SOLAR SYSTEM: AN INTERACTIVE LEARNING SUPPLEMENT FOR

SIXTH GRADE SCIENCE STUDENTS

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SOLAR SYSTEM: AN INTERACTIVE LEARNING SUPPLEMENT FOR SIXTH GRADE SCIENCE STUDENTS

by

BRETT CLAIR

DISSERTATION /THESIS

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SOLAR SYSTEM: AN INTERACTIVE LEARNING SUPPLEMENT FOR SIXTH GRADE SCIENCE STUDENTS

BRETT CLAIR
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The goal of this project was to measure the effectiveness of digital applications as an avenue of learning among sixth grade science students. Through the development and production of an interactive module focused on teaching students the components of the solar system, the developed interactive learning application was evaluated as an effective learning supplement in addition to traditional classroom teaching methods. The interactive module consists of an exploratory 3D learning environment that can be navigated nonlinearly, interspersed with quizzing sections that test knowledge of the material covered. Users were evaluated at two different segments of the module, and depending on their quiz score, were either allowed to continue to the next segment of the module, or forced to revisit the previous section in order to gain the knowledge needed to advance.

The application was evaluated by Jamie Sammis, on of WPA's sixth grade science teachers, Angela Diehl, M.A. of the University of Texas Southwestern Medical Center's Biomedical Communications program, as well as 85 sixth grade science students. During this evaluation, students were given a custom-designed interactive application and their comprehension of its content was monitored. In addition, students were asked to evaluate the application and their interest in taking advantage of similar digital supplemental learning applications in the future. To gauge efficacy, students were given a 20-question pretest before the implementation of the application, which was then re-administered as a post-test the following week. At the end of the evaluation, it was determined that the designed learning application produced marked improvement in content retention among students. In addition, students showed overwhelming preference to learning through digital interactive learning applications. Due to the structure of the classrooms participating in this evaluation, it was also possible to compare test and survey results between classes of all male or all female students and classes with both male and female students. At the end of the application's implementation, it was determined that students who used it in conjunction with normal classroom learning methods scored an average of 13.3% higher on TEKS-based evaluations.

VITAE

Brett Douglas Clair was born in Toledo, Ohio, on January 14, 1987, the daughter of Mark and Lisa Clair. After completing his work at Sylvania Southview High School, Sylvania, Ohio in 2005, he entered The University of Cincinnati's College of Design, Architecture, Art, and Planning, Cincinnati, Ohio. There he received the degree of Bachelor of Fine Arts, with a concentration in drawing and illustration. In May, 2010 he entered the University of Texas Southwestern Medical Center's Graduate School of Biomedical Communications. He was awarded the degree of Master of Arts in July, 2012. Since that time he has been employed as a dynamic media designer at SpineFrontier in Beverly, Massachusetts.

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BRETT CLAIR, M.A.

The University of Texas Southwestern Medical Center at Dallas, 2012

LEWIS CALVER, M.S.

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Introduction

Digital Learning

As interactive digital media becomes an increasingly prevalent and important form of communication it is important to constantly reevaluate its role as a teaching tool. A 2009 national survey of school districts found that 97% of school districts nationwide implemented local area network (LAN) connections among their computers, and 100% of these districts allow for access to the Internet. (Gray 5) With the computer and Internet access becoming not only commonplace, but also a standard in the classroom, it is important to analyze how best to harness this tool and best use it for educational purposes in ways that are not only informative, but also engaging to students. According to Barab, "[Interactive applications and games] provide entire worlds designed to help learners adopt roles and engage story lines previously inaccessible to them. If properly designed, they can provide the problems, tools, people, experiences, perspectives, and consequences to ensure that learners develop rich content understanding." (Barab 526) Additionally, interactive media allows for an even more in-depth approach to multi-modal learning. According to the results of Roxana Moreno and Richard Meyer's study on multi-modal learning, "students learned better when verbal input was presented auditorily as speech rather than visually as text." (Moreno 15) Also in support of multi-modal learning practices,

Williams Preparatory Academy and Uplift Education

Williams Preparatory Academy was established in 2007, as a member of Uplift Charter Schools. It was designated as a T-STEM school (Science, Technology, Engineering and Math) by the Bill and Melinda Gates Foundation. WPA has established partnerships with UT Southwestern and the Dallas Flight Museum. WPA recently began a partnership with UT Southwestern to pioneer effective ways to implement new and interactive media in the classroom setting.

Founded in 1997, Uplift Education was one of the first charter school systems in the state of Texas. Funded largely through personal investments and donations, Uplift Education charter schools consistently rank among the highest in the state, and North Hills Preparatory, the first school started by Uplift education, ranks among the top ten high schools in the country by Newsweek magazine, and in the "Best IB Programs in America" By US News and World Report.

TAKS & TEKS

The TAKS exam (Texas Assessment of Knowledge and Skills) is a standardized test throughout Texas that evaluates student understanding of TEKS objectives (Texas Essential Knowledge and Skills). As a public school operating in the state of Texas, WPA is subject to abiding by TEKS curriculum guidelines. TEKS curriculum guidelines for sixth grade science students pertaining to this application are as follows:

> "(11) Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to:
>
> (A) describe the physical properties, locations, and movements of the Sun, planets, Galilean moons, meteors, asteroids, and comets;
>
> (B) understand that gravity is the force that governs the motion of our solar system; and
>
> (C) describe the history and future of space exploration, including the types of equipment and transportation needed for space travel."

Currently Williams Preparatory Academy follows these curriculum requirements using mostly traditional media. They implement numerous paper handouts, which are then gathered and kept by the students in a journal collection. They also implement physical learning activities such as planet model building and paper-based quizzing games. While digital web-learning applications are used for some other science topics in this class, no content pertaining to Section 11 of the TEKS guidelines makes use of digital learning applications.

Materials and Methods

Audience & Content

To better understand the target audience, a shadow experience and evaluation was performed. While sitting in on three separate science classes led by Jamie Sammis, one of WPA's sixth grade science teachers, I gathered general impressions about how media was used in the classroom. I found that during the times digital media was implemented, this sampling of students seemed to be more focused and task-oriented, whereas when they were using traditional handouts to learn there was considerably more talking and commotion in class.

