# COMPARISON OF A VIDEO GAME BASED LEARNING ENVIRONMENT AND A TRADITIONAL LEARNING ENVIRONMENT

A Dissertation

Submitted to Duquesne University

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In partial fulfillment of the requirements for

the degree of Doctor of Education

By

Jessica Lynn Barron

August 2015

# DUQUESNE UNIVERSITY
## SCHOOL OF EDUCATION
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***Dissertation***

Submitted in Partial Fulfillment of the Requirements
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COMPARISON OF A VIDEO GAME BASED LEARNING ENVIRONMENT AND A TRADITIONAL LEARNING ENVIRONMENT

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# ABSTRACT

## COMPARISON OF A COMPUTER GAME BASED LEARNING ENVIRONMENT AND A TRADITIONAL LEARNING ENVIRONMENT

By

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August 2015

Dissertation supervised by David Carbonara, Ed.D.

There are many ways to teach within a classroom environment. Traditional teaching methods have been successful because they can be applied in almost any classroom and are useful for imparting knowledge to a learner (Chang & Fisher, 2001). However, understanding and being able to apply that knowledge can be a challenge within a normal classroom environment. Simulations and games have been used in both the past and the present by the military and the government to teach and fine tune desired skills (Balci, Bertelrud, Esterbrook, & Nance, 1997). Video games and simulations give the learner a chance to apply their knowledge in a range of situations safely and with minimal cost. Many current video games mimic real world situations and can be used to create hands-on learning experiences. Learners gain self-efficacy towards the selected topic and are able to apply their empirical knowledge and cognitive reasoning skills.

This study planned to evaluate and compare the effectiveness of using video games in the classroom to a traditional learning environment. Learners will be evaluated on their perception of the learning environment and their retention of knowledge. According to the literature, video games provide a unique and diverse learning environment. Popular video games often have the concepts of social cognitive theory, scaffolding and application of knowledge built into their gameplay. The layout of the study was created with these concepts in mind.

The participants were adult learners from a community college setting who volunteered to take part in the two hour study. They attended two modules; one module to gain a knowledge base and another module that split the group into two different classrooms: Video Game Based and Traditional. They took the WEBLEI-VGB (Web Based Learning Inventory) that was adapted from an instrument created by Chang and Fisher (2003) and a Content Knowledge Assessment. The data was analyzed and the two classrooms were compared. Despite low participation in the study, the reported data and the addressed literature emphasizes the need for future studies involving video games, learning environments and knowledge retention.

## DEDICATION

I would like to dedicate this to the dreamers and the wanderers, alone in their room, wondering "*What if*?" Know that a journey may begin on your own, but you will find wonderful people along the way. I hold all of you in my heart who have supported me to the very end.

"*You cannot swim for new horizons*

*until you have courage to lose sight of the shore."*

- William Faulkner

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I would like to thank my husband, Richard Barron. He has always been my biggest fan. I want to thank him for taking care of the household when I would disappear for classes and when I was writing and researching into the wee hours of the night. He would always pick me up when the going got rough, letting me whine just enough (but not too much). I would not have been able to finish this stage of my education with my sanity intact if it wasn't for him. I would also like to thank my sons, Alexander and Quentin, for being constant inspirations. They taught me to be a better mother, teacher, learner, and gamer!

A thank you to my sister, Jennifer Smith, for listening and encouraging me throughout this extensive process with a much needed vent session or coffee break. She

is one of the few people who understands the journey I have ventured; from playing video games as a child to graduating into adulthood. The next iced coffee is on me, big sis.

Credit is due on behalf of Duquesne University for their support and guidance. The classes and curriculum taught me how to be a better researcher and instructor, and opened up my eyes to the possibilities of effective online learning. I would like to thank Dr. David Carbonara for being a fantastic mentor and Dissertation Chair. His patience and wealth of knowledge was invaluable to me during the writing of my dissertation. He knew exactly when to let me wander and research, and then how to motive me to reign it all in to create something valuable and precise.

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I would like to thank individuals from Pennsylvania Highlands Community College for helping make my study a success. To Sherri Slavick for approving the content knowledge within the learning modules. To the IT department for installing SimCityEdu: Pollution Challenge for seamless gameplay. To the Institutional Research

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Lastly, I would like to thank all of my friends and family who have been an endless source of love and inspiration. There are no words to express how grateful I am for their constant support.

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# Chapter I

## Introduction

### Introduction

Computer games have been present in education since the 1980's when children were encouraged to learn about US history by playing a game called "Oregon Trail." While the game itself was basic in design, it became a staple in the classroom and served as an educational reward to students (Erickson, 2008, June 12).

The military also recognized video games for their learning potential and started to train their army recruits with basic hand eye coordination skills due to the increased interest in computer and video games amongst the youth. The military's successful use of game simulations to help soldiers in combat provided a gateway in which to help their soldiers safely learn teamwork in an engaging environment (Hsu, 2010).

As time progressed, instructors began to explore the link between playing computer and video games and performance in the classroom. Two of the first recognized skills gained from playing video games were increased hand eye coordination and reaction time. Schools that trained surgeons began to encourage their students to play video games in their free time. A study involving the connection of video game skills to laparoscopic surgery performance was conducted at the Beth Israel Medical Center in New York for the Laparoscopic Skill and Suturing Program. Their findings proved that when the students' video game skills improved, so did their skills performing laparoscopic surgery (Rosser, Lynch, Haskamp, Gentile, and Yalif, 2007). The usefulness of gaming grew beyond simple entertainment.

Renowned researchers and instructors, such as Sasha Barab, began to teach entire lessons using the video games as instructional tools. In 2010, Barab created a multiplayer videogame called Quest Atlantis that introduced the idea of Transformational Play (Barab, S. A., Gresalfi, M., Arici, A., Pettyjohn, P., & Ingram-Goble, A., 2010). Transformational Play is when a student is engaging in an activity that is seen as recreational, exciting, and educationally enriching. This began to change the learning climate of the classroom from a traditional sense. The students' attitude improved towards the subject matter, as well as their ability to understand it. They believed they were playing, when in fact, they were also learning.

**Statement of the Problem**

Traditional teaching methods are successful for imparting knowledge to a learner (Chang, & Fisher, 2001). However, understanding and the ability to apply what they have learned is a challenge within a classroom environment. Simulations and games on the computer have been used in the past by the military and government to train recruits to acquire desired skills (Balci, Bertelrud, Esterbrook, & Nance, 1997). This method gives the learner a chance to apply their knowledge in a range of situations safely and with minimal cost.

Many current computer and video games mimic real world simulations and can be utilized in the classroom by teachers in order to instill and apply empirical knowledge and cognitive reasoning skills. In addition to instilling knowledge, gaming can also be used as individual motivational tools. Social Cognitive Theory is based upon the idea that learners are influenced by the people around them, the situations they observe and the rules, skills and strategies they obtain in the process.

Social Cognitive Theory is different from most learning situations because the performance of the learned behavior may occur days, even years after the learning has taken place. Using the concepts of modeling, a variety of situations can be created in order to improve student's attitude towards the subject matter being taught and their ability to learn and use the subject matter. Modeling creates a platform of simulated experiences for learners to interact and experiment with. The learners may not encounter the simulated situation in the real world until years later. Previously learned concepts through viewing models guide their future actions (Schunk, Pintrich & Meece, 2008). This study will evaluate the effectiveness of using video games in the classroom in relation to student perception and retention of knowledge.

For the purpose of this study, when the term "video game" is used, it includes games that are played on a personal computer, a gaming console, or other handheld devices. The term *video* refers to the graphical nature of the game. When the term *computer game* is used, it is referring to a game that is played on the computer, but does not have a graphical interface. The focus of this study when using a video game is not on the visual interest that the game provides or even the quality (or presence) of graphics. Rather, the instantaneous feedback and interaction that the game are the primary factors. The instantaneous feedback provides interaction with the student and satisfaction when they make favorable decisions in the game. It also lets the student know when they do something wrong, and often times, provides information for possible solutions. This offers a learning environment that caters to the learner and their individual needs (Schunk, Pintrich & Meece, 2008).

**Research Objectives: Purpose of the Study**

The objective of this study is to determine how a video game can influence the student's perception of their learning environment and the quality of their knowledge retention in comparison to traditional teaching methods (using a debate).

The following figure visually represents the focus of the WEBLEI and is adapted from a similar figure Chang and Fisher (2001) created.

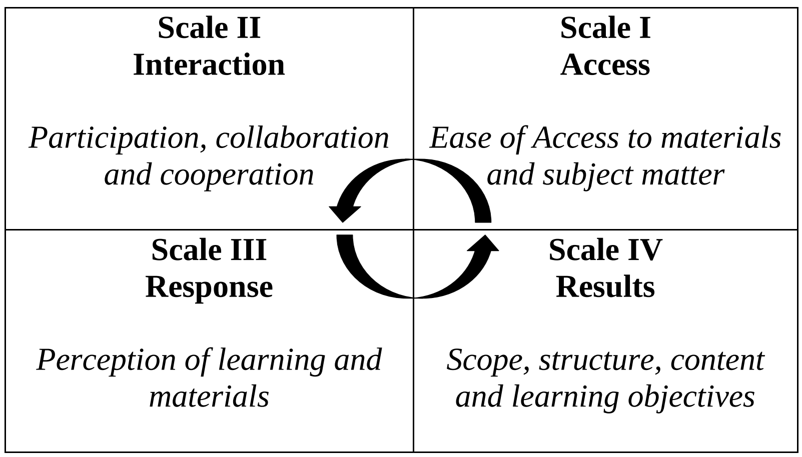



*Figure 1*: Learning Environment Scales

The edited instrument will be referred to as the WEBLEI-VGB (Web-Based Learning Environment Inventory Video-Game Based). The instrument will have basic questions to gather demographic information. In addition to measuring the learning environment, a Content Knowledge Assessment will be given to assess the learner's base knowledge and the knowledge gained throughout the modules. The questions are based upon objectives found within the lesson plans and SimCityEdu Pollution Challenge.

Two different learning environments will be examined; one will use traditional teaching methods. The other classroom will use the video game SimCityEdu: Pollution Challenge. Both classrooms will have the same learning objectives and content.

There will be two learning modules in the study (see Figure 2: Study Outline for a visual representation of the study). Learners will complete the Content Knowledge Assessment before the first module as a pretest. Learners will attend an hour long Module 1: Direct Instruction. The subject matter will cover pollution, different energy sources and the impact they both have on local residents and economy using direct instructional techniques. After Module 1 is completed, the participants will take the Content Knowledge Assessment again to assess the knowledge that was retained.

After completion of the assessment, the learners will be split into two groups and sent to either Module 2A: Video Game Based (VGB) Learning Environment or Module 2B: Traditional Learning Environment. Modules 2A and 2B will be an hour long. After the modules are completed, the WEBLEI-VGB (which includes demographic questions) and the last Content Knowledge Assessment will be administered. Both the pre- and post-test instruments will be identical. Results from the WEBLEI-VGB from Modules 2A and 2B will be compared and analyzed.

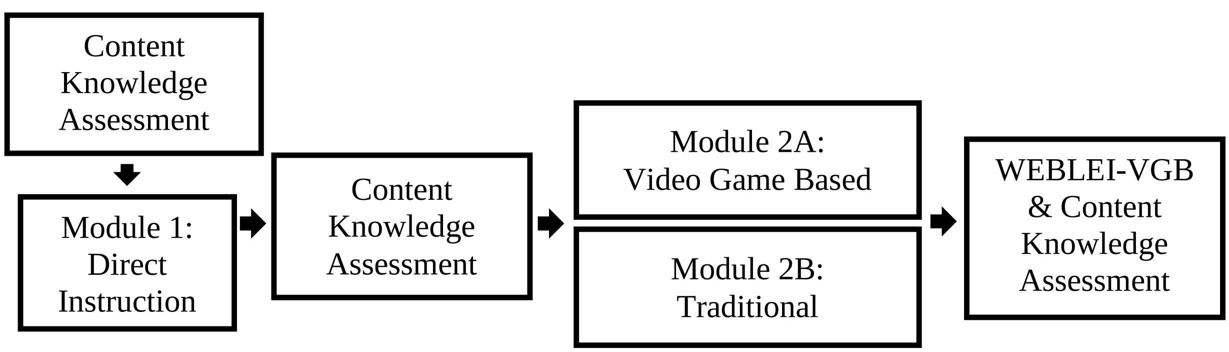



*Figure 2*: Study Outline

**Research Questions**

RQ1. As measured by the WEBLEI-VGB, how do students view their ease of access to learning materials (convenience, efficiency and autonomy) compared to students in a traditional classroom?

RQ2. As measured by the WEBLEI-VGB, how do students view their participation in the learning environment compared to students in a traditional classroom?

RQ3. As measured by the WEBLEI-VGB, how do students view their collaboration with their peers compared to students in a traditional classroom?

RQ4. As measured by the WEBLEI-VGB, how do students perceive the quality of the learning environment compared to students in a traditional classroom?

RQ5. As measured by the WEBLEI-VGB, how do students feel about their learning experience when learning about pollution compared to students in a traditional classroom?

RQ6. As measured by the WEBLEI-VGB, do students who play SimCity learn about pollution have better test scores (knowledge retention) compared to students in a traditional classroom?

**Definition of Terms**

*Auto Dynamic Difficulty (ADD):* Complex algorithms written into a video game that can alter the gameplay for the player. The game can either increase or decrease in difficulty, provide learning aids or cues and anticipate the player's actions (Chowdhury and Katchabaw 2012).

*Co-Participatory Activities:* Tobin explained co-participatory activities as (1998), "co-participation implies the presence of a shared language which can be accessed by all participants to engage the activities of the community, with a goal of facilitating learning." (Chang, V. S., & D. Fisher, 2001)

*Computer Games:* An electronic game that does not have graphical components and is played by reading and typing in text commands instead.

*Emancipatory Activities:* The achievement *of* convenience, efficiency and autonomy in learning materials. (Chang, V. S., & D. Fisher, 2001)

*Handheld Devices:* A device that allows the used to play a video game. They can include cell-phones, tablets and portable game consoles.

*Massively Multiplayer Online (MMO):* An online video game that is played synchronously by many people on a server. MMO's can be free or can charge a monthly fee in order for players to access the game (Fritts, 2014).

*Qualia*: Tobin (1998) explained qualia by describing knowledge which is considered "as embodied in neural networks as vectors of electric charge that reflect life experiences of individuals." (Chang, V. S., & D. Fisher, 2001)

*Video Game Consoles:* A device specifically made to outputs a video signal that displays a video game. A console is meant to play video games on a separate screen and is different than a machine found in an arcade. It is not used to describe handheld devices or personal computers (Fritts, 2014). .

*Video Games:* An electronic game in which players control images on a television or computer screen (Merriam Webster, 2014)

*WEBLEI:* WEBLEI (Web based learning environment inventory) is a research instrument that was partially adapted from Tobin's (1998) research focused on Connecting Communities Learning (CCL). The final scale measures the structure of information and the design of the web-based material. The intention was to gain insight on students' perceptions of web-based learning environments (Chang & Fisher, 2001).

**Limitations**

1. The study is limited to adult learners in a community college environment.
2. The study is limited to one community college that serves four counties in western Pennsylvania: Cambria, Somerset, Blair and Huntingdon.

**Delimitations**

1. The literature review will not specially cover the overall feelings about pollution by learners. The topic is general enough that most learners will know the effects of pollution either through everyday life or from previous schooling.
2. The study will only include adult learners because of the researcher's experience and interest in andragogy.

**Assumptions**

1. The responses gathered reflect the learner's perceptions of their learning environment and were given honestly and to the best of the leaner's ability.

## Chapter II

## Literature Review

### History of Video Games

Gaming is defined, in a basic sense, as any overt instructional or learning format that involves competition and is rule-guided (Dempsey, 1994). Gaming may seem like a new concept, but only the methods of playing games have changed in the classroom. In the article *Games and Simulations*, Balasubramanian and Wilson noted that textbooks from the 1950's to the 1970's have featured classroom techniques like simulations and games (2006). Technology has advanced the way we play and interact with games, and in some situations, made certain situations more accessible.

The first computer game was developed in 1947 and based upon WWII missile displays. It was only a dot on a screen, but it opened the world of gaming in a digital platform. As technology advanced, so did the possibilities for video games (O'Connor, 2013).

The first consumer targeted video games were released in the early 1970's and featured titles like "Spaceware!" and "Pong." Pong was first released as an arcade game, but was eventually available in consumers through the Apple II. Both games were considered arcade games, meaning they were less about cognitive reasoning and more about hand eye coordination. In Pong, the objective was to bounce a ball back and forth between two "paddles" in the form of long vertical rectangles. This game could be single player or could be played against a friend or the computer. Spacewar! was developed by students from MIT and would serve as a basis for future games. It consisted of two ships that would shoot missiles at each other until one of them was destroyed (O'Connor, 2013).

The Oregon Trail was a history lesson disguised as a computer game, taking the player and their in-game family on a journey across North America in 1848. Earlier versions of the game did not have graphics. The game contained many obstacles to overcome and the player was forced to make tough decisions that would impact the entire group. Choices included foraging for food when supplies were low, trading with locals in order to fix broken wagons and burying family members when they passed away from a disease like cholera. The Oregon Trail was based upon logic and luck (O'Connor, 2013).

Not all games played on a PC (personal computer) require graphical interfaces. In 1977, a game called "Zork" was introduced as a fictional text-based adventure. It was inspired by another game created a year earlier called "Colossal Cave Adventure." Simple commands, such as 'go north,' and 'look around' guided the player through the complex game. Zork was filled with puzzles, enemies and treasure. Since it was text-based, players resorted to creating their own maps in order to make sense of the confusing pathways and caverns within the game. The point of the game was to go on an adventure while searching for treasure, while defeating or outsmarting any hostile that approached. If the player succeeded, they would be named "Master Adventurer" (Barton, 2007).

In 1985, a gaming console was released by the name of *Nintendo*. It came with the popular gaming combination: Super Mario Brothers and Duck Hunt. Super Mario Brothers was a new style of gaming and was the first of many "platforming" games. Platforming is defined as using a character to advance through the game by using suspended platforms and jumping on them to avoid obstacles or enemies. Super Mario Brothers was a two dimensional game with simple graphics, but became an icon for a gaming system that is still popular today (O'Connor, 2013). Over several decades, various video game developing companies emerged, and other gaming systems were released.

Complex storylines were introduced into the gaming world, and soon, platforming games were no longer the only types of games being developed. 3D worlds emerged and many players took on the role of the primary character (often referred to as first person view). First person view allows the player to see and explore their virtual world as the character. Third person view is when the character can be seen on the screen moving around (Goldberg, 2012, January 30).

New genres of video games emerge and change every year. Some even fall under several genres, making them difficult to categorize. Popular ones are: adventure, roleplaying (RPG), first person/third person shooter, educational, platformer, sports/racing, simulation, arcade, and strategy. Web-based games (games that are exclusively played online) also exist, and typically begin with the letters MMO, meaning Massively Multiplayer Online (Goldberg, 2012, January 30).

