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USING A VIRTUAL WORLD FOR SCIENCE INSTRUCTION WITH FIFTH AND SIXTH GRADE STUDENTS

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USING A VIRTUAL WORLD FOR SCIENCE INSTRUCTION WITH FIFTH AND SIXTH GRADE STUDENTS

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ABSTRACT

USING A VIRTUAL WORLD FOR SCIENCE INSTRUCTION WITH FIFTH AND SIXTH GRADE STUDENTS

By

Amy Eileen Pihlainen

This qualitative study's purpose was to integrate virtual classroom assignments with traditional classroom activities. The integration of these virtual classroom assignments were used to assess the benefits of technology integration in a science classroom. Thirteen fifth and sixth grade students learned about the evolution and traits of organisms in accordance to the State of Michigan Grade Level Content Expectations. This unit followed a unit on animal systems. Students were given a pretest and posttest (in concept map form and unit test in essay form). Objectives were taught using a combination of lecture, discussion, and in class activities. The unit also contained three virtual world activities. Following each virtual world activity, students were given a questionnaire to give feedback regarding the retention of subject matter and presentation of material. The virtual world activities enhanced the animal systems unit. Students were able to learn the objectives and then extend their knowledge through interactive simulations and presenting their creations. Students also greatly benefitted from the social aspect of Biome. Students were able to understand big picture ideas and make real world connections through social expression, artistic expression and the sharing of their ideas.

DEDICATION

This thesis is dedicated to my parents, Terry and Tina Pihlainen.

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Chapter 1: INTRODUCTION

This thesis follows the format prescribed by the *APA Style Manual (6th ed.)* and The School of Education, Leadership, and Public Service.

Scientists seek knowledge to find answers to questions regarding the universe. Learned knowledge can be applied to a variety of concepts including the classification of a species, the form and function of the human body, the development of a breakthrough medication, and the exploration of space. Students must be shown the importance and relevance of science. Integrating technology into science curriculum can help students comprehend big picture ideas and make real world connections. Using virtual worlds can also help students become more social, express themselves, and share their ideas.

Background

Science has been a difficult subject for many students to comprehend. Teachers continue to try to find fun, interactive ways to enable students to understand and retain science concepts. Perhaps technology integration would enhance student learning by allowing students to see the big picture. Classrooms use scientific instruments, web based inquiry, and computer software to create interactive models. Students can create their own models and make decisions about how different elements work together (Kali & Linn, 2008), multimedia in science instruction may increase a student's reasoning ability (Zheng, Yang, Garcia, & McCadden, 2008), and hands-on simulations provided by teachers can allow students to have control in their own learning while providing challenges and motivation (Hennessy et al., 2007). Internet resources such as Web-Based Inquiry Science Environment (WISE) have modules for creating inquiry based science

projects and many teachers have been trained in technology enhanced inquiry science (Varma, Husic, & Linn, 2008).

Justification for the Research

Students should enjoy learning and teachers need to assist in helping students become life-long learners. A teacher must provide information and materials necessary to convey the relevance of science education. Information can be retained by applying learned knowledge to real-life situations. Relevance is one of the most important ideas in teaching concepts.

Technology integration can have negative results. Programs and instruments should be used properly to reduce the potential of negative effects. An example of a negative affect is a teacher not being able to monitor every student who could potentially be visiting websites not pertaining to the lesson (Klieger, Ben-Hur, & Bar-Yossef, 2009). The success of technology integration in a science classroom can be increased if students are already familiar with basic technology applications (Reid-Griffin & Carter, 2008).

Key Terms

Science Comprehension is "the act of grasping or understanding" science principles ("Comprehension," 2010).

"Technology Enhanced Inquiry Science is a professional development program to support teachers implementing instruction that features scientific visualizations embedded in inquiry-based modules. The Technology Enhanced Learning in Science Center developed the program" (Varma, Husic, & Linn, 2008, p. 341).

"Web-based inquiry environments feature built-in tools aimed at supporting specific aspects of students' inquiry processes" (Furberg, 2009, p. 397).

"WISE stands for Web-Based Inquiry Science Environment. The WISE platform supports inquiry pedagogy where students can design solutions to problems, generate predictions, conduct experiments, use scientific evidence to support theories or conclusions, and debate contemporary science issues" (Varma, Husic, & Linn, 2008, p. 346).