After sharing these results with Ms. Sammis, we both agreed that the development of an interactive learning supplement would be a worthy pursuit. We decided to focus on the section of the curriculum addressing space and the solar system, as we both agreed the content lent itself well to dynamic visual media and user-guided navigation and exploration. The application would serve to enhance traditional teaching methods, and to reinforce TEKS-compliant curricula as a computer-based learning supplement. The application would specifically target planets and moons of our solar system as its primary content, as the sheer volume of content would free up teachers to allocate more traditional classroom teaching time for broader space-based learning concepts such as gravity, electromagnetism, the speed of light, as well as the history of human space exploration. The application would serve as a repository for TEKS-relevant factual information about each planet and moon. Students would then be able to digest these individual facts at their own pace, potentially even outside of the classroom based on outside computer access.

Development

Assets for the application were developed in Autodesk Maya 2012, allowing for a fully three-dimensional representation of the solar system and its components. Animated video clips of each individual component, transitions between different planets and moons to simulate travel, and animated component facts were created with seamless transitions. The component planets and moons were arranged to represent their geographic location in the solar system. To facilitate structural comprehension, students would navigate primarily from planet to planet. If a planet had a moon covered by the application, it became accessible from the navigation hub of its respective planet. This branching form of navigation helps to both organize the content based on actual geography, and to create a structural hierarchy of relevant content to the user. To create these clips, image sequences were rendered in Maya and then exported to Adobe After Effects CS5, where they were compiled into separate video clips. These clips would then be stitched back together to allow for user interaction and control.

To take advantage of its robust quizzing support, it was decided that the clips would be reconstituted in Adobe Captivate CS5. The clips were arranged and stitched together in a branching format that allowed for nonlinear navigation. Students were able select different planets, "travel" to them, and learn facts about them via a "space cockpit" graphic user interface (GUI). They were also given access to a "solar map" from which they could navigate to any planet in their section of the solar system instantaneously. This allows for easy and quick access to relevant information, and also gives the user a sense of control and connection to the application.

To provide voice narration, a text-to-speech application called "Speak It!" was implemented. Factual information as well as user instruction was fed into the application in text form, and voice narration was then produced to aid in comprehension of the application's content. This was seen as a benefit due to the high amount of content and the variability of literacy rates inherent in a student audience so young. It was also noted that WPA has a higher than average English as a Second Language (ESL) student body, and it was determined that audio narration combined with text would aid in overall comprehension among these students as well. The voice narration manifested itself in the form of "LUNA" (Learning & Universe Navigation Assistant). LUNA was characterized as the artificial intelligence digital personality of the spaceship in which the user explored the solar system. LUNA acts as a guide for the user, explaining how to properly navigate the application's GUI, as well as narrating the application's educational content.

To provide a narrative arc, as well as motivation to participate in the application, a story was developed involving protagonists "Paz" and "Zoe." It was important to provide the application with protagonists that both male and female students would connect to. According to Jeroen Bourgonjon, research shows that common perceptions lead interactive applications and gaming to be considered a male-centric activity. (Bourgonjon 1437) Because of this, the protagonists were fashioned as students of a nonspecific but similar age group. Humor amongst the two protagonists was also implemented in order to bring levity to the application's story elements and further enhance engagement among students. In a similar fashion it was important to employ an antagonist that provided a challenge to the audience and further motivated students to use the application to its fullest. In the narrative, the evil "Quizbot" has kidnapped Paz and Zoe's classmates, and in order to rescue them, they must defeat Quizbot in two different fact-challenges. This manifest as two multiple-choice quizzes containing 10 questions each, and is placed at the midpoint and end of the application. If the user travels to each planet and moon, learns about them, and uses this information to successfully complete these two "Quizbot Challenges" he or she then "wins" and completes the application. If the user fails either of the challenges, they are redirected back to the learning portion of the application, and must review the content and retake the quizbot challenge in order to advance.

Publication

The application was published as a standalone program that is compatible with PCs, as that is what the students were provided in class. Performance quality was monitored throughout development, as students were provided small "netbook" computers with minimal processing power. It was important to make sure that the application ran properly and smoothly given this constraint. Also, file size for the application was limited, and in order to function properly, it was determined that the application needed to be divided into two different segments. Each segment contained half of the application's content, culminating in a Quizbot Challenge at its end. Given the nature of the content, it was decided that the split would occur between the inner and outer planets of the solar system, with the inner planets and their moons featured in part one, and the outer planets and their moons featured in part two. Future exploration into web-based implementation would be highly beneficial and circumvent several of the size and performance limitations inherent to the hardware, as well as providing a standard format that multiple models and operating systems would have equal access to. This unfortunately was not feasible in the timeframe the in which the application needed to be created to accommodate WPA's calendar availability.

Implementation

On April 25, 2012 students were given a pretest consisting of twenty questions, which directly correlate to the content covered by the application. The pretest was given after pertinent space and solar system concepts had been covered in class via normal teaching methods, but before the implementation of the application. The all-male class produced a mean score of 62.8% correctly answered questions. The all-female class produced a mean score of 50.8%, and the mixed class produced a mean score of 55.4%. The pretest's content would be directly addressed in the application and an identical post-test would follow.

