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The Effects of Learning in an Online Virtual Environment on K-12 Students

Christopher D. Carnahan
Indiana University of Pennsylvania

THE EFFECTS OF LEARNING IN AN ONLINE VIRTUAL ENVIRONMENT ON K-12 STUDENTS

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Christopher D. Carnahan
Indiana University of Pennsylvania
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Indiana University of Pennsylvania
School of Graduate Studies and Research
Department of Communications Media

We hereby approve the dissertation of

Christopher D. Carnahan

Candidate for the degree of Doctor of Philosophy

_____ _____
Mark J. Piwinsky, Ph.D.
Professor of Communications Media, Chair

_____ _____
James S. Lenze, Ph.D
Professor of Communications Media

_____ _____
Jeffrey A. Ritchey, D.Ed.
Associate Professor of Adult and Community Education

ACCEPTED

_____ _____
Timothy P. Mack, Ph.D.
Dean
School of Graduate Studies and Research

Title: The Effects of Learning in an Online Virtual Environment on K-12 Students

Author: Christopher D. Carnahan

Dissertation Chair: Dr. Mark J. Piwinsky

Dissertation Committee Members: Dr. James S. Lenze

Dr. Jeffrey A. Ritchey

Online learning has seen an explosive growth at the K-12 level, however little research has used an experimental design approach to specifically examine the outcomes of delivery methods. This study examines what effect learning in an immersive learning environment (virtual world) has on student achievement and satisfaction with the lesson. To conduct this experiment, four groups received instruction in their seventh grade science course. This occurred with two groups having live virtual lessons (synchronous), one simulated asynchronous, and one traditional classroom lesson serving as the control. The same instructor delivered all four lessons with identical content. The results of this study showed that no significant difference in achievement was present based on the method of instructional delivery. As for the motivation of learners, there was a significant difference for satisfaction with the virtual environment having a higher level of satisfaction. No significant difference was detected between genders within groups for either satisfaction or achievement. The results of this study show that learners in the virtual environment had at least equal achievement growth and had a higher level of satisfaction while learning in a virtual classroom. Additional research is called for to investigate the long-term impact that learning in an online virtual environment has on student achievement and satisfaction.

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CHAPTER 1

PROBLEM STATEMENT

Introduction

The past decade has seen an explosion of new programs in the arena of online and virtual K-12 education, resulting in increased student interest and enrollment. Despite the increased student enrollment in virtual programs, this approach to distance education remains largely unstudied as to whether it achieves equivalent or possibly superior outcomes compared to its traditional counterpart for both student motivation and achievement. Drawing comparisons between online and traditional learning is compounded by the fact that there are a variety of delivery methods for online learning, such as asynchronous, synchronous, and virtual worlds. This study will examine the key aspect of the impact of delivery methods on student achievement and satisfaction in virtual worlds.

The findings for online distance education are mixed. The meta-analysis conducted by Cavanaugh et al. (2004) lead to the determination that there is no significant difference between online K-12 education and its traditional brick and mortar counterpart. Smith, Clark, and Blomeyer (2005) supported the findings of no significant difference between learning methods. The U.S. Department of Education conducted their own meta-analysis of research in the K-12 setting for studies between 1996 and 2006 and found that no studies in this time frame met the definition of experimental design using a control group. Their expanded search from 2007 to 2010 only yielded five studies utilizing a control group. The use of experimental design research is important to control for confounding variables such as age, socioeconomics, aptitude, and prior knowledge. Hew and Cheung (2010) also found that the majority of studies in virtual education fall under the category of 'descriptive,' which are rather low level statistical analysis.

Without the control of outside factors, it is almost impossible for researchers to know what effect these outside factors may have had on their results.

As there is limited data existing that examines the outcomes of online education compared to its traditional counterpart, there is a need for additional research that substantiates the effects of this method of educational delivery. This dissertation seeks to contribute to the education field by examining this research gap using an experimental design study to evaluate the achievement and attitudinal impact that learning in online virtual environments has on middle school students.

Statement of the Problem

Online and virtual education is expanding at an unprecedented rate but there is very little research to support its effectiveness (Cavanaugh, Barbour & Clark, 2009). Even with rapid growth, no single format has been demonstrated to be the most effective method of eliciting student achievement or increasing student motivation. The U.S. Department of Education (2010) noted that few studies of virtual education have focused on experimental design, concluding that the majority of research has fallen under the category of descriptive or theoretical and has not served as a true comparison between different instructional delivery methods (Hew & Chung, 2010). The expanded opportunities and personalized learning that is provided by online education will continue to spur its growth. However, in order to provide students with the most effective education, research needs to test and validate pedagogical practices before they are instituted in the field. While there are many potential environments to research, this study will examine multiple delivery methods within a virtual world to establish an understanding of what might be viable approaches in developing effective learning environments.

Purpose of the Study

As online education continues to grow and evolve, research must be conducted to establish what should be considered viable approaches to these technologies. The purpose of this experimental design study is to compare the effect on student achievement between lessons that are delivered using a face-to-face approach and those that are provided via virtual classrooms to students in a public middle school in Pennsylvania. The study will use a science module that has been created by the school's science teacher for use in both the traditional classroom and the virtual environment. The lesson was then adapted to the virtual environment to allow for delivery both with a live instructor (synchronously) and for learners to work independently of the teacher (asynchronously). To control for any instructor variations, the same teacher who created the lesson will teach the science module in each of the delivery methods. The treatment groups will receive lessons in the virtual environment with variations in instructor presence, while the control group will receive instruction in a physical classroom. The control group will receive their lesson from the teacher in a classroom, just as they would every day. The treatment groups will have their lessons conducted in a virtual classroom that mimics a real school and allows each student to be "present" through the use of an avatar (i.e., virtual character). The dependent variables that will be examined in the study will be generally defined as academic achievement on the posttest and student perceived satisfaction from a survey. The intended outcome is to understand what impact different delivery methods have on student achievement and motivation.

Theoretical Perspective

The present study aligns to the theoretical perspective of information processing as it focuses heavily on how learners represent knowledge and transform information (Strauss, 1993). In this perspective, the mind is seen as a machine that receives information from the environment and uses schemas for understanding and encoding information (Derby, 2002). In this research, students will be given the same content using multiple delivery methods to examine what impact these methods have on achievement and motivation. As one of the important aspects of this research is to measure student achievement, using multiple treatments will allow for observation of what impact different environments have on the ability to learn information. The process of education requires learners to encode and decode information (Schraw, 2011). Swanson (1987) supports the use of Information Processing Theory (IPT) in this manner since it is a "study of how sensory input is transformed reduced, elaborated, stored, retrieved, and used" (p. 3).

Learning in a virtual environment allows for the delivery of content, while also, in theory, emphasizing students' enjoyment through participation in an interactive "game-like" world (Cacao, 2011). The concept of students learning through an environment that appears to be similar to a game can be troubling to parents, teachers, and administrators, who may view this instructional method more like play. However, Prensky (2001) discusses how current learners think and process information fundamentally different. Cacao (2011) notes the need to evaluate the effectiveness of virtual environments using incidental learning and the impact on achieving educational outcomes.

The connection of the virtual environment to incidental learning is that it has the potential to facilitate a community of learners. Kerka (2000) describes incidental learning as the

unplanned learning that occurs from other activities and can often be derived from social interactions. In the virtual world, students are able to communicate with one another just as they would in a physical school building with added opportunities that a traditional classroom would lack. Conversations are able to take place at a class-wide level or at a student-to-student level without disrupting the class through the use of technology. The environment provides the opportunity for learners to discuss ideas, talk, and share examples, which goes beyond the instructor's planned lesson.

Research Questions & Hypotheses

The grand research question will be: What are the effects of different delivery methods on the achievement of conceptual knowledge and motivation for middle school students? The methods of delivery will be through a virtual classroom environment, where in one option the teacher will have simultaneous interaction with students (synchronous) and in the other option the instructors will simply be delivering a lecture as if it were recorded (asynchronously). The control group for comparison will be a section of students who receive the instruction in a traditional classroom.

RQ#1: Is there a significant difference between delivery methods in learning outcomes?

H1.1: There will be no significant difference for student achievement across delivery methods.

Prior research in the field of online education shows that there is no significant difference between learning online and in a classroom. If this holds true, then there should not be a difference in academic outcomes despite the use of an online virtual classroom. The virtual classroom essentially serves as an alternative format through which distance education will be

delivered. The study uses a single instructor and students from the same school to help control for outside variables that may have an impact on learning.

H1.2: There will be no significant difference in student achievement based on gender.

The curriculum has been created and based on education practices that are suited for both genders. At the middle school level there were not substantial differences between genders on achievement for science (Ma & Wilkins, 2002). While male students in a virtual environment become engrossed in the play and competition of the simulation (Parrott, Olear, Carnahan, Lenze & Sherman, 2012), females are attracted to the ability to socialize and interact with others. There has been no gender-specific learning styles used in the construction of the lessons; gender-neutral state standards were used.

H1.3: Prior academic achievement will correlate to achievement scores.

Academic achievement is one of the primary predictors of future success in education. This means that if students are high achievers, they are going to push themselves to learn the material and be less reliant on the need for instructor assistance. These high achievers will succeed regardless of the traditional or virtual environment. The use of alternative delivery methods can also test to see if using a virtual environment allows for the students to better learn material that the teacher identified as difficult lesson based on prior experience.

RQ#2: Is there a significant difference in student satisfaction between delivery methods?

H2.1: There will be a significant difference in student satisfaction for students learning in a virtual environment.

Students who are using the "game-like" environment should, in theory, have a higher level of enjoyment since they are likely to believe that they are playing a game. The idea is that if the lesson in the virtual environment is done right, students will be focused on the game elements of entertainment and socialization and not the fact that they are learning information.

H2.2 There will be no significant difference in satisfaction based on gender.

The students are still at a young age where gender differences in science have not emerged as they do at later grades. Therefore, students should experience equal satisfaction with the lesson. Lauzon (2001) notes that differences between genders generally do not appear until later in school when students are taking more advanced science courses. This study is looking at a general science course at grade seven with the lesson delivered in a gender neutral manner.

RQ#3: Is there a correlation between student satisfaction and learning outcomes?

H3.1: Students who are more engaged and motivated in the virtual learning environment will have higher achievement scores than those in the traditional classroom.

Students who are actively engaged in an entertaining, active, and social environment will likely be able to recall the information better than those who are passively sitting in a classroom. This is also based on the idea that children will play games continuously in order to achieve a seemingly meaningless task (O'Connor, 2011). If there is no reward other than self-satisfaction when playing a video game, learners in a "game-like" environment should also exhibit a higher level of satisfaction and willingness to be engaged in the lesson.

Definition of Terms

The following terms have been defined to ensure continuity and understanding of the study:

Achievement

Achievement is the quantifiable result of student learning which is the learner's outcome on the assessment. Students will be given a pretest prior to learning the material to gauge for prior knowledge and then a posttest to assess what impact the lesson had on their conceptual knowledge.

Asynchronous learning

Asynchronous learning is a method of delivering instruction in which the instructor prepares the lessons but does not interact or deliver the content through live communication. The key aspect in asynchronous learning is that participants lack simultaneous interaction with the teacher (Matsuura, Kanenishi, Morikawa, & Yano, 2004). For this study, students will be able to communicate with one another but not with the teacher in real time. Asynchronous learning will only occur in one of the treatment groups.

Incidental Learning

Incidental learning is education that arises as a byproduct of another event, such as "an experience, observation, reflection, interaction, unique event or common routine task" (Konetes, 2011, p. 7). Specifically in this study, incidental learning will be used to examine what students gained from the experience in addition to the lesson content from the teacher. As students bring their own set of knowledge, experience, and examples to the classroom, this research will

explore whether the ability to collaborate amongst other students in the classroom while information is presented has an impact on learners that is in addition to the instructional content.

Immersive Learning Simulation

Immersive learning simulation is learning that requires students to actively participate in a virtual world (Carnahan, 2010b). This virtual environment serves as the delivery mechanism by which the instruction that the teacher has created will be delivered.

Online education

Online education includes approaches and practices that use computer technology and the Internet to facilitate the students' abilities to access course content and instructor support from separate locations (Beldarrain, 2006). This term includes schooling that is delivered supplemental (additional material for a course), district based, consortium (multiple districts), or through cyber charter schools (Cavanaugh, Barbour, & Clark, 2009).

Silo

A silo is a technological approach that ensures that students interacting in a virtual world cannot be accessed by outsiders and is structured so that students are unable to wander out of the predetermined boundaries (Martin & Crawford, 2008). This serves as the online equivalent of locking the doors of a schoolhouse and controls the experimental environment from outside factors as well.

Synchronous learning

Synchronous learning is learning that occurs when the instructor and student are present at the same time and place and are engaging in live interaction (Dupuis, 2010). Traditionally, this involved face-to-face instruction. However, with the advent of technology, simultaneous learning can happen even when the individuals are physically separated but occupying the same virtual space. Examples include chat rooms, web conferences, or virtual worlds.

Traditional classroom

The traditional classroom is a setting in which students receive instruction in a physical classroom in a brick and mortar building. Students sit in a classroom and learn face-to-face with their instructor.

Virtual Learning Environment

The virtual learning environment in this study will be the world that is created in Virtual Events, which is an online 3D environment. Developers are able to create a 3D setting that will enable learners to interact with the world. Students will use avatars, which are character representations of themselves, to move through and interact with others in the virtual classroom environment.

Delimitations & Limitations

This study will take place at a rural public middle school in western Pennsylvania and confine itself to the seventh grade science class. The use of a public school will aid in the external validity; however, constraining the study to a single institution will limit the ability to generalize the results. Another limitation of the study is that the school's demographics show

that it is comprised of a predominantly White, non-Hispanic population with a notable subset of students who are economically disadvantaged. As the study looks to include the entire population of seventh grade students at the school, the findings of the research will be able to be applied to other schools with similar characteristics.

A single teacher will deliver the content in both the virtual and traditional classroom environments to eliminate any instructor differences as a variable. In order to accommodate the scheduling of both the students and the teacher, the research will be conducted in a traditional classroom period of 42 minutes. Additionally, the scheduling of instruction in a virtual environment will not enable participants to be sectioned off. By preventing students from being sectioned off, the findings of the other treatment group will not be contaminated by delivering multiple treatments in the same world. Based upon these considerations, the study will not be able to use a true randomization of the participants. A prescriptive sample will be used as students are already divided into four sections of nearly equivalent group size by the school district; this will also mimic the organization of the school's academic program and minimize disruption.

CHAPTER 2

REVIEW OF THE LITERATURE

Introduction

This chapter is an examination of the literature for the newly emerging fields of online education and immersive learning simulations. The focus of this study is on the K-12 setting, thus the literature review focuses on the pedagogical practices in this area. In recent years, both simulations and online education have seen growth in the K-12 arena. This review will show connections between both areas and the manner in which they conceptually draw upon the same theoretical ideas.

The current status and practices in both online and immersive learning will be examined to provide a better understanding of what literature currently exists. The literature review will lay the conceptual foundation for why the study is needed in light of the absence of empirical data in these two fields. This deficit of information is primarily due to the fact that the literature basis in both online K-12 education and immersive learning has only been in existence for a decade and that technology develops and evolves quickly.

Online Education

Online education has seen dramatic growth in recent years, while lacking substantial research evaluating its practices. Cyber learning has faced criticism in its practices, specifically for the lack of socialization and the attrition rate at which students leave online programs to return to traditional education or drop out of school all together. There is a claim that students who stay in online education have scholastic achievement that is not significantly different than that of traditional education students.

Going Virtual

Online education in the K-12 setting has seen exponential growth in the past decade. Piccano and Seaman (2007) found that there was an approximate annual enrollment growth rate of 9% in cyber education. The International Association for K-12 Online Learning (iNACOL, 2011) reports that the total enrollment of online and blended K-12 courses is estimated at nearly three million students. According to the United States Census in 2011, there are 55.5 million students enrolled in K-12 schools across the country(United States Census, 2011). This means that about 5% of school age students are electing to take an online option.