WebQuest is inquiry based and allows students to interact with resources from the Internet. Students can explore scientific issues by participating in online discussions, engaging in role-play simulations, and work on their abilities to interpret data (Chang, Chen, & Hsu 2011).

"Audience Response Systems (ARS) permit students to click in answers to electronically displayed multiple-choice questions using a remote control device. After students select an answer, the results are instantly aggregated and displayed in chart form for the entire class to review" (Kay & Knaack, 2009, p.382).

Virtual World is a 3D online place where people are avatars and can do many different things they cannot do in the physical world (Lowe, Clark, Gasior, & Saunders, 2013).

Biome is a virtual world using OpenSimulator programming. It is based on Second Life programming and is run out of a server on the Northern Michigan University campus (Lowe, 2016).

Avatar is a graphical representation of the person using a virtual world. The representation can be human or animal (Lowe, Clark, Gasior, & Saunders, 2013).

Teleporting is to go from one point of the virtual world to another instantaneously (Lowe, Clark, Gasior, & Saunders, 2013).

Theoretical Framework

Liev Vygotsky believed the psychological development of humans was culturally determined and believed humans are born into evolved societies and taught to use a variety of tools and signs. Further development helps humans to internalize social interactions and promotes abstraction. Metacognition, self-regulation, awareness, knowledge, thoughts and behavior move along the same developmental path, which enables students to reflect on his or her learned systematized knowledge. Students are then able to apply their internalized symbols and tools to increasingly difficult tasks. Using Vygotsky's social constructivism theory and Zone of Proximal Development students have opportunities to transfer from the abstract back to the concrete to promote successful development of metacognition and self-regulation (Fox & Riconscente, 2008).

Research Questions

Will science activities in the virtual world increase a student's retention of the subject?

Can technology integration have negative effects?

Does the inclusion of virtual world technology aid in a student's comprehension of science?

Summary

A teacher's job is to create an environment where all students are able to learn. Technology integration is one way to use hands-on applications and tools to convey scientific ideas. Researchers have used multimedia, web-based inquiries, and other technological tools to enhance students' science comprehension. Technology cannot change a classroom by itself, but must be monitored and regulated by a teacher

(Warwick, Mercer, Kershner, & Staarman, 2010). When technology is monitored, students can have an extra tool that they can use in their learning toolbox.

Chapter 2: LITERATURE REVIEW

This literature review covers topics of how technology integration can help or hinder students' understanding of science and problem solving in science.

Technology Aided Science

Students may find the subject of science to be complicated and difficult to understand. Technology integration can aid in teaching science curriculum. A variety is currently used in classrooms to enhance students' learning. Audio response systems (ARS) have been used to provide immediate feedback for students and teachers. Two hundred thirteen students in grades 10, 11, and 12 were tested in biology, chemistry, physics and general science using audio response systems. Students would use remote clickers to choose a multiple-choice answer. Responses were anonymous but immediately displayed on a class projector and helped teachers identify science concepts requiring further explanation (Kay & Knaack, 2009). Computer models of atoms (Ingerman, Linder, & Marshall, 2009) and computerized laboratory equipment (Kaberman & Dori, 2009) can also aid in the understanding of difficult science concepts.

The use of multimedia has also aided in students' learning of science concepts. A correlational quantitative study investigated effects of multimedia and schema induced analogical reasoning on science learning. Research was conducted in the northeast United States. Eighty-nine fourth grade participants were included. Participants first completed a test called Group Embedded Figure Test (GEFT). They were placed into four random groups: interactive multimedia with analogy (MA), interactive multimedia without analogy (MNA), analogy without interactive multimedia (ANM), and no multimedia and no technology (NMNA). In MA, participants were given two Multimedia Learning

Objects (MLOs): electrical circuits and water system: water system being the analogy. In MNA, participants were given only electrical circuit multimedia. In ANM, participants were verbally given water system analogy without help from multimedia learning objects. In NMNA, participants learned about electrical circuits in a traditional method. All participants were instructed on principles of electric circuits and asked to memorize a table including various materials and the amount of resistance based on conductivity. MLOs provided an interactive representation of both a water system and electrical circuit. Prior knowledge of a water system would potentially activate and apply to electrical circuit function. At the end of the unit, participants were given an achievement test to recall information learned and gauge their ability to transfer knowledge to a new idea. The MA group outperformed all others in recall and transfer followed by the ANM and NMNA groups. The MNA group had the lowest mean scores in both recall and transfer. The results suggest that students can benefit from schema induced analogical reasoning in science learning concepts (Zheng, Yang, Garcia, & McCadden, 2008).