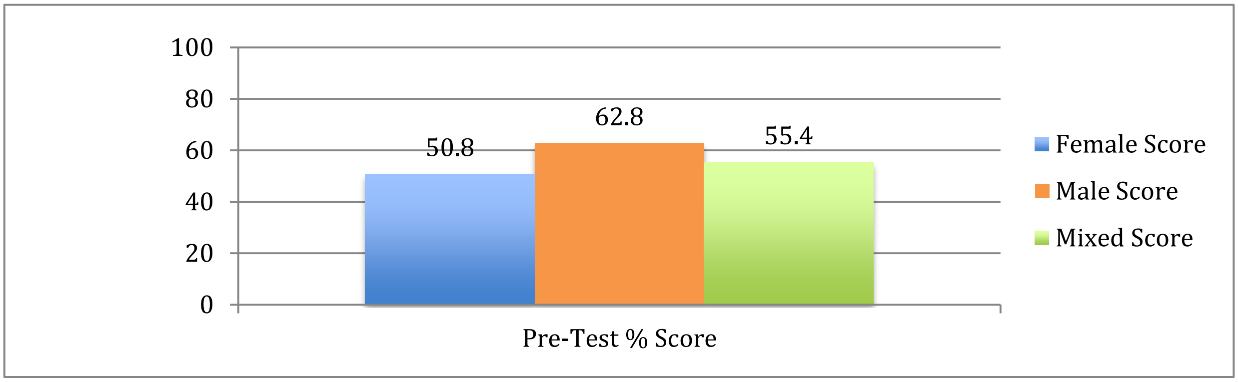

Figure 1.1: Pre-Test Results

On April 26, 2012 the application was fully implemented in Ms. Sammis' science curriculum. The sample size consisted of 85 students spread over three different classes. Due to WPA currently piloting gender-specific classes, the sample audience consisted of one all-male group, one all-female group, and one co-ed group. This provided a welcome but unexpected opportunity to gauge the effectiveness of the application in gender-specific environments, and data was subsequently recorded to facilitate this opportunity for analysis. Students were given approximately ninety minutes to complete the application, with the majority of individuals working on their own computer. Only 12 students out of the 85 evaluated needed to share a computer due to stock limitations. Upon implementing the application, I evaluated that enthusiasm for the application was relatively high compared to normal teaching methods. Students used headphones to be able to hear the audio portion of the application. This largely cut down on talking and commotion in class, and appeared to allow students to focus on the content of the application.

Students were given a "solar notebook" in which they could take notes on the factual information given throughout the application. The notebook was divided by component and allowed students to record the content provided by the application. This notebook could then be used as reference during the two Quizbot Challenges. The object of implementing this was twofold. First, it would increase multi-modal learning by including audio, visual, and kinesthetic approaches to the content. Second, it would encourage students to take notes and provide an information source they could use away from the computer.

Results & Discussion

Post-Test

The following week after implementing the application, students were subjected to a post-test examination. It was determined that the post-test would be given several days after using the application to help gauge long-term retention of content. While students were allowed to use their "solar notebook" during the course of the application, they were not allowed to use it for their post-test examination. The following represents a class analysis based on the percentage of correct answers on each of the post-test's twenty questions.