Prior to the increased use of technology, students had few choices in how to receive their education. The only option for many was a traditional brick and mortar classroom or homeschooling. However, in the digital age, technology can now eliminate the need for the learner and instructor to be in the same physical location (Beldarrain, 2006). Cavanaugh, Barbour, and Clark (2009) demonstrate how online education can take place in the format of supplemental (supporting face-to-face classes), district based (an online school operated by school district), or cyber charter schools (virtual schools that act as their own school district). Virtual schooling is in a growing phase as traditional and new educational entities are trying to establish the best approach to online education.

The rapid growth of online education can be linked to the increased demand for customized education that meets the personal needs of an individual student; whereas, traditional education is based on serving the masses (Carnahan, 2010a). Although the term customized or personalized learning often is used for online schools, its interpretation may not mean individualized courses, but rather that there is more flexibility in what courses are offered and

when work is completed. Students in a traditional school are not always given a chance to take the courses that they want since there are only eight school periods in a day (Kowch, 2009). Students are at times forced to choose between selecting two courses and are unable to take additional courses as there are limitations on time and staff in a physical school. Barbour (2007) discusses how online courses allow for those who do not have the same funding or resources to expand their opportunity to take courses. Online courses can be purchased from vendors for a single enrollment where districts may not find it cost effective to hire a teacher to instruct one student.

Virtual education is also a way for students to compliment their education (Doyle, 2009). Roblyer (2006a) discusses how online education has been utilized for credit recovery and advancement, a benefit that is particularly important as college acceptance and scholarships is competitive (Ashford, 2006). Online courses can help learners stand out from their peers by allowing students to take extra credits and AP courses that may not have been offered in their own school.

Online education initially gained traction with homeschooling parents who were drawn to the opportunity of keeping their children at home and having control over the education process while still giving their students the opportunity to take higher level courses (Huerta, d'Entremont, & Gonzalez, 2006). Virtual instruction meant that parents who were not skilled in advanced courses such as Calculus or Physics could keep their child at home while still providing the higher-level content that was previously lacking from the students' courseload.

Maintaining control over exposure to certain ideas is especially important for families who are trying to instill religious beliefs in their children. Online learning allows parents to

monitor and filter the spiritual ideas and course content that their children are receiving (Cambre, 2009). Parents are able to essentially preview the curriculum and discuss alternate views on topics such as evolution with their children. Since the instruction is happening in their homes, parents are also able to incorporate prayer and bible studies during the school day, acts that would not be included at public institutions.

Rice (2006) notes that online education can be used to eliminate social conflicts or issues that arise in a traditional school. Students are at home in a safe environment and do not have to deal with the pressures or situations that may arise with their peers in a school setting. There is less of a risk of the physical intimidation, embarrassment, or taunting of peers that can take place in a traditional school setting.

The opposing argument of removing students from a physical school is that learners using online education are faced with the challenge of working in an isolated environment, a sharp contrast compared to the socially charged learning community of a traditional school. There is evidence that "learning is not a singular event, learning does not occur in isolation" (Bronack, Sanders, Cheny, Riedl, Tashner, & Matzen, 2008, p. 64). Green (2006) called for an emphasis on incorporating adequate levels of social interaction in online education including both academic and extracurricular socialization. Barbour and Plough (2009) find that having a connection to the school and learning community yields better outcomes for the students. As online education has developed, there has been an increase in social events (e.g. field trips) that bring students together face-to-face. There has also been an increase in online communities for both students and parents to connect with others. The results of these efforts to increase socialization still remain in question as research has not validated whether or not they are enough to replace the social interactions students receive in school buildings.

Achievement

Online K-12 education is in its infancy compared to its traditional counterpart. Although there are those who may be skeptical about the learning outcomes of this alternate form of education, Cavanaugh et al. (2004) found in their meta-analysis that in online K-12 education, students should be able to achieve equivalent outcomes when compared to a traditional classroom. This study was the first to give the "no significant difference" label to the comparison of online K-12 education and its traditional counterpart.

Smith, Clark and Blomeyer (2005) found that academic performance in online courses and schools is at least equivalent with respect to performance as traditional brick and mortar classes. However, they also caution the use of the terms "equivalent or better" as such claims can only be made in relation to certain data. Public school comparisons have primarily used No Child Left Behind standardized testing as the bar. The use of standardized test data on student performance has become the accepted norm for comparing schools. However, the use of standardized data does not account for factors such as students, teachers, curriculum or an endless number of other potentially confounding factors such as aptitude and commitment.

In a five-year case study involving 200,000 students, researchers found that online learners in Newfoundland and Labrador performed as well as classroom-based students (Barbour, 2009). Barbour (2009) admits that students who took the assessment may have been more motivated and higher achievers. Additionally, this finding was based on final course scores and did not use an experimental design to control for any outside variables.

Smith, Clark and Blomeyer (2005) also discuss how those that seek to simply provide alternatives will likely produce equal programs. However, those who look to improve

achievement will build programs that deliver outcomes that are superior to traditional education. The rationale for this supposition is that the motivation and goals of the creator of online courses or programs usually have a relationship with the learners' outcomes. Online education has developed because of the ability of technology to create a learning environment that meets the needs of the students. This has transformed the educational setting as one that is more oriented to customer service. Thus, the belief is that the schools who keep student achievement and motivation as the driving forces of decision making will be more successful.

Just as school administrators have struggled with designing online schools, the research evaluating programs has been disjointed as well. There has been a lack of consensus about the goals of online education that is accompanied by a lack of examination and assessment of these programs (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). Another weakness in the literature is that most studies have a focus on policy rather than on academic outcomes (Cavanaugh, 2009). Although best practices and interpretive pieces about what is occurring in the field can have benefits, qualitative and descriptive studies lack the degree of academic rigor and comparative data that is necessary to make informed decisions about programs and their effectiveness.

In the majority of online education settings, the courses are using asynchronous communication, meaning that students and teachers are not involved in live classroom interaction. This is currently the most common form of online K-12 delivery that is occurring in the United States (Barbour, 2009). The lack of a constant instructor presence leads to the parent serving in the capacity of the primary level of support and supervisor (Bogden, 2003). Parents are often referred to as the learning coach since they are mentoring their child and assisting them with instructional components such as answering questions (Pape, Revenaugh, Watson, &

Wicks, 2006). Marsh, Carr-Chellman, and Sockman (2009) note that this system works well for a parent who wants to be engaged in the educational process. However, depending on the parent and child relationship, this can prove to be a challenge, especially if parents ignore their duties.

There is a tension that exists in online education between structure and freedom. Students and parents are seeking academic freedom but enough framework must exist to provide positive achievement outcomes. One noted point of failure for cyber students is when there is not enough teacher and learner interaction (O'Dwyer, Carey, & Kleiman, 2007). The best communication technologies are useless if students and teachers are not utilizing them to take advantage of the available resources (Murphy & Manzanares, 2008). Blomeyer (2002) reports that programs that incorporate some face-to-face meetings have a greater level of retention. This requirement may, however, defeat the convenience of online and distance education.

Academic achievement is one of the primary concerns within the discussion of online learning effectiveness. One of the critical attributes that successful students in online learning must possess is a high level of self-efficacy (DeTure, 2004). However, Price (2004) finds that psychological screenings do not appear to have much value in predicting educational outcomes in distance education. Smith, Clark, & Blomeyer (2005) find that prior academic success is likely the best predictor of achievement as traditional class rankings and GPAs are generally correlated to the likelihood of student success. This means that good students are going to be good students regardless of the environment, students with strong self-efficacy will have high levels of achievement. However, an alternative environment may have the ability to alter student motivation and perhaps encourage less engaged students to gain educational motivation.

Attrition

Attrition is one of the focal points in the online education debate. Cavanaugh, Barbour, and Clark (2009) discuss that the retention statistics of students in online K-12 education has been a recurring theme. The number of students who have entered and then withdrawn from online programs has ranged from a high of 60% to 70% (Roblyer, 2006b) to a low of 10%-40% (Barbour and Mulcahy, 2008). Barbour and Mulchay (2008) surmise that programs with low turnover rates are likely using a selective enrollment process.

The difficulty in tracking student retention is due to the inconsistent classification of who is a dropout or non-completer (Smith, Clark, Blomeyer, 2005). An example of this trend is evidenced by the Florida Virtual School practice of allowing students 28 days to determine if they want to remain in the program (Brandao, 2002). Students who do not continue in cyber education may not be deemed the traditional idea of a dropout since students are not completely quitting school; rather, they return to traditional brick and mortar alternatives.

With online education still in its infancy, there remains a burden on the student and parent as high levels of self-efficacy and support are required for success. Students and parents possess the freedom of when and where they conduct their education. However, the absence of hard deadlines can create issues for younger learners (Cavanaugh, Barbour, & Clark, 2009). Parents must ensure that students are completing all assignments and not picking what they want to complete. With flexibility of courses and soft deadlines, students may choose to ignore hard subjects or lessons or not complete any work at all. Constant monitoring and support from the parent is needed to monitor progress and ensure that learners do not become frustrated or stop working.

Online education is more of a pull model, where students must make the effort to retrieve the educational materials and resources; whereas, the traditional form of education has a teacher who pushes information. Online teachers serve as a guide for the educational process rather than the leader which places the onus of the workload onto the student (Oliver, Osborne, Patel, & Kleiman, 2009). Students can become overwhelmed by the number of tasks to complete especially if they lack time management skills (Podoll & Randle, 2005).

Another problematic aspect is that some students are drawn to online education because they feel studying on a computer will be more entertaining than traditional classroom instruction (Wijekumar, Meyer, Wagoneer, & Ferguson, 2006). Falduto and Ihde (2007) find that this misconception can lead to a negative result. Once students realize that they must do substantial amounts of work to complete courses, they can become disenchanted with the courses and opt out. An associated issue is that programs cannot screen out potentially unsuccessful students if they are operating at public schools since public schools are required to deliver education to everyone (Ronsisvalle & Watkins, 2005). Private schools and public schools who offer online programs to select individuals can evaluate candidates and discourage or not accept individuals who they do not believe will fulfill the requirements of cyber education. This is one of the potential explainations why there is a such a variance in attrition rates for online programs.

In order to increase success and achievement, schools should have adequate procedures in place to recognize and take action for students who are at-risk (Roblyer, Davis, Mills, Marshall, & Pape, 2008).) There is also a need to prepare students for their induction into online education. Smith, Clark, and Blomyer (2005) note that the Educational Success Prediction Instrument (ESPRI) is one such assessment that can prove helpful in predicting the success of

students. This assessment focuses on evaluating what skills online learners need to improve, as well as what support should be given to them by the institution.

Immersive Learning

To a generation of children who have grown up with constant attachment to media in the forms of movies, video games, and social networking, they can become bored with traditional forms of media used in instruction (Blashki, Nichol, Jia, & Prompramote, 2007). Davis and Roblyer (2006a) assert that there needs to be a shift in instructional techniques to engage students using virtual communications.

Forman (2003) explains that there are five deficiencies in traditional classroom courses that can be fixed with immersive learning (p. 14). The five deficiencies are rectified by:

1. Simulations that are specific to each individual, meaning that each student can have his own experiences and outcomes;
2. Immediate feedback;
3. The ability for learners to construct their own learning, allowing them to explore and experience;
4. The motivational aspect of simulations, provided by learners *doing*, rather than *hearing* about a topic; and
5. The process of applying concepts and procedures, which commits this new information to the learners' memory.

These five points outline some of the key elements for designers on immersive learning. Each student must be able to interact with the virtual world. This hands-on activity ensures that learners are engaged and actively involved in the lesson. Students need to have choices that allow them to explore and accomplish tasks on their own. However, this needs to be confined and directed by instructors or designers to make sure that students are still meeting educational objectives.

Research in immersive learning environments has previously explored environments that were “game-like” and that allowed students to explore the virtual world. Previous projects like that of "River City", which was created by a team at Harvard using a National Science Foundation grant, allowed learners to interact with a town and make decisions about things such as illness prevention, treatment, and ecology. These learners could see what the actual results and implications were from their decisions (Clarke, Dede, & Dieterle, 2008) and were able to use avatars to navigate throughout the environment. This type of scenario allows for cross-subject education, incorporating science, history and geography content while utilizing the students’ inquiry skills (Nelson & Ketehut, 2007).

Another example of a large-scale immersive learning environment was the Euroland project that was created to allow for students of different countries to explore other cultures (Ligorio & VanVeen, 2006). In this system, students were both contributors and learners. They would create their own information while exploring the information of and interacting with others. Similarly, Almeida (2008) found that student users who were empowered with the responsibility of their own (and others’) learning created a community of practice when assigned to create their own games.

Ausburn & Ausburn (2008) describe immersive systems as "very effective" although these systems may pose both financial and technical obstacles for schools and teachers. As with many of the studies in this field, this research was qualitative in nature. This means that despite their contributions, there remain questions on the learning outcomes and generalizability of the study. As educational funding cuts continue, research is lacking to justify the use of simulation based learning using a cost-benefit analysis. There needs to be a sound foundation on which to base such decisions and more research is needed.

As with any technology, there may be issues or limitations that users must be prepared to understand and overcome. Examples of limitations could be Internet speed, computer processor speed and memory, and adequate staff to design, create, and maintain the virtual worlds. Other issues can include the limitations of the immersive systems such as only having a certain number of users in-world at a given time (Ligorio & Van Veen, 2006).

Bajas and Owen (2000) conclude that "everybody can have access to quality courses" and all they need is "money, time and the required background" (p. 40). This statement illustrates the point that there are hurdles of not only a fiscal nature, but also the difficulties of ensuring that there is staff with the necessary skill set to ensure the creation and delivery of effective virtual courses. Luo and Kemp (2008) found that 67% of respondents in a survey of educators using *Second Life* had experienced technical issues. McKerlich and Anderson (2007) also noted issues with computer requirements in their research of simulations as did Parrott, Olear, Carnahan, Lenze & Sherman (2012). When trying to create virtual environments, teachers must also be willing to invest a substantial amount of personal time (Ligorio & Van Veen, 2006). This time commitment can be a daunting addition of duty for teachers who must often work on these projects in their free time and already have work that must be completed outside of the classroom.

A critical element in these immersive environments is that students are able to interact with the content. The Narrative Immersive Collaborative Environment (NICE) is a garden that was created for students to navigate subsoil to examine plant root structure and soil (Moher, Leigh, Vasilakis, & Barnes, 1999). Scenarios have also been created to allow for a special needs population. Adamo-Villani (2007) found that a 3D environment specifically designed for deaf students allowed them to interact with the world and practice their sign language. Regular

education students often practice their vocabulary with skill and drill programs, this environment allowed the same practice for learners with special needs.

As the potential uses of virtual learning are seemingly limitless, instructors and designers are tasked with creating environments that are meaningful and authentic, yet meet lesson objectives (Coffman & Klinger, 2007). Managing to achieve both meaning and authenticity can prove challenging as the activity must stimulate the learner while meeting academic requirements, a difficult task as virtual does not automatically equate to engaging (Herrington, Reeves, & Oliver, 2007). For example, working in a production line creating cogs can be a real world, but it doesn't mean that students will be excited about the experience. Conversely a race car game may be entertaining, but not educational.

In a virtual environment, students are able to work at a time, place, and pace that is convenient for them. Students are also able to explore and make mistakes without any real world repercussions (Savin-Baden,2008). Learners can manipulate objects, investigate, and experiment in ways that would otherwise pose the potential for physical harm. Learning and exploring without potential threats can have both positive and negative implications. A field trip to the Egyptian pyramids or an experiment involving a nuclear reactor become feasible as the constraints of finance and safety are non-issues in a virtual environment. A negative impact may be that learners feel that they can perform some virtual acts in real life without realizing the real life consequences. This artificial environment can lack the complexity of the real world such as injuries or costs involved in some experiences. Additionally, the fact-to-face social interaction is also missing from this virtual world.

Virtual worlds that are not siloed, or access-restricted by outsiders, have a potential for virtual hazards (Johnson & Levine, 2008). This lack of a "locked down" setting became an issue with some platforms such as *Second Life*, where individuals outside of the contained world could enter and disrupt students. Just as education sees the classroom as a place that should be safe and without distractions, precautions should be taken to provide for a safe environment within a virtual world.