Not only are there different genres, but the structure of the game may differ. Some games are linear and do not allow the player to deviate from the storyline or current objective. Other games are described as “sandbox games,” and allow players to immerse themselves in an unconfined gaming experience. The player can pursue the current task, or they can divert from the single objective and complete other missions in the game. Some games, known as simulations, give the player complete control and have very loose objectives (Fritts, 2014). The objectives often serve as teaching tools on how to play the game, as the game never has an official end. For example, in the game "The Sims," created by EA games, the player can craft characters (called Sims) down to the tiniest detail, such as hair color, ethnicity, and even cheekbone height. The player can unleash their creativity through the game's boundless options and choices. They can assemble a neighborhood full of custom-made buildings, colorful characters, and extraordinary stories. Every aspect of the game is controlled by the player, from when their Sims eat to where they use the bathroom. While there are mini objectives the player can achieve, there is no official end to the game (EA Maxis, 2014).

Video games like Zork and the Oregon Trail are still popular; however, they have progressed a great deal in how they are delivered. The latest technology is used in order to immerse the player in fictional and nonfictional settings. Video games are played on personal computers, consoles, handheld devices, phones, and tablets. They give the option of single player or multiplayer, and many of them offer additional objectives that can be achieved online with other players (Goldberg, 2012, January 30).

Game developers have also begun to use techniques within the mechanics of the game to adapt and change according to a player's behavior and skill level. One of the common techniques used in gaming is Auto Dynamic Difficulty (ADD). Similar terms that have been used to reference ADD include Dynamic Difficulty Adjustment (DDA) and Dynamic Game Balancing (DGB). Despite the various labels of the technique, the general idea remains the same. Developers using the ADD approach write complex algorithms that can change gameplay while the player is completing the game. The game can either increase or decrease in difficulty, provide learning aids or cues, and anticipate the player's actions (Chowdhury and Katchabaw 2012). ADD increases the usability of video games, preventing the player from getting to the point of frustration due to a lack of understanding or expertise of an in-game concept. A game should be challenging, but a player should never be driven to the point of quitting a game impossible to beat. ADD creates an optimal playing experience that creates a balance between adaptive play and playability techniques.

Kücklich points out in the article *Play and Playability as Key Concepts for New Media Studies* (2004) that the game must be functional and accessible. Although, it is important not to allow the player to have full access to specific game options until they have invested considerable time playing and exploring the game. "The playability of a game is actually increased by this strategy of deferral, because it challenges the player to spend an increased amount of time playing the game" (p. 22). For example, the game Assassins Creed: Brotherhood is a sequel to Assassin's Creed 2. The main character, Ezio, begins the sequel with his previous set of weapons and armor. However, after the first few missions, he loses everything when his home base is destroyed. The player has become accustomed to playing in a specific way and using the special abilities. In order to get Ezio's equipment back, the player must perform additional missions and "unlock" his abilities in order to proceed in the game (Ubisoft, Inc., 2010). Using this technique, the player gets a taste of game's possibilities and works with great effort to retrieve the belongings. If the player was given everything at the beginning without working for it, the game would seem too easy and subsequently boring.

**Gaming in Education**

As the interest in video games increased, the desire to incorporate them into the classroom was driven by the curiosity of its potential instructional impact. Slowly, video games began to find their way into the classroom. Students and teachers alike grew up playing video games, so the concept was endorsed by many of all ages. During the early stages of the implementation, video games were used to reward good behavior or during playtime. However, computer games like The Oregon Trail were created specifically to incorporate educational subjects like history into gaming, allowing students to learn while they played (Lussenhop, 2015).

There are a number of notable educationalists who are not only using video games in certain aspects of the classroom, but are developing entire classes around them. Using video games to teach creates a technology rich learning environment for the student. There are three notable educationalists whose research is relevant to this concept. The paper will examine Sasha Barab, a Professor in the Teachers College at Arizona State University and co-founder/Executive Director of the Center for Games and Impact. Also on the roster of exploration is, James Paul Gee, a faculty affiliate of the Games, Learning, and Society group at the University of Wisconsin–Madison will be studied for his expertise in using video games in education. The works of Kurt Squire, who is an associate professor at University of Wisconsin–Madison, will also be discussed. Professor Squire is the Director of the Games, Learning & Society Initiative, and best known for his work in educational video game design.

**Sasha Barab: Transformational Play**

In order to be a leader, one must not only study the possibilities, but they must be willing to take risks as well. Dr. Sasha Barab has not only experimented with the use of video gaming in the classroom, but he has gone so far as to create an entire online educational gaming system. With the assistance of fellow professors and the support of

Indiana University, Dr. Barab created the online simulation game Quest Atlantis. His intention was to provide an environment for students to learn using *transformational play*. Transformational play is the concept of creating an environment in which curriculum and play is combined and presented to the learner. His idea was to craft real life learning conditions in the game where students could play, work, and experiment. Barab firmly believed that learning did not have to be stale or boring. He wanted a setting where play and learning could be synonymous. Quest Atlantis employs transformational play in the way it connects the learner with content and context (Barab, Gresalfi, Arici, Pettyjohn Ingram-Goble, 2010).

In the article *Transformative Play: Games as 21st Century Curriculum*, Barab encourages educators to realize that students are discouraged by the unrealistic concepts presented in their daily curriculum. Simple rote memorization and tedious projects do not translate into real world settings. Therefore, the solution was to use tools and technologies that possess the ability to create bridges to real world settings. Online video games can mimic the complexities of entire worlds, allowing students to participate, interact, and apply knowledge in a diverse simulation. The students explore and play within these worlds, complete with the ability to make decisions they would not be able to easily make in real life. For example, they can make decisions regarding entire eco-systems without the risk of destroying actual wildlife (Barab, Gresalfi, Arici, Pettyjohn Ingram-Goble, 2010).

In the article *Why Educators Should Care About Games: Virtual accomplishments lead to real learning*, Barab, Gresalfi & Arici, use the concept of transformational play to give examples of how to use gaming in the classroom. "By helping students connect virtual accomplishments to real-life scenarios, we lead learners closer to John Dewey's ideal of learning. Dewey (1938/1963) argued that education should be about giving learners the motivation and expertise to act in problem-filled contexts where applying that expertise makes a difference" (2009, p 80). Video games provide a workable experience for the learner to experiment and apply their knowledge like Dewey suggested.

The journal article *Transformative Play: Games as 21st Century Curriculum* expands upon transformative play. Barab asserts that there are three things that must be united in learning: person, content, and context. Video games can create an immersive learning experience with complex scenarios played out in a matter of minutes. Using this concept, Cameron Pittman, a Physics and Chemistry Teacher at LEAD Academy in Nashville, TN, demonstrated the concept of velocity using the video game Portal 2 (Pittman, 2012). Portal 2 is a first person shooter game featuring a girl named Chell who is trapped in a sadistic scientific lab. Her goal is to navigate through complex test chambers while trying to survive harrowing traps. Her weapon is not meant to defend or attack; rather, it is a portal gun that can create two adjoining portals. Chell can jump through the portals, use her own speed, large cubes, and various gels to navigate and complete the test chambers. Portal 2 was created for entertainment purposes, but has now been embraced by physics instructors as a way to put their teachings into motion. Different theories and complex concepts can be demonstrated in entertaining ways using the game. His blog contains lesson plans and videos cataloging his experience using Portal 2 to teach his classes (Valve Corporation, 2011).

Students playing video games will be placed into a role where their educational background and expertise will help them explain and overcome the issues and problems presented in their simulated world. In the article *Narratizing Disciplines and Disciplinizing Narratives: Games as 21st Century Curriculum*, Barab, Gresalfi, Dodge and Ingram-Goble explain that using the video game to engage the learner is transformative play in action; it allows for concrete application of complex ideas. "My hope for the future is that schools focus more on engaging students in the game (narrative particulars) and less on providing them the manual (disembodied universals)" (2010, p 16).

**James Paul Gee: Complex Video Games**

James Paul Gee is another well-known educator who has published a number of articles supporting the use of video games in education. In 2005, Gee wrote an essay titled *Good video games and good learning*. Through research and experience, Gee reflects on the complexity and difficulty of most mainstream video games. Adults and children alike will invest time and money into video games with the expectation of being challenged. "Lots of young people pay lots of money to engage in an activity that is hard, long, and complex. As an educator, I realized that this [motivation] was just the problem our schools face: How do you get someone to learn something long, hard, and complex and yet enjoy it" (p. 1).

When one plays a video game, they are using specific learning techniques in order to progress through the game. Tutorials are used to explain how to control the character. The player must learn complicated patterns and press buttons in an exact order on the controller or keyboard in order to get a character to perform a task. Rules are created in the game and must be followed. Gee explains that true knowledge does not come from memorization, but from demonstrating the knowledge learned. For instance, one does not simply learn Biology, they "do Biology" (Gee, 2005, p. 4).

In the article *Learning by Design: good video games as learning machines*, Gee points out that not all video games are good learning tools. Instructors should know how to choose and evaluate a game for effectiveness. A good game designer pays attention to practical learning theories and creates a game that is deep and engaging. Levels must increase in difficulty so that the player feels a sense of achievement when completing specific objectives of the game. The player has the ability to make decisions, and not just take in what an author wants them to see. The whole point to a video game is the interactivity it provides to the consumer. This is the key to providing a technology enriched learning environment (2005).

**Kurt Squire: The Future of Learning**

Kurt Squire and James Paul Gee have worked together on several different initiatives involving instructional gaming. Squire's experience with educational game design makes him a valuable resource in the learning community. The article *Video Games and the Future of Learning* points out the relevancy of educational video games in the military, corporations and governmental programs. Shaffer, Squire, Halverson, & Gee argue that K-12 programs and Higher Education institutions should follow the example being set by the professional communities using video games to inspire and instruct their learners (2005).

The article begins by analyzing why video games are so popular. They point out that there is a misconception about video game players (referred to as "gamers"). They are often viewed as loners who lock themselves away and have minimal social contact. However, the article goes on to state "thousands of players are simultaneously online at any given time, participating in virtual worlds with their own economies, political systems, and cultures" (p. 106). A majority of the games being produced and released have a robust multi-player element to them by default. These multi-player options lead to diverse communities being formed. These communities allow the players to take on new roles and identities, which allows them to reinvent themselves and learn about the world around them simultaneously. Within these communities, certain rules of learning are applied. Learning occurs when players become a part of a community. They develop a sense of practice and acclimate themselves to their behavior and feelings (Shaffer, Squire, Halverson & Gee, 2005).

In his article *Games, Learning and Society: Building a Field,* Squire points out that some educationalists consider the idea of using a video game in the classroom, but never seriously critique the types of games they use. For example, a 30 minute standalone game tailored towards a specific subject is extraordinarily different than a video game made for mass release. How they function in a learning environment will differ and require different approaches (2007). Many educational games have been originally released as mainstream games and then later adapted for the classroom. Games like Portal 2 have been used to teach Physics and Math in the classroom using a distribution service called *Steam for Schools* (by the mainstream company named Valve). The game also comes with a puzzle creator, allowing students to create their own levels for others to solve (Valve Corporation, 2015).

Squire urges that educators need to develop new instructional theories to explain why games like Portal 2 are popular. He states that these theories need to be studied and applied in the classroom. One could argue that the game is entertaining and that is why people want to play. Portal 2 is a strategic game where the player is armed with only a portal gun and their brain. Players are forced to think, experiment and tinker with the level—not unlike a classroom setting. Squire explains that a gaming learning environment creates situated learning. This is a theory that guides instruction in a more natural way compared to working on projects and traditional classroom interaction (Squire, 2007).

**Direct Instruction: The Traditional Model**

Direct Instruction is a teaching model that can describe the set-up of most traditional based classrooms. Different methods are used within the model, and can include techniques like lectures, case studies and demonstrations. The purpose of these methods are to relay factual information to the learners in a structured and fast paced environment. A traditional classroom in the eyes of Chang and Fisher is a group of students who are navigating through their educational career using a cookie-cutter set of instructions. This environment can be applied to a variety of subject matters, but has little room for innovation because students, regardless of ability, are normally taught chunks of information and then tested for retention of the information. "Mandl and Reinmann-Rothmeier (1995) classified the traditional approach as a "system-mediated learning environment" which implies that the learning is primarily a passive and receptive process" (Chang & Fisher, 2001).

In the book *Teaching Strategies: A Guide to Better Instruction*, direct instruction is often referred to as a “whole group” or “teacher-led” style of classroom management. The purpose of the instruction is to convey factual knowledge to the classroom as a whole. While direct instruction receives criticism because of the focus on rote learning, there are many positives to direct instruction. It is useful for transferring knowledge and skills across a wide range of student populations. “The technique is used to increase on-task learning time, thinking skills, problem solving, computer literacy, writing skills, and science learning” (Orlich, Harder, Callahan & Gibson, 1998).

The base of direct instruction is lecture followed by in depth discussion. Stephen D. Brookfield wrote a chapter in the book *Adult Learning Methods (1998)* describing this particular teaching technique. Discussion is most favored by adult educators because it is viewed as allowing learners to be included and participate because of its democratic roots. Discussion is valued not only in the classroom, but in communities, the workplace and in politics. It allows people to learn and critically evaluate when others are speaking truths and untruths alike. “To neophyte adult educators, therefore, the use of the discussion model has become an unchallenged pedagogical given” (p. 170).

Although direct instruction has a place in education, it requires a lot of work for the learners and the instructors (Adult Learning Methods, 1998). Instructional methods that provide factual knowledge and create an environment for the students to apply their knowledge through play and experimentation create a favored learning environment by the student and the instructor (Shaffer, Squire, Halverson & Gee, 2005). The following sections will explain how video games can provide a better learning environment and how it will be tested using the WEBLEI-VGB.

**Access and Empowerment through Learning**

The WEBLEI-VGB will evaluate four different scales. Scale I is comprised of emancipatory activities. It measures the ease of access of the learning activities. Three elements of access are used: convenience, efficiency and autonomy. These perceptions are based upon the leaners ability to learn at their own pace and have learning goals that they have power over (Chang and Fisher, 2001).

In the journal article "How computer gamers experience the game situation: A behavioral" study, Clarke and Duimering produced an interview based study that explored the learning possibilities in a first-person shooter (FPS) game style. When playing an FPS game, the learner takes on problem solving activities that are rapid and complicated. The player must evaluate their surroundings and make decisions based upon the situation they are presented with. Within the article, the players are studied and their perceptions and evaluations of their experience within the game is noted. Their thoughts can include everything about the game, whether it deals with the game interface system to the computer generated characters they interact with (2006).

The study proposes that the aspects of FPS games that impacted the players the most were the goals set within the constraints of the game. Their attentiveness to other features of the game directly dealt with the attainment of the goal and whether they supported or hindered their progress. "Consistent with the latter work, it is a basic contention of this article that understanding how gamers make sense of computer games as complex socio-technical behavior settings and understanding how they behave while playing games are worthwhile research objectives" (Clarke and Duimering, 2006, p. 3).

Goal setting in the classroom is a useful motivational technique. By setting clear and specific goals that are challenging, students are given smaller, achievable benchmarks to accomplish. Schunk, Pintrich and Meece describe goal setting as establishing qualitative and quantitative standards of performance. Learners must be aware of the ultimate goal. The goals should be at moderate difficulty; they should be moderately challenging, but attainable. When learners perceive that they are accomplishing specific steps towards a goal, their self-efficacy is raised. Creating mutual goals in the classroom leads to a sense of involvement and belongingness (Schunk, Pintrich & Meece, 2008).

In addition to teaching concepts and theories, gaming can also be used as individual motivational tools. Social Cognitive Theory is based upon the idea that learners are influenced by the people around them, the situations they observe and the rules, skills and strategies they obtain in the process. Social cognitive theory is different from most learning situations because the performance of the learned behavior may occur days, or even years after the learning has taken place. They may not encounter a specific situation until years later, and previously learned concepts through models guide their future actions. Using the concepts of modeling, a variety of situations can be created in order to improve student's attitude towards the subject matter being taught and their ability to learn and use the subject matter (Schunk, Pintrich & Meece, 2008).

While the class is working on duplicating the model, the instructor will show advanced versions and techniques to the students. This will give the learners an idea of what they can accomplish by using their knowledge. The examples will also be creatively superior, using methods that require them to be innovative and imaginative.

This will show the learner what they are capable of if they are dedicated and work hard. Schunk, Pintrich and Meece use the research of Bandura for this theory (2008). When providing a model that shows the possibilities of learning, the students will then want to explore further, hopeful that they too will unlock different perks associated with the advanced model (Kauchak & Eggen, 2001)

Video games can serve as a model within the classroom, creating interest and a positive reaction to the subject being taught. The instructor will present a game and show the class basic techniques within the game. The students will then be allowed to play their own version of the game. Sometimes there is no need for the instructor to show the students advanced perks and challenges within the game. Many games have tutorials and teasers built into the gameplay, giving the students ideas and encouraging them to complete additional tasks and complete secret levels.

Some video games are able to be played online or on a PC. If a student has interest in a particular learning module within the game, they can continue to work on the game at their own convenience. Lectures and discussions can only be accessed in the classroom unless recorded for later use. Recordings are limited and are not interactive. A video game can be replayed multiple times and offer instant feedback, allowing the learner to set their own pace.

**Participation, Collaboration and Cooperation**

Scale II measures the co-participatory activities. A common goal is created when students learn as a group. When they are able to share and troubleshoot their own experiences with their peers, they feel a sense of community. There are six elements that define interaction: flexibility, reflection, quality, interaction, feedback and collaboration (Chang and Fisher, 2001).

In *Social Cognitive Theory of Mass Communication (2009)*, Bandura analyzes personal and social transformations by using the model of mass communication through media. Social media is used to link participants together in a community setting. These communities can form support groups, informational systems and personal networks that can socially impact more people than direct media influence (Bandura, 2009). Video games can provide a sense of cohesion and collaboration in the classroom. This section will summarize the basics of Social Cognitive Theory, its importance in education and how video games can help.

Self-efficacy drives the belief that one person can make a difference. They believe that their actions are significant and will allow them to persevere in the most difficult situations. Self-efficacy can be developed in the following four ways: mastery experiences, social modeling, social persuasion and construal of physical and emotional states. There is also collective efficacy, which is the belief that a community, organization or family structure can band together and critically solve problems. Self-efficacy is the basis for equity in the classroom (Bandura, 2009).

The article shifts on to the idea of creating a social model in order to influence learning. These models are made to be similar to specific groups of people in order to create a sense of empathy with the models. These models are played out in dramatizations on TV, and are popular because of the social and moral conflicts they experience. The main purpose of these segments are to encourage a group of people (in this case, women) to be more confident and to pursue opportunities that would benefit them and their families (Bandura, 2009).

Online and multiplayer interaction through video games can provide the social model aspect in learning. Bandura states that socialization has a significant influence on how people feel about their decisions. This makes an impact on the decisions they make in the future. Social situations greatly influence the way we act and react. Most interesting is the explanation of the concept of groupthink or mob mentality. The power of humanization has a comparable effect. People are reluctant to cause harm to someone when they are personalized, if only a little. This is true in a variety of situations, whether it be a hostage sympathizing with their captor or supporters of the death penalty favoring a death row inmate. This suggests that it is easier to make a decision when one never sees the consequences. However, when the person is able to personalize a situation and see the results of their actions, they are more careful with the decisions they make (Bandura, 1991).

Video games can provide these social situations in which judgments are made that not only affect themselves, but others as well. This creates a sense of satisfaction with their accomplishments and feeling of classroom equity because of the positive interactions with their peers. In the article *Mad City Mystery: Developing scientific argumentation skills with a place-based augmented reality game on handheld computers*, Squire and Jan point out the importance of giving students in the science fields an ability to ask critical questions and develop intricate solutions. Video games assign specific roles to the player and give them abstract goals that can be solved with practical solutions. Much like instructors use jigsaw pedagogies in the classroom to encourage cooperation with peers, game designers create situations within the game in order to encourage (and sometimes force) cooperation (Squire & Jan, 2007).