Technology and the Comprehension of Science Knowledge

Science comprehension goes beyond fact-based knowledge. Comprehension of a concept enables a student to apply learned knowledge to other areas of study and make real-world connections. The integration of Web-based Inquiry Science Environment (WISE) into science instruction was the goal of Lee, a fifth grade teacher. WISE module *Plants in Space* was used to scaffold students' activity while making predictions, inferences, comparing plant growth, collecting data, graphing results, and analyzing findings. During year one, Lee elicited students' science ideas mainly through conceptual questioning. In the second and third years, Lee integrated WISE, allowing students to

interact through small group WISE online investigations and whole class discussions. Lee encouraged students to make science personally relevant to them by connecting science ideas with other domains of knowledge (Williams, 2008).

One hundred three sixth-grade students in a public school in Tainan, Taiwan were separated into three groups for mobile learning (m-learning) using WebQuest. The majority of WebQuest activities were conducted inside a classroom. This study used a teaching scenario of WebQuest and mobile technology in an outdoor setting to examine the effect on environmental education. Teaching scenarios of WebQuests were created to support engaging outdoor education. The students were separated into three groups: experimental, first control, and second control. The experimental group was composed of 35 students. This used WebQuest in an outdoor setting. The teaching activities occurred at the treasure house of the school. The first control group consisted of 34 students. They were taught using traditional teaching methods in the classroom. The second control group consisted of 34 students and had a combination of traditional and WebQuest teaching methods. The teacher was the same for all three groups. Pre and post examination was done to look at prior knowledge as well as retention of learned material.

The students in the first control group learned about resource recycling through a series of lectures. If the students had a question regarding the topic, the teacher would answer them directly. The second control and experimental groups both used a WebQuest teaching website created for this study. The website consisted of six modules including Introduction, Task, Process, Resources, Evaluation, and Conclusion. Both groups used the same content. The differences between the two groups were the settings where the learning took place (the second control group's activities took place in a computer-

classroom using computers) and the tools that were used. The experimental group participated in learning activities to enforce resource recycling and classification in the treasure house using both PDAs (to gather information) and computers (to create a PowerPoint and a website). The results of this study showed that students can achieve better performance while participating in the learning task in an outdoor setting (Chang, Chen, & Hsu 2011).

Web-based Laboratories have been used to determine the effectiveness of virtual learning . One such study consisted of three steps. The first step consisted of pre-testing, sampling and grouping. The second step consisted of an experimental treatment. The third step consisted of a post-test and a questionnaire survey about Web-based lab teaching. The LINUX Redhat 7.X was used as the operating system and platform for the Web-based virtual lab. The lab consisted of an experimental desktop (where experiments would be conducted) and cabinets storing lab tools and instruments (e.g. thermometers, alcohol burners, burning cups, and test tubes). Using the Web-based lab, students could operate each tool individually while the system recorded each step (which teachers could use to analyze and correct student errors). The research intended to examine whether or not the designed virtual lab can be an effective tool to facilitate primary school learning of natural sciences.

The findings of the research indicated that using the Web-based teaching lab had a positive influence on primary school students. Sixty-five students were surveyed using "The Questionnaire on Web-Based Lab Teaching for Science Courses." Of the 65 students surveyed, 56 valid questionnaires were obtained. The results were nearly three-fourths of the students were willing to use the Web-based lab (Sun, Lin, & Yu, 2008).

Negative Effects of Technology Integration

Teacher monitoring and proper instruction are necessary for technology integration to be successful. Use of the ARS may help teachers identify problem areas, but could potentially create anxiety for students who participate in the activities. Some students found the use of the clickers in the audio response systems study to be tedious and would rather have listened to a science lecture. A few students thought that the use of the ARS was stressful and 35% of students felt bad when selecting an incorrect response (Kay & Knaack, 2009). From the effects of multimedia and schema induced analogical reasoning study, the multimedia and no analogy group of fourth grade students were given the technology, but without an analogy (the water system model) could not make prior knowledge connections and therefore could not understand the function of an electrical circuit. The multimedia and no analogy group had the lowest mean scores on recall and transfer (Zheng, Yang, Garcia, & McCadden, 2008).