O'Connor (2011) found that students using a virtual environment were enthusiastic about their project and, more importantly, that they expanded both content knowledge and technology skills. Virtual education presents an interesting format that allows students to engage in social interactions and communications that other formats of online education may not provide. The critical component of any educational delivery method is that it is achieving the academic objectives. However, studies such as O'Connor's do not investigate the potential impact of long term exposure to virtual environments on students. Potentially, the novelty of the new environment could wear off and just as children lose interest in video games, the same may occur for virtual worlds. Caution should be taken when reviewing studies that examined single lessons over a short period of time and applying these findings to the long term nature of education.

Role of Incidental Learning

As outlined in the online learning section of this document (p. 21), online courses have a serious issue with attrition and motivation especially when students are primarily working asynchronously. The current movement is towards learning that embraces immersive learning. However, many educators have been missing the mark, as "games" that focus on learning objectives may not be as attractive to learners (Cacao, 2011). Rather, the basis of virtual

learning needs to be a fun and stimulating game that incorporates learning. Prensky (2000) supports the idea that educational games need to be fun while making it difficult for students to detect that learning is taking place.

Mcferrin (1999) noted that in a learning environment the unintended outcomes of the experience often times have a greater impact on the learner than the original objectives and that learners often make no distinction between incidental and formal learning. Prensky (2001) describes how learners of today do not think or process information in the same manner as previous generations. The current learner has grown up in a gaming world and desires speed and urgency when completing a mission. Shorter attention spans and need for more media can be complaints of educators. Although shorter attention spans may not necessarily be readily applicable to the workforce, it still remains the job of instructors to understand the learning styles of their pupils and deliver content in a way that engages their audience in the learning process. This study will look to examine if learning in a "game-like" environment can have an effect on the learner's satisfaction.

Younes & Asay (2003) found that learning derived from incidental learning had positive outcomes and that retention of information was greater than that in a classroom lecture approach. The idea of incidental learning has been well established as Cohen (1967) showed that incidental stimuli could be used in a classroom to allow intentional and incidental learning to occur simultaneously. Outcomes of incidental learning outside the context of a traditional classroom setting have been shown to be equivalent to that of formal learning (Joosten-ten, Sluijsmans, & Jochems, 2009). This emerges from the idea that students can learn language by immersing themselves in a culture and experiencing a foreign language as compared to learning in a

classroom. It should be cautioned that there are only a limited number of these incidental learning studies to draw upon.

Konetes (2011) found that incidental learning was higher in traditional classes as compared to their online counterparts. This study however was done in an environment that was asynchronous, meaning that students and teachers had the ability to use discussion threads but did not have real time communication with one another. Based on the potential value that students can receive from learning from one another, it is possible to explain Konetes' findings as a result of the lack of available communication and the inability of students to interact with one another as the online students were working independently. Konete's study also went beyond just course content when analyzing what was classified as incidental learning, so students who did not have direct instruction or on campus contact would be more inclined to be missing this element. The lack of direct instruction and contact is an issue that online education needs to consider when designing its structure. The virtual classroom environment used in the present study allows for synchronous interaction amongst students' avatars as well as real time voice and messaging. As the premise of incidental learning is that learners can learn from one another or experiences, providing students with the tools to correspond and interact with one another could have a direct impact on this type of learning. The virtual learning environment affords the ability to engage in synchronous interactions between students and teachers, which simulates that of a traditional classroom and potentially emulates the forum for incidental learning to occur.

Incorporating interactive experiences into the virtual curriculum should be part of routine instructional delivery (Kinder, 2010). Including immersive learning in the educational process has the possibility to engage and motivate a new generation of learners (Whiton, 2007). These positive effects can extend to those who do not consider themselves game players. Baylor (2001)

recognized that learning while "not trying" (incidental) allows for the acquisition of factual knowledge while engaging in a pleasurable activity.

McFerrin (1999) reported that the use of incidental learning resulted in an improvement of self-confidence and self-determination. Children will spend countless hours in front of a screen trying to accomplish missions in a video game that has no reward other than the value awarded to it by the player. However, students may have difficulty finishing homework, paying attention in class, or finding a reason to be interested in a lesson. The problem is not always in the child, as the instructor has to help find a way to properly motivate the learner.

A potential argument against learning in a simulation is that it does not reflect the needs of employers and set the stage for moving into the work environment. Contrary to those who discredit virtual learning in education, participatory learning as virtual environments has been utilized by the workforce, including NASA, airlines, doctors, and the military (Prensky, 2007). However, these uses are primarily to practice skills on which learners have already received face-to-face instruction and already have a degree of competency.

Although some research exists supporting the use of incidental learning, the trend has not gained much traction with educators or gamers, largely due to the lack of validation of effectiveness (Cacao, 2011). Additionally, the use of virtual environments for incidental learning can take longer to develop and requires the money to purchase and maintain the world. Marsick, Watkins, Callahan, & Volpe (2006) note that the majority of incidental learning research has come from qualitative studies. Although motivating learners is important and games play a large role in students' lives (Green & McNeese, 2010), fun does not always equate to learning. Prensky (2008) best summarizes the point as, "the role of technology in our

classrooms is to support the new teaching paradigm" (p. 1). This study will look to examine the academic achievement in delivering online course content through an immersive learning simulation by creating and evaluating students based on content that is aligned to state standards.

Pedagogy

Schrader (2008) concludes that, "technology does not drive instruction; instruction and pedagogy drive the way technology is integrated" (p. 469). Therefore, even though online and virtual education present unique and vastly different formats for the delivery of learning, traditional pedagogical practices and theory should still be taken into consideration and utilized. The use of cognitive research and established learning theories should never be trumped by the entertainment value or flashy features of technology or games or the fundamental restrictions the games impose (Green & McNeese, 2010).

While using immersive learning environments, there needs to be assurances that learning objectives are being met and it is not just a tool for entertaining the students (Gonzalez, 2007). Hew & Cheung (2010) found that the majority of immersive learning literature was not based on experimental design studies that examined the effectiveness of student achievement.

Sancho et al. (2009) outlined the educational objectives that an immersive learning simulation is conceptually able to address when the students use avatars in the world (p. 112):

- Abandon passive attitudes or personalities so that the students are more likely to participate;
- Include communities of practice so that social and affective bonds are created between players; and
- Promote competition so that competition can add motivation and push students.

Virtual world-based learning can be used to initiate communication and experiential components of learning (Hew & Cheung, 2010). Learners are able to have alternative personalities while in a virtual world that allows them to participate where they may otherwise be shy in a face-to-face classroom. Similar to the traditional classroom, students are able to socialize with other students and compete with them within the virtual world. This can help motivate some individuals to work harder. Students in virtual worlds appear to believe that they are actively engaged in the learning process since they are moving and interacting with objects and other students. Since students cannot always do every task such as seeing atomic particles, visiting an active volcano, or walking on a civil war battle field, a virtual learning simulation can be a close substitute. Using an avatar, they can virtually engage in the learning while never leaving the safety of their own computer.

Another reason that virtual worlds can enhance the educational experience is that students who are separated by distance do get to have the same face-to-face incidental learning ability. Without the virtual environment, there is little chance that distance students can meet and discuss a project (Bronack et al., 2008). Pulling from the gaming world, Prensky (2004) describes "win-win" scenarios of games where users must unite to conquer a particular task. Applying that social aspect to virtual learning allows for increased interaction between learners who are physically separated and the potential development of a support structure that could reduce turnover.

Immersive learning often claims to be based on the constructivist framework that was laid out by Gagne (deFreitas et al., 2010). However, this claim greatly depends on the design and evaluation of the environment and is inherently one of the arguments against immersive learning. Under the constructivist structure, students are able to explore and create their own meaning.

This becomes problematic as educators are under pressure to teach to the test and meet state standards and assumes that learners have acquired all of the foundational information. Students may not learn in a timely fashion in a completely unstructured environment. Although it would be idealistic that online environments allowed students to create their own understanding and explore at their own pace, the reality is that learners must apply their knowledge in a manner prescribed by the state standards and this is assessed primarily by multiple choice testing. K-12 education is based upon and evaluated by standards that are set by the state and requires schools to meet certain levels of proficiency. This moves the learning theory to the behaviorist level where learners must understand conceptual knowledge and recall it. The role of technology and pedagogy is to provide a supportive structure for children to essentially teach themselves while under the guidance of a teacher (Prensky, 2008). This is why the study has used a virtual learning environment with a multiple choice assessment to create a standardized curriculum based on state standards, while still affording students an opportunity to engage in the learning process in a ”game-like” atmosphere.

Gender and Science

There has been a long standing sentiment that males often out perform females in the area of science. Based on the selection of seventh grade students to participate in this study the affect should be negligible. Lauzon (2001) discusses that substantial gender differences are recognized in the last year of secondary school (grade 12) where students are taking more advanced classes. Ma & Wilkins (2002) found that academic growth from seventh grade science students did not show a significant difference based on gender. Despite equal performance in middle school, Sorge (2007) found that attitudes towards science of both genders traditionally drops around age

12 and they do not change as they grow older. Thus, considering motivational strategies is an important need.

Another aspect that originates from the Ma & Wilkins (2002) study is the influence that schools and specific teachers have on the learners. They note that "science teachers have a great influence on student academic outcomes, and teacher influence is often more important that student background" (p. 398). National studies often encompass vast populations in their generalities; however, when looking at a particular school, their variance is minimized. This study utilizes students who come from the same community and school and have taken the course with the same teacher used for an entire school year. Therefore, any effect based on gender or teacher influence on gender should be minimal.

Type of Design

Smith, Clark, and Blomeyer (2005) cite that although descriptive studies have been conducted in online K-12 education, there is not a systematic approach currently being utilized to collect data in the field. Cavanaugh et al. (2004) recognize that there is a need for more data on academic performance to help inform decisions about virtual K-12 education. Cavanaugh, Barbour, & Clark (2009) also called for more empirical research, supporting the assertion that no systematic approach currently exists for K-12 online education research. According to Carr-Chellman and Marsh (2009) this is still a developing field in which more examination and research is needed.

The U.S. Department of Education in their 2010 meta-analysis of K-12 online learning studies determined that there is no significant difference between online and traditional learning. Additionally, this research revealed that no studies existed between 1996-2006 that used a pretest-posttest experimental design with a control group. By expanding their analysis to 2008,

they only identified five controlled studies where researchers compared online to classroom-based instruction. The researchers from the Department of Education called for rigorous research to examine the effectiveness of online learning.

Although Cavanaugh et al. (2004) deemed online and traditional education to have no significant differences, their meta-analysis failed to be based on research using an experimental design. The same could be said for the analysis conducted by Smith, Clark and Blomeyer in 2005, which is also cited as having labeled online K-12 education with the 'no significant difference' brand. As noted by the U.S. Department of Education, there were no experimental design studies prior to 2006.

Likewise, in the area of immersive learning in virtual worlds, Hew and Cheung in their 2010 meta-analysis found only one study that used experimental design to gauge academic achievement. The majority of the studies fall under the descriptive category. Although virtual worlds are reported to have positive effects on student performance, the data that was collected and published in this field was primarily self-reported in either interviews or surveys (Hew & Cheung, 2010). This means that participants in the study were describing the impact of the world but there was not a scientific method used to determine if there was a significant difference between virtual learning and in- classroom learning. Additionally, the use of meta-analysis has the potential to generalize the findings of many studies without including the consideration of their controls and confounds.

There is little empirical research that exists for online K-12 schools (Cavanaugh, Barbour, & Clark 2009). There are only a few previous studies that have taken an experimental approach and fewer yet that examine the outcomes of learners in a virtual world environment in a

K-12 class. Studies have had two primary foci in either a qualitative or survey form, centering on (1)characteristics of course design or (2)perceptions of students and teachers (Roblyer, 2006a; Barbour, 2007; Cavanaugh, Barbour, & Clark, 2009). It is critical, with the explosion of online education, that research be conducted to validate the design and approach that are taking place in virtual education.

More importantly, little is known about the actual outcomes for learners in online K-12 environments making an experimental design extremely valuable. Adding an immersive environment to online education can help with the emotional and cognitive processing of learners (Blashki, Nichol, Jia, & Prompramote, 2007). Bronack, Sanders, Cheny, Riedl, Tashner, & Matzen (2008) also note that learning does not take place in isolation. Thus creating a community of learners should help with the engagement of students and give them a sense of community which fosters learning. However, as is the case with much research in online educational outcomes, these studies come from a higher education setting, not that of a K-12 environment.

Conclusion

As online programs continue to grow and develop new delivery methods, there needs to be research conducted to validate these approaches. Attrition and social interaction were identified as two of the major issues within online K-12 education. Immersive learning simulations appeared to be the next progression of online education but have quickly lost support as they are burdensome to create and maintain.

The purpose of this research is to examine learning for K-12 students in an online immersive setting. To create the design, the virtual environment was selected to simulate an

experience that encouraged the students to believe that they were in a "game-like" world while allowing for social interaction. Although the lesson is not designed as a game, the use of an avatar may help to virtually transport the learners outside the limitations of a classroom setting. However, the virtual setting is essentially an online replication of a classroom where the instructor can deliver a lecture-style lesson. As Konetes (2011) demonstrated, traditional classroom students showed higher levels of incidental learning than their counterparts participating in an online environment. By using avatars and allowing for freedom of movement and communication among students in a "game-like" environment, virtual learning offers the potential for social interaction within a replication of a traditional learning environment. This enhanced virtual classroom environment could be engineered to create equivalent levels of incidental learning. This virtual world also addresses the idea that learners needed to have increased social interaction in online learning. Allowing students to interact within the virtual environment sets the stage for learners to experience incidental learning from one another.

The use of an experimental design study was selected so that it afforded the best opportunity to control for confounding factors. Utilizing experimental design allowed for specific attention to be paid to the effect that the environment and delivery method had on the students' learning and motivation. Since other studies have primarily looked at descriptive aspects of learning, a study providing hard evidence is needed to assist instructors, educational lawmakers, and even parents in making future educational decisions. Student perceptions are important but just because learners find something to be fun does not mean that adequate learning is taking place.

CHAPTER 3

METHODS

The purpose of this study is to examine the impact of delivery methods on achievement and perceptions of students who learn in a virtual environment. An experimental design was chosen since this method best tests the impact of the treatment (Cresswell, 2003). This study will examine the use of a virtual environment as the delivery method of learning compared to the control environment of a traditional classroom. Due to the need for rigorous empirical data, this study will use a pretest-posttest experimental design to gather data on students' achievement in virtual learning compared to the traditional alternative. Specifically, the study will examine if there is an impact on the students learning a science lesson in a virtual world compared to students in a traditional setting receiving the same lesson in a physical classroom.

Pilot Testing

As the literature review showed, research in online education using experiments is limited. In light of this data, the first step in creating the study's procedures was to conduct a pilot study to test and validate the methods. In the Fall of 2011, the researcher, as part of the Virtual Environments Research Group in Education at Indiana University of Pennsylvania, conducted an experiment with an all male boarding school, Kiski Virtual School for Boys, under a grant-funded project. The following section will detail the approach that was utilized and the findings that became the basis of the current study.

The pilot study took place at a small all male private boarding school in Western Pennsylvania. The sample for this experiment was 200 students from grades nine through twelve. Teachers from the school served as subject matter experts and created lessons and

assessments that would be delivered in both the traditional classroom and the virtual environment.

The project consisted of two phases of testing. A pilot test of individuals who recently graduated from high school was used to give the instructors practice on the virtual environment and to work out system and delivery issues. Additionally, subject matter experts from Indiana University of Pennsylvania were used to validate both the content and assessments of the lessons. The subject matter experts also used a modified version of the International Council for Online Learning's (iNACOL, 2011) standards for courses to ensure that the virtual online course aligned with pedagogical norms. The researcher obtained permission from iNACOL to use these standards in this manner.