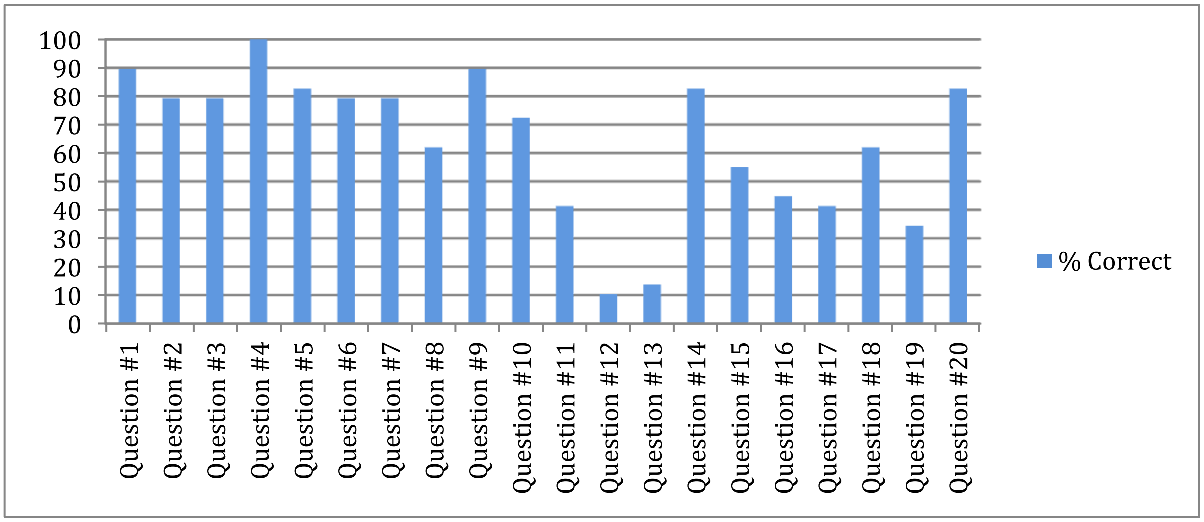

Figure 2.1

Post-Test Results: All Female

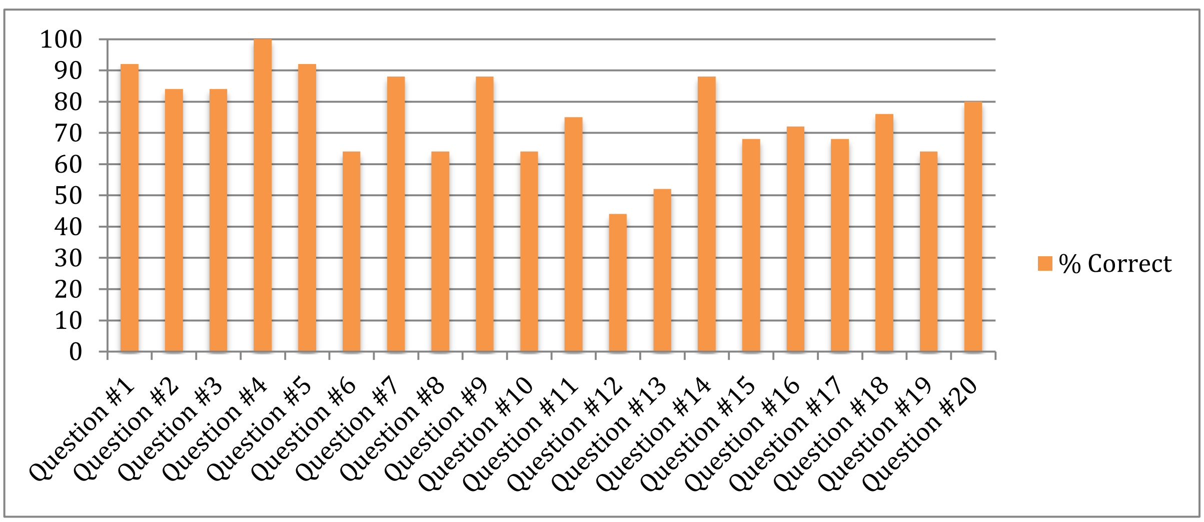

Figure 2.2

Post-Test Results: All Male Class

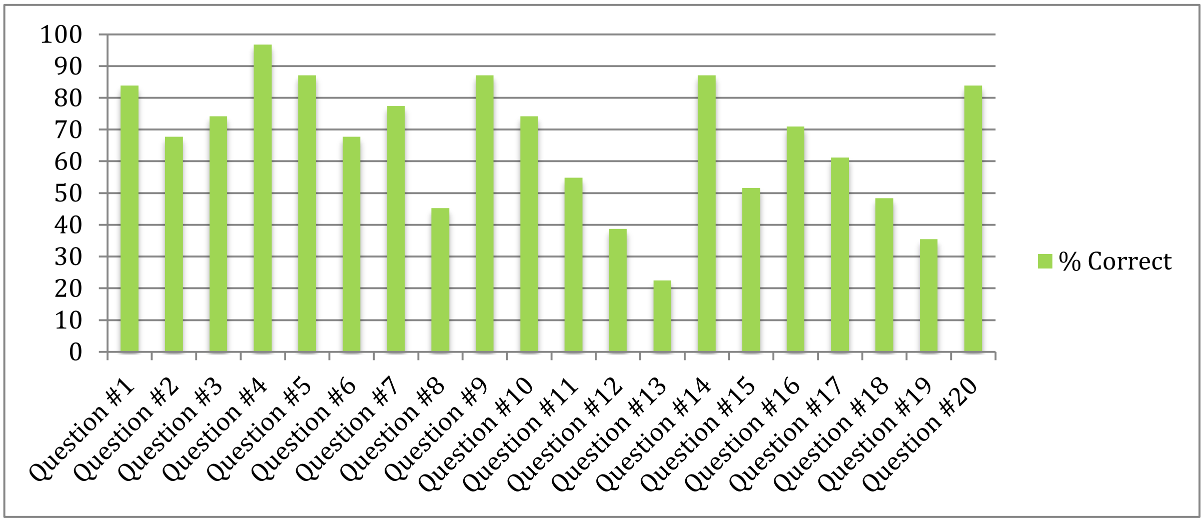

Figure 2.3

Post-Test Results: Male & Female Class

Students in all three classes exhibit similar patterns in the percentage of correct answers based on specific questions in the examination. For instance, nearly every student answered question #4 correctly. Similarly, questions #12 and #13 proved difficult to the majority of students across all classes. Whether this is based on the relative ease of the questions themselves or the thoroughness of the application to explain the content is yet to be determined. Upon general examination the data points to scoring solidarity among testing classes. Each class tested within a relatively tight margin, exhibiting comparable ranges in average correct answers.

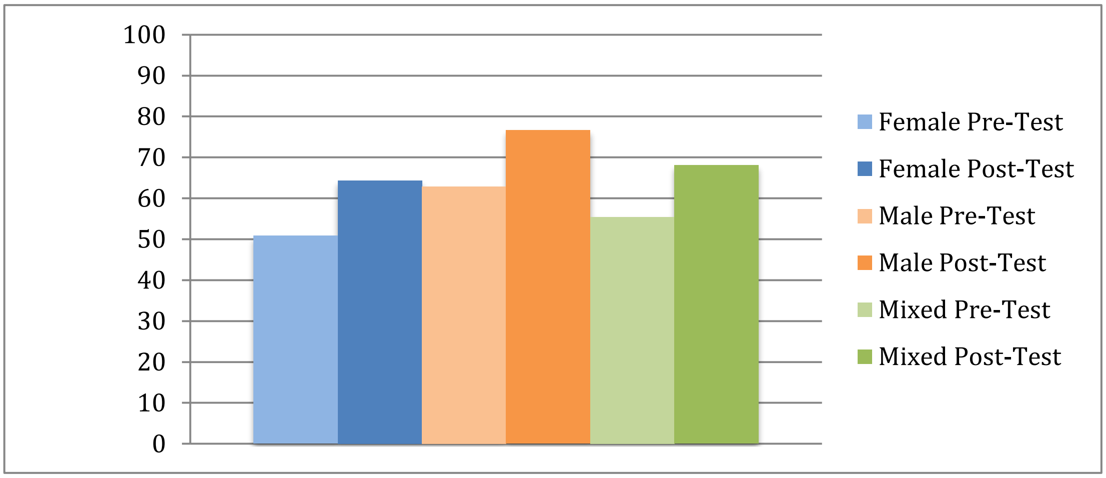

Figure 3.1
Pre-Test / Post-Test Comparison

Upon reviewing the post-test data in detail, it was determined that students on average scored 13.3% higher after implementation of the application. The all-female class scored an average of 13.5% higher, the all-male class scored 13.8% higher and the mixed group scored an average of 12.7% higher. The narrow range of these results helps to discount the notion that class variation may greatly impact these results. Concurrently it alludes to the notion that both male and female students find the application equally useful.

Survey

Upon completion of the application students were also asked to complete a survey examining their opinion of the usefulness, format and fun-factor of the application, as well as their opinion of interactive media in the classroom as a whole. Upon review, it was discovered that preference of interactive learning to traditional classroom learning techniques was overwhelmingly high. Out of 62 answers received to the question "Do you prefer traditional teaching methods or computer-based interactive learning?" an impressive 59 students chose interactive learning activities over normal teaching methods. Also of note, an overwhelming majority of surveyed students also described the application as either "quite enjoyable" or "so much fun!" This alone asserts that regardless of possible test score variation in future iterations of this application or ones similar, its use promotes active engagement among students.