Another way to create interest in the materials by using a video game is the strength in the communities that are built when playing games online. This permits for easy cooperation amongst learners. The gaming community allows for comfortable and natural social interactions between players. Learning can be obtained through the setup of the game, and also through cooperation and collaboration with their peers. Large virtual learning environments can be created in an online environment that mimics a classroom. However, virtual video games can provide interest and intrinsic motivation because the learner feels connected to the materials being presented (Bellotti, Berta, De Gloria, & Primavera, 2009).

Real life experiences can often be time consuming, expensive or unavailable. Gaming, on the other hand, can offer process through simulations. It provides the ability to interact with situations while using their knowledge. Video games can provide the learner with unpredictable results and encourage them to react spontaneously to the game. This type of learning is memorable, even if the learner does not succeed right away. Their determination to create favorable results within the game is a part of the learning process, and creates interest to further experiment. This experimentation as a social group allows the learners to act upon the interest together (Steinkuehler, 2007).

Commonly, when gaming is used in a classroom, the class itself is geared towards using one specific game. The game becomes the content for the course and the activities become valuable learning tools that can be more valued than traditional lecture and discussion. The game becomes the center of the lesson plan. The instructor provides the learners with theories and basic understanding of a concept. Then, the game will simulate the concepts in a variety of ways. The students will interact with the game and witness the theories previously presented (Coombs, 1976).

Storytelling is a key component in many video games, and has been used in the classroom in a multitude of mediums. Digital storytelling is a concept that Jason Ohler showcases in his book, *Digital Storytelling in the Classroom*. Digital Storytelling is the contemporary version of a learning tool that humans have used for thousands of years. When there was no way to record the past and history of our people, we learned and taught through stories. It is natural that humans are taking advantage of the latest technology and converting our thoughts and feelings into digital form. Ohler asserts that providing basic information in a creative way unlocks possibilities for the classroom. Simple math problems can be transformed into intricate puzzles; complex topics such as physics and geometry can be broken down and digested in mini digital stories that are both educational and engaging. These stories create a sense of cohesion and the possibilities with storytelling are limitless. Video games are another way that educators can share stories in the classroom (2008).

The article presents simple questions that allow for future expansion and exploration. It examines the player's feelings by asking questions about gameplay, social dynamics, objects within the game and options to play against human opponents. Understanding the motivation behind FPS gaming can help educators understand how to correctly use a game within the classroom. What is especially useful is that this study does not focus on one game; rather, it allows the participants to pull experiences from any

FPS they have ever played. They are encouraged to talk about what is effective by providing specific examples (Clarke & Duimering, 2006).

In addition, the term First Person Shooter implies the use of a gun; however not all first-person shooters are based upon wanton killing. Some games have complicated ethics. In the game Fallout: New Vegas, a character is created by the player and then placed into a post-apocalyptic world to survive. The game is considered a first person shooter/sandbox game. If the character makes sound, moral decisions, they will gain positive karma and favorable standing with the towns, factions and people they visit. However, if the character makes immoral decisions, they will gain negative karma. If a character steals, kills, makes selfish decisions or rude comments, their reputation will be affected. The game creates a social model that the player should follow. When they accomplish a mission with favorable results, they receive satisfaction with the decisions they make. These decisions feel real to the player, motivating them to continue their path of good decisions (Obsidian Entertainment, 2010).

When it came to the social aspect of gaming, a majority of the respondents preferred playing in a multi-player setting rather than single-player. They also favored the dynamic experience of playing against a human competitor rather than a computer generated bot, referred to as an AI (Artificial Intelligence). Single player was viewed as boring compared to the social interaction that multi-player could provide (Clarke & Duimering, 2006).

An additional benefit of playing against a human competitor, besides simple enjoyment, is that the learner will start to form a bond with the other players in the game. This bond will lead to a mini society that is separate from what is intended in the gameplay. “Studies of socialization practices show that social sanctions combined with reasoning foster self-restraints better than do sanction alone (Parke, 1974; Sears Maccoby, & Levin, 1957) (Bandura 1991, p 53).” This suggests that the group will start to regulate themselves, creating their own set of morals. For example, there is a term called “camping.” In real life, camping refers to sleeping in a tent or a cabin in the woods. However, in a video game (most often an FPS), camping refers to a player who hides in a tactical spot within the game.

Often, campers will take advantage of “spawn points,” which are spots where the player’s characters will enter the game (at the start of the game and when the character “respawns” when they die within the game). If a player is camped out next to a spawn point, the respawning character is vulnerable to attack by the camper over and over again. This is seen as a form of cheating, since it takes away from the true objective of the game. Camping is a controversial technique, and many players refuse to play with people who use it. Some games even allow for these players to be kicked out of the session if enough people agree that they are not playing fairly.

Not all multiplayer video games have simultaneous gameplay. Sometimes a player will have to wait their turn in order to contribute towards the game. In the meantime, they can watch the other players play the game and make decisions. “In addition to contending with their own self-censure, people are concerned about how they appear in the eyes of others when they engage in conduct that is morally suspect (Bandura, 1991, p. 95).” Simply playing against an AI isn’t enough. When a learner knows that they are being observed by their peers, they will be more likely to make better decisions.

Online and multiplayer video games have become increasingly popular. Dabbish states that around 200 million people can be considered casual gamers. The games range from Sudoku and strategy based word games to first person shooters and adventure games. “Early work by Deutsch discovered that when a cooperative task outcome is satisfactory, it increases people’s liking of the task partner” (Dabbish, 2008, p. 353). Using this concept, if a game is made with a goal in mind, the relationship between the two players will improve with every positive accomplishment. Whether the game is based online, or is a multiplayer game played on a local server, the interactions between the players can create a unique and positive social learning opportunity.

Online multiplayer games can either be collaborative or competitive. In the article *Jumpstarting Relationships with Online Games: Evidence from a Laboratory Investigation*, Dabbish compared the differences between collaborative and competitive games and the differences in perceptions that players had on their partners. The study provided implications that collaborative online game activities could create social bonds between relative strangers. “The results highlight the positive impact of a cooperative game structure, and the potential for positive performance or enhanced visual representations of partner effort to increase interpersonal attraction” (Dabbish, 2008, p. 356).

**Perception of Learning**

Scale III involves the Qualia of the learning environment. It is referred to as response, and there are six elements: enjoyment, confidence, accomplishments, success, frustration and tedium (Chang and Fisher, 2001). When students have a positive perception of learning, their desire and motivation to continue learning increases.

Modeling in the classroom creates interest by using response facilitation and observational learning**.** The model then creates a cognitive focal point in the classroom when the students observe the instructional model. Increased interest causes the students to become motivated to duplicate the results, which ultimately improves their attitude towards the subject matter. Models can provide social prompts to the learners and provoke specific responses upon observation (Kauchak & Eggen, 2001).

Schunk, Pintrich and Meece explain that by using variety and novelty in the classroom, the instructor will avoid boredom in the classroom. Using a combination of lecture and video games in the classroom provides interesting variety for the learners. This will encourage them to cooperate to learn new concepts and promote cohesion in a technology rich learning environment (2008).

Interest and affect has been studied and evaluated over the years in many situations. Philosophers such as Dewey and Herbart mused upon the ideas of interest in the classroom but provided very little research to support their claims. Berlyne and Evans tied interest into behaviorism by relating it to curiosity and attitudes towards learning. Eventually three perspectives were developed towards interest in the classroom: Personal interest, interestingness as a contextual factor and interest as a psychological state (Schunk, Pintrich & Meece, 2008).

Personal interest can be attributed to the individual and their specific beliefs, disposition, traits and past experiences. Many career tests, such as the Meyer Briggs Personality Test, use the learner's attitudes, values and interests to determine how well they would perform in particular situations. Using these findings, the test can assign the learner to a career suited to them (Schunk, Pintrich & Meece, 2008). Dickey suggests that when a player creates a character within a MMORPG, they are able to have complete control over how the character looks, acts and feels. They evaluate the game and what skills they may need to progress effectively. Picking different attributes and skills for their character impacts how others will view them in the online community. The learner must understand what will be needed and wanted in the MMORPG environment (Dickey, 2007).

Gaming can provide intrinsic motivation for the learning using curiosity, control and fantasy. Curiosity can be achieved by presenting ideas slightly discrepant from learners' existing knowledge and beliefs. The instructor should incorporate surprise and incongruity into classroom idea. Students must have a preexisting knowledge base in order for curiosity to exist. In order to create curiosity, the instructor will create several simulations that will fail (sometimes with funny or shocking results). The students will then have to investigate the scenario to find out why each simulation failed. The curiosity is created when the students ask the question, *Why*? (Bailey, Pearson, Gkatzidou & Green, 2006).

Interestingness as a contextual factor is related to the concept of situational interest, a theory developed by Andreas Krapp. This theory holds the belief that different situations and methods will produce different results depending upon the material being presented and the attitude towards that method. Video games provide interesting and new situations. The setting is not just of a classroom, but can be expanded to unreachable locations, such as the moon or the ocean floor. Interest can then become contagious in the classroom. One student will notice another student discovering new ideas and will want to share in that experience, creating a cohesion within the classroom (Krapp, 2002).

Interest as a psychological state relies heavily upon how the topic is being presented as well as how it is being perceived. Many researchers have studied the relation between interest and knowledge in a particular topic. Some claim that one must have interest and high knowledge in order to be motivated in a topic. Researchers like Sigmund Tobias suggest that while low-knowledge and high interest is a rare condition, it is more likely to be seen in a transitional learning state. This can be described as a child seeing a dinosaur for the first time in a museum and wanting to learn more about them because of the generated interest (Tobias, 1994).

Video games provide access to new techniques and situations, filled with colorful graphics and personalized characters. Using interest and affect in the classroom ties directly into the concepts of gaming. A student may have a negative view of a particular subject area, such as science or math. Creating surprise and disequilibrium in the classroom can produce a situation that will grab the students' curiosity and allow them to think about the class with a different perspective. If students are able to see the effect of their decisions in real time, their level of interest may change when they start to alter their choices based upon the reactions in the game (Dempsey, 1994).

**Summary**

Traditional classrooms provide a solid basis for learning and has its place within the modern classroom. When an instructor uses non-traditional learning methods, the learning climate of the classroom shifts. The students take on a different perception of the learning environment and they are motivated to learn beyond the classroom. Bringing a sense of play into learning leads to further exploration and a motivation to acquire more information about the subject being presented. This study will attempt to measure the perceptions of the learners in a video-game based learning environment in order to bring attention to non-traditional teaching methods in the classroom.

# Chapter III

# Research Methodology

## Data Collection Method: Instruments and Methods

### WEBLEI: Methods and Use

The WEBLEI was created and described in 2001 by Vanessa Change and Darrell Fisher of Curtin University in their publication titled *The Validation and Application of a New Learning Environment Instrument to Evaluate Online Learning in Higher Education*. Their intention was to examine the "psychosocial aspects of online learning environments" (p. 3). Chang and Fisher sought to inspect and analyze the social and psychological aspects based upon the students' own perceptions (Chang & Fisher, 2001). The reason why this instrument was chosen to be adapted for this study was because of its ability to measure a learning environment that was non-traditional (See Appendix F: Web Based Learning Inventory – Video Game Based).

Chang and Fisher administered the WEBLEI to 13 groups of online learners, six of them being undergraduate students and seven of them graduate students. A total of 334 students participated in the study. "Statistical analyses, Cronbach alpha reliability coefficient, factor analysis, and discriminant validity, indicate that the WEBLEI is a reliable and valid instrument" (Chang & Fisher, 2001, p. 1). "The Cronbach alpha reliability coefficients…ranged from 0.65 to 0.88. According to Nunnally (1967), a reliability coefficient of 0.60 or greater is acceptable" (Chang & Fisher, 2001, p. 15).

A factor analysis determined there were four distinct (but somewhat overlapping) scales to the WEBLEI. The instrument uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always).

The mean scores were as follows: Scale I Access: 3.90; Scale II Interaction: 3.52; Scale 3 Response: 3.38; and Scale IV Results: 3.75. It was indicated that the students gave a response of 'Sometimes' to 'Often' on the items in these scales. The mean for all of the scales combined was 3.64, which is relatively high (Chang, & Fisher, 2001).

Three questions were omitted from the WEBLEI in this study. These questions referenced traveling to and from the classroom and asynchronous communication, which are not relevant to the current study. They are as follows:

- **Scale I: Access**: I can use time saved in traveling and on campus class attendance for study and other commitments.
- **Scale II: Interaction**: I communicate with other students in this subject electronically (email, bulletin boards, chat line).
- **Scale III: Response:** This mode of learning enables me to interact with other students and the tutor asynchronously.

Four different scales are being used in the WEBLEI. Figure 3: Learning Environment Scales visually describes the connection between the four scales. The full instrument can be found in Appendix F.

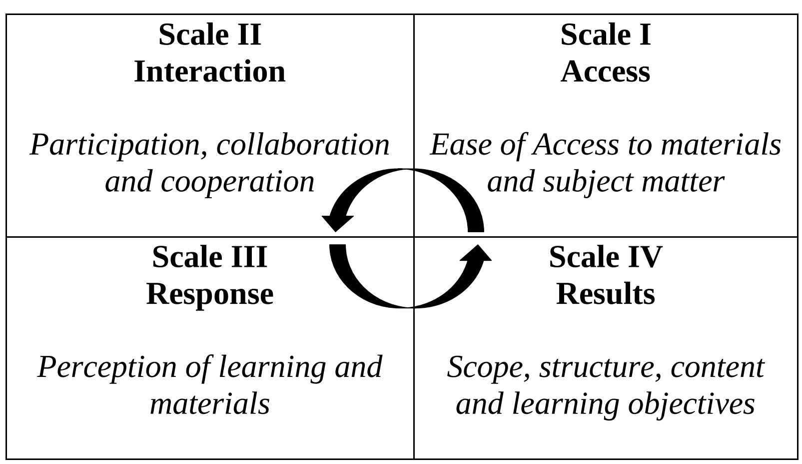



*Figure 3*: Learning Environment Scales

Scale I involves emancipatory activities. It measures the ease of access of the learning activities. Three elements of access are used: Convenience, Efficiency and Autonomy. The materials should be convenient to access, allowing the learners to set their own pace. Efficiency refers to the ability to learn outside of the traditional classroom. Students can access materials at places like their home or while traveling. Autonomy gives the students the ability to decide how and when they would like to participate in the learning activities (Chang & Fisher, 2001).

Scale II measures the co-participatory activities. When the students learn in a group, they share a language and common goals. A community is formed when they are learning the materials with others in the classroom. There are six elements that define interaction: flexibility, reflection, quality, interaction, feedback and collaboration. Flexibility gives the student the ability to reach their goals with a variety of solutions. Reflection allows the students to think about the results of their decisions and interact with peers at a later time. Quality refers to the learning achieved within the level of interactivity while learning. Interaction refers to the activities in the class and the discussion the students can have with each other. Feedback refers to the amount of help available to the students while they are learning and completing the classroom activities. Finally, collaboration refers to the opportunities the students have to collaborate while in and out of the classroom (Chang & Fisher, 2001).

Scale III involves the Qualia of the learning environment. It is referred to as response, and there are six elements: enjoyment, confidence, accomplishments, success, frustration and tedium. Enjoyment refers to the student's mastery of the technology and their ability to learn. Confidence is gained when the student feels that they are successful completing their assignments while receiving adequate support while accomplishing their goals.  Accomplishments are created when the students are able to display their success to their peers.  Success is broken into two parts; their ability to use the available technology correctly and their understanding of the concepts being taught.  Frustration is the opposing side of success (their inability to use the available technology correctly and their misunderstanding of the concepts being taught).  Tedium is connected to the repetition of specific activities (Chang & Fisher, 2001).

Scale IV describes how the information being taught is structured, designed and organized.  Goals must be presented in a logical way and follow basic instructional design standards.  The elements of this scale include relevance and scope of content, validity of content, accuracy and balance of content, navigation, and aesthetic and affective aspects.  The content must be relevant and valid for the students and their level of learning.  The information provided should be accurate and able to be applied in real life scenarios. Materials should be easy to read and have aesthetics that are not complicated or difficult to understand (Chang & Fisher, 2001).

In addition to measuring the learning environment, a Content Knowledge Assessment (see Appendix G: Content Knowledge Assessment) will be given in order to assess the learner's knowledge gain. The questions are based upon objectives found within the lesson plans and SimCityEdu Pollution Challenge.  Sherri Slavick, an Instructor in the Physical Sciences department at Pennsylvania Highlands Community College, evaluated the content assessment.  Not only is she in charge of the online learning initiatives, but she led a committee in reevaluating the college's environmental program.  She viewed the lessons plans, the objectives of the game and the content assessment and sent them to the environmental committee for review. Slavick stated that the assessment matched the content within the lesson plans and the game (S. Slavick, Personal Communication, November 26, 2014).

The intention of this study is to gather data about the Video-Game Based learning environment and compare it to a traditional classroom (using a debate). The students' perceptions and their retention of the materials being taught will be compared. An optimal learning environment will have high student perceptions as well as a high knowledge retention rate.

**SimCityEdu: Methods and Use**

SimCityEdu: Pollution Challenge is a video game based learning tool used to create an immersive learning environment for the student. The game presents scenarios that are able to be explored. The student will then use previously given knowledge in order to solve the problems presented within the game. These problems simulate real life events and demonstrate actual consequences of the chosen resolutions.

Auto Dynamic Difficulty (ADD) is used within SimCityEdu: Pollution Challenge in order to challenge the learner and keep their attention and interest. "A good game adapts constantly to the skill level of the player without making it too hard or too easy for a sustained amount of time. This is similar to adaptive testing from an experiential perspective, and compatible as well with Vygotsky's (1978) famous notion of the zone of proximal development" (GlassLab, 2014)

**Research Questions**

RQ1. As measured by the WEBLEI-VGB, how do students view their ease of access to learning materials (convenience, efficiency and autonomy) compared to students in a traditional classroom?

RQ2. As measured by the WEBLEI-VGB, how do students view their participation in the learning environment compared to students in a traditional classroom?

RQ3. As measured by the WEBLEI-VGB, how do students view their collaboration with their peers compared to students in a traditional classroom?

RQ4. As measured by the WEBLEI-VGB, how do students perceive the quality of the learning environment compared to students in a traditional classroom?

RQ5. As measured by the WEBLEI-VGB, how do students feel about their learning experience when learning about pollution compared to students in a traditional classroom?

RQ6. As measured by the WEBLEI-VGB, do students who play SimCity learn about pollution have better test scores (knowledge retention) compared to students in a traditional classroom?

## Context of the Study

### Research Strategy

There will be two learning modules in the study.  See Figure 4: Study Outline for a visual representation of the study.