A study was conducted to research and discuss the effectiveness and possible issues that arise when assigning a WebQuest. Common issues that arise are the lack of prior teaching regarding the creating what is required (in this study they used a travel brochure), and research techniques regarding search engines. The authors' had hypotheses regarding this study. The first was freedom of given to children by a search engine such as Google will produce higher learning gains and qualitatively better assignments because students are searching for their own information. The second was boys were expected to profit less from this condition than girls because of previously supported information regarding the less reading. The third was children with limited cognitive capacities and lower linguistic abilities were provided with Internet links to aid in

research. This limited search condition was thought to benefit them more. The fourth was that learning via the Internet would have a positive influence on the students' attitudes regarding the computer.

Participants were 229 sixth-grade students from eight elementary schools in the eastern part of the Netherlands (116 boys and 113 girls). The schools were randomly assigned (either closed or free search). Six groups (a total of 116 children) were assigned to a closed condition and four groups (a total of 113 children) were assigned to a free search condition. A series of computer lessons regarding ancient Rome were assigned. The children had to write a travel brochure where a trip to ancient Rome was described. The WebQuest consisted of the following sections: introduction, task, process guidance & resources, evaluation of task performance and brief conclusion. In the closed-search WebQuest, questions and links to web pages were given in the guidance & resources section. In the free search WebQuest, a link to Google was give in the guidance & resources section. All parts of the WebQuest were presented to the students in the closed-search section. Both groups received classroom instruction and assignment clarifications were given. All of the brochures were assessed by an experiment who had no knowledge of the two search conditions. The first hypothesis on the free-search condition providing higher learning gains was rejected. Positive effects were found in a sheltered learning environment. The quality of the WebQuest work correlated with their cognitive and linguistic abilities as well as their knowledge pretest scores (Segers & Verhoeven, 2009).

Students should also be given time to ask questions regarding the use of technology. The questions students ask should go beyond the basic instructions of a lesson. Allowing a question and answer session prior to teaching concepts could

potentially lessen student anxiety when using science enhancing technology tools (Korakakis, Pavlatou, Palyvos, & Spyrellis, 2009).

Problem Solving

Teachers strive to create a fun learning environment for students and many teachers have searched for new ways to incorporate technology in science curriculum. Education professors emphasize the importance of instructional technology applications in science to education students by conducting self-reflective studies (Capobianco, 2007). Education students have participated in studies where they implement technology into math and science. Upon completions of this implementation, education students found more difficulty integrating subjects than originally thought (Berlin & White, 2010). Teachers also use written reflections and videos of student and teacher interactions during technology-based activities to identify patterns of change in comprehension (Williams, 2008).

School districts have implemented programs to increase the number of teachers and students using technology based inquiry. The Technology Enhanced Learning in Science (TELS) center developed a professional development program to support teachers implementing instruction that incorporates scientific visualizations in inquiry-based modules. The modules are designed to support a student's inquiry thinking while the teacher facilitates that role (Varma, Husic, & Linn, 2008). An example of a TELS program is Lesson Seasons which promotes understanding of the reasons why there are four seasons (Hsu, Wu, & Hwang, 2008). School principals have been asked to generate ideas regarding TELS and develop workshops to aide technology integration in science (Gerard, Bowyer, & Linn, 2008).

Professional development programs were implemented in Maryland in order to create several lessons on how authentic data can be collected from the Chesapeake Bay area. These data could then be made readily available to those individuals using the Internet. Teachers and undergraduate students were taken to a section of the Chesapeake Bay to collect authentic environmental data on water chemistry. Two assessment standards from the Maryland State Department of Education were used regarding the demonstration of ability to use scientific skills, processes and major biological concepts to explain uniqueness and interdependence of organisms. The data collected could show how temperature, density, salinity and diffusion could explain how the physical environment behaves. Included was a table of Internet sources of authentic research in the Chesapeake Bay. The main idea of these professional developments was to emphasize importance of collecting authentic data to teach science concepts or if that is not a possibility, to find resources on the Internet that can provide authentic data (Bell, Fowler, & Stein, 2003). The instruction of pre-service teachers, the self-reflective studies of current teachers, and the implementing of modules that promote inquiry thinking all contribute to the comprehension of science through technology.