The second phase of the study was conducted at Indiana University of Pennsylvania where the private school students were brought to the campus to be taught both the virtual and traditional lessons. This relocation was necessary as the school's technology infrastructure did not allow for the virtual environment to operate appropriately. The same teachers delivered lessons in both environments to ensure internal validity. Students received lessons in two subjects, one in the classroom and one online. Assigning students to participate in control and treatment groups in separate subjects was done to increase the number of participants for each treatment from 20 to 30 each. This assignment was done through random selection.

Results of Pilot Study

The pilot study resulted in the following conclusions that served in creating the design of this study:

1. Achievement – There was no significant difference in achievement for students between two of the disciplines studied, specifically Math and English ($p > 0.05$). Studying the results from the remaining two disciplines, Science and History, showed that students in the traditional setting performed significantly better ($p < 0.05$). These findings were confusing as Wang (2005) noted that math and science scores are traditionally associated with one another while the same is true for history and English. This lead to the conclusion that for the two lessons that did have a significant difference, the issue could have been due to the malfunctions that occurred with the virtual environment itself, such as lagging and freezing resulting in instruction that was not completely delivered or received. Student behavior had a potential impact here since students in the virtual environment were at times uncontrolled and not paying attention. Additionally, different instructors were used to deliver the same lesson, so this introduced a confounding variable that could not be controlled for as teachers have different delivery methods and styles.

This lead to the determination that in order for instruction to be appropriately measured, a virtual environment must be able to function properly. A fully functional virtual environment will allow for the lesson to be delivered and received. Additionally, it appeared that with proper design, virtual education needed similar teacher controls. This means that a teacher must have the ability to control students if they should misbehave or lose focus. The lesson plan must also have enough structure to ensure that students remain on task (Parrott, Olear, Carnahan, Lenze & Sherman, 2012). A single instructor model was identified as the best way to control for differences between instructors, which was a confounding, uncontrolled variable.

2. Validity – The process of creating lessons by using teachers as subject matter experts with designers skilled in the virtual environment provided a sufficient level of construct validity. This was supported by the use of content experts— professors from Indiana University of Pennsylvania—who reviewed the course content and assessments. These reviewers used standards set by the International Council of Online Learning to critique the lessons. The use of content experts supports construct validity, indicating that the assessments adequately measure the variables for this research (Cresswell, 2003).

   To enhance validity and remove confounding variables, the present study utilizes a single science teacher to create the lesson and assessments. A single teacher eliminates the potential confounds that multiple instructors can have on the process. Additionally, the teacher used in this study has been in the field for 10 years and is recognized by the district administration as an excellent teacher. Having the teacher create the assessment also allows for a practical application as it is the method utilized daily in the traditional school environment. The teacher is also able to align the assessment to the standards that students are required to meet.

3. Design – The lesson design in the virtual world was essentially lecture or show and tell. The virtual lesson had to be delivered with a teacher synchronously with the students. During the lessons, some students became bored and disengaged in the lesson and began to explore the world on their own. Unfortunately, students realized their performance in the class and on the assessment did not have any impact on their school grades and did not take the activity seriously. The students' lackadaisical attitude posed a threat to the results of the study.

Changes to Current Study from Pilot Study

To address the issues that were encountered in the Kiski pilot study, the current research has made several adaptations to the delivery format and design. The present study will deliver lessons with and without an instructor presence to determine if this has any impact on the students. Based on the literature review there is a prevalence of both synchronous and asynchronous delivery methods used. As both types have prevalence in online education, both will be tested in this study which will examine how an instructor present in a virtual world affects learners.. Additionally, as the Kiski study had multiple instructors teaching the lesson, this study will use only a single teacher to help ensure consistent delivery across all methods.

All learners will be told that the lesson will be graded and counted as part of their science grade. This should aid in ensuring that students are focused on the lesson. As the Kiski study found, students in a virtual environment have the potential to become distracted and begin to play without consequence. Creating the deception that their course grade is attached to the lesson should cause students to be more focused on the lesson. This is similar to every day practice where a teacher delivers instruction and then gives a quiz to gauge for understanding and ensure students are on task.

Additionally the current study will use a different virtual world. In this environment students will have the ability to be locked down and removed by the instructor. This mean that the teacher can move the learners to his location, remove them from the world, and control their ability to communicate through messages and voice if necessary.

Sample

The research is unusual as administrators of the school district are working in collaboration with the researcher to allow access to the students. The lack of access to K-12 students has previously been a major issue in conducting experimental research for online education (Smith, Clark, & Blomeyer, 2005). The school district is interested in the deployment of a virtual education environment but wants to see what effects it has on student achievement and motivation before investing in a comprehensive online program.

Population

This research will focus on a seventh grade science class at the school district. This population was chosen because of the collaborative efforts between the administration and researcher to explore the possibilities of the virtual environment. The project will be aided by an instructor who teaches four sections of the seventh grade comprehensive science course with a total population of approximately 110 students. The school is located in rural Western Pennsylvania and there are approximately 1250 students in grades K-12.

This seventh grade middle school population represents a critical time for students to develop an interest in science. At this age, learners are beginning to lose interest in the subject and action needs to be taken to ensure that learners are not lost. Sorge (2007) found that students have a significant drop in attitude towards science at the age of 12 and the learners do not usually change their perception as they grow older. Using a virtual world environment can have positive effects on students motivation and learning outcomes of middle school students (Min, 2005). This is one of the main reasons that the researcher has chosen to develop these lessons.

The population is divided into four sections, each of which is tracked by academic performance. Students are tracked in a cohort for all of their courses not just science. The sections are comprised of a low performing, two groups of average performance and one high level section. These sections were predetermined by the school and are how the students have previously been tracked. This determination was not made by the researcher as the tracking is done based on the grades that students received in prior years. Each of the groups have an average class size of approximately 27 students.

Sampling

This study seeks to examine the results of instructional delivery methods in a real school environment. As the school operates on a seven period day, the research must be conducted in a manner that causes the least amount of disruption to the students and the school environment. In order to achieve this goal, the researcher has chosen not to use a true random assignment of subjects to each treatment; rather, the treatment will be given to an entire class section. The use of this logic to assign students will aid in the practicality of this research to schools that use similar tracking methods for students. There are approximately 110 students in the seventh grade at the district, divided amongst the four sections.

One section of the average level achievers will be the control group in the traditional classroom. The other section of average achievers and the low achievers will be given the virtual environment treatment with the instructor in world to guide them through the activity and help them as necessary. The final treatment will be asynchronous and the high performing students will be on their own in the virtual environment. These students have been chosen to examine if students, who the classroom instructor has noted can be given a book and a task and learn on

their own, actually perform as well when placed in a virtual environment. Table 1 has these distributions.

Table 1

Description of Sample Distribution

	Group 1 (Control)	**Group 2 (Treatment 1)**	**Group 3 (Treatment 2)**	**Group 4 (Treatment 3)**
Delivery	Traditional Classroom with teacher	Virtual Classroom with instructor present (Synchronous)	Virtual Classroom with instructor present (Synchronous)	Virtual Classroom without instructor present (Asynchronous)
Student Achievement Level	Average	Average	Low	High

Students who participate in the virtual environment will use avatars to move through the world. These avatars will be created by the virtual world designer and allow for the tracking of individual students. This will also add a realistic approach for a school as students' identities are always known when they are in a traditional school setting. Knowing the identity of individual students aids in ensuring accountability for both behavior and performance.

Procedure

The present study was conducted over two days, May 11th and 14th, 2012 at Bellwood Antis School District. On the first day the researcher gave the pretest and conducted an orientation to the virtual environment. This will ensure that students are able to perform during

the class day, as well as diminishing the newness and need to play rather than follow the lesson. The second day, the students took the lesson and then completed the survey and quiz.

Student Experience

In order to standardize instruction the teacher has prepared a PowerPoint presentation (Appendix C) to deliver in both the virtual and traditional classroom. The use of a PowerPoint ensures that the instructor covers the same content and utilizes the same visuals for all sections of the study. The control group (Group 1) will receive instruction in the same physical classroom as they routinely do. They will have the instructor in front of the classroom and a projector will display the PowerPoint on the whiteboard at the front of the classroom. The teacher will be delivering instruction in a lecture format and be able to talk to the students.

In order to participate in the virtual world, the students were moved to the school's computer lab. Students were given headphones and the computers had built in microphones. They were instructed to only communicate with one another through the virtual world. The teacher remained in his classroom rather than the lab to simulate a distance education course with an instructor not having a physical presence with the students. The same PowerPoint that the teacher used in a traditional classroom was used in the virtual environment. The virtual world had a presentation screen that allowed for the PowerPoint to be loaded into a viewer that simulated a projection screen. The virtual world was a replicated classroom in which students were able to use and move their avatar and sit in seats with the teacher at the front of the room.

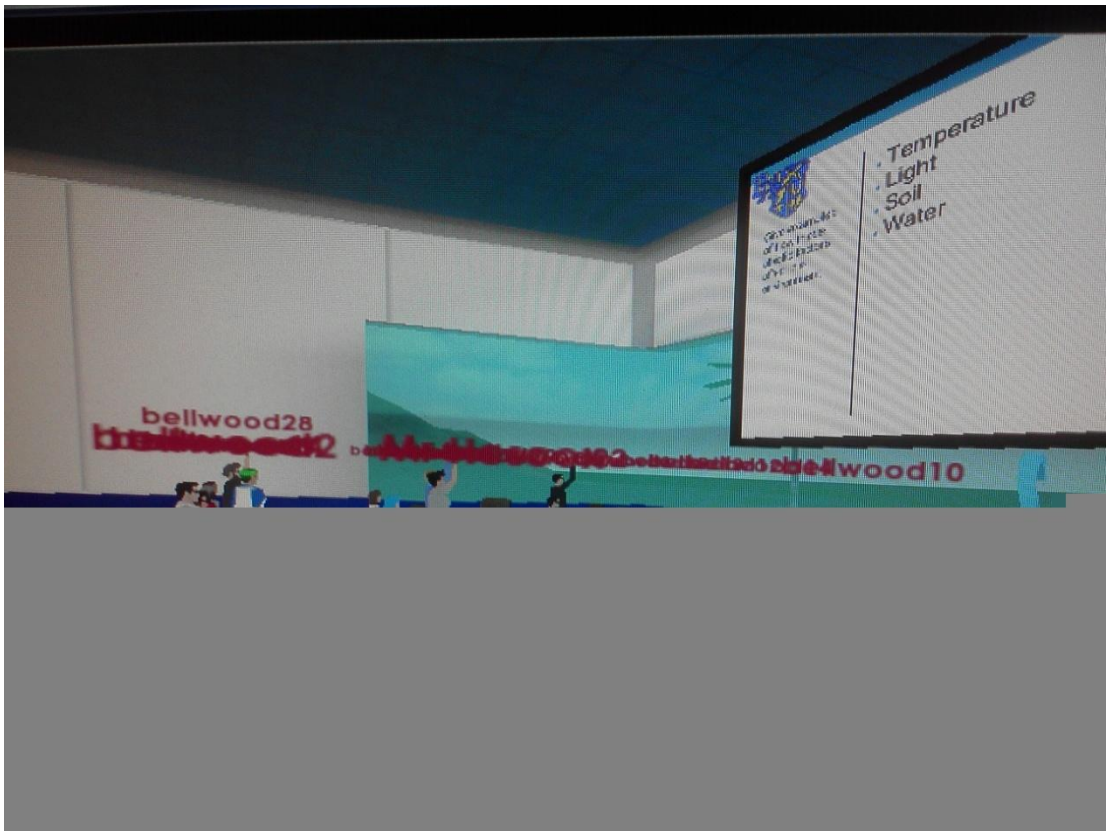
Students logged into the virtual world under general logins (Ex. Bellwood 12). The student's login was then recorded on the student's survey and pretest scores. However, the teacher and other learners did not have the information on the identity of each student. This

provided a level of anonymity to the students. This was done for technical considerations as there was a limit on the number of user accounts that were allowed in the virtual world. Having general logins allowed for repeated use throughout the day without having to recreate accounts for the users to login. Anonymity could potentially help or hurt this study. As in the Kiski study, there is the possibility that students will feel that there is no way to have repercussions. Alternatively, the ability to remain anonymous could help increase student participation and communication as the technology could serve as a medium to reduce shyness of the students.

The students in groups 2 and 3 were the synchronous groups. This meant that the teacher used both the chat and voice options to communicate back and forth with the students. In group 4, communication was simulated to be asynchronous only. In order to produce this effect, the teacher turned off the microphones and did not communicate with the students. However students were able to communicate amongst one another using the text based chat feature. This was done to replicate instructional delivery that would be prerecorded with online chat options for the students.

Figure 1

Screenshot from the Virtual Environment



Data Collection (Instrument, Variable, and Materials)

The data collection in this study will be done in three phases: pretest, posttest, and survey. The pretest will serve as a baseline of prior knowledge about the topic that is used in the experiment. Since the study is using a prescriptive sample in order to cause minimal intrusion on the school setting, the pretest scores can serve as somewhat of a base line when analysis is done. This will allow the researcher to determine the gain in achievement that students received based on the instruction. If only a posttest design was utilized, prior knowledge could potentially confound the findings.

Both the pretest and posttest will be constructed by the regular classroom instructor. Each was a 12 point multiple choice quiz that covered the content of the lesson (Appendix A). This method was validated in the pilot testing where the teacher created the assessments as the subject matter experts from Indiana University of Pennsylvania found that an experienced teacher can create a valid assessment of their subject content. The teacher has received years of training on how to assess student performance using the state standards. This approach will also aid in the ability to generalize the findings of this study as the teacher, not the researcher, has created this content. This study looks to have practical applications and the use of a veteran classroom teacher will support this element.

The same instructor will teach both the control group in the traditional setting as well as the treatment groups in the virtual environment. Using the same instructor in both environments will control for the instructor as a variable and should eliminate potential differences that multiple instructors might have. The students have already been in a classroom with the teacher for nine months, so they are familiar with him. Although, a single teacher establishes consistency, the fact that student have a rapport with the teacher does have a potential to impact the study. Students entering an entirely online school likely have not met the teachers face to face prior to beginning their learning.

The lessons in the virtual environment were created using *Virtual Events*. *Virtual Events* was selected as it allowed for the creation of owned content and virtual spaces, capabilities not available with free software such as *Second Life*. The developers, with direction from the teacher, were able to create lessons over which they had complete control. Another feature of *Vitual Events* is that it allows for students to be siloed meaning that no one, without permission,

can access the virtual classroom that they are in. This affords the same protection that students in school have so that they can learn without distraction or intrusion from outsiders.

The subject matter was energy flow through an ecosystem that consists of producers, consumers and decomposers. Additionally, the lesson will include how energy is passed through the levels in an ecosystem. An example would be learning about how energy moves from the sun to a plant to a rabbit to a fox. This content was picked so that it would not contain any controversial or possible sensitive material that some science lessons may present.

The content of this lesson will be based on Pennsylvania state science standards. This will aid in the ability to generalize the findings as it is content that is required to be taught by the Pennsylvania Department of Education. The following are the current state standards for Pennsylvania that are covered by the lessons in this study:

> S8.A.3.1 Explain the parts of a simple system, their roles, and their relationships to the system as a whole.
>
> S8.A.3.1.1 Describe a system (e.g., watershed, circulatory system, heating system, agricultural system) as a group of related parts with specific roles that work together to achieve an observed result.
>
> S8.A.3.1.4 Distinguish between open loop (e.g., energy flow, food web) and closed loop (e.g., materials in the nitrogen and carbon cycles, closed-switch) systems.
>
> S8.B.3.1.1 Explain the flow of energy through an ecosystem (e.g., food chains, food webs).

Ethical Concerns

There will be no compensation or alternative for participation in this study. The students who elect to participate in this study will be given instruction using standardized pedagogical

practices. The school district has given permission for this research to be conducted at their school. The researcher has received the authorization of Indiana University of Pennsylvania's Internal Review Board (IRB) to conduct this research and experiments.