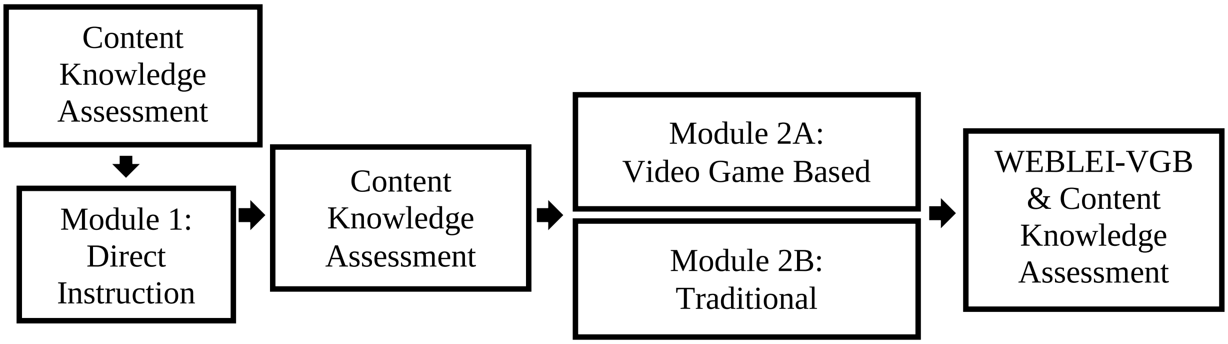



*Figure 4*: Study Outline

Here is a breakdown of the study in according to steps.

**Step one:**  The consent form will precede the study in order to determine if the student willing and eligible to participate in the study.  A Content Knowledge Assessment will be given to the student.  The assessment will be completed online.  Participants will be given the link to access the survey, along with instructions, details of the study, and the degree of confidentiality for participation.

**Step two:**  The student will attend Module 1.

**Step three:** The student will take the Content Knowledge Assessment for a second time.

**Step four:** Student will be randomly selected to attend either Module 2A: Video Game Based (VGB) Classroom or Module 2B: Traditional Classroom.

**Step five:** After completing Module 2A or 2B, student will take the WEBLEI-VGB (Web-Based Learning Environment Inventory - Video Game Based). It will have basic questions in order to gather demographic information, including age. Student will take the Content Knowledge Assessment for a third time. Participants will be given the link to access the survey, along with instructions, details of the study, and the degree of confidentiality for participation.

**Research Structure**

Module 1: Direct Instruction will be an hour long; all of the learners will participate in the module. They will be presented concepts about pollution, different energy sources and the impact they both have on local residents and economy using direct instructional techniques. The lesson plan, teaching method and classroom structure will be the same for all learners (see Appendix H: Module 1 Lesson Plan). Tasks involving relationship diagrams will be completed by the students. A content assessment will be given to all of the students at the beginning and at the end of Module 1. After Module 1, the participants will take the Content Knowledge Assessment again to see what they have learned.

After completion of the assessment, a designated assistant in the Institutional Research department at Pennsylvania Highlands Community College will assign the learners a number. The researcher will not know the numbers. Only the learner and a select assistant from the community college will know the numbers and the names they were assigned to. The learners will be randomly split up into two even (or as close as possible) sections and will attend either Module 2A: Video Game Based (VGB) Learning Environment (see Appendix I: Module 2A Lesson Plan) or Module 2B: Traditional

Learning Environment: Module 2 (see Appendix J: Module 2B Lesson Plan, Appendix K: Module 2B Worksheet & Appendix L: Module 2B Worksheet Debate Roles). Modules 2A and 2B will be taught at the same time for an hour long. After modules 2A and 2B are completed, all of the subjects will complete the WEBLEI-VGB (which includes demographic questions) and one last Content Knowledge Assessment. The assigned numbers will be used to match the measurements of the pre- and post-test instruments. Both the pre- and post-test instruments will be identical.

In Module 2A: VGB Learning Environment, students will be given logins by an assistant for SimCityEdu Pollution Challenge and will enroll in a virtual classroom. They will be prompted to complete a mission within the game. The particular mission they will be completing will simulate a city that is polluted and has an energy deficiency. SimCityEdu Pollution Challenge has a time limit of ten minutes for the learner to come up with a solution for the simulation. Students will be given multiple chances to complete the game within the class period. If they are not pleased with their progress in the simulation, they can restart the game and try another solution. Instant feedback within the game will let the student know if their decision was effective. The students have the option of working as a group to complete the game. Each student will receive detailed written and oral instructions on how to play the game. They will have to use the knowledge they learned in the previous module (Module 1) in order to complete the game session. After the learners have completed the game, there will be a five to ten minute wrap up session in order to discuss what happened in their simulations.

In Module 2B: Traditional Learning Environment, students are introduced to the worksheet by the instructor who will explain the scenario and expectations to them

Students will complete an informational worksheet about each of the power sources and list the pro and cons for each source. After they complete the worksheet, the students will be split into teams and be given roles within the city. They will use the information within the worksheet in order to help them debate one of four positions; each group will be assigned a different position: Mayor, Renewable Energy Entrepreneurs, City Financial Planner and City Residents. The debate will cover topics such as coal plants, green technologies, factories, and non-renewable energy resources and can lead to multiple outcomes. Similar to VGB Learning Environment, students in the Traditional Learning Environment will have to use the knowledge they learned in the previous module (Module 1) within their debate. Students will work together (while still maintaining their roles) to come up with a solution to rid the city of pollution. Students will write a summary of their solution.

**Learning Objectives**

While completing the learning modules, students will meet the following learning objectives:

- Use systems thinking by analyzing how parts of a whole interact with each other to produce overall outcomes in complex systems.
- Solve different kinds of non-familiar problems in both conventional and innovative ways.
- Identify sources where pollution is created in a city
- Identify different power options needed to power a city.
- Compare the pros and cons of using different energy resources to power a big city.

- Troubleshoot the different options to avoid power blackouts in a city.
- Learn how to create new power sources without causing a city to go dark,
- Describe the role of technology and design in reducing human impact on the environment.

**Demographics and Population**

The target population are adult learners enrolled in a community college who are pursuing education beyond high school. The accessible population attends a community college in western and central Pennsylvania with five campuses serving different geographical areas in Richland, Huntingdon, Somerset, Ebensburg, and Blair. The majority of the learners are 18-24 years of age and are seeking degrees. A little over half of the population is female. Students come from a variety of backgrounds, including traditional and non-traditional students seeking two-year and four-year degrees. It is expected that 30-40 students will participate in this research study.

**Recruitment of Subjects**

Students attending the community college will be given the opportunity to volunteer to be participants in the study. Flyers will be placed in designated areas on campus (see Appendix D: Recruit Flyer). Two emails detailing the study will be sent out to all students using the school's general notification system used to advertise school club activities and other campus events (see Appendix C: Participation Email). Email #1 will be sent a month before the study will be conducted and email #2 will be sent a week before the study is conducted.

A consent form will be required for all learners in order to participate in the study. Learners under the age of 18 will not be allowed to participate in the study. Students will be offered snacks after the modules are completed. Students will also receive a certificate of completion of the module. All activities will be held on one day for all subjects. It will take approximately two and a half hours total to complete.

**Data Analysis**

The WEBLEI-VGB will be completed by the learners through an online survey. They will use their assigned numbers in order to distinguish which learning environment in Module 2 they attended. A factor analysis will be conducted to describe and summarize the data from the WEBLEI-VGB. The results from the VGB module and the Traditional module will be compared. According to the literature review, a favorable learning environment provides better motivation for the student to learn and apply their knowledge beyond the classroom

**Variables**

*Dependent Variable:* The perceptions of the learner regarding the learning environment. This will be measured by the WEBLEI-VGB (Scale I-IV)

*Dependent Variable:* The retained content knowledge from Modules 1, 2A & 2B. This will be measured by the WEBLEI-VGB (Content Knowledge Assessment)

*Grouping Variable:* The grouping variable will be the two different learning environments that will be compared; the VGB Learning Environment and the Traditional Learning Environment.

**Limitations**

1. The study is limited to adult learners in a community college environment.
2. The study is limited to one community college that serves four counties in western Pennsylvania: Cambria, Somerset, Blair and Huntingdon.

## Delimitations

1. The literature review will not specially cover the overall feelings about pollution by learners. The topic is general enough that most learners will know the effects of pollution either through everyday life or from previous schooling.
2. The study will only include adult learners because of the researcher's experience and interest in andragogy.

## Assumptions

1. The responses gathered reflect the learner's perceptions of their learning environment and were given honestly and to the best of the learner's ability.

## Ethical Concerns

1. There are no risks in participating in tests, surveys and video games greater than those encountered in everyday life of playing a video game about pollution, game management and learning in a traditional classroom. There aren't any direct benefits, other than the knowledge gained from the learning modules presented. No credits will be awarded to the students. All data collected will be de-identified by the research assistant before being provided to the researcher.

# Chapter IV

# Results

## Introduction

This chapter will present the analysis of the data collected from the WEBLEI-VGB and the Content Knowledge Assessment as well as demographic information. The objective of this study is to determine how a student perceives their learning environment and the quality of the knowledge retained when a video game is used within the classroom in comparison to using only traditional teaching methods.

While traditional teaching methods are valuable and effective within the classroom (Chang & Fisher, 2001), using a video game to enhance their learning through play can motivate the learner by using the idea of transformational play (Barab, Gresalfi, Arici, Pettyjohn Ingram-Goble, 2010) and concepts like Social Cognitive Theory. Learners can be influenced by the situations that are created within the video game and the skills they obtain throughout the gameplay interactions (Schunk, Pintrich & Meece, 2008).

Participants volunteered to participate in the study's learning modules to contribute their perceptions of the learning environments. Two emails were sent out to the student body mass email address to a total of 864 students to request participation in the study. The email also alerted the students of the day and time of the study (see Appendix C: Participation Email). The first email was sent two weeks before the study was scheduled, and a second was sent a week later. Fifty flyers were placed around campus in key locations and in the hallways where students congregate before classes (see Appendix D: Recruit Flyer). The researcher did not directly contact the students in her classroom in order to avoid intimidating them into participating. Pizza and soda was offered to the students as compensation for attending the modules.

One initial session was offered to the students. Fifteen students signed up for the study, but only ten attended. Two students walked out of the traditional classroom before they could take the WEBLEI VGB. They did not give reasons for leaving.

There was an additional session offered to the students. Three students signed up; two attended. Some students expressed interest in the study, but cited class conflict as a major reason for not signing up or participating in the study; the study would take a little over two hours to complete. A pep rally for the basketball team was scheduled for the same day as the second session and students declined to participate because of the rally.

For each session, the two classrooms had to be reserved and instructors to teach the modules needed to be secured (as the researcher could not teach the sessions in order to avoid bias). The instructors needed to meet specific criteria and follow the lesson plans exactly. Conflicting schedules with the classrooms and the instructors prevented further sessions from being scheduled.

**Response Rate**

Participants in this study were adult learners enrolled in a community college who were pursuing education beyond high school. The sessions were held at the main campus. A total of 864 (1% response rate) distinct students, 354 (3% response rate) part-time and 539 (1% response rate) full-time, took a physical on-campus course at the Richland site during the Spring 2014-15 semester; of those 864 students above, 395 of them also took an online course. The first session was held on a Thursday afternoon; the second was held on a Friday at noon. Classes during the day are either on a Monday, Wednesday and Friday schedule, or a Tuesday and Thursday schedule. While this study had a low participation rate, the classroom size for the study is comparable to the average classroom size for Pennsylvania Highlands Community College. The average number of students per class at Penn Highlands for the Spring 2014-15 semester, excluding Dual Enrollment high school classes, is: 14.91 students per class.

It is not uncommon to use smaller samples when investigating the effects of a video game within the classroom. One should consider the recommendations given in the study *Virtual Worlds in the General Education Curriculum.* Braman, Meiselwitz and Vincenti (2013, p. 2696) state that when employing a virtual world in a classroom, it is optimal to have smaller classrooms in a university setting in order to give enough attention to the students playing the game. They generally cap their virtual classrooms at 20 students. This allows for critical discussion to form, which is favored when playing a video game in a classroom environment (Braman, Meiselwitz & Vincenti, 2013). In addition, there have been studies involving video games in the classroom that only have one participant. In the paper *Learning from the Student: The Application of Virtual Reality in Distance Education Successes and Failures* by Krismer and Abram (2013) data and testimony was collected from a single participant over a four year period. It is imperative to recognize the appropriateness and limitations of the study when considering the data collected.

**Organization of Data Analysis**

A pretest of the Content Knowledge Assessment was given to the learners before the modules (see Appendix G: Content Knowledge Assessment). The assessment contained questions about the content learned in Module 1, 2A and 2B. It addressed the chemicals released when diesel fuel is burned, the effects and advantages of having a shipping port near a big city, the advantages and disadvantages to different power sources and the role of technology and design when reducing human's impact on the environment. The learners took the Content Knowledge Assessment after Module 1 was completed. Then, one more survey was given to the learners at the end of the modules. The survey contained the WEBLEI-VGB, demographical questions and the Content Knowledge Assessment.

If you combine the learners for the sessions, ten learners attended Module 1: Direct Instruction. After completing the Content Knowledge Assessment, the learners were randomly split into two groups. Six students attended Module 2A: Video Game Based Environment. Four students attended Module 2B: Traditional Environment. At the end of Module 2A and 2B, they completed an online survey containing the WEBLEI-VGB, demographical questions and the Content Knowledge Assessment. Results of the WEBLEI-VGB and the Content Knowledge Assessment will be compared between the two learning environments (2A and 2B) and analyzed below. Demographics will also be addressed for both environments.

**Instrument: WEBLEI and Content Knowledge Assessment**

The WEBLEI (see Appendix F: Web Based Learning Environment) uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). Four different scales are measured in the WEBLEI-VGB.

- *Scale I: Access (ACC)* involves the perception of emancipatory activities. Results will measure the ease of access of the learning activities.

- *Scale II: Interaction (INT)* measures the perception of co-participatory activities. Common goals and language patterns are formed when students learn in a group. This forms a community in the classroom when they learn the materials as a group.
- *Scale III: Response (RSP)* involves the Qualia of the learning environment. This represents the learner's enjoyment of the materials and how they perceive their ability to accomplish tasks in the classroom. Their frustrations and boredom with the materials are also addressed.
- *Scale IV: Results (RES)* describes the how the students perceive the structure, design and organization of the information presented. There must be a logical sequence of goals that follow instructional design standards.

The Content Knowledge Assessment (see Appendix G: Content Knowledge Assessment) was given in order to assess the knowledge gained during the modules. The questions were created using the content and objectives found within the lesson plans and SimCityEdu Pollution Challenge. Sherri Slavick read the lesson plans and evaluated the Content Knowledge Assessment and expressed her approval (S. Slavick, Personal Communication, November 26, 2014).

**Presentation of Descriptive Characteristics of Respondents**

Table 1

*Demographic Characteristics*

| | **N** | **%** |
|---|---|---|
| *Gender* | | |
| Male | 9 | |
| Female | 1 | |
| *Race/Ethnicity* | | |

| | | |
|---|---|---|
| African American/Black | 1 | 10% |
| Asian/Pacific Islander | 0 | 0% |
| Hispanic/Latino | 0 | 0% |
| Multiracial | 0 | 0% |
| Native American/American Indian | 0 | |
| White | 8 | 80% |
| Other | 1 | 10% |
| Prefer not to respond | 0 | 0% |
| *Age* | | |
| 18 to 24 years | 9 | 90% |
| 25 to 34 years | 1 | 10% |
| 35 to 44 years | 0 | 0% |
| 45 to 54 years | 0 | 0% |
| 55 to 64 years | 0 | 0% |
| 65 or older | 0 | 0% |
| *Class Status* | | |
| First Year | 4 | 40% |
| Second Year | 5 | 50% |
| Continuing Education Student | 1 | 10% |
| *Area of Study* | | |
| Associate Degree | 8 | 80% |
| Certificate or Diploma | 1 | 10% |
| Transfer Program | 1 | 10% |
| *Hours of video games played in a week* | | |
| 1-3 | 0 | 0% |
| 4-6 | 1 | 10% |
| 6-9 | 4 | 40% |
| 9-12 | 1 | 10% |
| 12 or more | 4 | 40% |
| Do not play video games | 0 | 0% |
| *Hours of studying/school work in a week* | | |
| 1-3 | 1 | 10% |

| | | |
|---|---|---|
| 4-6 | 5 | 50% |
| 6-9 | 2 | 20% |
| 9-12 | 1 | 10% |
| 12 or more | 1 | 10% |
| No studying /school work | 0 | 0% |

**Research Questions and Associated Hypotheses**

The following research hypotheses will be discussed:

H1. Students in a video game based environment do not have a more positive view of their *ease of access to learning materials* (convenience, efficiency and autonomy) compared to students in a traditional classroom

H2. Students in a video game based environment do not have a more positive view of their *participation in the learning environment* compared to students in a traditional classroom

H3. Students in a video game based environment do not have a more positive view of their *collaboration with their peers* compared to students in a traditional classroom

H4. Students in a video game based environment do not have a more positive perception of the *quality of the learning environment* compared to students in a traditional classroom.

H5. Students in a video game based environment do not have a more *positive view of their learning experience* when learning about pollution compared to students in a traditional classroom.

H6. Students in a video game based environment do not have *better test scores (knowledge retention)* compared to students in a traditional classroom

**Analysis of Data**

An analysis was conducted on the data from the WEBLEI-VGB. There were a total of ten participants in the study. Six students attended the video game based environment and four students attended the traditional learning environment. Descriptive Statistics were created in SPSS using the data collected from the WEBLEI VGB (see Appendix M: Descriptive Statistics). Case Summaries were created in SPSS to show the answers for the WEBLEI (see Appendix N: Case Summaries). The Case Summaries included the research numbers, class associated for that number (identifier 2A designates a participant in the Video Game environment and Identifier 2B is a participant in the Traditional environment) and their answers for each question in the WEBLEI.

**Research Questions and Hypothesis**

*Research Question 1:* As measured by the WEBLEI-VGB, how do students view their ease of access to learning materials (convenience, efficiency and autonomy) compared to students in a traditional classroom?

*Hypothesis 1*: Students in a video game based environment do not have a more positive view of their *ease of access to learning materials (convenience, efficiency and autonomy)* compared to students in a traditional classroom

Descriptive statistics was run in SPSS for Scale I: Access (see Tables 2-5), as well as a frequency table for all of the questions within the scale. The students who responded reported the data found in Tables 2-5. The WEBLEI uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). The reported means for Scale I: Access VGB Learning Environment were slightly higher than those found in the Scale I: Access Traditional

Learning Environment. The average mean for the VGB environment was 3.93 (6, 0.83), with the frequency of responses being 2 (n=2), 3 (n=9), 4 (n=14), and 5 (n=11). The average mean for the Traditional was 3.61 (4, 0.83) with the frequency of responses being 2 (n=6), 3 (n=8), 4 (n=5), and 5 (n=9).

Due to low participation, T-Tests or an ANOVA could not be run because the degrees of freedom and the variance would be negatively impacted.