Chapter 3: METHODS

The purpose of this study was to integrate virtual classroom assignments with traditional classroom activities to assess the benefits of technology integration in a science classroom. This qualitative study consisted of 13 fifth and sixth grade students. The fifth grade was comprised of eight students (three female and five male students). The sixth grade was comprised of five students (two female and three male students). The combined grades learned about the evolution and traits of organisms in accordance to the State of Michigan Grade Level Content Expectations (GLCEs). This unit directly followed a unit on animal systems.

Students were given a pretest and posttest (in concept map form and a unit test in essay form). Objectives were taught using a combination of lecture, discussion, and in class activities. The unit also contained virtual world activities. Following each virtual world activity, students were given a questionnaire to give feedback regarding the retention of subject matter and presentation of material.

Beginning in Biome

Students had to learn how to use the virtual world. Biome, a virtual world created by Carolyn Lowe, was used for this study. Students chose an avatar (which was a type of animal (e.g. panda) that would represent them in the virtual world. Students were then allowed to explore Biome and understand how to control his or her avatar, teleport to different parts of the world, and communicate either by instant messaging each other or by communicating with the whole group. Students were told the rules that must be followed regarding appropriate language and proper treatment of each other in the virtual world.

Students then learned how to build in Biome. Basic instructions were given on how to manipulate the geometric shapes available to create complicated items. Students' first building assignment was to build a chair. Most students were able to grasp the idea of combining the geometric shapes together to create objects. Where some created simple chairs, others created sofas. This difference in chair construction showed how differentiated the instruction was because the students would make their chairs as complicated as their abilities would allow.