As the content of this study is based on Pennsylvania state standards that are assessed on standardized testing, there is a potential risk to the students and school to ensure that the content is mastered. The study will use the deception that the quiz is going to count towards their course grade. After the day of research, the instructor will debrief all of the students that the quiz did not count towards academic credit. As part of the research, the teacher will grade the assignments of the posttest, enabling the teacher to use the posttest as a formative assessment and use his or her professional judgment as to whether or not the students need additional instruction or can move forward. If the teacher determines students need additional material, arrangements have been made for him to provide this additional instruction. However, as the lesson development is based on Pennsylvania state standards, there is a reduced chance that the subject and experiment will raise ethical concerns.

CHAPTER 4

DATA ANALYSIS

Characteristics of the Sample

This chapter is an analysis of the results from the science lesson that was conducted in the seventh grade class. The lesson was delivered in a traditional classroom as well as in a virtual "game-like" environment where students used character representations (avatars) of themselves to interact and participate. The primary focus is to determine if the use of a virtual environment had an impact on student achievement and perceived satisfaction with the lesson. To do this a combination of quantitative analysis of achievement scores on pretest and posttest assessments and survey responses as well as qualitative feedback received from open ended questions will be utilized.

Lesson

The lesson content was created by the instructor, who has been teaching middle school science for ten years. The teacher developed a PowerPoint presentation that was used in both the traditional and virtual lessons. This standardized the content delivery so that the same material and visuals were used in both environments. In addition, the teacher created the assessment, mimicking what he normally used in his lessons. When the assessment was distributed, one student said that it was "just like a Mr. Hescox quiz". The students were not informed that the assessments were created by their teacher but this comment shows they felt it was similar to what they have used in the classroom. These comments indicate the attempt to mirror the instructional practices of a typical classroom were successful and to aid in the validity of the research.

Participation

The response rate for participation in this study was outstanding as the study received consent forms from 100% of the students and parents. In total, there were 101 participating students. However, this study took place over two days in an active school setting and was, therefore, subject to the same factor of absenteeism as the regular classroom would experience. The impact of said absenteeism was minimal with only four students not completing either the pretest or posttest. Any subject who did not have a complete response set of pretest, posttest, and survey data was excluded from analysis and considered a non-participant for the purposes of this study. Ninety-six percent of the seventh grade population (N=97) had complete participation in the research.

Table 2 below shows the breakdown of how students were grouped. It is important to remember that the research utilized classes of students who were grouped and academically tracked by the school; therefore, groups were not evenly divided. The sections are comprised of a low performing, two groups of average performance and one high level group. In total, 18 students (Group 1) completed the traditional lesson in the control group and 78 engaged in the virtual lesson in three treatment groups (Groups 2, 3, & 4). Group 1 was the control group which was deemed to have average performance level and received a traditional lesson in the classroom. Group 2 was also average and group 3 was low performing. Both received instruction asynchronously in the virtual environment. Group 4 was the high performing group and received instruction asynchronously via the virtual environment.

Table 2
Distribution of Population by Group

	Total Number	Missing	Total Complete
Group #1 (Avg. –Trad.)	19	1	18
Group #2 (Avg.- Virt. Sync.)	27	1	26
Group #3 (Low-Virt. Sync.)	27	0	27
Group #4 (High – Virt. Async.)	28	2	26

Students

The student population was derived from a seventh grade class at a middle school. The majority of the students were 13 years old with some students being 12 or 14. This study was completed near the end of the school year, explaining why the majority of students were in the 13 year old category. The table below gives a complete breakdown of the ages by the groups.

Table 3
Distribution of Sample Age by Group

	Age 12	Age 13	Age 14
Group #1 (Avg. –Trad.)	4	13	1
Group #2 (Avg.- Virt. Sync.)	3	22	1
Group #3 (Low-Virt. Sync.)	8	19	0
Group #4 (High – Virt. Async.)	12	13	1

The gender of the population was roughly even overall as the breakdown was 47% male and 53% female. This roughly equivalent distribution held for each of the groups as the table below demonstrates. The relatively comparable distribution allows for easier examination of any effects by gender and increases the ability to transfer the results.

Table 4
Distribution of Sample Gender by Group

	Male	Percent Male	Female	Percent Female
Group #1 (Avg. –Trad.)	10	56%	8	44%
Group #2 (Avg.- Virt. Sync.)	12	46%	14	54%
Group #3 (Low-Virt. Sync.)	13	48%	14	52%
Group #4 (High – Virt. Async.)	11	42%	15	58%
Total	46	47%	51	53%

Research Question 1

RQ#1: Is there a significant difference between delivery methods in learning outcomes?

The first research question centered on the impact that the treatment had on achievement for the students. In this study, each student took a pretest and posttest assessment. Using a control group (Group 1) allowed for the examination of any impact that the virtual environment may have on the students.

First Hypothesis

H1.1: There will be no significant difference for student achievement across delivery methods. The first hypothesis is based on prior studies that found no significant difference between online and offline methods of instruction. To ensure that the delivery method was the primary variable, the same instructor and content were used in all four delivery designs. The change (posttest score minus pretest score) was used for analysis in this hypothesis. There were a total of 12 questions and 12 points possible on the assessment.

Using a one way ANOVA, the hypothesis was supported as there was not a significant difference at the $p<.05$ level [$F(3,93) = 1.89$, $p = .137$]. Table 5 reflects the outcomes from the ANOVA. This indicates that there was no statistical difference in achievement between the instructional delivery methods across the four groups. Table 6 contains the descriptive data for this comparison, where the mean (M) score for the control group was actually higher than that of treatment group. For the control group, M= 1.05 points in average gain for receiving instruction, while the treatment group all had positive growth as well with Group 2 (M=.28), Group 3 (M=.19), and Group 3 (M=.54).

Table 5
One Way ANOVA – Achievement

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	9.663	3	3.221	1.890	.137
Within Groups	158.523	93	1.705		
Total	168.186	96			

Table 6

Descriptive Data for the Change in Achievement

	N	Mean Change	Std. Deviation	Std. Error
Group #1 (Avg. –Trad.)	19	1.05	1.545	.354
Group #2 (Avg.- Virt. Sync.)	25	.28	.843	.169
Group #3 (Low-Virt. Sync.)	27	.19	1.469	.283
Group #4 (High – Virt. Async.)	26	.54	1.303	.256

One point of interest is that the treatments groups all had lower means for the change in academic achievement than that of the control group. This difference was not statistically significant and has the potential to be explained by the newness of the environment for a slight difference. Students underwent an exposure to a virtual world three days prior but this was the first lesson they received in that setting. Additionally, on the day of testing, students were separated from their normal instructor and had the presence of two researchers and a school administrator in the room. These factors may have made them nervous or not entirely focused on the lesson.

To further explore the no significant difference observed using the ANOVA for change, subsequent ANOVAs were used to examine if there was a significant difference on the pretest and posttest. Both of the examinations for the pretest and posttest differences revealed a significant difference. The pretest showed significance at the $p < .01$ level [$F(3,93) = 5.93$, $p = .002$]. Group 1 (Traditional) had the lowest mean score with 9.05. Table 7 shows the rest of the

mean scores which were all above 10. Group 1 also exhibited the highest standard deviation with 2.57 which was nearly one point higher than any other group.

Table 7
Comparison of Pretest Scores by Group

	Number of Students	Mean	Standard Deviation
Group #1 (Avg. –Trad.)	19	9.05	2.57
Group #2 (Avg.- Virt. Sync.)	25	10.44	1.44
Group #3 (Low-Virt. Sync.)	27	10.22	1.34
Group #4 (High – Virt. Async.)	26	11.04	1.25

Another ANOVA was used to examine the posttest assessment and also yielded a significant difference between groups. The posttest comparison showed significance at the $p < .01$ level [$F(3, 93) = 5.15$, $p = .002$]. Table 8 shows the mean scores and standard deviations for the pretest. This shows that although the average for the majority of scores for each of the groups was in the 10 point range, there was a difference in their standard deviation. Group 1 (Traditional) had a standard deviation of 1.94, which again indicates the highest variability of any group.

Table 8
Comparison of Posttest Scores by Group

	Number of Students	Mean	Standard Deviation
Group #1 (Avg. –Trad.)	19	10.11	1.94
Group #2 (Avg.- Virt. Sync.)	25	10.72	1.24
Group #3 (Low-Virt. Sync.)	27	10.41	1.53
Group #4 (High – Virt. Async.)	26	11.58	1.45

The use of the ANOVA served its purpose in examining all of the groups combined. However in order to compare additional groups to one another the use of independent sample T-tests were done. The first comparison was to look at Group 1 (Traditional) versus Group 2 (Synchronous Virtual) as both of these groups were deemed to be average in terms of their academic performance by the school district. This indicates, that at least theoretically, they should be the closest two groups.

The t-test for independent sample showed a significant difference in the academic growth between Groups 1 and 2 with $t(42) = 2.12$, $P = .04$. As table 9 shows Group 1 had a higher average change with $M = 1.05$ as compared to Group 2 with $M = .28$. Despite the higher level of change from the traditional group, this may not illustrate better achievement.

Table 9
Descriptive Data Comparing Change in Achievement for Group 1 to Group 2

	N	Mean	Std. Deviation
Group #1 (Avg. – Trad.)	19	1.05	1.545
Group #2 (Avg.- Virt. Sync.)	25	.28	.843

A possible explanation of the students in group one having a significantly higher level of achievement growth may lie in the fact that they underperformed their virtual counterparts on both the pretest and posttest. As table 10 shows, learners in Group 1 had lower scores in both administrations of the assessment.

Table 10
Comparison of Mean Scores on Pretest and Posttest by Group

	Pretest	Posttest
Group #1 (Avg. –Trad.)	9.05	10.11
Group #2 (Avg.- Virt. Sync.)	10.44	10.72
Group #3 (Low-Virt. Sync.)	10.22	10.41
Group #4 (High – Virt. Async.)	11.04	11.58

To further investigate if this difference on prior knowledge was significant a t-test was used. The results showed that there was a significant difference ($t(42) = -2.72$, $p = .028$) between Group's 1 and 2 pretest scores. A potential explanation here is that Group 2 had higher achievement prior to the lesson, so they may have hit a ceiling with their knowledge. Group 1 had lower scores before the lesson resulting in room for more growth. Group 2 (virtual) also had higher posttest scores compared to the traditional lesson.

Another t-test was conducted on the posttest scores for Group 1 and Group 2 that yielded no significant difference at the $P < .05$ level ($t(28.86) = -1.20$, $p = .24$). The no significant difference here shows that after the lesson that scores between students yield no significant difference, despite a difference existing in both the pretest and academic growth. Examination shows that Group 1 started lower and gained more but had a similar learning outcome as Group 2. The standard deviation for Group 2 must be recognized as a potential factor as throughout the study this group exhibited the greatest amount of deviation on the pretest, posttest, and change.

In summation there was not a significant difference for the achievement growth across all of the groups. However there was a significant difference when comparing scores on the pretest and posttest. This likely indicates the fact that Group 1 had lower pretest and posttest scores than

the other groups. Additionally, Group 1 exhibited a greater amount of deviation on both assessments. This means that there was a greater amount of variability within Group 1 and that it likely had outliers both low and high affecting the outcomes of the ANOVA on the pretest and posttest. This is why using the ANOVA to look at change was so important. Change or academic growth best describes what happened to individual students rather than mean scores of the entire group. The higher pretest scores that Group 1 and 2 showed also played a role in the difference on the t-tests as these statistics showed that there was a significant difference. Group 1 had lower pretest scores which would cause the significant difference here. In addition, lower pretest scores allow for more academic growth to take place. Students in Group 2 on average had answered 1 more correct answer on the pretest than Group 1, demonstrating an increased ability to answer more questions correctly on the posttest.

The findings here are substantiated by prior findings in the literature. It is not surprising to find that when the same teacher delivers identical content to multiple sections of the same class that similar outcomes are discovered. As medium of delivery was the only changing variable in this study, it should not be unusual for a veteran teacher who knows his content area to design the instructional lesson and assessment to elicit equivalent results from students.

Second Hypothesis

H 1.2: There will be no significant difference in student achievement based on gender. The second hypothesis explored if there was a difference in learning outcomes based on gender. Of the 78 students in the virtual world, 36 were male and 42 female. Again, for comparison the change in academic outcomes was based on the difference between the pretest and posttest. A one-way ANOVA was used to examine the learning outcome between males and females in the

virtual world. The results indicated that there was not a significant difference based on gender at the p<.05 level [F(1,76) =.302, p =.584] (Table 9). Table 12 shows that the mean change for scores was relatively close for both males (M=.25) and females (M=.40). Additionally, the SD for males was 1.22 and females 1.25 respectively.

Table 11
One Way ANOVA - Gender Differences

	Sum of Squares	Df	F	Sig.
Between Groups	.464	1	.302	.584
Within Groups	116.869	76		
Total	117.333	77		

Table 12
Descriptive Data Comparing Mean Change in Score by Gender

	N	Mean Change in Score	Std. Deviation
Male	36	.25	1.228
Female	42	.40	1.251
Total	78	.33	1.234

Additional analysis was conducted in the form of ANOVAs on both the pretest and posttest assessments to determine if there was a difference based on gender. Both tests revealed that no significant difference existed based on gender. The pretest showed no significant difference between genders at the p< .05 level [F(1,76) =.077, p =.782]. Table 13 shows that males had a slightly higher average pretest score, but that the females had a lower standard deviation.

Table 13
ANOVA – Pretest Gender

	N	Mean Score	Std. Deviation
Male	36	10.61	1.48
Female	42	10.52	1.29

The posttest also showed that there was no significant difference amongst learners in the virtual environment. The ANOVA showed at the $p < .05$ level [$F(1,76) = .054$ $p = .82$] no significant difference existed. Table 14 shows that female students actually switch with males in the posttest. This means that female students exhibited a somewhat greater gain in achievement and higher posttest scores on average compared to their male counterparts in the virtual environments. However, this difference was not statistically significant.

Table 14
ANOVA – Posttest Gender

	N	Mean Score	Std. Deviation
Male	36	10.86	1.20
Female	42	10.93	1.35

To further investigate if there was a significant difference between male and female learners for their achievement gain a series of t-tests were conducted. Table 15 shows the results for the within group t-tests. There was no significant difference in academic growth based on gender in any of the groups including the control.

After finding that no significant difference existed in academic growth, an analysis was conducted on both the pretest and posttest scores of the students within each group based on gender. Table 16 (pretest) and Table 17 (posttest) show the analysis of the series of t-tests which were conducted. In both the pretest and posttest no significant difference was detected at the $p < .05$ level for within group scores based on gender.

Table 15

t-tests for Gender Difference on Achievement within Group

Group	t-test Result	Gender	Mean	SD
Group #1 (Avg. –Trad.)	t(17) = .14, p = .89	Male	1.10	1.73
		Female	1.00	1.41
Group #2 (Avg.- Virt. Sync.)	t(23) = .30, p = .77	Male	.33	.89
		Female	.23	.83
Group #3 (Low-Virt. Sync.)	t(25) =.41, p = .69	Male	.31	1.38
		Female	.07	1.59
Group #4 (High – Virt. Async.)	t(24) = -1.54, p = .14	Male	.09	1.45
		Female	.87	1.12

Table 16

Comparison of Within Group t-test for Gender Differences on Pretest

Group	t-test Result	Gender	Mean	SD
Group #1 (Avg. –Trad.)	t(17) = -.99, p = .34	Male	8.50	3.20
		Female	9.67	1.158
Group #2 (Avg.- Virt. Sync.)	t(23) = -.08, p = .94	Male	10.42	1.44
		Female	10.46	1.51
Group #3 (Low-Virt. Sync.)	t(25) =-.54, p = .60	Male	10.08	.35
		Female	10.36	.39
Group #4 (High – Virt. Async.)	t(24) = 1.20, p = .24	Male	11.31	1.55
		Female	10.73	.96

Each analysis of both the posttest and academic growth indicated that no differences were detected between learners based on the gender of the student. The students were almost evenly divided by gender in the cohorts that they were tracked within. The instruction was what a classroom teacher would use on a daily basis and not specifically geared for either gender. Without the use of gender specific elements in the treatment, similar results should be expected. This has been the established practice in public education as classroom teachers do not specifically gear lessons by gender nor do states differentiate by gender on how learners are assessed.