Table 2:

*Access Descriptive Statistics VGB Learning Environment*

| **Scale I: Access VGB** | | | | |
|---|---|---|---|---|
| Questions | N | Mean | S.E.M. | Std. Deviation |
| Q1ACC | 6 | 3.50 | .224 | .548 |
| Q2ACC | 6 | 4.17 | .307 | .753 |
| Q3ACC | 6 | 4.00 | .365 | .894 |
| Q4ACC | 6 | 3.67 | .558 | 1.366 |
| Q5ACC | 6 | 4.17 | .307 | .753 |
| Q6ACC | 6 | 4.00 | .365 | .894 |
| Q7ACC | 6 | 4.00 | .258 | .632 |
| Mean | | 3.93 | 0.34 | 0.83 |

Table 3:

*Access Descriptive Statistics Traditional Learning Environment*

| Scale I: Access Traditional | | | | |
|---|---|---|---|---|
| Questions | N | Mean | S.E.M. | Std. Deviation |
| Q1ACC | 4 | 3.00 | .707 | 1.414 |
| Q2ACC | 4 | 3.75 | .479 | .957 |
| Q3ACC | 4 | 3.50 | .645 | 1.291 |
| Q4ACC | 4 | 3.25 | .750 | 1.500 |
| Q5ACC | 4 | 3.50 | .289 | .577 |
| Q6ACC | 4 | 3.75 | .750 | 1.500 |
| Q7ACC | 4 | 4.50 | .500 | 1.000 |
| Mean | | 3.61 | 0.59 | 1.18 |

Table 4:

*Frequency Video Game Based Scale I: Access*

| **Frequency: Video Game Based Environment** | | | | | |
|---|---|---|---|---|---|
| | Value | Frequency | % | Valid % | Cumulative % |
| *Q1 ACCESS* | | | | | |
| | 3 | 3 | 50.0 | 50.0 | 50.0 |
| | 4 | 3 | 50.0 | 50.0 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q2 ACCESS* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 3 | 50.0 | 50.0 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q3 ACCESS* | | | | | |
| | 3 | 2 | 33.3 | 33.3 | 33.3 |
| | 4 | 2 | 33.3 | 33.3 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q4 ACCESS* | | | | | |
| | 2 | 2 | 33.3 | 33.3 | 33.3 |
| | 4 | 2 | 33.3 | 33.3 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q5 ACCESS* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 3 | 50.0 | 50.0 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q6 ACCESS* | | | | | |
| | 3 | 2 | 33.3 | 33.3 | 33.3 |
| | 4 | 2 | 33.3 | 33.3 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q7 ACCESS* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 4 | 66.7 | 66.7 | 83.3 |
| | 5 | 1 | 16.7 | 16.7 | 100.0 |

| | | | | |
|---|---|---|---|---|
| Total | 6 | 100.0 | 100.0 | |

Table 5:

*Frequency Traditional Scale I: Access*

| **Frequency: Traditional Environment** | | | | |
|---|---|---|---|---|
| Value | Frequency | % | Valid % | Cumulative % |
| *Q1 ACCESS* | | | | |
| 2 | 2 | 50.0 | 50.0 | 50.0 |
| 3 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q2 ACCESS* | | | | |
| 3 | 2 | 50.0 | 50.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q3 ACCESS* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q4 ACCESS* | | | | |
| 2 | 2 | 50.0 | 50.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q5 ACCESS* | | | | |
| 3 | 2 | 50.0 | 50.0 | 50.0 |
| 4 | 2 | 50.0 | 50.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q6 ACCESS* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 5 | 2 | 50.0 | 50.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |

| | | | | |
|---|---|---|---|---|
| *Q7 ACCESS* | | | | |
| 3 | 1 | 25.0 | 25.0 | 25.0 |
| 5 | 3 | 75.0 | 75.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |

*Research Question 2:* As measured by the WEBLEI-VGB, how do students view their *participation in the learning environment* compared to students in a traditional classroom?

*Hypothesis 2:* Students in a video game based environment do not have a more positive view of their *participation in the learning environment* compared to students in a traditional classroom

The design was to answer the questions with these variables. Descriptive statistics was run in SPSS for Scale II: Interaction (see Tables 6-9), as well as a frequency table for all of the questions within the scale. The students who responded reported the data found in Tables 6-9. The WEBLEI uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). The reported means for Scale II: Interaction VGB Learning Environment were slightly higher than those found in the Scale II: Interaction Traditional Learning Environment. The average mean for the VGB environment was 3.97 (6, 1.05), with the frequency of responses being 0 (n=1), 1 (n=1), 3 (n=12), 4 (n=4), and 5 (n=18). The average mean for the Traditional was 3.21 (4, 1.15) with the frequency of responses being 0 (n=1), 1 (n=1), 2 (n=4), 3 (n=5), 4 (n=12) and 5 (n=1).

Due to low participation, T-Tests or an ANOVA could not be run because the degrees of freedom and the variance would be negatively impacted.

Table 6:

*Interaction Descriptive Statistics VGB Learning Environment*

| **Descriptive Statistics: Video Game Based Environment** | | | | |
|---|---|---|---|---|
| Interaction | N | Mean | S.E.M. | Std. Deviation |
| Q1INT | 6 | 3.67 | .422 | 1.033 |
| Q2INT | 6 | 4.67 | .211 | .516 |
| Q3INT | 6 | 4.50 | .342 | .837 |
| Q4INT | 6 | 3.67 | .422 | 1.033 |
| Q5INT | 6 | 4.50 | .342 | .837 |
| Q6INT | 6 | 2.83 | .833 | 2.041 |
| Mean | | 3.97 | 0.43 | 1.05 |

Table 7:

*Interaction Descriptive Statistics Traditional Learning Environment*

| **Descriptive Statistics: Traditional Environment** | | | | |
|---|---|---|---|---|
| Interaction | N | Mean | S.E.M. | Std. Deviation |
| Q1INT | 4 | 2.75 | .750 | 1.500 |
| Q2INT | 4 | 3.25 | .479 | .957 |
| Q3INT | 4 | 3.00 | .577 | 1.155 |
| Q4INT | 4 | 3.50 | .289 | .577 |
| Q5INT | 4 | 4.00 | .408 | .816 |
| Q6INT | 4 | 2.75 | .946 | 1.893 |
| Mean | | 3.21 | 0.57 | 1.15 |

Table 8:

*Frequency Video Game Based Scale II: Interaction*

| **Frequency: Video Game Based Environment** | | | | | |
|---|---|---|---|---|---|
| | Value | Frequency | % | Valid % | Cumulative % |
| *Q1 INTERACTION* | | | | | |
| | 3 | 4 | 66.7 | 66.7 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q2 INTERACTION* | | | | | |
| | 4 | 2 | 33.3 | 33.3 | 33.3 |
| | 5 | 4 | 66.7 | 66.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q3 INTERACTION* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 1 | 16.7 | 16.7 | 33.3 |
| | 5 | 4 | 66.7 | 66.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q4 INTERACTION* | | | | | |
| | 3 | 4 | 66.7 | 66.7 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q5 INTERACTION* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 1 | 16.7 | 16.7 | 33.3 |
| | 5 | 4 | 66.7 | 66.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q6 INTERACTION* | | | | | |
| | 0 | 1 | 16.7 | 16.7 | 16.7 |
| | 1 | 1 | 16.7 | 16.7 | 33.3 |
| | 3 | 2 | 33.3 | 33.3 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |

Table 9:

*Frequency Traditional Scale II: Interaction*

| Frequency: Traditional Environment | | | | | |
|---|---|---|---|---|---|
| | Value | Frequency | % | Valid % | Cumulative % |
| *Q1 INTERACTION* | | | | | |
| | 1 | 1 | 25.0 | 25.0 | 25.0 |
| | 2 | 1 | 25.0 | 25.0 | 50.0 |
| | 4 | 2 | 50.0 | 50.0 | 100.0 |
| | Total | 4 | 100.0 | 100.0 | |
| *Q2 INTERACTION* | | | | | |
| | 2 | 1 | 25.0 | 25.0 | 25.0 |
| | 3 | 1 | 25.0 | 25.0 | 50.0 |
| | 4 | 2 | 50.0 | 50.0 | 100.0 |
| | Total | 4 | 100.0 | 100.0 | |
| *Q3 INTERACTION* | | | | | |
| | 2 | 2 | 50.0 | 50.0 | 50.0 |
| | 4 | 2 | 50.0 | 50.0 | 100.0 |
| | Total | 4 | 100.0 | 100.0 | |
| *Q4 INTERACTION* | | | | | |
| | 3 | 2 | 50.0 | 50.0 | 50.0 |
| | 4 | 2 | 50.0 | 50.0 | 100.0 |
| | Total | 4 | 100.0 | 100.0 | |
| *Q5 INTERACTION* | | | | | |
| | 3 | 1 | 25.0 | 25.0 | 25.0 |
| | 4 | 2 | 50.0 | 50.0 | 75.0 |
| | 5 | 1 | 25.0 | 25.0 | 100.0 |
| | Total | 4 | 100.0 | 100.0 | |
| *Q6 INTERACTION* | | | | | |
| | 0 | 1 | 25.0 | 25.0 | 25.0 |
| | 3 | 1 | 25.0 | 25.0 | 50.0 |
| | 4 | 2 | 50.0 | 50.0 | 100.0 |
| | Total | 4 | 100.0 | 100.0 | |

*Research Question 3*: As measured by the WEBLEI-VGB, how do students view their *collaboration with their peers* compared to students in a traditional classroom?

*Hypothesis 3:* Students in a video game based environment do not have a more positive view of their collaboration with their peers compared to students in a traditional classroom

The design was to answer the questions with these variables. Descriptive statistics was run in SPSS for Scale III: Response, as well as a frequency table for all of the questions within the scale (see Tables 11-13). The students who responded reported the data found in Tables 10-13. The WEBLEI uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). The reported means for Scale III: Response Video Game Based Learning Environment were slightly higher than those found in the Scale III: Response Traditional Learning Environment. The average mean for the VGB environment was 3.74 (6, 1.096) with the frequency of responses being 0 (n=1), 1 (n=2), 2 (n=1), 3 (n=13) 4 (n=11), and 5 (n=14). The average mean for the Traditional was 3.36 (4, 1.27) with the frequency of responses being 0 (n=1), 1 (n=1), 2 (n=5), 3 (n=6), 4 (n=10) and 5 (n=5).

Due to low participation, T-Tests or an ANOVA could not be run because the degrees of freedom and the variance would be negatively impacted.

Table 10:

*Response Descriptive Statistics VGB Learning Environment*

| Descriptive Statistics: Video Game Based Environment | | | | |
|---|---|---|---|---|
| Response | N | Mean | S.E.M. | Std. Deviation |
| Q1RSP | 6 | 3.67 | .333 | .816 |
| Q2RSP | 6 | 4.50 | .342 | .837 |
| Q3RSP | 6 | 3.83 | .307 | .753 |
| Q4RSP | 6 | 3.50 | .428 | 1.049 |
| Q5RSP | 6 | 3.83 | .401 | .983 |
| Q6RSP | 6 | 4.17 | .401 | .983 |
| Q7RSP | 6 | 2.67 | .919 | 2.251 |
| Mean | | 3.74 | 0.45 | 1.096 |

Table 11:

*Response Descriptive Statistics Traditional Learning Environment*

| Descriptive Statistics: Traditional Environment | | | | |
|---|---|---|---|---|
| Response | N | Mean | S.E.M. | Std. Deviation |
| Q1RSP | 4 | 3.00 | .913 | 1.826 |
| Q2RSP | 4 | 3.50 | .645 | 1.291 |
| Q3RSP | 4 | 3.50 | .645 | 1.291 |
| Q4RSP | 4 | 3.25 | .250 | .500 |
| Q5RSP | 4 | 4.00 | .408 | .816 |
| Q6RSP | 4 | 3.75 | .629 | 1.258 |
| Q7RSP | 4 | 2.50 | .957 | 1.915 |
| Mean | | 3.36 | 0.64 | 1.27 |

Table 12:

*Frequency Video Game Based Scale III: Response*

| **Frequency: Video Game Based Environment** | | | | | |
|---|---|---|---|---|---|
| | Value | Frequency | % | Valid % | Cumulative % |
| *Q1 RESPONSE* | | | | | |
| | 3 | 3 | 50.0 | 50.0 | 50.0 |
| | 4 | 2 | 33.3 | 33.3 | 83.3 |
| | 5 | 1 | 16.7 | 16.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q2 RESPONSE* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 1 | 16.7 | 16.7 | 33.3 |
| | 5 | 4 | 66.7 | 66.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q3 RESPONSE* | | | | | |
| | 3 | 2 | 33.3 | 33.3 | 33.3 |
| | 4 | 3 | 50.0 | 50.0 | 83.3 |
| | 5 | 1 | 16.7 | 16.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q4 RESPONSE* | | | | | |
| | 2 | 1 | 16.7 | 16.7 | 16.7 |
| | 3 | 2 | 33.3 | 33.3 | 50.0 |
| | 4 | 2 | 33.3 | 33.3 | 83.3 |
| | 5 | 1 | 16.7 | 16.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q5 RESPONSE* | | | | | |
| | 3 | 3 | 50.0 | 50.0 | 50.0 |
| | 4 | 1 | 16.7 | 16.7 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q6 RESPONSE* | | | | | |
| | 3 | 2 | 33.3 | 33.3 | 33.3 |
| | 4 | 1 | 16.7 | 16.7 | 50.0 |
| | 5 | 3 | 50.0 | 50.0 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q7 RESPONSE* | | | | | |
| | 0 | 1 | 16.7 | 16.7 | 16.7 |

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 33.3 | 33.3 | 50.0 |
| 4 | 1 | 16.7 | 16.7 | 66.7 |
| 5 | 2 | 33.3 | 33.3 | 100.0 |
| Total | 6 | 100.0 | 100.0 | |

Table 13:

*Frequency Traditional Scale III: Response*

| **Frequency: Traditional Environment** | | | | |
|---|---|---|---|---|
| Value | Frequency | % | Valid % | Cumulative % |
| *Q1 RESPONSE* | | | | |
| 1 | 1 | 25.0 | 25.0 | 25.0 |
| 2 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q2 RESPONSE* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q3 RESPONSE* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q4 RESPONSE* | | | | |
| 3 | 3 | 75.0 | 75.0 | 75.0 |
| 4 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q5 RESPONSE* | | | | |
| 3 | 1 | 25.0 | 25.0 | 25.0 |
| 4 | 2 | 50.0 | 50.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q6 RESPONSE* | | | | |

| | | | | |
|---|---|---|---|---|
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 4 | 2 | 50.0 | 50.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q7 RESPONSE* | | | | |
| 0 | 1 | 25.0 | 25.0 | 25.0 |
| 2 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 2 | 50.0 | 50.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |

*Research Question 4:* As measured by the WEBLEI-VGB, how do students perceive the *quality of the learning environment* compared to students in a traditional classroom?

*Hypothesis 4:* Students in a video game based environment do not have a more positive perception of the quality of the learning environment compared to students in a traditional classroom.

The design was to answer the questions with these variables. Descriptive statistics was run in SPSS for Scale IV: Results, as well as a frequency table for all of the questions within the scale (see Tables 14-17). The students who responded reported the data found in Tables 14-17. The WEBLEI uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). The reported means for Scale IV: Results VGB Learning Environment were slightly higher than those found in the Scale IV: Results Traditional Learning Environment. The average mean for the VGB environment was 3.58 (6, 1.42) with the frequency of responses being 0 (n=4), 1 (n=0), 2 (n=3), 3 (n=12), 4 (n=15) and 5 (n=14). The average mean for the Traditional was 3.53 (4, 1.30) with the frequency of responses being 0 (n=1), 1 (n=2), 2 (n=3), 3 (n=6), 4 (n=13) and 5 (n=7).

Due to low participation, T-Tests or an ANOVA could not be run because the degrees of freedom and the variance would be negatively impacted.

Table 14:

*Results Descriptive Statistics VGB Learning Environment*

| **Descriptive Statistics: Video Game Based Environment** | | | | |
|---|---|---|---|---|
| Results | N | Mean | S.E.M. | Std. Deviation |
| Q1RES | 6 | 3.50 | .764 | 1.871 |
| Q2RES | 6 | 3.33 | .715 | 1.751 |
| Q3RES | 6 | 4.00 | .365 | .894 |
| Q4RES | 6 | 4.17 | .307 | .753 |
| Q5RES | 6 | 3.67 | .760 | 1.862 |
| Q6RES | 6 | 3.00 | .730 | 1.789 |
| Q7RES | 6 | 3.50 | .500 | 1.225 |
| Q8RES | 6 | 3.50 | .500 | 1.225 |
| Mean | | 3.58 | 0.58 | 1.42 |

Table 15:

*Results Descriptive Statistics Traditional Learning Environment*

| **Descriptive Statistics: Traditional Environment** | | | | |
|---|---|---|---|---|
| Results | N | Mean | S.E.M. | Std. Deviation |
| Q1RES | 4 | 3.50 | .866 | 1.732 |
| Q2RES | 4 | 4.25 | .250 | .500 |
| Q3RES | 4 | 3.25 | .854 | 1.708 |
| Q4RES | 4 | 3.25 | .479 | .957 |
| Q5RES | 4 | 4.00 | .408 | .816 |
| Q6RES | 4 | 3.00 | 1.080 | 2.160 |
| Q7RES | 4 | 3.50 | .645 | 1.291 |
| Q8RES | 4 | 3.50 | .645 | 1.291 |
| Mean | | 3.53 | 0.65 | 1.30 |

Table 16:

*Frequency Video Game Based Scale IV: Results*

| **Frequency: Video Game Based Environment** | | | | | |
|---|---|---|---|---|---|
| | Value | Frequency | % | Valid % | Cumulative % |
| *Q1 RESULTS* | | | | | |
| | 0 | 1 | 16.7 | 16.7 | 16.7 |
| | 3 | 1 | 16.7 | 16.7 | 33.3 |
| | 4 | 2 | 33.3 | 33.3 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q2 RESULTS* | | | | | |
| | 0 | 1 | 16.7 | 16.7 | 16.7 |
| | 3 | 1 | 16.7 | 16.7 | 33.3 |
| | 4 | 3 | 50.0 | 50.0 | 83.3 |
| | 5 | 1 | 16.7 | 16.7 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q3 RESULTS* | | | | | |
| | 3 | 2 | 33.3 | 33.3 | 33.3 |
| | 4 | 2 | 33.3 | 33.3 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q4 RESULTS* | | | | | |
| | 3 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 3 | 50.0 | 50.0 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q5 RESULTS* | | | | | |
| | 0 | 1 | 16.7 | 16.7 | 16.7 |
| | 4 | 3 | 50.0 | 50.0 | 66.7 |
| | 5 | 2 | 33.3 | 33.3 | 100.0 |
| | Total | 6 | 100.0 | 100.0 | |
| *Q6 RESULTS* | | | | | |
| | 0 | 1 | 16.7 | 16.7 | 16.7 |
| | 2 | 1 | 16.7 | 16.7 | 33.3 |
| | 3 | 1 | 16.7 | 16.7 | 50.0 |
| | 4 | 2 | 33.3 | 33.3 | 83.3 |
| | 5 | 1 | 16.7 | 16.7 | 100.0 |

| | | | | |
|---|---|---|---|---|
| Total | 6 | 100.0 | 100.0 | |
| *Q7 RESULTS* | | | | |
| 2 | 1 | 16.7 | 16.7 | 16.7 |
| 3 | 3 | 50.0 | 50.0 | 66.7 |
| 5 | 2 | 33.3 | 33.3 | 100.0 |
| Total | 6 | 100.0 | 100.0 | |
| *Q8 RESULTS* | | | | |
| 2 | 1 | 16.7 | 16.7 | 16.7 |
| 3 | 3 | 50.0 | 50.0 | 66.7 |
| 5 | 2 | 33.3 | 33.3 | 100.0 |
| Total | 6 | 100.0 | 100.0 | |

Table 17:

*Frequency Traditional Scale IV: Results*

| **Frequency: Traditional Environment** | | | | |
|---|---|---|---|---|
| Value | Frequency | % | Valid % | Cumulative % |
| *Q1 RESULTS* | | | | |
| 1 | 1 | 25.0 | 25.0 | 25.0 |
| 4 | 2 | 50.0 | 50.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q2 RESULTS* | | | | |
| 4 | 3 | 75.0 | 75.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q3 RESULTS* | | | | |
| 1 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q4 RESULTS* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 2 | 50.0 | 50.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q5 RESULTS* | | | | |

| | | | | |
|---|---|---|---|---|
| 3 | 1 | 25.0 | 25.0 | 25.0 |
| 4 | 2 | 50.0 | 50.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q6 RESULTS* | | | | |
| 0 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q7 RESULTS* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |
| *Q8 RESULTS* | | | | |
| 2 | 1 | 25.0 | 25.0 | 25.0 |
| 3 | 1 | 25.0 | 25.0 | 50.0 |
| 4 | 1 | 25.0 | 25.0 | 75.0 |
| 5 | 1 | 25.0 | 25.0 | 100.0 |
| Total | 4 | 100.0 | 100.0 | |

*Research Question 5:* As measured by the WEBLEI-VGB, how do students *feel about their learning experience* when learning about pollution compared to students in a traditional classroom?