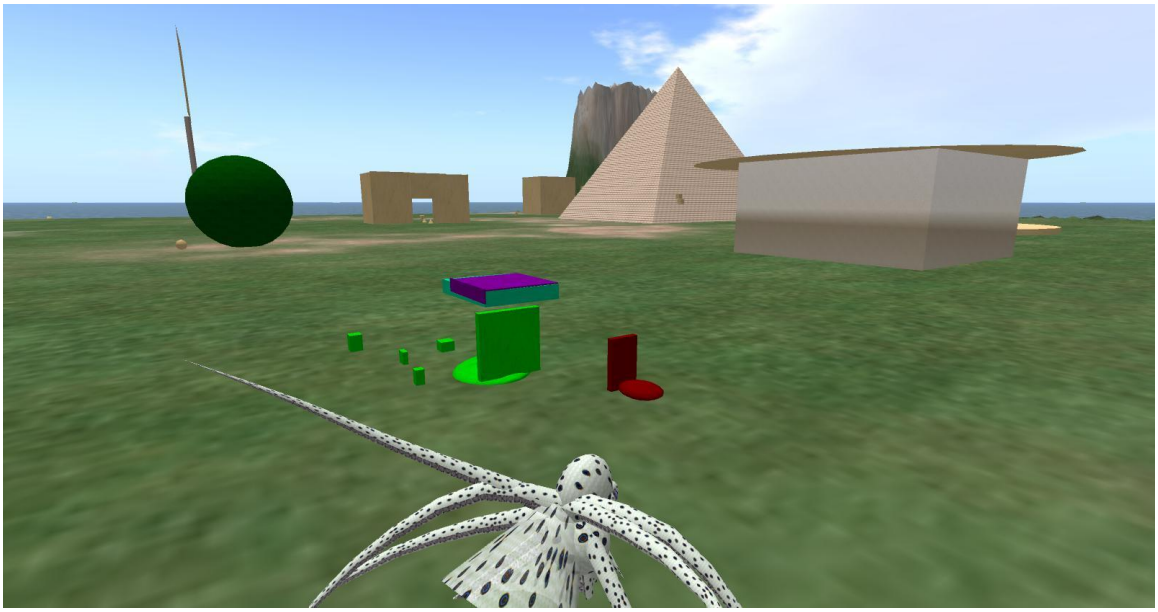

Figure 1: Chairs

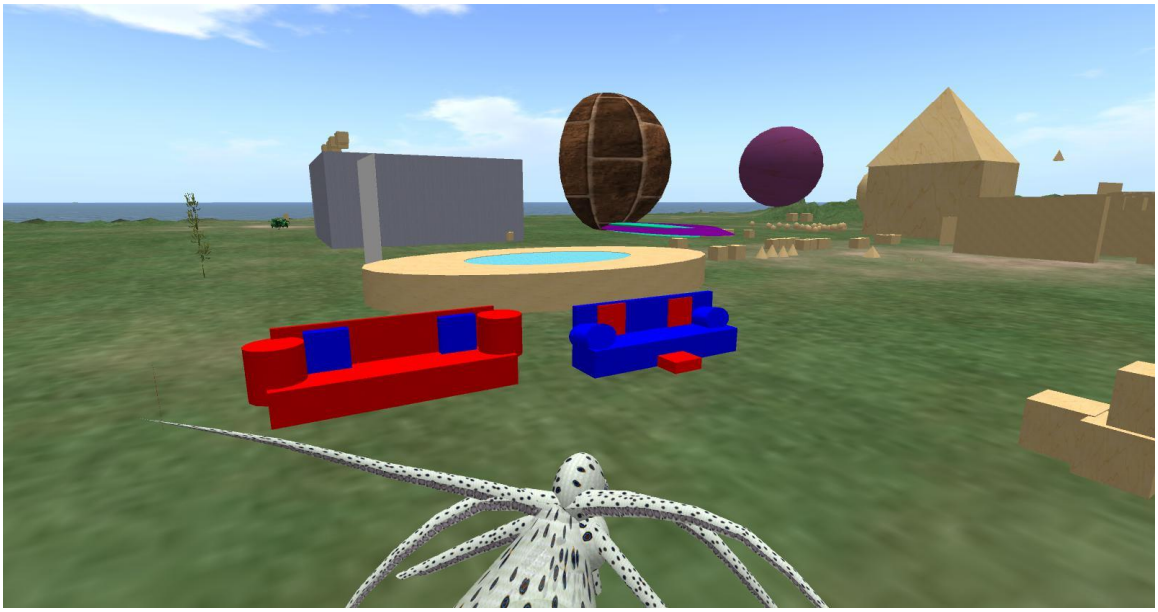

Figure 2: Sofas

Animal Classification

Following a pretest, students each chose an ocean creature to research. They drew a picture of that creature and took a digital image of it. The students also created PowerPoint presentations on their chosen animal. Students then uploaded their digital animal image and PowerPoint slides to a virtual world presenter. This presenter was in a virtual coral reef. Students were able to explore the coral reef and feel as though they were in the coral reef themselves. Each student presented on his or her chosen creature in the virtual world (by typing their presentation) while the other students read what the presenter was typing and responded (also by typing). Following all of the presentations the students were given a questionnaire and a posttest.