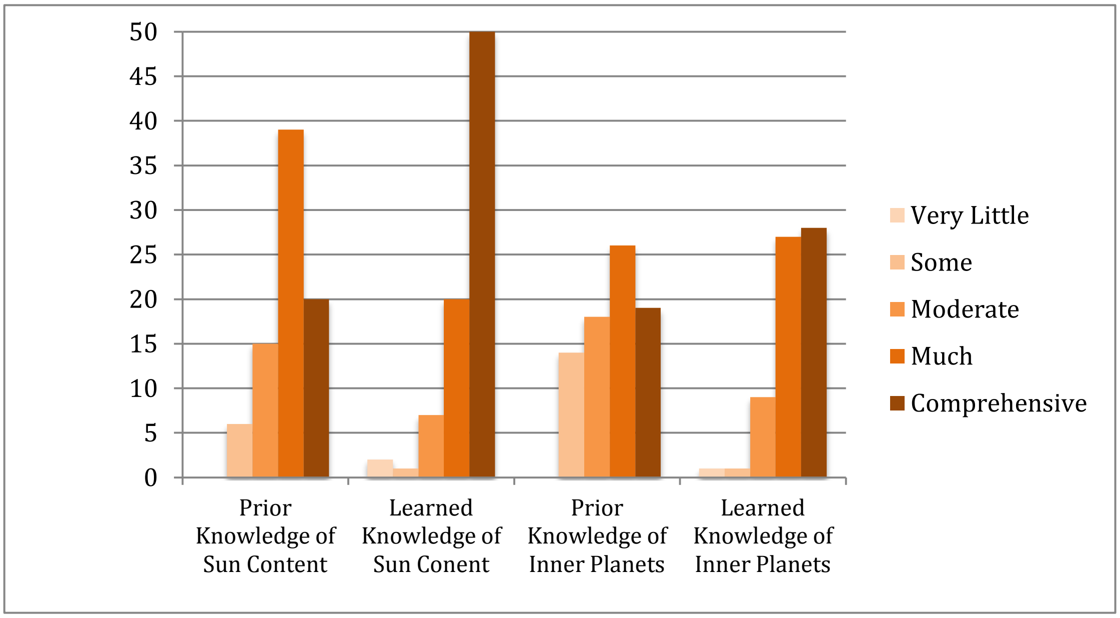

Figure 4.1

Survey Results - Students' Opinion on Knowledge of Sun and Inner Planets Prior to and After Application Implementation

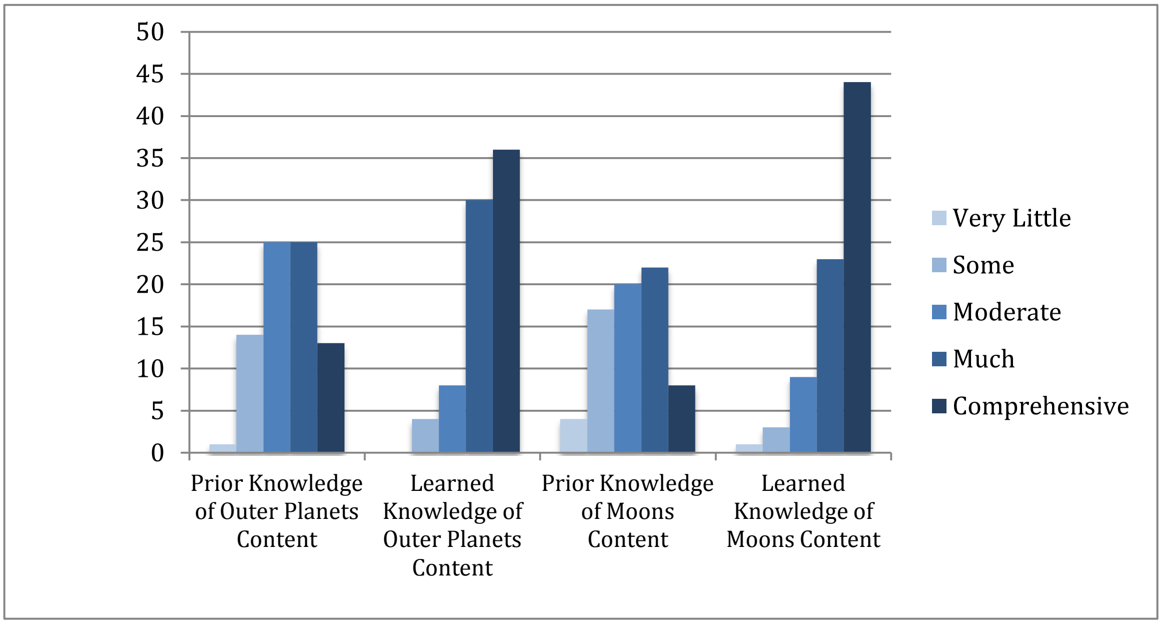

Figure 4.2

Survey Results - Students' Opinion on Knowledge of Outer Planets and Moons Prior to and After Application Implementation