*Hypothesis 5:* Students in a video game based environment do not have a more positive view of their learning experience when learning about pollution compared to students in a traditional classroom.

The design was to answer the question with the variables from the combined scales. Descriptive statistics was run in SPSS for all four of the scales, then means were calculated for each learning environment using the four scales as well as a frequency table for the questions for all four scales (see Tables 18-21). The WEBLEI uses a 5-point

Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). The reported means for Scale IV: Results VGB Learning Environment were slightly higher than those found in the Scale IV: Results Traditional Learning Environment. The mean for the VGB Learning Environment was 3.80 (6, 1.1) with the total frequency of responses being 0 (n=6), 1 (n=3), 2 (n=6), 3 (n=46), 4 (n=44) and 5 (n=57). The average mean for the Traditional Learning Environment was 3.42 (4, 1.22) with the total frequency of responses being 0 (n=3), 1 (n=4), 2 (n=18), 3 (n=25), 4 (n=40) and 5 (n=22).

Due to low participation, T-Tests or an ANOVA could not be run because the degrees of freedom and the variance would be negatively impacted.

Table 18:

*WEBLEI Average VGB Learning Environment*

| **WEBLEI: Video Game Learning Environment Averages** | | | | |
|---|---|---|---|---|
| | N | Mean | S.E.M. | Std. Deviation |
| Scale I: Access | 6 | 3.93 | 0.34 | 0.83 |
| Scale II: Interaction | 6 | 3.97 | 0.43 | 1.05 |
| Scale III: Response | 6 | 3.74 | 0.45 | 1.096 |
| Scale IV: Results | 6 | 3.58 | 0.58 | 1.42 |
| Mean | | 3.80 | 0.45 | 1.1 |

Table 19:

*WEBLEI Average Traditional Learning Environment*

| **WEBLEI: Traditional Learning Environment Averages** | | | | |
|---|---|---|---|---|
| | N | Mean | S.E.M. | Std. Deviation |
| Scale I: Access | 4 | 3.61 | 0.59 | 1.18 |
| Scale II: Interaction | 4 | 3.21 | 0.57 | 1.15 |
| Scale III: Response | 4 | 3.36 | 0.64 | 1.27 |

| | | | | |
|---|---|---|---|---|
| Scale IV: Results | 4 | 3.53 | 0.65 | 1.30 |
| Mean | | 3.4275 | 0.6125 | 1.225 |

Table 20:

*Video Game Based Environment: Frequency Totals*

| **Video Game Based Environment: Frequency Totals** | | | | | | |
|---|---|---|---|---|---|---|
| Likert Scale Response | 0 (N/A) | 1 (Never) | 2 (Seldom) | 3 (Sometimes) | 4 (Often) | 5 (Always) |
| Access | 0 | 0 | 2 | 9 | 14 | 11 |
| Interaction | 1 | 1 | 0 | 12 | 4 | 18 |
| Response | 1 | 2 | 1 | 13 | 11 | 14 |
| Results | 4 | 0 | 3 | 12 | 15 | 14 |
| Totals | 6 | 3 | 6 | 46 | 44 | 57 |

Table 21:

*Traditional Environment: Frequency Totals*

| **Traditional Environment: Frequency Totals** | | | | | | |
|---|---|---|---|---|---|---|
| Likert Scale Response | 0 (N/A) | 1 (Never) | 2 (Seldom) | 3 (Sometimes) | 4 (Often) | 5 (Always) |
| Access | 0 | 0 | 6 | 8 | 5 | 9 |
| Interaction | 1 | 1 | 4 | 5 | 12 | 1 |
| Response | 1 | 1 | 5 | 6 | 10 | 5 |
| Results | 1 | 2 | 3 | 6 | 13 | 7 |
| Totals | 3 | 4 | 18 | 25 | 40 | 22 |

*Research Question 6:* As measured by the WEBLEI-VGB, do students who play SimCity learn about pollution have *better test scores (knowledge retention)* compared to students in a traditional classroom?

*Hypothesis 6:* Students in a video game based environment do not have *better test scores (knowledge retention)* compared to students in a traditional classroom

Scores for the Content Knowledge Assessment were organized by class (see Tables 22 & 23 and Figures 5 & 6). If a learner answered a question correctly, they were awarded a point. Total points for each test are displayed, as well as charts for the marginal means. The marginal means for the Video Game Based Environment (2.5, 5.67, 5.67) were slightly higher than the Traditional Environment (3, 5.75, 5). Due to low participation and unevenness of the two groups, a repeated measures ANOVA was unable to be run on the data collected.

Table 22:

*Content Assessment Video Game Based*

| **Content Assessment Scores: Video Game Based Environment** | | | | |
|---|---|---|---|---|
| Research Number | Module | PreTest | Midlevel Test | PostTest |
| 492978 | 2A | 4 | 5 | 6 |
| 560115 | 2A | 2 | 4 | 4 |
| 719523 | 2A | 2 | 7 | 7 |
| 249477 | 2A | 5 | 6 | 6 |
| 270067 | 2A | 1 | 5 | 4 |
| 357549 | 2A | 1 | 7 | 7 |
| Means | | 2.5 | 5.67 | 5.67 |

*Figure 5:*

Content Knowledge Assessment Marginal Mean Video Game Based

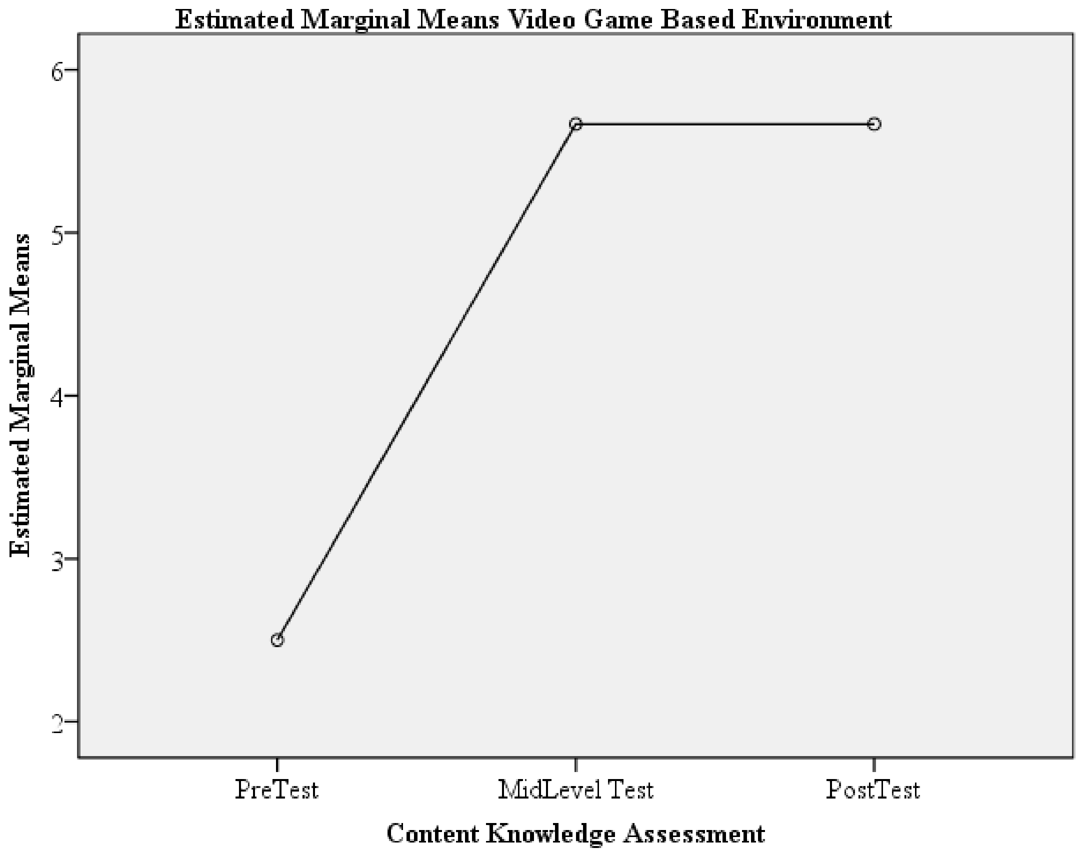


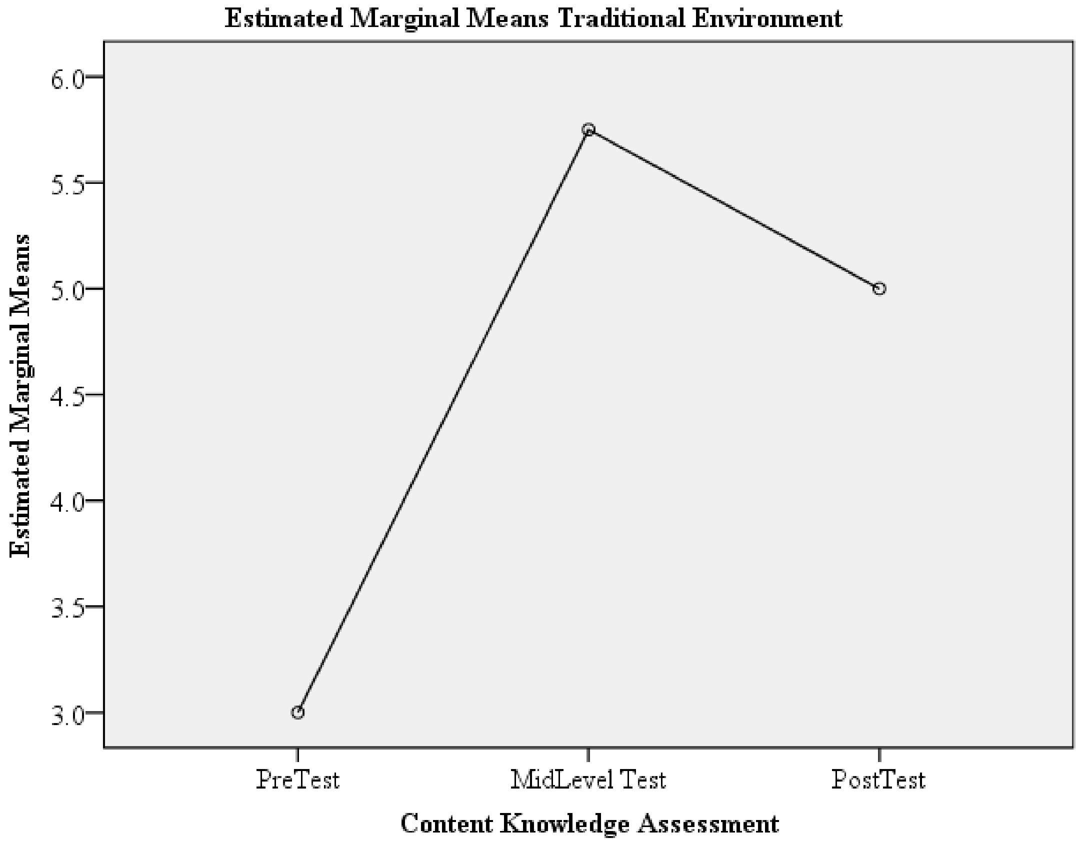

Table 23:

*Content Assessment Traditional*

| Content Assessment Scores: Traditional Environment | | | | |
|---|---|---|---|---|
| Research Number | Module | PreTest | Midlevel Test | PostTest |
| 551724 | 2B | 3 | 5 | 5 |
| 482835 | 2B | 3 | 5 | 1 |
| 786406 | 2B | 3 | 7 | 7 |
| 335789 | 2B | 3 | 6 | 7 |
| Mean | | 3 | 5.75 | 5 |

*Figure 6*:

Content Knowledge Assessment Marginal Mean Traditional




**Summary**

Introducing video game in the classroom is not a new concept. However, what are the effects and benefits to using video games to teach? "Government and industry are investing millions in investigating these questions. As educational technologists, we can choose to join those embracing more expansive views of research and pedagogy-or we can stay on the sidelines as the 21st century marches ahead" (Squire, 2007, p. 54). The purpose of this study was to compare and analyze the learner's perceptions of their learning environments and to test the knowledge they retained. This chapter presented a summary of the data collected using an adapted version of the WEBLEI and a Content

Knowledge Assessment. There were two sessions held in the study. Each session had two learning modules; all of the learners attended the first module. After the first module, the learners were split into two groups and then attended one of two classrooms: Video Game Learning Environment or the Traditional Learning Environment. The content knowledge assessment was taken three times by all of the learners; as a pretest, after the first module and after the second module. The WEBLEI was taken by all of the learners after all of the modules were completed.

The intent of the WEBLEI was to measure four different scales using a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). Scale I: Access had questions that measured the ease of access of the learning activities. Scale II: Interaction had questions that measured the perception of co-participatory activities with their fellow learners. Scale III: Response asked questions about the Qualia of the learning environment and how the student enjoyed the materials. Lastly, Scale IV: Results has questions that described the overall perception of the structure, design and organization of the information presented. The Content Knowledge Assessment tested the participants on the content taught in Modules 1, 2A and 2B.

Descriptive Statistics were run on the date for both classes and were organized by scale. Frequency charts were presented to represent each question within the four scales. Data from the Content Knowledge Assessment was organized and placed into tables and charts. Due to a response rate of 1-3% out of 864 students, generalizations could not be made about the learner's perceptions or their knowledge retention. Based on the limited data obtained, analytical statistics could not be calculated.

## Chapter V

## Conclusion

### Introduction

Learning in the classroom should not be limited to rote memorization and recitation of facts. Application of knowledge and theory in real life situations creates a unique and optimal learning environment. However, most instructors do not have access to situations to allow their students to experiment and explore. Field trips and science labs can be costly. Video games can create these situations for students to apply their knowledge without even leaving the classroom. They can play and safely make mistakes in a controlled and cost effective environment (Barab, Gresalfi, Arici, Pettyjohn Ingram-Goble, 2010).

This purpose of this study was to discover the potential of using a video game to teach students about pollution. Two learning environments were compared using the WEBLEI-VGB and a Content Knowledge Assessment. This chapter will provide an overview for the entire study, including the literature review, the methodology and the analysis of the data. This chapter will also include conclusions, implications and limitations of the study as well as suggestions for future research.

### Summary of the Study

Traditional teaching methods, including lecture and discussion, are valuable learning techniques in the classroom (Chang & Fisher, 2001). Traditional techniques are good for imparting knowledge, but are not always successful at teaching learning how to apply their knowledge. Simulations, computer and video games have been commonly used as tools to teach in the military and government agencies. Simulations, computer and video games give the learner a safe environment in which to train and learn new skills (Balci, Bertelrud, Esterbrook, & Nance, 1997).

Educationalist like Dr. Sasha Barab, James Paul Gee and Kurt Squire embrace the concept of using video games in the classroom.  Barab teaches with the idea of transformational play in mind.  He creates entire worlds using video games and allows his students to explore and experiment with their surroundings.  The students interact with one another in cooperative play, allowing for seamless enjoyment and learning. Video games provide a world of problems waiting to be solved, allowing the learner to become motivated to create solutions (Barab, 2010).  James Paul Gee questioned the unique design found within popular video games; he wondered how the player still remained interested in playing a game that is hard to master.  In the article *Good video games and good learning*, Gee observes that mainstream games are popular because they are complex and challenging.  Players are taught how to overcome obstacles within the game, and are rewarded in increments (levels) when they master a particular skill (Gee, 2005).  This uses the popular teaching method of scaffolding used in classrooms to teach difficult material (Vygotsky, 1978).

Video Games also connect learners to their fellow classmates and their instructor by using the concepts of Social Cognitive Theory.  Learners can gain knowledge by observing people and situations.  They share social norms, skills, and knowledge while working together.   Video games create a model for the learning, forming a variety of situations for the learners to apply their knowledge and experiment with different outcomes and solutions.  The learners can use those experiences within the game if and when they encounter similar situations in the real world. Their past experiences with the simulated model influence their future actions (Schunk, Pintrich & Meece).

The purpose of this study was to have students attend one of two learning modules: one using Traditional techniques, such as lecture and a debate, and the other using a Video Game Based environment, the game SimCityEdu: Pollution Challenge. After they attended the modules, the students would be tested for the knowledge gained during the learning modules and take the WEBLEI-VGB in order to gauge their perception of each learning environment. Figure 4: Study Outline shows a visual representation of the study.

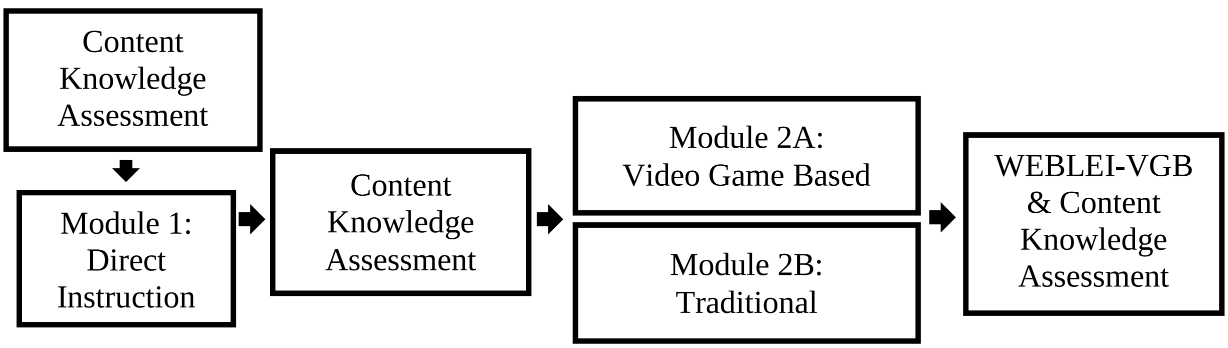



*Figure 7*: Study Outline

The population was comprised of adult learners enrolled in a community college in western and central Pennsylvania with five campuses serving different geographical areas in Richland, Huntingdon, Somerset, Ebensburg, and Blair. Two sessions were held and ten learners participated in both modules. 1-3% of 864 students (full time and part time) participated in the study. While there was a large population of students available for the study, the low participation rate put a limitation to making generalizations about the data and its implications. The results would not adequately represent the student population and their perceptions on the two learning environments. Therefore, no analytical statistics could be run on the collected data from the Content Knowledge Assessment and the WEBLEI-VGB.

## Findings

The following research questions were analyzed:

RQ1. As measured by the WEBLEI-VGB, how do students view their ease of access to learning materials (convenience, efficiency and autonomy) compared to students in a traditional classroom?