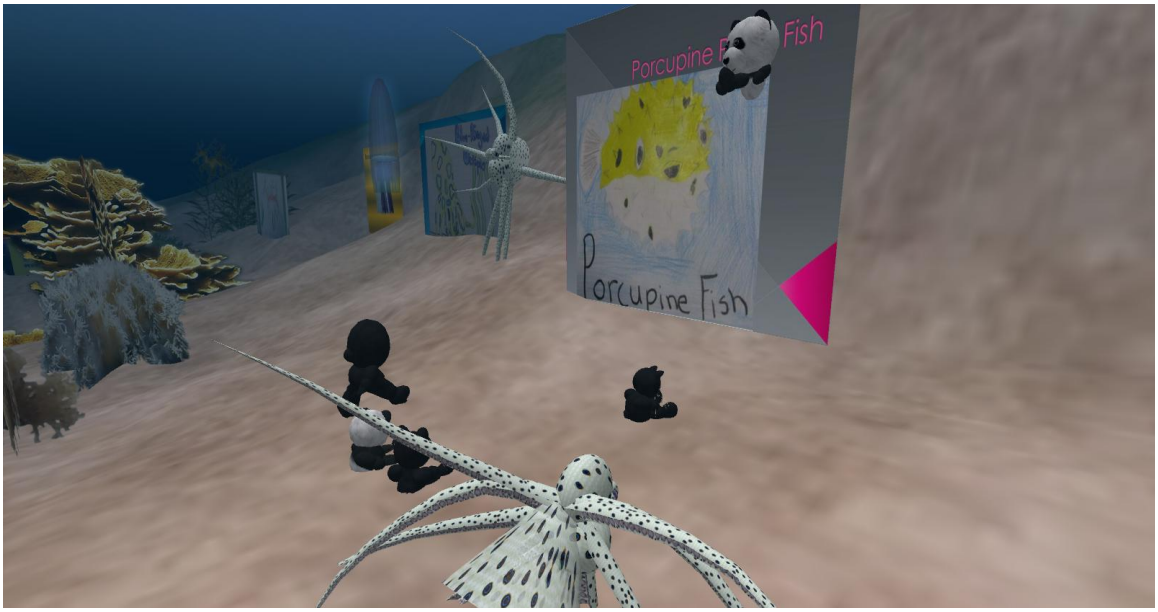

Figure 3: Porcupine Fish Presentation

Figure 4: Seahorse Presentation

Inherited and Acquired Traits

After a pretest students were shown a bacteria simulation. This simulation had regular bacteria and antibiotic resistant bacteria. You could kill a bacteria by putting the computer mouse cursor on top of the bacterium and clicking. The number of times one had to click the mouse to kill the antibiotic resistant bacteria was greater than the regular bacteria. While one was trying to "kill" this bacteria the volume of bacteria was getting higher and higher simulating how bacteria can become antibiotic resistant. A discussion followed this simulation on antibiotic resistance bacteria. A questionnaire was then given, followed by a posttest.

Figure 5: Bacteria Simulation

Species Adaptation and Survival

Students began with a pre test followed by a discussion on species adaptation and survival. Their assignment was to create two animals, one that would survive in a cool, dry, climate and another that would survive and warm, wet climate. Students researched different animal species and their adaptations to create ultimate animals that could survive these places. The animals were then built in the virtual world using basic geometric shapes to construct complex creatures. Students presented on their creations highlighting each adaptation and the benefits of having such adaptations.

Figure 6: Green Fish

Figure 7: Anteater

Chapter 4: RESULTS

Below are examples of the students' responses on their pretest and posttest concept maps.

Table 1

Animal Classification

Pretest	Posttest
I think it is about how big a fish can grow to not be big for a tank	Animal classification is how to tell animals apart
The kind of animal	Like if an animal is marked with lines or dots
Fish they live in the sea	Animals are mostly classified on what their characteristics are and how they act
Teeth, tail, ears, claws	They have teeth, they have tails, they have ears, some have claws
Means stuff about different animals	Snake- they eat rodents like field mice, some can swim well, some are poisonous some are not, can shed its skin, slithers fast, likes cool places, is a reptile
A way of classifying an animal, kangaroo, animal, mammal	Mammal- warm blooded, has hair, cannot breathe underwater, gives live birth
Animals are classified usually by their traits. Fish-breathes underwater, gills fins	Classification of an animal (type, scientific name, habitat, domestication or not, Kingdom)

Table 2

Inherited and Acquired Traits

Pretest	Posttest
Acquired traits are traits an animal gets after birth and they can be changed	Inherited traits are traits that are passed down from an animal's parents, acquired traits are traits that an animal acquires from the environment
Same eyes as mom or dad (color), same hair	Inherited traits are physical traits that are passed down in a family- same eye color, acquired traits are traits that come from the environment around you-scars
When hair is growing out of your head	Acquired- something you get over time, inherited- something you were born with, hair, eye color
I'm really not sure	Inherited means something got passed down like skin color
Acquired means you have to have it, a bird has to fly	A trait is something you have, Inherited traits is something that is passed down from your family- hair color, skin color, height. Acquired traits is something that happened over time- a broken bone, how you act, personality.
Money that you inherit and acquire from family	Inherited- something passed down like skin color, eye color
Something you need for a job, inherited someone's looks	Inherited like something passed down, born with brown hair maybe

Table 3

Species Adaptation and Survival

Pretest	Posttest
Surviving by killing other things, they survive by finding water	Deer- Have great hearing, has horns to fight each other, fur to keep warm
Shelter, food, water, air, what it was born with	The heat or temperature or if there is water, food, shelter, fur for snow leopard, color of fur or scales or skin
Water, food, shelter, species have to adapt to the weather	Animals need lots of fur to survive the cold, carnivores need sharp teeth to eat flesh, a fawn has white dots on it to camouflage itself
Certain species of an animal can adapt or survive in a certain place, food, water, shelter	An animal may stand up or bristle its fur to make it look bigger when trying to scare away predators, bright flashing colors (like the blue-ringed octopus) warn off predators, poison for self defense and paralyzing prey
They way they live, what they use for homes, how they use it, what they learned like swimming or climbing	Things that help animals live like scales, fur, prehensile tails, food, shelter, water, frog's webbed feet
Adaptations- something you have to adapt to, to survive you have to have oxygen, food, water, and shelter	In Biome we chose two animals or more and researched about them, (their survival needs, their adaptations, and their species), then we built the creatures on the atmosphere
Adaptations is how a species gets a certain trait	A lot of acquired traits help survival, whales have big lungs to hold their breath, frogs have jumping leg

