *Beyond Nintendo: Design and Assessment of Educational Video Games for First and Second Grade Students*. *Computers & Education*. 71-94.
- [2] Franklin, T., Mayles, J., Liu, C., & Chelberg, D. (2007). *Games and Engineers in the Science Classroom: A Case Study*. Presented at Site Conference 2007.
- [3] Tekaat-Davey, D. (2006). *Virtual Learning is the Real Thing*. *Techniques: Connecting Education and Careers*. 81 (1) 32-35.
- [4] Franklin, T., Chelberg, D., & Liu, C. (2008). *Digital simulations for improving education: Learning through artificial teaching environments* (D. Gibson & Y.K. Baek, Eds.). IGI Global, PA: Hershey.
- [5] Ye, E., Fang, Y., Liu, C., Chang, T., & Dinh, H. (2007). *Appalachian Tycoon: An Environmental Education Game in Second Life*. Presented at Second Life Community Convention 2007.
- [6] Franklin, T. (2008). Teaching digital natives: 3-D virtual science lab in the middle school science classroom. *Journal of Educational Technology*, 4(4), 39-47.