The first research question addressed Scale I: Access in the WEBLEI-VGB. The WEBLEI uses a 5-point Likert scale having the following response options: 0 (N/A); 1 (Never); 2 (Seldom); 3 (Sometimes); 4 (Often); 5 (Always). Scale I measures the ease of access of the learning activities, including convenience, efficiency and autonomy. Materials in the learning environments should be challenging, but not confusing. Learners should feel that they can set their own pace when learning new materials (Chang and Fisher, 2001). Goals should be set, and the learner needs to believe that they are relevant and achievable. Self-efficacy is improved upon when the learner accomplishes their set goals (Schunk, Pintrich & Meece, 2008).

The reported means for Scale I: Access VGB Learning Environment were slightly higher than those found in the Scale I: Access Traditional Learning Environment. The average mean for the VGB environment was 3.93 (6, 0.83), with the frequency of responses being 2 (n=2), 3 (n=9), 4 (n=14), and 5 (n=11). The average mean for the Traditional was 3.61 (4, 0.83) with the frequency of responses being 2 (n=6), 3 (n=8), 4 (n=5), and 5 (n=9).

RQ2. As measured by the WEBLEI-VGB, how do students view their participation in the learning environment compared to students in a traditional classroom?

The second research question addressed Scale II: Interaction in the WEBLEI-VGB. Interaction can be compared to activities that allow the learners to participate with their peers and their instructor. The elements that describe interaction are: flexibility, reflection, quality, feedback and collaboration. A sense of community can be created when the students are learning as a group with common goals (Chang and Fisher, 2001). Creating goals as a group when learning can lead to feelings of sharing and connection with others (Schunk, Pintrich & Meece, 2008). Bandura pointed out that social media is used to link people as a community. The community naturally forms support groups, informational systems and personal networks. This community has the potential to reach and affect more people than direct media influence (Bandura, 2009).

The reported means for Scale II: Interaction VGB Learning Environment were higher than those found in the Scale II: Traditional Learning Environment. The average mean for the VGB environment was 3.97 (6, 1.05), with the frequency of responses being 0 (n=1), 1 (n=1), 3 (n=12), 4 (n=4), and 5 (n=18). The average mean for the Traditional was 3.21 (4, 1.15) with the frequency of responses being 0 (n=1), 1 (n=1), 2 (n=4), 3 (N=5), 4 (N=12) and 5 (n=1).

RQ3. As measured by the WEBLEI-VGB, how do students view their collaboration with their peers compared to students in a traditional classroom?

The third research questions addressed Scale III: Response in the WEBLEI-VGB. This provides the perception of the Qualia of the learning environment. Qualia is described with the following six elements: enjoyment, confidence, accomplishments, success, frustration and tedium (Chang and Fisher, 2001). One common way to create enjoyment and confidence in the classroom is to create a model of what is expected for the learner to emulate. Modeling creates interest by generated a response from the learners through their observations**.** The model becomes a focal point of the instructions; this can generate conversation and exploration, providing interest to the materials being presented. When the interest occurs, the students are positively motivated (Kauchak, & Eggen, 2001).

The reported means for Scale III: Response VGB were slightly higher than those found in the Scale III: Response Traditional Learning Environment. The average mean for the VGB environment was 3.74 (6, 1.096) with the frequency of responses being 0 (n=1), 1 (n=2), 2 (n=1), 3 (n=13) 4 (n=11), and 5 (n=14). The average mean for the Traditional was 3.36 (4, 1.27) with the frequency of responses being 0 (n=1), 1 (n=1), 2 (n=5), 3 (n=6), 4 (n=10) and 5 (n=5).

RQ4. As measured by the WEBLEI-VGB, how do students perceive the quality of the learning environment compared to students in a traditional classroom?

The fourth research question addressed Scale IV: Results in the WEBLEI-VGB. Results are measured by the perception of how learning materials are structured, designed and organized. Instructional design standards should be followed, as well as structured and logical goals pertaining to the materials being taught. The six elements of this scale include relevance and scope of content, validity of content, accuracy and balance of content, navigation, and aesthetic and affective aspects (Chang and Fisher, 2001).

The reported means for Scale IV: Results VGB Learning Environment were slightly higher than those found in the Scale IV: Results Traditional Learning Environment. The average mean for the VGB environment was 3.58 (6, 1.42) with the frequency of responses being 0 (n=4), 1 (n=0), 2 (n=3), 3 (n=12), 4 (n=15) and 5 (n=14). The average mean for the Traditional was 3.53 (4, 1.30) with the frequency of responses being 0 (n=1), 1 (n=2), 2 (n=3), 3 (n=6), 4 (n=13) and 5 (n=7).

RQ5. As measured by the WEBLEI-VGB, how do students feel about their learning experience when learning about pollution compared to students in a traditional classroom?

The fifth research question addressed the data collected from all four scales: Access, Interaction, Response and Results. This would provide an overall perception of the learning environment. An optimal learning environment will have high student perceptions in each scale (Chang and Fisher, 2001).

The mean for the VGB Learning Environment was 3.80 (6, 1.1) with the total frequency of responses being 0 (n=6), 1 (n=3), 2 (n=6), 3 (n=46), 4 (n=44) and 5 (n=57). The average mean for the Traditional Learning Environment was 3.42 (4, 1.22) with the total frequency of responses being 0 (n=3), 1 (n=4), 2 (n=18), 3 (n=25), 4 (n=40) and 5 (n=22).

RQ6. As measured by the WEBLEI-VGB, do students who play SimCity learn about pollution have better test scores (knowledge retention) compared to students in a traditional classroom?

The final research question addressed the knowledge retained during the learning modules. The Content Knowledge Assessment was given three times during the study; as a pretest, after Module 1 and after Module 2. The questions were based upon the content and objectives found within the lesson plans and SimCityEdu Pollution Challenge.

Scores for the Content Knowledge Assessment were organized by class. If a learner answered a question correctly, they were awarded a point. The final marginal means for the Video Game Based Environment (2.5, 5.67, 5.67) were slightly higher than the Traditional Environment (3, 5.75, 5).

The researcher observed that the test scores were overall comparable; however, one of the participants in the Traditional Environment seemed to purposefully answer badly for the last Content Knowledge Assessment. It is not clear if the participant did not know the content or was frustrated with the survey or the learning module.

**Conclusions**

Technology is constantly moving forward, altering how people live, learn and work. The integration of education and technology into specific content areas is necessary to improve learning on the intrinsic level. Video games in the classroom provide that seamless integration, but not just for the sake of using technology. Video games use classic learning theories within their game structure, like Vygotsky's theory of scaffolding to Piaget's development theory of learning in stages (Blake & Pope, 2008). In order to create an ideal learning environment where a student can play and learn, one must merge pedagogy, video games and knowledge within their curriculum.

The WEBLEI's intention was to measure the student's perceptions of their learning environment. Four scales are used in the instrument to achieve this. The first three are based upon Tobin's (1998) work on Connecting Communities Learning. The fourth scale is based upon the structure and design of the material being presented (Chang & Fisher, 2001).

The first scale addresses the ease of access of learning materials. The video game market continues to flourish, using old and new technologies in order to excite their players. Most popular video games have their players progress through the game using procedural and knowledge based scenarios (Bellotti, Berta, De Gloria, & Primavera, 2009). Games like *The Legend of Zelda* series have been labeled as puzzle games; players expect to be challenged in order to make it through the vast world and complex dungeons within it. Even though the main character, Link, is armed with a sword and a shield, it is not just a “hack and slash” game that requires the player to mindlessly swing a sword to get to the end. Link acquires different tools to aid his quest along the way, including iron boots, a butterfly net and even an ocarina. The player must use each tool in a unique way to advance through the game, such as walking through the depths of a lake with the help of iron boots, or playing the *Song of Storms* with an ocarina that cause it to rain and drain a well of its water (Nintendo, 1998). Simple organizational concepts in the game make them easy to set and achieve goals. Learners are challenged, but not frustrated when using games to learn. “Video games are usually perceived and appreciated as highly dynamic personal challenges” (Bellotti, Berta, De Gloria, & Primavera, 2009, p. 15).

The second scale designates how the learner feels about interacting with their peers and their instructor. Video games allow for learners to cooperate with their peers on a cognitive level. Jen Deyenberg, a Learning Services Coordinator (Educational Technology) for Northern Gateway Public Schools in Whitecourt, Alberta, uses SimCity to teach her students about government and civics. She states, “A simulation environment allows students to experiment and try with different approaches and strategies. They immediately see the consequences of their decisions or lack of decision making" (Deyenberg, 2010). According to Bandura (1991), working as a group or seeing a model play out in real time influences the decisions the learner will make in the future. Social situations impact the way learners solve complex problems. When decisions are humanized, learners take into account what their peers feel and believe; it can have a powerful effect on their decisions when playing a video game.

One of the instructors for the VGB learning environment was observing two learners play SimCityEdu: Pollution challenge in Module 2A. The first learner was demolishing buildings and causing havoc in the city they were working on. The second learner verbalized his frustrations and asked to restart the game. The next time through, the second learner took control and explained how he wanted to explore other less destructive solutions. As they clicked on different buildings and selected different options, the learners started to ask questions about the game. "The water is polluted in this water tower. How can I make it cleaner?" There were other options to the game featured in previous lessons, like creating jobs and providing schooling to residents. The students began clicking random options in the game in order to see what impact they had on the residents. When unwanted results occurred, they would reset the city back to its original state. Even though the original razing of the town by the first learner frustrated the second learner, it did lead to further exploration of other options within the game. Sometimes a learner can get so stuck on reaching a goal in a specific way; exploration is not encouraged. However, creativity and innovation is encouraged when working in a gaming environment with a peer.

The third and fourth scales are Response and Results, and describe the learner's perceptions of the quality of the learning materials and their overall feelings of the learning environment and how it is structured. James Paul Gee (2007) addresses why video games make good learning tools in his unpublished manuscript *Why are Video Games Good for Learning?* Inspired by a paper written by Michael Zyda, Gee describes the unique nature that makes a video game "good". While certain games like *Tetris* and *Trivial Pursuit* are enjoyable, they are not considered thought-provoking. Gee points out that games like *The Sims, Sim City, Half-Life* and *The Elder Scrolls III: Morrowind* are video games that are also simulations. This is important to note, because most scientific labs are run with a simulation in mind. A theory is proposed, often with complex systems to evaluate. These systems are hard to predict (for example, earthquakes or the weather), so the researchers create simulations in order to run set scenarios. After each scenario, the researcher collects data, experiments with different outcomes and eventually fine-tunes their hypothesis (Gee, 2007). SimCityEdu: Pollution Challenge is a simulation with multiple solutions. When the researcher was approved to run the study, she met with the first instructor for Module 2A: VGB Learning Environment to teach him how to play the game. Together, they came up with four unique solutions to fixing the pollution in the simulated city within the first hour of playing. The students came up with additional solutions when the study was conducted. Different goals were offered to the learner as the game was played, providing interest and satisfaction when they reached the set goals.

Using all four scales to gauge the perception of a learning environment is crucial to understanding how to appropriately present information in a classroom setting.

Allowing for critical evaluation of knowledge through play and experimentation improves the learner's attitude towards the subject matter being taught. They begin to believe in themselves and their abilities to cognitively understand complex concepts. The key is that the learner simply thought they were playing, when in fact, they were learning. Overall, the reported means for all four scales in the VGB Learning Environment were slightly higher than those found in the Traditional Learning Environment. In addition, the scores for the Content Knowledge Assessment were overall better for the VGB Learning Environment. Even though no conclusions can be made about the results of the WEBLEI and their knowledge retention, it certainly supports further research to understand the effects that video games can have on learners in a classroom setting.

**Implications**

Video games have the potential to be great motivators, particularly in the STEM (Science, Technology, Engineering and Mathematics) fields, which are in demand. As stated in *Video Gaming for STEM Education* (Hyatt, Barron & Noakes, 2012, p. 106), "Since there is a need to increase participation and interest in STEM areas, President Obama issued a national call to action to promote STEM education. As a result, a partnership of industry groups and technology companies was formed to focus on creating video games to promote STEM education."

In the article *Games and Motivation to Learn Science* (2008, p. 603), Foster asserts that there are few studies that address the effectiveness of playing video games to learn topics in the sciences. We have yet to analyze what games can provide is in the classroom or what subjects they are capable of teaching. Because this is a new initiative, instructors and researchers alike should be exploring the possibilities of using video games in the classroom. Studies that evaluate the learning environment when using a video to teach are crucial to understanding the long term effects it may have on a student's motivation to learning the STEM fields. Knowledge retention and the ability to apply what they know in real situations should be a priority in the learning community.

This study attempted to answer those very basic, yet crucial questions. It is not enough to use technology in a classroom to create interest and motivate learners. One must use the technology in a way that benefits the classroom as a whole. Millions of dollars are being spent every year to integrate technology into the classroom. Peggy Ertmer addresses the barriers to using technology in the classroom in her article *Addressing first-and second-order barriers to change: Strategies for technology* (1999). The first order barriers are extrinsic. They have to deal with cost and availability of the technology, as well as instructional support. Second order barriers are intrinsic. They refer to the instructor's belief about using technology, their fears and trepidations with learning new things, and avoiding embarrassment or frustration when the technology malfunctions (Ertmer, 1999).

The researcher used Ertmer's article to present the parallels with these barriers that instructors face integrating video games into their curriculum at the 6th Annual Conference on Higher Education Pedagogy held at Virginia Tech (Barron, 2014, February 5). Tips and techniques to overcome barriers to using video games in the classroom were discussed and examples of lesson plans and learning modules were demonstrated at the conference. The lesson plans came from websites like www.glasslabgames.com (SimCityEdu), www.Minecraftedu.com (Minecraft) and www.teachwithportals.com (Portal 2); they are all educational resources for mainstream games that are now turning their attention to instructors using their games to teach.

There is both the desire to use video games in the classroom and the need to regulate and understand how to use them correctly. This study provides a glimpse into the possibilities and necessity to achieving both.

**Limitations**

The purpose of this study was to create a unique learning environment with two different approaches in methodology. The environments were designed to be identical in content and in structure. The lesson plans were carefully written in order to best utilize each teaching method: Traditional and Video Game Based. While the study was meticulously planned and executed, there were difficult barriers to overcome with the recruitment of subjects. This section will discuss the limitations that hindered the recruitment.

The first limitation was conflicts with current classes and activities planned on campus. Regular classes are during the day and normally follow a Monday, Wednesday, Friday schedule or a Tuesday and Thursday schedule. There are other classes that are only held for one day (the day it's held varies). Evening classes start at 6pm. The campus is mostly empty of students from the hours of 3:00-6:00pm. The first session was held on a Thursday at 2:00pm. Ten students were recruited, but two left before taking the WEBLEI. They stated that they needed to take the bus home (which left around 3:00pm). The two students who left were emailed the final part of the survey (the WEBLEI) to complete it at home, but they never finished it. The second session was held at noon on a Friday.  A pep rally was scheduled at the same time.  Three people signed up for the study, but only two attended both modules.

The second limitation had to do with the method to let students know about the study.  Students were recruited through fliers and mass emails.  Over one hundred fliers were placed around campus.  Two emails for each session was sent out through mass student activity email.  864 students was sent the recruitment notification through their official campus email address.  There was no way to check if the students received or read the email since there was no read receipt available.  Therefore, it is not known how many of the students actually saw the email. Since the researcher is also an instructor on campus, directly recruiting students was not used in order to avoid giving feelings of being coerced into attending the study.  The researcher did not want students to think their grades may be impacted (positively or negatively) by attending or refusing to attend. In addition, the fliers needed to contain detailed information about the study.  The information was mandatory and involved the student's rights as participants.  The fliers may have seemed cluttered, and students may not have read or understood the importance or purpose of the study.

The third limitation dealt with the instructors teaching the modules.  The researcher could not participate in the instructional modules directly in order to avoid creating a bias in the classroom.  When the study was first created, the researcher secured two instructors who were qualified and able to teach both modules. Module 1 and 2B required an instructor familiar with pollution and the sciences who was able to teach in a traditional learning environment.  Module 2A required an instructor familiar with pollution and able to teach the video game based learning environment using

SimCityEdu: Pollution Challenge. Luckily, SimCityEdu: Pollution Challenge is a simple game to master. The first two instructors lived in Pittsburgh, two hours away from the study site. The researcher had to work around their schedules, as well as the school's schedule (in order to secure two specific classrooms, one with a computer lab with SimCityEdu: Pollution Challenge installed on all stations). When the first session had fewer participants than expected, a second session was created a week later. The two original instructors could not teach the second session due to conflicts with travel and work. So the researcher found two more instructors who fit the exact criteria mentioned above. Both of them were able to take off work in order to teach the modules. They were coached on how to teach the sessions and were informed that deviation from the lesson plan was not allowed. One of the instructors lived in Pittsburgh as well, and was not able to teach any additional sessions. The researcher did not want to keep recruiting new instructors for further sessions because of the impact it would have on the results of the study. Changes in teaching style could positively or negatively alter the perceptions of the learner.

The fourth limitation addresses the length of the study. One of the instructors for the traditional learning environment mentioned that the length of the modules made it difficult to recruit students. She asked a few passing students why they were not able to attend the study. They mentioned they were interested, but did not have two hours to spare for the study. It was difficult for the students to devote the amount of time to learning a new concept for two hours with competing obligations. The two hours may seem excessive, but the study was set up to be longer in order to properly gauge knowledge retention. A pretest, a midlevel and a posttest would provide the correct amount of data for a repeated measures ANOVA. If perceptions were only being gauged, the study could have taken less than an hour to complete. The study may have been seen as less meaningful if data was only collected to prove that students enjoyed playing a video game over lecture. The purpose of this study was to prove that not only do student enjoy playing while learning, but they also learn better in a video game based environment compared to a traditional learning environment.

This study is only focusing on the use of one game within a small classroom setting in a community college. Video games in the classroom should be used as a tool, and not as a replacement to learning. SimCityEdu: Pollution Challenge is a unique game created to teach students a very specific topic; the results are specific to that subject area. Not all video games will create the same motivational effects.

While the limitations did not detract from the learning environments, they did limit the amount of students willing or able to participate in the study. The next section will address these issues and how to avoid them in future studies.

**Future Research**

As educators explore the use of nontraditional teaching methods in the classroom, the desire to use video games and simulations may increase. Non-traditional methods have the potential to create interest and motivation to learn beyond the classroom (Shaffer, Squire, Halverson & Gee, 2005). Based upon the research and the limitations discovered in the process of conducting this study, the researcher has four recommendations for future exploration on using video games to teach.

The first recommendation is to integrate the video game into the curriculum of a pre-scheduled class. Both Sasha Barab and Bellotti created entire classes with specific learning objectives and a video game that helped them teach those objectives. The college could offer the class to all students in the college. This will reduce the outside conflicts with attending the class (besides typical classroom absences). Data can be collected and analyzed for an entire semester. This would eliminate the timing and lack of instructor limitations as well.

The second recommendation would be to add additional questions to the survey to collect the student's thoughts and perspectives of the learning environment. Learning the "why" behind their choices give deeper meaning to the statistics being presented and would provide.

The third recommendation would be to analyze the differences in perceptions of the learning environment according to age and gender. Understanding the differences in generational and gender learning styles can be beneficial when creating a class trying to recruit different populations into their fields.

The fourth recommendation would be to examine the use of video games to teach subjects outside of the STEM fields. According to Wideman, Owston, Brown, Kushniruk, Ho, and Pitts (2007) in the article *Unpacking the potential of educational gaming: A new tool for gaming research,* the majority of video games have been used to teach medical and business students. The studies being completed are only anecdotal in nature, and the knowledge in gaming process is limited. There is a definite need for research that targets the basics of learning with video games in order to investigate the possibilities of using them in the classroom.