Table 17
Comparison of Within Group t-test for Gender Differences on Posttest

Group	t-test Result	Gender	Mean	SD
Group #1 (Avg. –Trad.)	t(17) = -1.21, p = .24	Male	9.60	2.32
		Female	10.67	1.32
Group #2 (Avg.- Virt. Sync.)	t(23) = .11, p = .91	Male	10.75	1.22
		Female	10.69	.37
Group #3 (Low-Virt. Sync.)	t(25) =-.07, p = .94	Male	10.38	1.39
		Female	10.43	1.70
Group #4 (High – Virt. Async.)	t(24) = -.28, p = .78	Male	11.54	.52
		Female	11.60	.16

Third Hypothesis

H1.3: Prior academic achievement will correlate to achievement scores. The third hypothesis examined whether a student's prior academic performance was an indicator of his/her score on the posttest. This again used the difference between the pretest and posttest as the factor as well as the student's usual science grade. It was found that there was not a significant

correlation with $p < .05$ for either the traditional or virtual groups. As table 18 shows, the two tailed Pearson correlation for the virtual group was $r(78) = .09$, $p = .41$ and the traditional group had a $r(19) = -.34$, $p = .15$.

Table 18
Correlation of Prior Achievement to Academic Change

	Pearson Correlation	P	N
Virtual	.09	.41	78
Traditional	-.34	.15	19

A correlation was also conducted to examine the final level of achievement on the posttest as compared to prior academic achievement. This analysis used a Pearson R and found that a correlation existed for the virtual group at the $p < .01$ level while no correlation existed for the traditional group. Table 19 shows these results. A potential factor for the lack of correlation for the traditional group may because of the variability of scores as well as lower pretest scores.

Table 19
Prior Achievement Correlated with Posttest

	Pearson Correlation	P	N
Virtual	.341	.002	78
Traditional	-.043	.862	19

To follow up the correlation of the entire virtual group additional analysis was conducted using a Pearson R at the Group level. In this investigation, no correlations were found at the $p <$

.05 level (Table 20). This means that in the virtual group overall there was a correlation between prior achievement and posttest results, however when analyzing each virtual group individually this correlation did not emerge.

Table 20
Prior Achievement Correlated with Posttest by Group

Group	Pearson Correlation	P	N
Group #1 (Avg. –Trad.)	.17	.47	19
Group #2 (Avg.- Virt. Sync.)	.18	.40	25
Group #3 (Low-Virt. Sync.)	.10	.63	27
Group #4 (High – Virt. Async.)	.11	.59	26

A possible explanation of why this hypothesis was not validated may be explained by the data collection for the student's grades. In order to have the least impact on the educational environment, the students filled out a survey with their grade on it. The self-reporting of the grade was specifically utilized to eliminate any potential issues with the school or teacher giving the researcher student information. This self-reporting may have lead to students rating themselves higher or lower than their actual ability. Examination of the actual data shows students marking themselves seeming low and then receiving high scores and vice versa. As this hypothesis used a correlation for analysis, a method looking for patterns, having abnormalities is a potential justification for the lack of significance.

Research Question 2

RQ#2: Is there a significant difference between student perceptions of delivery methods?

H2.1: *There will be a significant difference in student satisfaction for students learning in a virtual environment*. The explanation for this hypothesis is that students learning in an environment that they may associate with gaming and fun will show more interest and satisfaction as compared to the traditional classroom environment. After completing both the lesson and posttest, both groups of students participated in a survey that, amongst other factors, measured how much they liked the lesson. The scale used was a five point Likert scale on which students were able to rate their satisfaction with the lesson. To analyze the data for this question a one way ANOVA was used to test the hypothesis. A significant difference was found between the methods of delivery with $P < .01$ [$F (1, 95) = 11.57$, $p = .001$) . Table 21 shows that mean for the virtual lesson ($M=4.35$) was rated higher than traditional ($M=3.63$).

Table 21
Descriptive Data for Learner Satisfaction by Delivery Method

	N	Mean	Std. Deviation	Std. Error
Traditional	19	3.63	.895	.205
Virtual	78	4.35	.803	.091

The hypothesis was strongly supported as the students in the virtual classroom revealed that they significantly enjoyed the lesson more than their classroom counterparts. This is an extremely important revelation in this study as it shows that, even with the exact same teacher that they encounter daily and the same content, students find the virtual learning environment

more enjoyable. Realistically, some of the difference may be explained by the newness and deviation from routine that is provided by the virtual world. However the significant difference with $p < .01$ shows that there is a positive impact of the virtual world on students' perceptions of the lesson. Although it cannot be verified, the traditional group had lower pretest scores, which means that they may have had a harder time learning the material. This could make the task less enjoyable.

H2.2 *There will be no significant difference in satisfaction based on gender*. Analysis was conducted to inspect whether the virtual environment was biased in either direction for either males or females. This is different than the achievement component as students could potentially learn in an environment that they did not like. An examination of within group differences based on gender showed no significant difference for any of the groups, including the traditional lesson. Table 22 shows the results from the t-tests that were used.

Table 22
t-tests for Gender Difference on Satisfaction

Group	t-test Result	Gender	Mean	SD
Group #1 (Avg. –Trad.)	t(17) = 1.42, p = .18	Male	3.90	.74
		Female	3.33	1.00
Group #2 (Avg.- Virt. Sync.)	t(23) = -.17, p = .87	Male	4.17	.94
		Female	4.23	.93
Group #3 (Low-Virt. Sync.)	t(25) = -.99, p = .33	Male	4.15	.80
		Female	4.43	.65
Group #4 (High – Virt. Async.)	t(24) = .554, p = .59	Male	4.64	.51
		Female	4.47	.92

Research Question 3

RQ#3: Is there a correlation between student motivation and learning outcomes?

H3.1: Students who are more engaged and motivated in the virtual learning environment will have higher achievement scores than those in the traditional classroom. The idea is that students who are motivated to participate in the environment will be more inclined to pay attention to the content and this will translate into higher levels of learning. The variable used for this hypothesis was the student's rating of engagement on a five point Likert scale which is being treated as ratio data for this analysis. For achievement, the student's change in score from the pretest to the posttest was used. This hypothesis was not supported by the findings as there was not a significant correlation with $p < .05$ for either the traditional or virtual groups. As table 23 shows, the two tailed Pearson correlation for the virtual group was $r(78) = .15$, $p = .18$ and the traditional group had a $r(19) = -.27$, $p = .26$.

Table 23
Correlation of Achievement and Motivation

	Pearson Correlation	P	N
Virtual	.15	.18	78
Traditional	-.27	.26	19

A second correlation was conducted to examine if a relationship existed between student's posttest scores and their motivation levels. Again, the hypothesis was not supported as no significant correlation was found with $p < .05$. Table 16 shows the result for both the traditional and virtual groups.

Table 24
Correlation of Posttest and Motivation

	Pearson Correlation	P	N
Virtual	.17	.13	78
Traditional	.29	.23	19

The findings here show that students can be motivated to participate in the lesson but this doesn't correlate to an impact in their achievement. This was found to be true in both virtual and traditional settings. Perhaps this speaks to the limitations of student ability. Some students may be motivated by the lesson but this does not necessarily result in an increase in their achievement.

Qualitative Data

In addition to the quantitative component of this study, there were three open-ended questions on the students' surveys. This was done so students could describe in their own words their experience as well as the perceptions of the virtual environment. The three questions centered on what they found unclear, what was useful, and what they would potentially change.

Issues

The response to the virtual environment was overwhelmingly positive, but there were several responses that emerged as possible issues. Negative comments centered primarily on user issues that could be fixed with additional training on the platform. As this study was conducted within a school environment some students were not present for the orientation day to the virtual world and as a result they were not as familiar with the procedures and controls of the

virtual world. All students completing the full orientation would have eliminated the potential issues about changing character identity and navigation.

Another possible issue discovered was that students had generic user logins that did not reflect their names. Although the researcher collected the information connecting students to their log in names, the students, at some points, may have felt that anonymity afforded them the ability to give silly and off task responses to the instruction. This disruption was noted by both the teacher and students in their responses. It is important to note that this only happened with a handful of students and the teacher was able to correct their actions even though they were not in the same room. Additionally, there was some peer correction of other students figuring out who the student was and reporting that to the teacher or making comments for the offending student to stop.

Attention

As the quantitative data bears out, the virtual environment held the students' attention and they enjoyed the lesson. As one student indicated in their open-ended response, "you could learn as much as a regular classroom" while another noted that, "it took my attention and sucked me in". It is important to have students interested in the lesson and the virtual environment seems to be an effective means to capture this audience.

Students didn't seem to notice that this lesson was identical to what they would have received if they were in the regular classroom. A response came close to the point with, "it was almost like the lessons in class but more fun". Students perceived that the environment was primarily a game format that made learning fun. This was an extremely interesting finding as students received instruction while sitting in chairs in the classroom computer lab environment using a virtual whiteboard. Students focused on engaging in the virtual world rather than

focusing on the fact that they were still in a classroom computer lab. This is also supported by the researcher's observation that students, once in-world, communicated through the tools there and students that were rowdy upon entering the lab quickly fell silent and concentrated solely on the screen in front of them. This was an interesting finding as the students were in the computer lab due to the technology infrastructure needed and allowed to choose their seats, so presumably they sat with friends and this could have become a distraction. Students were reminded that they would be taking a quiz. However the instructor would have had no direct supervision over their behavior as he was in a separate room.

Collaboration & Competition

Anonymity played a dual role in this experiment as the students freely communicated with one another and answered the teacher's questions. The online interaction was high as the learners communicated primarily through chat messages. Even in the asynchronous lesson, where the teacher would not directly communicate with the learners, students could discuss answers amongst one another. The teacher at times posed a question and students would provide feedback to one another. In all treatment groups, responses to the instructor's questions involved almost the entire class.

The teacher noted that he was reluctant at first, as he was used to having one student respond in a traditional classroom question. It became apparent to him as the experiment progressed that involving the entire class could be beneficial. Students had comments about this such as, "everyone could put their answers and you can learn from what people said," "I could learn not only from Mr. Hescox, but my classmates," and "we could participate so much". The

process was not intimidating as indicated by one respondent, "I wasn't shy about saying an answer".

This communication process quickly became a competition as students rushed to be the first with an answer. During the lesson, one student said to a friend, "I can't type as fast as you", highlighting the point that the virtual world quickly promoted a contest for students to be first. In each section of the treatment, comments were made both verbally and on the survey to attest to the fact that the world made them compete.

In addition to the competition, students responded independently to questions and all shared different ideas. For example, when the teacher asked, "name an example of a herbivore" there are potentially 25 different responses (responses were not recorded for a count only observed by the researcher), since each student could name an example such as deer, rabbit, and cow. Students noted that this allowed them to compare answers and, "all give feedback". Broadening the understanding of a concept by eliciting more examples is a potential benefit as students can associate concepts with more examples.

Perception of Game

The lesson was never intended to be a game. Instead, instructional delivery was to be conducted in a “game-like” environment. The virtual classroom mimicked a traditional lecture style lesson with the seats for the students and screen for the PowerPoint to be displayed. To most educators this would be equal to the use of a web conferencing tool that allowed the students to have a virtual presence through the use of an avatar. However, students perceived the environment as a game and referred to elements of competition amongst one another in the open ended portion of the survey. The students used the term game without prompting, questioning, or using the term "game" by the researcher either verbally or on the survey instrument. This may

have been conceived because of the use of an avatar which allowed them to move a physical representation of themselves within the world.

Students noted the environment was a game when talking to the teacher after the lesson as well as in their survey. Some of the responses were: "we get to play the game, I like this lesson better of all the ones this year," "fun on the video game," "It was entertaining," and "we are learning and we are playing a game". One response even indicated that this was too much of a game and that "I would have wanted it to be less of a game and more of a learning experience". These findings were interesting given that it was not the attempt of the research to have a game, rather to evaluate a lesson in a virtual world.

Conclusion

The analysis of the data has revealed several key points about the learners' outcomes as well as their satisfaction in this lesson. An important component was that the online virtual environment yielded a result of no significant difference based on the student's achievement when comparing the virtual and traditional lessons. This supports previous findings by Cavanaugh et al (2004) and Smith, Clark, and Blomeyer (2005). Additionally there was no statistical difference based on gender of students. At the same time, there was a statistically significant difference between delivery methods in favor of the virtual groups for satisfaction with the content deliver.

In support of the statistical findings, students were given a survey with open ended questions. Through the qualitative analysis, trends of collaboration, competition, and a game emerged. Students found that they were better able to communicate with their instructor as in a classroom only one student may participate with the instructor at a given point. Online chat

messages actually allowed more students to engage the teacher and respond at a given time. This open collaboration allowed for students to see examples and answers other students were giving and developed into a competition between students. The use of a virtual world as well as the building of competition between students lead to students referring to the lesson as a game, even though at no point did the teacher or researchers use the term game. Although this study was conducted in a brick and mortar school, where application of these findings and technologies may be limited, the concept of an online platform that allows for equal achievement and is able to engage students in a manner that they find enjoyable has a great deal of usability for designers of entirely online schools.

CHAPTER 5

DISCUSSION & RECCOMENDATIONS

Introduction

From the onset, an essential component of this study was the potential applicability that this research can have on day-to-day instruction for students in a K-12 setting. The ultimate goal was to examine the effects of online, virtual instruction on students from an average middle school. The subject of science was chosen as students often begin to lose interest in this topic around grade seven so it is important to design instruction that engages the learners. With practicality in mind, this is the rationale for why the particular subjects, teacher and platform were chosen.

From the experiment, the majority of the findings were not surprising and primarily affirmed the hypotheses that were set out. Students achieved equivalent educational gains in virtual and traditional environments. Additionally, students were more motivated and liked the lesson more when the same content was delivered in a virtual environment. The use of an environment that resembled a game likely appealed to the students as it was a variation from the traditional way that they receive instruction. Even though the instruction was primarily delivered using a lecture format with PowerPoint slides embedded as a screen in the virtual classroom, this alternative approach created a level of newness that excited the learners.

The qualitative component of this study not only supports the quantitative achievement and survey data but also gives a critical understanding of how students saw the environment. To the learners, this virtual classroom transformed their learning experience from an everyday lesson to something that they perceived as a game. This resulted in healthy competition amongst classmates in a quest to answer questions correctly. The learners competition to answer

questions was only enabled by their ability to communicate through instant messages. Thus even though a competition emerged in the lesson, the key component here is the ability to communicate to both the instructor and other students. Through this communication and competition process, students were not only learning from their instructor's lesson but incidentally via a community of learners.

Methods

The study used an approach that attempted to include an entire middle school grade seven class that totaled 101 students. Every student returned a consent form and participated in the study to some degree. The research was done in a school setting and subsequently faced absenteeism or other obligations by students. In the end, 97 students completed both the pretest, posttest, and survey in entirety, resulting in a 96% completion rate for the study. Those who did not complete the entire set of data were removed as a 96% completion rate was more than satisfactory. There were four sections of the course taught at the school and divided by achievement level. To keep the order of the school day and class period and to be able to monitor the students in their natural groupings, the study utilized a prescriptive sample and did not randomize the students.

The school's teacher played an integral role in the process of selecting the topic and producing the content. The specific topic was selected as it was one that had proven problematic in previous experience. The approach was to use a tougher lesson and teach it in an alternative way as a means to potentially better engage students in the learning process. The teacher created and delivered the PowerPoint that was used in both the virtual and traditional environment to help standardize content and delivery amongst sections. The PowerPoint for both traditional and

virtual lessons were identical, containing the same content and graphics. Using the PowerPoint as the script for the lesson delivery the teacher attempted to deliver identical lectures. The lesson was delivered within the standard 42 minute period for the school.