Chapter 5: SUMMARY AND CONCLUSIONS

The results of the pre and post concept maps showed that the students did learn the assigned material. Some students' responses from pre to posttest showed that they learned what the concept was. A few students had difficulty with the terminology, but were able to write down basic ideas. Other student responses from the pre to posttest became more specific and in depth. Students overall enjoyed the three activities. By looking at the questionnaires they enjoyed the interactive activities, especially the building. They also enjoyed being able to chat with their friends and ask for help from their classmates and their teacher. One of the things they did not like was when too many people were building in the same place causing difficulty to see what each student built (initially the geometric shapes are the same color, but with closer examination are labeled as to who created them). Other issues were computer issues such as not being able to be logged in or being logged out of the program, which could be difficult when all of the students were trying to log on at the same time.

The virtual world activities enhanced the animal systems unit. Students were able to learn the objectives and then extend their knowledge through interactive simulations and presenting their creations. Students also greatly benefitted from the social aspect of Biome. Some students who were shy and would not participate in class would chat in the virtual world. They would also frequently instant message me just to say "hi." One student had a very positive outcome from learning in the virtual world. This student was socially awkward and did not have many friends, but excelled at Biome right away. The other students wanted to do well in Biome and started to ask this student for help. The student benefitted from the increased social interaction with the other students.

Science activities in the virtual world increased students' retention of the subject. Each student was able to create and present projects that met assigned objectives. The integration of technology did not have any negative effects. As long as a teacher has well defined goals and objectives and monitors the technology, positive outcomes of the usage can be seen. The inclusion of virtual world technology did aid in students' comprehension of science. Each assignment followed a lesson or multiple lessons and students were able to create and present their projects in an environment that was not their typical classroom. The nontraditional classroom environment was intriguing to the students and they wanted to do well. Science was made relevant to them through the introduction of virtual world learning. Students were able to understand big picture ideas and make real world connections through social expression, artistic expression and the sharing of their ideas.

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Appendix A: IRB Approval

Northern Michigan University

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Memorandum

TO: Amy Pihlainen
Education Department

CC: Carolyn Lowe
Education Department

DATE: March 6, 2013

FROM: Brian Cherry, Ph.D.
Assistant Provost/IRB Administrator

SUBJECT: **IRB Proposal HS13-511**
IRB Approval Dates: 3/6/2013-3/6/2014**
Proposed Project Dates: 3/6/2013-6/1/2013
"Learning Life Science in a Virtual World"

The Institutional Review Board (IRB) has reviewed your proposal and has given it final approval. To maintain permission from the Federal government to use human subjects in research, certain reporting processes are required.

A. You must include the statement "Approved by IRB: Project # HS13-511" on all research materials you distribute, as well as on any correspondence concerning this project.

B. If a subject suffers an injury during research, or if there is an incident of non-compliance with IRB policies and procedures, you must take immediate action to assist the subject and notify the IRB chair (dereande@nmu.edu) and NMU's IRB administrator (bcherry@nmu.edu) within 48 hours. Additionally, you must complete an Unanticipated Problem or Adverse Event Form for Research Involving Human Subjects

C. If you find that modifications of methods or procedures are necessary, you must submit a Project Modification Form for Research Involving Human Subjects before collecting data.

D. **If you do not complete your project within 12 months from the date of your approval notification, you must submit a Project Renewal Form for Research Involving Human Subjects. You may apply for a one-year project renewal up to four times.

All forms can be found at the NMU Grants and Research website:
http://www.nmu.edu/grantsandresearch/node/102

ljc

Appendix B: Student Questionnaire following Virtual World Activities

1. Describe the purpose of this activity.

2. A. How was the information presented?

B. Did that make the learning task easier or more difficult?

3. A. Compare this activity to a non virtual activity of the same concept.

B. Was one easier or more difficult? If so, please identify which.

4. How would you improve this virtual activity?