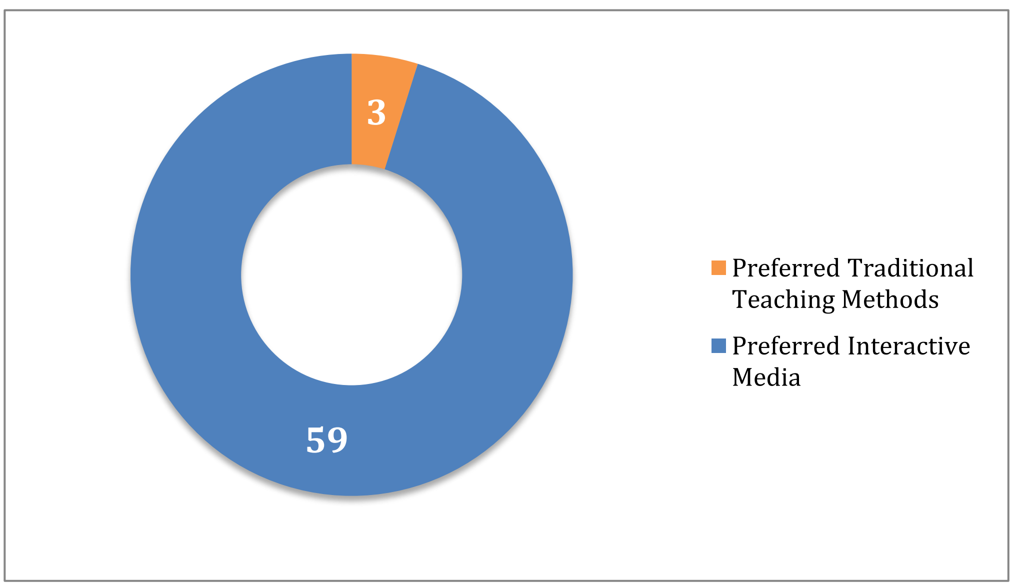

Figure 4.3

Survey Results: Teaching Method Preference

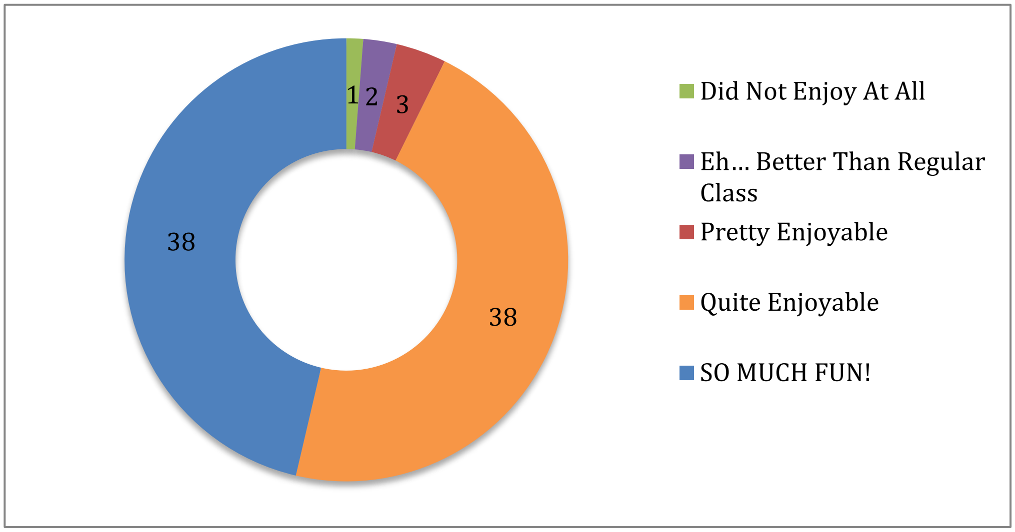

Figure 4.4

Survey Results: Fun-Factor

There are several modifications to be made that would be beneficial to both improving the effectiveness of the application and providing more accurate analytical data. The first and most important is that the application needs to be more accessible to students both in and out of class. Creation of a web-based application would alleviate this by allowing multiple types of operating systems to have equal access to it without custom modification, as well as making the application available outside of school, as students do not take the school netbooks home with them. Through content-streaming methods, a web-based application would also allow for the game to be implemented as a whole, instead of it needing to be broken into segments due to file size limitation.

Another chance to improve the application would be to analyze answer patterns to isolate questions that are too easy, too hard, or not taught to the student in the best possible manner. There are several questions that students scored uniformly high or low on, namely questions #4, #12, and #13, which would be a good starting point to begin analysis.

Finally it would be beneficial to improve upon the application's interactive functionality. Currently the application involves "point and click" functionality with a simulated three-dimensional overlay. Though a challenge, exploring game-engine based functionality with a fully 3D environment that can be freely navigated would increase user interaction, and hopefully content retention in the process. This type of development requires a high level of interdisciplinary expertise, and would be best suited for a group of developers rather than single individual. Thus it was not explored in the application's initial development cycle.

Acknowledgements

Many thanks to my content advisor, Jamie Sammis, for making time within her class to accommodate this project, and for her contribution in making this application as audience-aware as it could possibly be. I would also like to thank the members of my thesis committee, Lewis Calver and Angela Diehl. Their knowledge and guidance proved invaluable, and will help to inform all of my future endeavors. Thanks also to my classmates, Mollie Gove, James Montgomery and Elizabeth Sumner. Our teamwork over the past two years has turned what could have been a grueling experience into a fun and exciting challenge. I would like to express sincere gratitude to my family. Without their support I would never have come to know and love the field of biomedical communications. Finally I would like to express my unending appreciation to my fiancée, Lesley Olson, who unwaveringly demonstrated her love, commitment and support, even from a thousand miles away.

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Appendices

Appendix A: Example Question Set

Part II

1.) Which of the following planets has a composition similar to the Sun?

A.) Mercury
B.) Venus
C.) Mars
D.) Jupiter

2.) The density of a planet is 0.69 g/cm^3 (density of water is 1.0 g/cm^3) Which of the following planets might this be?

A.) Mars
B.) Mercury
C.) Saturn
D.) Venus

3.) In 1930, Scientists discovered Pluto and labeled it as the 9th and smallest planet in our solar system. Later, other planet-like objects that were larger than Pluto were discovered. This caused scientists to redefine the term "planet" in 2006, and Pluto was relabeled as a "dwarf planet."

So, the discoveries that followed the finding of Pluto led to the…

A.) Changing of Pluto's composition
B.) Changing of Pluto's physical characteristics
C.) Changing of Pluto's original location
D.) Changing of Pluto's classification

4.) Ruby is constructing a model of the solar system. Which two planets should be placed between Jupiter and Neptune?

A.) Saturn & Uranus
B.) Venus & Mercury
C.) Uranus & Earth
D.) Earth & Mars

5.) The solar day on Mars is almost the same as Earth's solar day. The days are almost the same because…

A.) The revolution rate of Mars and Earth around the Sun are nearly equal.
B.) The revolution rate of Earth around the Sun is much faster that the revolution rate of Mars.
C.) The rotation rate of mars is much faster than the rotation rate of Earth
D.) The rotation rate of Mars and Earth are nearly equal

6.) Which moon is the most volcanically active?