Discussion

Achievement

The first research question examined if there was a significant difference between the online and virtual lesson delivery methods. The first hypothesis specifically was supported as there was not a significant difference between virtual and traditional courses while using an ANOVA. The findings here are similar to the conclusions of studies conducted by Cavanaugh et al (2004) and Smith, Clark, and Blomeyer (2005). The instructional design and delivery processes as well as the instructor were almost identical in both environments so the study effectively examined the role that a virtual environment can play in the delivery of content.

After using the ANOVA, a t-test was used to compare the academic change in students in Group 1 (Traditional Lesson) and Group 2 (Synchronous Virtual Lesson) as both groups were considered average. This revealed a significant difference between Group 1 and 2 with Group 1 having more of an increase in their mean scores. This change can likely be explained by the point that on both the pretest and posttest assessments Group 2 had higher scores. Group 1 had lower pretest scores and greater standard deviation in scores. This meant that Group 1 would have more potential information to learn from the lesson as they had lower scores to start with (If a student already had 100% on the pretest, then there is no room for growth; however if a student had a 60%, there is significantly more potential for a student increase the number of correct responses).

The study used a population that had almost equal distribution of male and female participants in each treatment group. This is important when considering the second hypothesis which examined whether there was a measurable achievement amongst genders for achievement in the lesson. The hypothesis was supported as there was not a significant difference between genders. Additionally a series of t-tests were used to determine if there was any variance within each group. These t-tests found that no significant difference occurred within each group including the treatment. This finding is important to note since there has been some research that virtual environments and games are geared toward boys for the game and competition, while female students tend to enjoy the socialization. The result is not surprising as the lesson was designed by a veteran instructor who designed and delivered content using the same pedagogical practices he utilizes daily in the classroom. Instructional practices are not differentiated on a daily basis for classroom instruction, therefore this finding reflects current educational practices.

Satisfaction

Satisfaction is an equally important finding in this study and was the focus of the second research question examining the satisfaction that students experienced in the virtual world. The hypothesis was that student satisfaction would be higher in the virtual world as compared to the traditional lesson. This hypothesis was supported by the findings with the significant difference having at $P < .01$; therefore, it is extremely likely that these findings hold true. The basic premise of the hypothesis was that students would enjoy learning in a "game-like" environment with all else held equal. Students received identical instruction from the teacher using the same content and were significantly happier learning in the "game-like" environment.

This finding was similar to that of O'Connor (2011) which found that student enthusiasm was high when learning in a virtual environment. As Sorge (2007) found, the middle school years are critical in terms of students' gain and retention of an interest in the sciences as it is evidenced that if they lose that interest, it is highly unlikely that they will gain it back later. Therefore, finding a method of instructional delivery that gains and retains student interest in the subject area is so critical. As research question one in this study showed, there was not a difference in achievement. However, the finding of the second question shows that students are more interested when learning in a gaming environment.

The mean interest of students in a traditional environment (M=3.63) was between neutral and slight interest, whereas learners in the virtual world (M=4.35) placed their interest between slight interest and strong interest in the lesson. This higher level of interest in the virtual environment did not result in a correlation to achievement and, subsequently, did not support research question three. Despite this lack of correlation, it is important to look at the overall picture that students had higher satisfaction levels in the virtual environment and achieved statistically equivalent results on their standardized assessment.

A series of t-tests within groups showed that no significant difference occurred between genders either. Within the same group, both the boys and the girls were equally happy with the lesson that they were taking. It is important that a "game-like" environment was not overly geared towards one gender thus losing satisfaction for one in pursuit of increasing it for another.

With the findings of no significant difference between virtual and in classroom environments, the question may be asked is it worth the cost? Although the experiment was conducted in a brick and mortar school, the use of a virtual world may not be practical for this

type of school. The cost of the software and time and effort for teachers and staff would likely be higher than the gain in student motivation and achievement. However the cost of a lecture style virtual environment is not as great as a more complex virtual world. The virtual world still may have applicability for use with difficult science lessons in a traditional school as a means to engage or excite learners. What is important is the ability to apply the results of this study exist entirely online. Cyber schools have emerged and are rapidly growing using primarily software that was designed for use in the business world. Younger learners may feel disengaged with these types of technologies as they are normally bland and lack visual stimulation for the learner. The virtual world as a meeting place to for students and teacher to interact with one another is a viable alternative as most online schools already deploy some variant of a collaboration technology. This study dealt with a single lesson, so further research would be needed to determine student perceptions of the virtual world over the period of an entire school year. The technology may suffer the same fate as PowerPoint in the classroom which is no longer considered a new or engaging technological approach to instruction. However, this issue is tempered by the need for cyber schools to have a platform that allows students to engage one another entirely online, meaning that a virtual classroom, easily used by teachers and student, could be the best alternative to a collaborative environment.

The idea of introducing a technology simply to increase motivation may seem impractical for the traditional brick and mortar classroom; however, for the online education student, retention is a crucial theme. Cavanaugh, Barbour, and Clark (2009) point out that student attrition in online education is a significant issue. Focusing on this aspect of online education is critical as one of the problems with virtual learning is that there is a lack of teacher and student interaction (O'Dwyer, Carey, & Kleiman, 2007). One way to increase retention is by instituting

more face-to-face meetings (Blomeyer, 2002). The virtual world may be the needed piece for the attrition issue as it is a way to increase student satisfaction and have a face-to-face meeting time between students and teachers without having to meet in a physical space.

Incidental Learning

McFerrin (1999) indicated that, unintended consequences in an educational experience often can have a greater impact on learners than planned instruction. This is where incidental learning steps into the process. The teacher's objective is to instill the students with knowledge that is aligned to state standards. Although the instructor has an approach to increase student knowledge on a particular subject, there is often learning that occurs in addition to the teacher's plan.

In the case of this study, it was designed that the teacher would deliver a lecture style lesson in the virtual environment. One of the key observations from the open ended questions in this study was that students noted that the learning experience became a way to learn from their peers. In a typical classroom environment only one student at a time may express his opinion as multiple voices answering in unison would not be feasible. In return, few students are given the opportunity to respond due to the constraints. In the virtual environment, in addition to the audio of a classroom, learners were able to use text messaging enabling all learners to respond. Students noted that it was good to learn from one another as multiple examples for the same question could be given.

Konetes (2011) identified information awakening, motivation to learn, and interpersonal relationships as potential outcomes resulting from incidental learning. This study found that there was a significantly higher level of motivation to participate in the lesson in the virtual

environment. Additionally, there was a noted response of students both observed and demonstrated through their open ended responses that indicated that they were happier in the virtual world. They specifically enjoying the ability to communicate with their peers and view example responses that others had given which lead to a better understanding of the subject. These findings help reinforce the findings of Konetes as elements beyond the actual instruction play an important role in education.

It is important to note that this was an experience in a single lesson delivery while other studies on incidental learning typically examine the practices and results of a course through its entire duration. Within a single lesson it may be difficult to judge what incidental outcomes emerge or what ones would develop through continued use of the virtual world. The teacher in the lesson noted that at first, he was uncomfortable with all of the students answering at the same time with the use of the available technology. However, he soon recognized that this format was working and was not an issue for the students.

The ability for increased student interaction with the lesson in the form of responses from the majority of the class was an unintended result for this study. It may point to one of the more valuable observations of this experiment. Students are comfortable with typing and communicating through virtual mediums such as chat and voice through the computer. This type of communication is what students commonly do online in spare time in forums such as Facebook. It is possible that this type of communication using synchronous text based communication that allows for class wide (public) and peer (personal) chats may be the underlying reasons, or at minimum a contributing factor, for the results of this study. The students have a reduced risk of being embarrassed in an online forum as the participants are not as personally engaged and surrounded by their peers. In the event that they give a wrong answer

they would feel less humiliation than compared to being the lone respondent in a classroom and possibly giving the incorrect response.

The engagement of students in the learning process became a competition and learners routinely noted that it was a game. As Prensky (2000) discovered, the use of technology makes learning more enjoyable, as the virtual environment changes student perception and interest. This study showed that by simply putting the same content in a virtual environment, student perceptions changed. In this study, students perceived the experience as a game despite the fact that the teacher was delivering the same content as he would have presented in traditional lesson format in the classroom.

The virtual environment became more than just a means for the teacher to deliver content at a distance; rather, it became a community of learners who were deeply involved in their "game". Students even began to discourage those who gave bogus responses as a means to gain attention. In their learning community, they focused heavily on the content and competition aspect and did not want to be distracted by misbehavior. As the results of student satisfaction indicate, this was seen as a more pleasurable way to learn and one that was primarily game-like for the learners. These findings align with the concept that students can learn information incidentally while involved in a pleasurable activity (Baylor, 2001).

The factors that may have contributed to this perception of a game could be the competition between learners in giving responses and the use of the virtual world. Although the students were essentially receiving a lecture style lesson, the virtual environment likely was associated with games that they play for entertainment and allows for competition and social interaction. It is important to remember that this was a study conducted on a single lesson. This

perception of a game may be extinguished as the students use the world more times where they finally realize that it is a learning environment and not just a game or the newness wears off.

Limitations

This study looked at the effects of a virtual environment in a traditional school setting for an entire population of seventh grade students in the middle school. Although the same size and participation rate are acceptable for experimental research studies, there were inherently some limitations that came with this study. The population was predominantly Caucasian and identification of other racial demographics would have identified single students. Due to this limited variability, the data was not broken down by race as is done with standardized assessments in the state. Future studies can expand the limitations of this research to other participants including a more diverse population.

Additionally, a caveat needs to be placed on the findings so that they are not blindly applied to any online virtual environment. This lesson took collaboration between the researcher, teacher, school administration, and designer of the virtual world to ensure that the process was smoothly completed and followed established educational practices. The fact that the study found no significant difference in achievement does not mean that anyone with a virtual lesson, students, and a teacher will establish an equivalent learning environment. As Schrader (2008) surmised, "instruction and pedagogy drive the way technology is integrated" (p. 469). Creating a virtual world for the purpose of learning without the involvement of educational practices would make for an environment designed simply to entertain the students. The process of creating lesson content was very purposive in content selection and determination of the manner in which it was delivered.

Although this study did not have the intent to introduce anonymity as a variable, its potential impact on this study should be recognized. All of the students were given anonymous logins such as "Bellwood 3" in order to accommodate the number of students in this research in a brief period of time. Some students were able to figure out who one another were through chat messages and essentially asking who are you. However, largely the students remained anonymous to both the teacher and the other students.

It is unclear the impact that this anonymity had on the research and whether or not it played a role in student actions. Student activity in the computer lab and virtual world was primarily considered acceptable behavior for a school setting but this may have been attributed to the student's familiarity with the teacher, becoming engrossed in the virtual world (technology), or belief that they would need to know the information for the assessment. With these other potential factors in mind, anonymity has the ability to help increase student participation and motivation in this study. Students were able to participate in the lesson, without being afraid of giving incorrect information in front of their peers. This could have eliminated a barrier for students to participate.

Having a teacher that the learners had worked with over the past school year (as this study took place in the last week of school) also could nullify the anonymity factor. The students could have known the expectations of the teacher for behavior even while he was absent physically from the classroom. Students may have translated being in a separate computer lab as the teacher stepping out of the room for a minute and not wanted to suffer any future disciplinary consequences as they would have to be back in the traditional classroom with the same teacher the following day.

Recommendations for Future Research

The primary question that needs to be investigated in future research is the long-term effects of learning in an online virtual environment. As this study shows, the learning platform using a game like virtual environment was appealing to students; however, long-term effects are unknown. Specifically, research needs to examine if, over the length of an entire course, the learning outcomes would be the same for the virtual world and the classroom setting. Additionally, it is necessary to determine if the motivation and perceived attraction to this type of learning is long term or if it is just an effective hook to engage learners. The potential argument against sustaining long-term virtual environments would be the tendency of children be to initially be drawn to a new game—only to lose interest after the novelty has worn off.

Another area of future research should be on the anonymity of the learner in the virtual environment. Based on the reactions of both the teacher and students, it was clear that students enjoyed the virtual world and were more engaged in the learning process. Students were freely communicating with the teacher and other students about answers while being assigned a random user name that did not reflect their identity. Some students were able to figure out who one another were; however, for the most part, students were anonymous to one another. It was beyond the scope of this study to examine if this phenomenon was due to the fact that the technology allowed students an opportunity to respond without speaking or if it was based on anonymity. Technology-based communication similar to that of text messaging may have been another explanation for this as younger generations will predominantly choose to text message rather than use voice communication.

The ability for students to have a means to collaborate with one another and the teacher via instant messaging is a phenomena that also should be explored. The study finds that no significant difference was found when the lesson was delivered in a virtual world or classroom. but had a higher satisfaction in the virtual world. As the academic components did not change, the forum for communication was the primary difference. This seems to have allowed the learners to open up and increase their participation in the class. The simple messaging may have additional value within a traditional classroom as a means to elicit student interaction. This is similar to the concept of response clickers, however this allows for answers that go beyond just selecting multiple choice answers. Using this type of technology for students to have a backchannel of messages to one another allows for increased communication of ideas and examples.

The argument from a teacher could potentially be that students would chat with one another and ignore the lesson. However, in this study student achievement and gains were equal to that of an in class lecture without the students ability to use technology. Additionally, students were separated from their teacher and online in the treatment groups. In theory if they were going to misbehave and not follow along, this would have been the opportune time for that to take place. Just as students are sometimes rowdy on the first day of school, maturation and rules established by the teacher lay the framework for what type of behavior is acceptable and will guide the learners on how to act with the technology. There was also a certain amount of students correcting peer behaviors. Students would still be accountable to the instructor for their performance and conduct, so this would simply have to be a factor that the instructor took into consideration with implementation.

The study did position itself in relation to the students that they would be assessed on their performance, so this practice may be needed in a classroom to facilitate the process as well. This type of research could be conducted with technology such as an IPad for each of the students and the teacher being able to see the chat as well. As many schools already deploy laptops and IPads, this could potentially be an inexpensive way to increase student motivation and participation with technology that already exists in a school. Additionally, another way to test the novelty of the virtual environment would be to include a game style format for instructional delivery in the traditional classroom. This would enable researchers to see if the change in student satisfaction was due to switching the instructional approach or the environment itself.

Conclusion

The main research questions for this study focused on determining the achievement and satisfaction that learners experienced while receiving instruction in a virtual environment. The study supports the concept that online learning produces at least equivalent achievement outcomes as traditional instructional delivery. Additionally, the current research found that student satisfaction was significantly higher for learners in the virtual environment.

Finding no significant difference based on the delivery of lessons in the virtual and traditional environment puts the teacher as a central focus. The teacher remains a key component of any instructional design and delivery process. This study used a veteran teacher who had over a decade of experience and a high level of technology ability. When discussing virtual versus traditional environments, it often becomes easy to focus on differences in technology and overlook the teacher. This study compared how the same teacher delivered lessons in both

environments, so this minimized teacher differences as a variable. However, this may also mean that quality instructors with training and technology skill sets are able to adapt and perform equivalently under any circumstances.

This study's finding of no significant difference between virtual world instruction and that of a classroom, while having higher student interest, lays the groundwork for a potentially significant step for education. Online education is growing and establishing competition amongst its players who are all attempting to gain the enrollment of a student. Based on this type of research, if a long-term study examining virtual education can have similar outcomes in achievement and motivation, this rapidly deployable online world has the potential to change education. As schools establish marketing campaigns to recruit students, having a learning environment that looks like an immersive virtual environment game as a hook for students and a substantial research base supporting its effectiveness to parents would provide great leverage for the online school market. Additionally the study contains aspects such as the implementation of text based communication for classrooms that could prove to be a valuable addition using technology that already exists in the schools. This study does not purport to be a complete examination of whether virtual education is a holistically valid solution; rather, it serves as a step towards exploring the impact of virtual worlds on learners.

With any new technology, the question must be asked if the cost and time of a technology is worth the benefit. Although this study was conducted in a traditional school, the value of virtual environments which are simple for teachers to use, including loading content and participant control, have a great deal of value for schools which are entirely online. The return on investment for a traditional school is not apparent. However as online programs usually incorporate a collaborative technology, this type of platform may have the most benefit. As

other communication platforms have been primarily developed for business, this type of virtual environment is clearly geared towards the students. As this study shows, there was equal achievement but students had higher levels of motivation and satisfaction with the virtual world. Online schools continue to grow, as does competition, a school that uses a virtual environment has the ability to alleviate some of the issues with cyber education while giving an appealing platform to attract and engage students.