A.) Callisto
B.) Io
C.) Phobos
D.) Europa

7.) Which of the following planets is classified as a "gas giant?"

A.) Mercury
B.) Mars
C.) Venus
D.) Neptune

8.) The Closer a Planet is to the Sun, the _________ the gravitational force is between them and the _________ the planet's orbital speed.

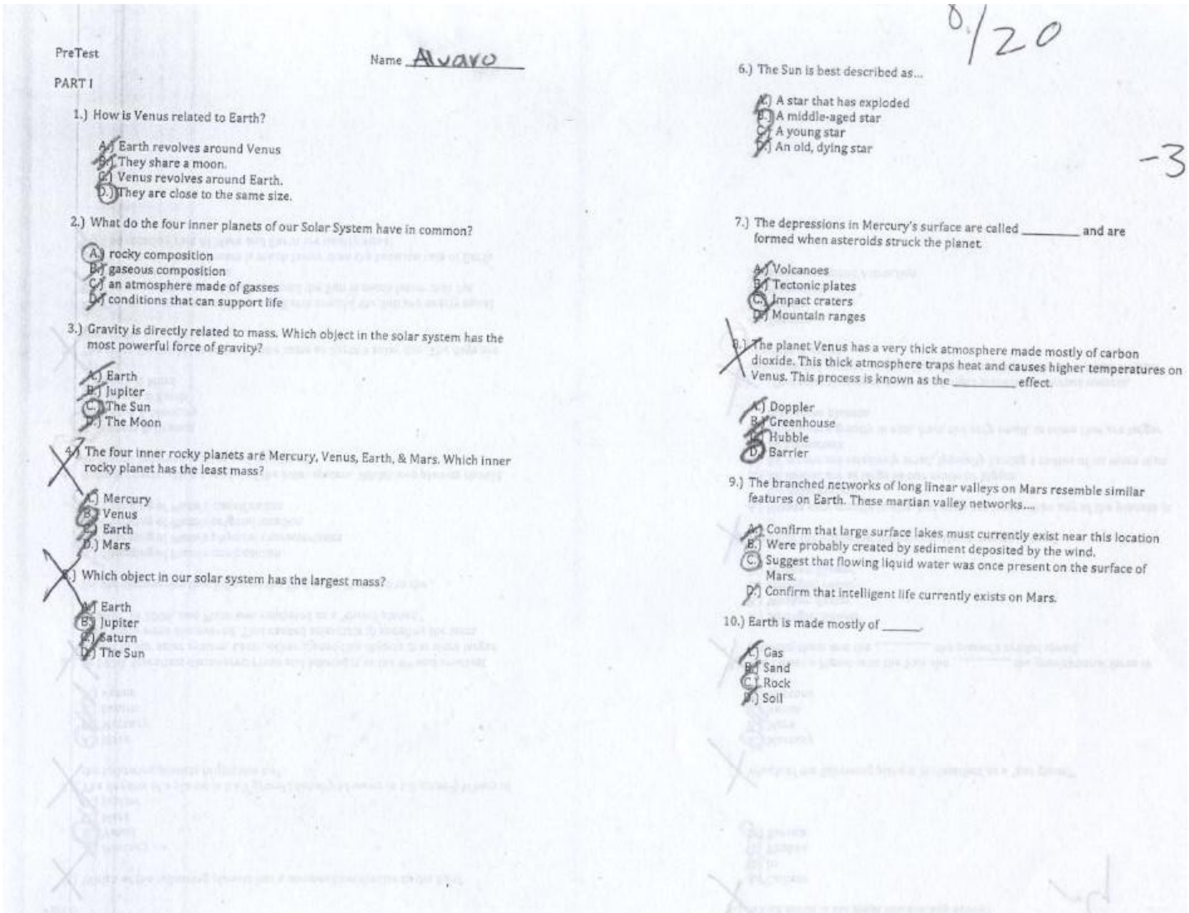
A.) Stronger; Slower
B.) Weaker; Faster
C.) Stronger; Faster
D.) Weaker; Slower

9.) Which of the following statements about moons is true?

A.) Moons vary greatly in size, but none are larger than any of the planets in the solar system.
B.) All moons are as large as our moon or bigger.
C.) All moons are relatively small, typically having a radius of no more than 20 kilometers
D.) Moons very greatly in size, from the very small, to some that are larger than some planets.

10.) Our solar system is made up of eight planets, numerous comets, asteroids and moons, and the Sun. The force that holds all of these objects together is called ____

A.) Tension
B.) Gravity
C.) Magnetism
D.) Electromagnetic Attraction



PreTest

Name Alvaro

PART I

1.) How is Venus related to Earth?

A.) Earth revolves around Venus
B.) They share a moon.
C.) Venus revolves around Earth.
D.) They are close to the same size.

2.) What do the four inner planets of our Solar System have in common?

A.) rocky composition
B.) gaseous composition
C.) an atmosphere made of gasses
D.) conditions that can support life

3.) Gravity is directly related to mass. Which object in the solar system has the most powerful force of gravity?

A.) Earth
B.) Jupiter
C.) The Sun
D.) The Moon

4.) The four inner rocky planets are Mercury, Venus, Earth, & Mars. Which inner rocky planet has the least mass?

A.) Mercury
B.) Venus
C.) Earth
D.) Mars

5.) Which object in our solar system has the largest mass?

A.) Earth
B.) Jupiter
C.) Saturn
D.) The Sun

8/20

6.) The Sun is best described as...

A.) A star that has exploded
B.) A middle-aged star
C.) A young star
D.) An old, dying star

-3

7.) The depressions in Mercury's surface are called ________ and are formed when asteroids struck the planet.

A.) Volcanoes
B.) Tectonic plates
C.) Impact craters
D.) Mountain ranges

8.) The planet Venus has a very thick atmosphere made mostly of carbon dioxide. This thick atmosphere traps heat and causes higher temperatures on Venus. This process is known as the ________ effect.