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Appendix A: Pretest/Posttest Assessment

Life Science

Name_____

Quiz 14.3

Date_____

Answer the following questions with the best possible answer.

1)_____ The three energy roles in the environment are _____, consumer, and decomposer.

A) scavenger B) omnivore C) carnivore D) producer

2)_____ Organism that eats plants and animals

A) scavenger B) omnivore C) carnivore D) producer

3) _____ These breakdown dead organic matter so it can be recycled

A) scavenger B) decomposer C) producer D) consumer

4) _____ This organism is the source of energy for all ecosystems

A) scavenger B) omnivore C) carnivore D) producer

5) _____ Only eating meat

A) scavenger B) omnivore C) carnivore D) herbivore

6)_____ Deer only eat plants they are

A) scavenger B) omnivore C) carnivore D) herbivore

7) _____ The source of energy for most ecosystems

A) scavenger B) sun C) producer D) consumer

8)_____ The main producer in the ocean

A) fish B) clams C) phytoplankton D) zooplankton

9)_____ These produce sugars that store energy

A) scavenger B) sun C) producer D) consumer

10)_____ Bears eat berries, grubs, and animals what type of consumer are they?

A) scavenger B) omnivore C) carnivore D) producer

11)_____ Hawks love to feed on rabbits and snakes they are

A) scavenger B) omnivore C) carnivore D) producer

12)_____ Sulfur bacteria at the bottom of the ocean feed the entire ecosystem off of the sulfur from the deep ocean vents. They are an example of

A) scavenger B) omnivore C) carnivore D) producer

Appendix B: Survey

I. Demographics

A. What is the number that the researcher gave you_____

B. What is your age_____

C. I am Boy / Girl

D. Most of my grades are:

A	B	C	D	F

E. How many hours per week do you play video games: _____

II. Select how much you agree or disagree with the statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I like Science					
I liked the lesson.					
I was motivated to participate in the lesson.					
I was able to stay on task during the lesson					
I became distracted during the lesson.					
I knew what I was supposed to do during the lesson					
I was well behaved					

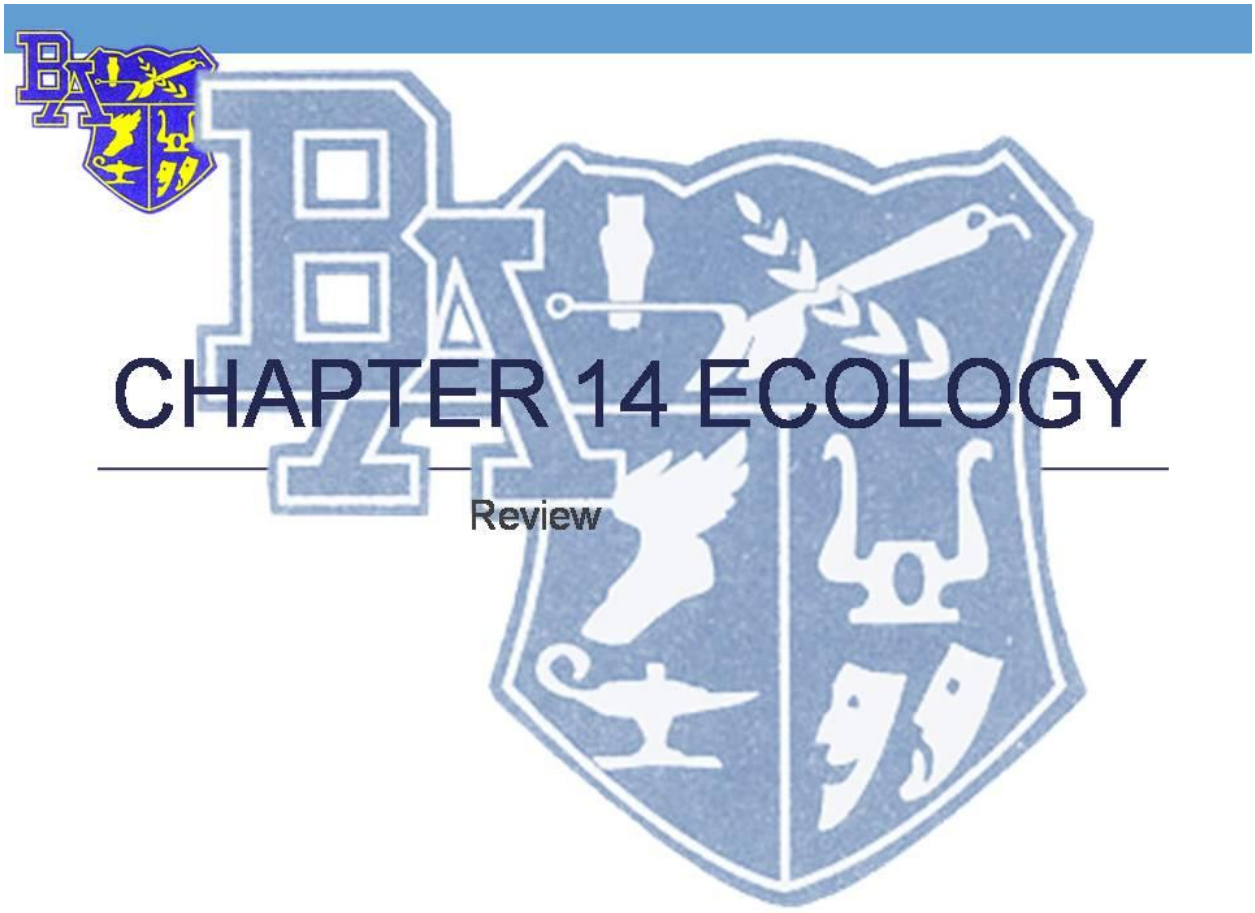
III. **Write a brief response to the following items:**

A. What did you find unclear or frustrating about the lesson?

B. What did you find useful or interesting about the lesson?

C. What would you change about today's lesson?

Appendix C: PowerPoint



What is Ecology?

- **Ecology** is the study of how organisms interact with their environment and all the other organisms that live in that environment.
- **Ecosystem** is an environment and all of the living things that are supported by it.
  - It can be small or huge (pond or ocean).
  - The living things relate to the nonliving things
  - These are biotic and abiotic factors.

What are abiotic and biotic?

- **Biotic Factors** interact with an ecosystem:
  - Plants can affect the nutrients in the soil.
  - Animals can affect an ecosystem by overgrazing or building dams.

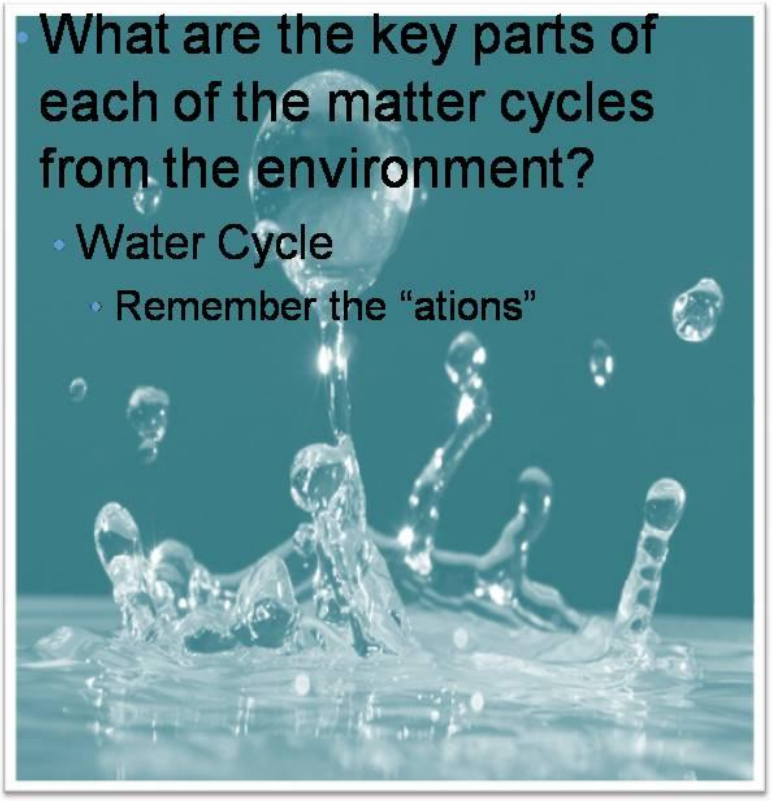
  Abiotic Factors affect ecosystems:
  - These are physical and chemical aspects of the environment such as light, temperature, soil, water, and air.

Give examples of how these abiotic factors affect the environment

- Temperature
- Light
- Soil
- Water

Cycle are processes that happen over and over

- What are the key parts of each of the matter cycles from the environment?
  - Water Cycle
    - Remember the “ations”

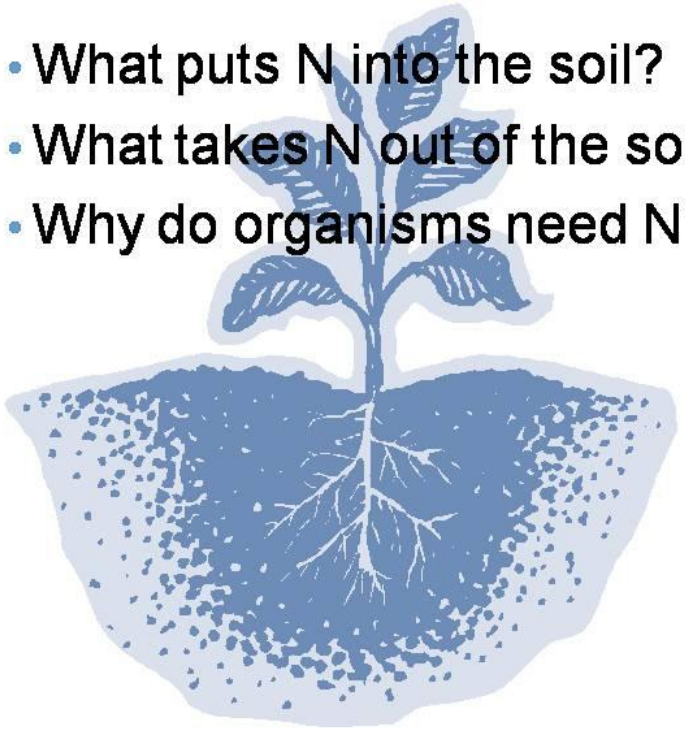


Carbon and Oxygen Cycle

1. **Remember the equations**
2. **Why is it upset?**

Nitrogen Cycle

- What puts N into the soil?
- What takes N out of the soil?
- Why do organisms need N?



Energy Roles in the Environment

1. Producer
2. Consumer
3. Decomposer

What are producers?

- Auto what?
- Give some examples
- What is the major producer of the oceans?
- What about the deep oceans?

What are Consumers?

- Heterotrophs verses Autotrophs
- Herbivores
- Carnivores
- Omnivores
- Scavengers

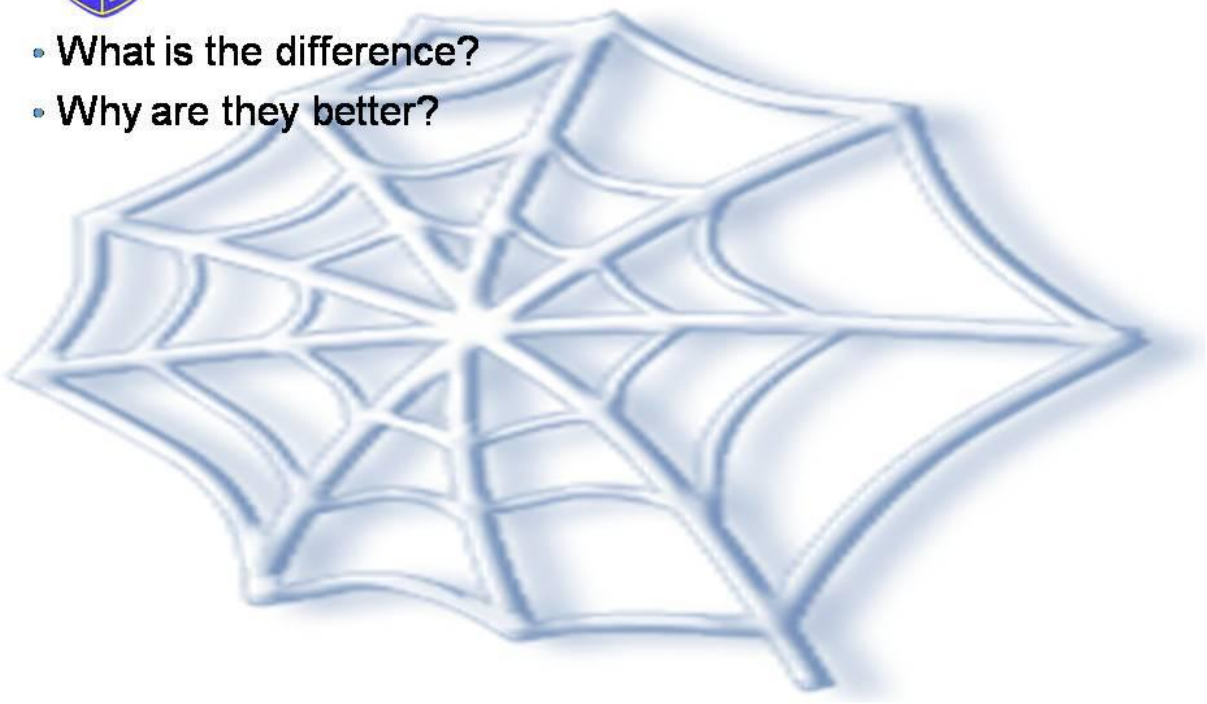
Why are Decomposers important?

- What do they do?
- Decomposers types:

What are Food Chains?

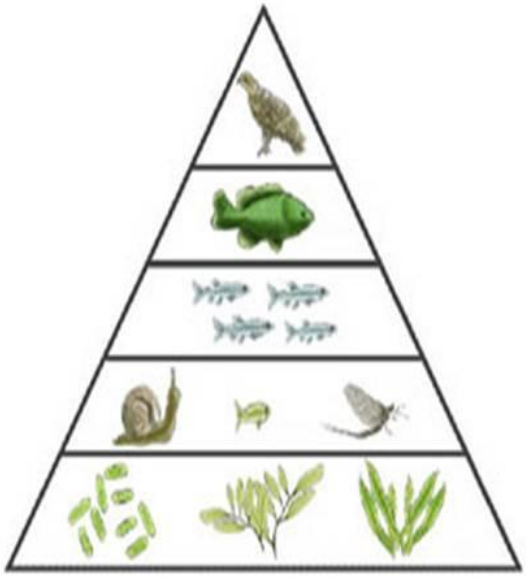
How can a chain become a web?

- What is the difference?
- Why are they better?



What are Energy Pyramids?

- Where does the energy go?



Characteristics of the biomes

- Tundra
  - Cold and Dry
  - Permafrost
  - Producers
  - Consumers
- Taiga
  - Major producer
  - Soil
  - Climate
  - Consumers

Temperate Biomes

- Grasslands
  - Where are they?
  - Producers
  - Why aren't there trees?
  - Soil
  - Consumers
- Deciduous Forest
  - What gives the name?
  - Producers
  - Consumers
  - Climate
  - Soil

Warm Biomes

- Desert
  - Usually warm and dry
  - Producer adaptations
  - Consumer adaptations
- Tropical Rainforest
  - Hot but how wet?
  - Producers
  - Consumers
  - Soil

Water Biomes

- Marine
  - Divided into zones
  - Tides
  - Producers
  - Consumers
- Estuary
  - Brackish
  - Great Biodiversity
  - Usually Shallow
  - Largest
- Fresh Water
  - Types
  - Producers
  - Consumer adaptations