A.) Doppler
B.) Greenhouse
C.) Hubble
D.) Barrier

9.) The branched networks of long linear valleys on Mars resemble similar features on Earth. These martian valley networks....

A.) Confirm that large surface lakes must currently exist near this location
B.) Were probably created by sediment deposited by the wind.
C.) Suggest that flowing liquid water was once present on the surface of Mars.
D.) Confirm that intelligent life currently exists on Mars.

10.) Earth is made mostly of ______

A.) Gas
B.) Sand
C.) Rock
D.) Soil

Appendix B: Example Survey

Amy Salazar

Solar System Game Survey

Did not get to part 1

Before you played the game, how much do you feel you **already knew** about each of the following:

	I knew nothing	I knew very little	I knew some	I knew quite a bit	I knew a LOT
The sun	1	2	3	4	5
The inner planets (Mercury, Venus, Earth, Mars)	1	2	3	4	5
The outer planets (Jupiter, Saturn, Uranus, Neptune)	1	2	3	4	5
The moons in our solar system (including moons around other planets)	1	2	3	4	5
Other objects in the solar system (meteoroids, asteroids, comets, etc.)	1	2	3	4	5

Part 2 not done

Please rate how well this game **helped you learn** about each of the following:

	I learned nothing	I learned very little	I learned some	I learned quite a bit	I learned a LOT
The sun	1	2	3	4	5
The inner planets (Mercury, Venus, Earth, Mars)	1	2	3	4	5
The outer planets (Jupiter, Saturn, Uranus, Neptune)	1	2	3	4	5
The moons in our solar system (including moons around other planets)	1	2	3	4	5
Other objects in the solar system (meteoroids, asteroids, comets, etc.)	1	2	3	4	5

taking notes to find corect answers

Give an example of something you learned about one of the above topics:

Like I found out that Jupiter has wind that has been blowing in their for a long time planets closer to sun are harder and longer / fatner were colder

What was your favorite part of the game? Why?

That you had to defeat the robot to go to the other part of our solor system

How do you think the game could be improved?

By going less fast or have a button that lets you go back when you were ready to go back.

How much did you enjoy playing this game?

Did not enjoy at all	Eh…better than regular class, I guess	Pretty enjoyable	Quite enjoyable	SO MUCH FUN!!!!
1	2	3	4	5

How many hours per week would you guess that you spend playing computer or video games currently? 5 or 6

Appendix C: Example Solar Notebook

Solar Notebook

The Sun

Overview

Closest star to earth. Takes over four years to reach earth. Light from the sun only takes eight minutes to travel to earth.

Red Giants

Our sun will expand to become a "Red Giant". The sun will grow even larger than some of the planets' orbits.

Main Sequence Stars

Our sun is a "main sequence star." The sun is middle-aged. Our sun was born in a "nebula".

Mercury

Overview

Is the smallest planet. A little larger than Earth's moon. Is a terrestial planet. Made mostly of rock.

Atmosphere

has a very thin atmosphere. the surface that is facing the sun is extremely hot. the surface that faces away from the sun is extremely cold.

Days & Years

Takes 88 earth days to revolve around the sun. days are much longer than earth's days. Takes a whole 58 days earth days to rotate once on its own axis.

Venus

Overview

Called earth's "sister planet" because it's very close to the same size as earth. Has a very thic atmosphere. The temperature is hot enough to melt lead.

Rotation

Venus is a terrestrial planet. Spins clockwise which means the sun rises in the west and sets in the East.

Days & Years

A day on Venus lasts longer than a year. Takes 243 earth days to rotate once on its own axis. Takes 225 earth days to revolve around the sun once.

The Magellan Mission

The magellan mission used technology called RADAR to look through the clouds to see Venus' surface.

Earth

Overview

Just one moon. The planet's surface has a lot of different features. A terrestrial planet. A 24 hour day and 365 day year.

Life on Earth

Has lots of water. If Earth was much farther away we would freeze. If Earth was much closer to the Sun we'd all burn up.

The Moon

Overview

Covered in craters. Has no atmosphere. No liquid water on the moon.

Gravity

A force that causes objects to be attracted to all other objects. Makes the moon orbit around earth. The more mass an object has the more gravity it has.

Tides

the moons gravity is strong enough to affect ocean tides on Earth's surface.

Mars

Overview

Surface is very dry. Dust storms are common on the planet. Has two small moons. A terrestrial planet.

Color

on mars

Much smaller than earth. The temp" stays below freezing its farther from the sun than earth.

Temperature

Its color comes from a chemical in the soil called "iron oxide" or rust.

Phobos

Overview

Larger and closer of Mars' two moons. Approximately 18 miles long. Gets its name from a greek god.

Deimos

Overview

Is the smaller and more distant of Mars' two moons. Gets its name from the god Deimos in Greek mythology. Approximately 9 miles long.

Jupiter

Overview

Largest planet. Jupiter is a "gas giant". has a very short day. rotates on its axis once every 10 hours.

Stripes

Its fast rotation gives the planet a striped appearance. Takes 12 earth years to revolve around the sun.

The Great Red Spot

actually a giant hurricane that has been blowing for over 3 centuries. Larger than the entirety of earth.

Moons

Much bigger than Earth. Jupiter has much more gravity. 63 total moons.

Io

Overview

More active volcanoes than any other moon or planet in the solar system. the rocks produce friction when they rub against each other.

Ganymede

Overview

Largest moon in the solar system. Actually bigger than Mercury.

Europa

Overview

Its surface is icy. Might be liquid water under the ice.

Callisto

Overview

the third largest moon in the solar system. Think that its surface is very old. has more craters than any object in the solar system.

Saturn

Overview

best know for the rings that orbit the planet. Spins very fast, each day is just over 10 hours.

Composition

these elements are less dense than water. is the lightest, least dense planet in the solar system.

Wind Speed

Can blowup to almost 450 miles per hour. has more than 33 known moons.

Uranus

Overview

has a thick layer of ice. Take 84 earth years

The Planet's Core

Neptune

Overview

Pluto

Overview

Size

Orbit Shape