**Summary**

The purpose of this study was to measure and analyze the differences in learning environments in order to bring attention to non-traditional teaching methods in the classroom. Traditional teaching methods will continue to be the backbone to instruction because it is simple and successful (Chang, & Fisher, 2001). When learners want to apply their knowledge in a safe and diverse environment, video games can provide a solution. The government and the military have successfully used simulations and video games to train their recruits in a safe and cost effective environment. Learning to fly a helicopter can be dangerous and expensive if an accident occurs in real life. However, games and simulations provide cheap alternatives that also save lives (Balci, Bertelrud, Esterbrook, & Nance, 1997).

Learners were given a consent form before the study was conducted in order to determine if they were willing and eligible to participate in the study. Then, the learner was given a research number to ensure anonymity. A Pretest Content Knowledge Assessment was given to the student and was completed online. They were also provided with instructions, details of the study, and the degree of confidentiality for participation. After the Pretest was completed, the learner attended Module 1: Direct Instruction. The module took around fifty minutes to complete. Afterwards, the learner took the Content Knowledge Assessment for a second time. The learner was randomly assigned to attend either Module 2A: VGB Classroom or Module 2B: Traditional Classroom. After completing Module 2A or 2B, the learner completed WEBLEI-VGB. It also contained basic questions in order to gather demographics. The learner took the Content Knowledge Assessment for a third time.

Data from the WEBLEI and the Content Knowledge Assessments were compiled and presented. No definite conclusions were able to be made with the data due to a low participation rate. However, the reported means for all four scales in the VGB Learning Environment and the scores for the Content Knowledge Assessment were slightly higher than those found in the Traditional Learning Environment.

The limitations that effected the size of participants in the study included conflicts with existing classes and activities, the limited methods available to contact students (without coercion or bias), the lack of qualified instructors able to teach the modules and length of the learning modules. The researcher provided critical evaluation of these limitations and solutions for future research.

The growing popularity of using video games as a teaching device creates a need for studies to pinpoint the exact benefits of using gaming in educational settings. This study helps to build the case that video games like SimCityEdu: Pollution Challenge can be valuable in the classroom by motivating a learner through transformational play. Students are allowed to apply their knowledge in a fun and diverse environment. Recently, educators have begun to use the game Portal 2 to assist with the Science, Technology, Engineering and Mathematics learning track (STEM). “One of the biggest challenges in teaching science, technology, engineering, and math is capturing the students’ imaginations long enough for them to see all of the possibilities that lie ahead” (Learn with Portals, 2011). The researcher hopes that this study will lead to successful future research involving video games in the classroom.

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## Appendix A: IRB Approval

To: Jessica Barron
From: Linda Goodfellow, IRB Chair
Subject: Protocol #2014/12/8 - Approval Notification
Date: 12/22/2014

The protocol **Comparison of a computer game based learning environment and a traditional learning environment** has been approved by the IRB Chair under the rules for expedited review on **12/22/2014**.

The consent form is stamped with IRB approval and one year expiration date. You should use the stamped forms as originals for copies that you distribute or display. In addition, I stamped the recruitment flier. Please note that you will need to also copy/paste the approval stamp after you add the additional information related to meeting place. If you have difficulty doing this, please let me know. Lastly, I removed a few words from the email blast due to the expedited rather than exempt review. Please be sure to revise your email blasts accordingly.

The approval of your study is valid through 12/21/2015, by which time you must submit an annual report either closing the protocol or requesting permission to continue the protocol for another year. Please submit your report by **11/23/2015** so that the IRB has time to review and approve your report if you wish to continue it for another year.

If, prior to the annual review, you propose any changes in your procedure or consent process, you must complete an amendment form of those changes and submit it to the IRB Chair for approval. Please wait for the approval before implementing any changes to the original protocol. In addition, if any unanticipated problems or adverse effects on subjects are discovered before the annual review, you must immediately report them to the IRB Chair before proceeding with the study.

When the study is complete, please terminate the study via Mentor by completing the form under the Continual Renewal tab at the bottom of your protocol page and clicking on terminate. Please keep a copy of your research records, other than those you have agreed to destroy for confidentiality, over a period of five years after the study's completion.

If you have any questions, feel free to contact me.

Linda Goodfellow, PhD, RN, FAAN
IRB Chair
goodfellow@duq.edu

Duquesne University IRB
Protocol #2014-12-8
Approved: 12-22-2014
Expiration Date: 12-21-2015

## Appendix B: Consent Form

DUQUESNE UNIVERSITY

Duquesne University IRB
Protocol #2014-12-8
Approved: 12-22-2014
Expiration Date: 12-21-2015

600 FORBES AVENUE ♦ PITTSBURGH, PA 15282

### CONSENT TO PARTICIPATE IN A RESEARCH STUDY

| | |
|---|---|
| **TITLE:** | Comparison of a video game based learning environment and a traditional learning environment |
| **ADVISOR: (if applicable:)** | David D. Carbonara, Ed.D.<br>Assistant Professor<br>School of Education, Instructional Technology<br>327A Fisher Hall<br>600 Forbes Avenue<br>Pittsburgh, PA 15282<br>412-396-4039<br>carbonara@duq.edu |
| **INVESTIGATOR:** | Jessica L Barron, M.A.<br>Ed.D. Candidate in Instructional Technology & Leadership<br>213 Allegheny Street<br>Boswell, PA 15531<br>717-695-1516<br>barronj@duq.edu |
| **SOURCE OF SUPPORT:** | This study is performed as partial fulfillment of the requirements for the doctoral degree in the School of Education at Duquesne University |
| **PURPOSE:** | You are asked to participate in a research project that seeks to investigate student perceptions and knowledge gained in two different learning environments; one a traditional classroom, the other with a video game. After participating in a Content Knowledge pre-test, you will attend Module 1 which will cover pollution and energy resource management. Then you will be randomly grouped into one of the two different learning modules; Module 2A: Video Game Based or Module 2B: Traditional. Once you are placed into a group, you will receive content information about pollution and |

energy resource management. The information will be the same, but the lesson will be presented in a video game or traditional classroom setting. A Content Knowledge Assessment WEBLEI (Web-Based Learning Environment Inventory) will be conducted at the conclusion of the learning modules. The lessons will take up approximately two and a half hours total of your time.

The WEBLEI-VGB, demographic information and the Content Knowledge Assessment will be accessed through an online survey service called SurveyMonkey. SurveyMonkey has a security protocol and uses SSL/TLS Encryption to ensure the data is safe and secure.

These are the only requests that will be made of you.

**RISKS AND BENEFITS:** There are no risks in participating in tests, surveys and video games greater than those encountered in everyday life of playing a video game or learning in a traditional classroom setting. There aren't any direct benefits, other than the knowledge gained from the learning modules presented.

**COMPENSATION:** Participation in the project will not require any monetary cost from you. You are welcome to refreshments and snacks after both modules are completed. You will also receive a certificate of completion immediately at the end of the module.

**CONFIDENTIALITY:** Your name will never appear on any survey or research instruments. No identity of you or your institution will be made in the data analysis. All data will be kept on a secure, password protected network drive only accessible by an assistant in the research department at Pennsylvania Highlands Community College. Your data will be de-identified and then provided to this research for statistical analysis. Your response(s) will only appear in statistical data summaries.

**RIGHT TO WITHDRAW:** You are not under any obligation to participate in this study. Research will not affect your GPA or classroom grades. Research will not be related to your academic progress in the college and there will be no consequence to you or your grades for withdrawing. You are free to withdraw your consent to participate at any time. If you choose to withdraw your participation after the modules are completed, simply provide the number that was issued to you on the date of the study to the assistant in the Institutional Research Department at Pennsylvania Highlands Community College. The assistant will be able to delete your data. At no time will the researcher have access to data with the names attached.

**SUMMARY OF RESULTS:** A summary of the results of this research will be supplied to you, at no cost. Information on how to access the data tables created from the results of this study will be provided to you. The results will be accessible six months after the study is conducted and will be available for a year.

**VOLUNTARY CONSENT:** I have read the above statements and understand what is being requested of me. I also understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project.

I understand that should I have any further questions about my participation in this study, I may call the researcher, Jessica Barron (717-695-1516), or her doctoral advisor, Dr. David Carbonara (412-396-4039). For questions related to human subjects in research, you may contact Dr. Linda Goodfellow, Chair of the Duquesne University Institutional Review Board (412-396-6326).

__________________________________ _____________

Participant's Signature Date

__________________________________ _____________

Researcher’s Signature Date

## Appendix C: Participation Email

Email #1

BCC: (email addresses will be in the BCC line to ensure security)

From: Jessica L Barron jbarron@pennhighlands.edu

Subject: Research Participation Invitation: Traditional Learning and Video Games

Email Body:

Research Participation Invitation: Comparison of a video game based learning environment and a traditional learning environment held on **February 5, 2:00 pm, located in Room** ###, Richland Campus. Please go to room ### to sign up.

This email message is an approved request for participation in research that has been approved by the Duquesne University Institutional Review Board (IRB).

This study will attempt to measure the perceptions of the learners in two different learning environments. Participants will attend two learning modules pertaining to Pollution and Energy Resource Management. They will then be randomly grouped into two different learning environments, one involving traditional learning methods and the other involving a video game. Data about knowledge gained, perceptions of the learning environment and demographics will be collected via an online survey service called SurveyMonkey. SurveyMonkey has a security protocol and uses SSL/TLS Encryption to ensure the data is safe and secure.

Refreshments will be provided to all participants. You are not under any obligation to participate in this study. Research will not affect your GPA or classroom grades. Research will not be related to your academic progress in the college and there will be no consequence to you or your grades for withdrawing. You are free to withdraw your consent to participate at any time.

*Participants must be 18 years or older and a student or alumni of Pennsylvania Highlands Community College. Data collected will be anonymous and kept confidential. There are no risks in participating in tests, surveys and video games greater than those encountered in everyday life of playing a video game or learning in a traditional classroom setting. There aren't any direct benefits, other than the knowledge gained from the learning modules presented.*

If you have any further questions about participation in this study, you may call the researcher, Jessica Barron (717-695-1516), or her doctoral advisor, Dr. David Carbonara (412-396-4039). For questions related to human subjects in research, you may contact Dr. Linda Goodfellow, Chair of the Duquesne University Institutional Review Board (412-396-6326).

Thank you!

Duquesne University IRB
Protocol #2014-12-8
Approved: 12-22-2014
Expiration Date: 12-21-2015

Email #2

BCC: (email addresses will be in the BCC line to ensure security)

From: Jessica L Barron jbarron@pennhighlands.edu

Subject: Last Call: Research Participation Invitation!

Email Body:

Research Participation Invitation: Comparison of a video game based learning environment and a traditional learning environment held on **February 5, 2:00 pm, located in Room** ###, Richland Campus. Please go to room ### to sign up.

This email message is an approved request for participation in research that has been approved by the Duquesne University Institutional Review Board (IRB).

This study will attempt to measure the perceptions of the learners in two different learning environments. Participants will attend two learning modules pertaining to Pollution and Energy Resource Management. They will then be randomly grouped into two different learning environments, one involving traditional learning methods and the other involving a video game. Data about knowledge gained, perceptions of the learning environment and demographics will be collected via an online survey service called SurveyMonkey. SurveyMonkey has a security protocol and uses SSL/TLS Encryption to ensure the data is safe and secure.

Refreshments will be provided to all participants. You are not under any obligation to participate in this study. Research will not affect your GPA or classroom grades. Research will not be related to your academic progress in the college and there will be no consequence to you or your grades for withdrawing. You are free to withdraw your consent to participate at any time.

*Participants must be 18 years or older and a student or alumni of Pennsylvania Highlands Community College. Data collected will be anonymous and kept confidential. There are no risks in participating in tests, surveys and video games greater than those encountered in everyday life of playing a video game or learning in a traditional* *classroom setting. There aren't any direct benefits, other than the knowledge gained from the learning modules presented.*

If you have any further questions about participation in this study, you may call the researcher, Jessica Barron (717-695-1516), or her doctoral advisor, Dr. David Carbonara (412-396-4039). For questions related to human subjects in research, you may contact Dr. Linda Goodfellow, Chair of the Duquesne University Institutional Review Board (412-396-6326).

Thank you!

Duquesne University IRB
Protocol #2014-12-8
Approved: 12-22-2014
Expiration Date: 12-21-2015

**Appendix D: Recruit Flyer**

# Research Recruitment!

## VOLUNTEERS ARE BEING RECRUITED FOR RESEARCH PURPOSES!

You are not under any obligation to participate in this study. Research will not affect your GPA or classroom grades. Research will not be related to your academic progress in the college and there will be no consequence to you or your grades for withdrawing. You are free to withdraw your consent to participate at any time.

**PURPOSE: This study will attempt to measure the perceptions of the learners in two different learning environments.**

Participants will attend two learning modules pertaining to Pollution and Energy Resource Management. They will then be randomly grouped into two different learning environments, *one involving traditional learning methods and the other involving a video game.* Data about knowledge gained, perceptions of the learning environment and demographics will be collected via an online survey service called SurveyMonkey. SurveyMonkey has a security protocol and uses SSL/TLS Encryption to ensure the data is safe and secure.

**Refreshments will be provided to all participants**

*Participants must be 18 years or older and a student or alumni of Pennsylvania Highlands Community College. Data collected will be anonymous and kept confidential. There are no risks in participating in tests, surveys and video games greater than those encountered in everyday life of playing a video game or learning in a traditional classroom setting. There aren't any direct benefits, other than the knowledge gained from the learning modules presented.*

## February 5, 2015 2:00 pm

Located in Room A143 Richland Campus. Please go to IR rooms A140 or A141 to sign up from 8am to 5pm daily in order to participate or e-mail research@pennhighlands.edu

SPONSORED BY:
DUQUESNE UNIVERSITY, SCHOOL OF EDUCATION, INSTRUCTIONAL TECHNOLOGY
327A Fisher Hall, 600 Forbes Avenue, Pittsburgh, PA 15282
412-396-4039 | barronj@duq.edu

DUQUESNE UNIVERSITY
SCHOOL OF EDUCATION

PENNSYLVANIA HIGHLANDS COMMUNITY COLLEGE
101 Community College Way, Johnstown, PA 15904
814.262.6400

## Appendix E: Permission to Use WEBLEI

Re: WEBLEI research instrument
Vanessa Chang [Vanessa.Chang@cbs.curtin.edu.au]
Sent:Monday, July 14, 2014 6:37 PM
To: Jessica L. Barron
Cc: Darrell Fisher [D.Fisher@curtin.edu.au]

Dear Jessica

Your research sounds exciting and is current. I am thrilled that you find the WEBLEI relevant as a learning instrument. Feel free to use it but do let me know what you have changed and perhaps in return I can use it for my work here too. I am currently working on immersive 3D virtual learning environment.

Best of luck in your research. Please keep in touch.

Regards
Vanessa Chang

## Appendix F: Web Based Learning Inventory – Video Game Based

*Demographic Information (1-2 minutes to complete)*

Are you 18 years of age or older?
______Yes (please proceed with survey)
______No (do not proceed with survey)

Gender
______Male
______Female

Race/Ethnicity
______African American/Black
______Asian/Pacific Islander
______Hispanic/Latino
______Multiracial
______Native American/American Indian
______White
______Not listed (please specify)
______Prefer not to respond

Age
______18 to 24 years
______25 to 34 years
______35 to 44 years
______45 to 54 years
______55 to 64 years
______65 or older

Class status
______First Year
______Second Year
______Continuing education student

Area of Study
______Associate Degree
______Certificate or Diploma
______Transfer Program

Hours of video games played in a week
______1-3 hours
______4-6 hours
______6-9 hours
______9-12 hours
______12 or more hours

______I do not play video games

Hours of studying/school work in a week
______1-3 hours
______4-6 hours
______6-9 hours
______9-12 hours
______12 or more hours
______I do not study/complete school work

**WEBLEI – VGB (Web-based Learning Inventory – Video Game Based)**

*Directions for Respondents (5-10 minutes to complete)*

This questionnaire contains statements related to your learning environment. You will be asked how often each practice takes place. There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Think about how well each statement describes what the learning environment is like for you. Draw a circle around

**5** if the practice takes place **Always**
**4** if the practice takes place **Often**
**3** if the practice takes place **Sometimes**
**2** if the practice takes place **Seldom**
**1** if the practice takes place **Never**
**0** if the practice is not a part of this course

Your responses will remain anonymous.

| **ACCESS** | | | | | | |
|---|---|---|---|---|---|---|
| | **Always** | **Often** | **Sometimes** | **Seldom** | **Never** | **N/A** |
| I can access the learning activities at times convenient to me. | 5 | 4 | 3 | 2 | 1 | 0 |
| The learning material is available at locations suitable for me. | 5 | 4 | 3 | 2 | 1 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| I am allowed to work at my own pace to achieve learning objectives. | 5 | 4 | 3 | 2 | 1 | 0 |
| I decide how much I want to learn in a given period. | 5 | 4 | 3 | 2 | 1 | 0 |
| I decide when I want to learn. | 5 | 4 | 3 | 2 | 1 | 0 |
| The flexibility allows me to meet my learning goals. | 5 | 4 | 3 | 2 | 1 | 0 |
| The flexibility allows me to explore my own areas of interest. | 5 | 4 | 3 | 2 | 1 | 0 |

| **INTERACTION** | | | | | | |
|---|---|---|---|---|---|---|
| | **Always** | **Often** | **Sometimes** | **Seldom** | **Never** | **N/A** |
| In this learning environment, I have to be self-disciplined in order to learn. | 5 | 4 | 3 | 2 | 1 | 0 |
| I have the autonomy to ask my instructor what I do not understand. | 5 | 4 | 3 | 2 | 1 | 0 |
| I have the autonomy to ask other students what I do not understand. | 5 | 4 | 3 | 2 | 1 | 0 |
| Other students respond promptly to my queries. | 5 | 4 | 3 | 2 | 1 | 0 |
| I regularly participate in self-evaluations. | 5 | 4 | 3 | 2 | 1 | 0 |
| I was supported by positive attitude from my peers. | 5 | 4 | 3 | 2 | 1 | 0 |

| **RESPONSE** | | | | | | |
|---|---|---|---|---|---|---|
| | **Always** | **Often** | **Sometimes** | **Seldom** | **Never** | **N/A** |

| | | | | | | |
|---|---|---|---|---|---|---|
| I felt a sense of satisfaction and achievement about this learning environment. | 5 | 4 | 3 | 2 | 1 | 0 |
| I enjoy learning in this environment. | 5 | 4 | 3 | 2 | 1 | 0 |
| I could learn more in this environment. | 5 | 4 | 3 | 2 | 1 | 0 |
| It is easy to organize a group for a project. | 5 | 4 | 3 | 2 | 1 | 0 |
| It is easy to work collaboratively with other students involved in a group project. | 5 | 4 | 3 | 2 | 1 | 0 |
| This learning environment held my interest throughout the learning modules. | 5 | 4 | 3 | 2 | 1 | 0 |
| I felt a sense of boredom towards the end of the learning modules. | 5 | 4 | 3 | 2 | 1 | 0 |

**RESULTS**

| | **Always** | **Often** | **Sometimes** | **Seldom** | **Never** | **N/A** |
|---|---|---|---|---|---|---|
| The scope or learning objectives are clearly stated in each lesson. | 5 | 4 | 3 | 2 | 1 | 0 |
| The organization of each lesson is easy to follow. | 5 | 4 | 3 | 2 | 1 | 0 |
| The structure keeps me focused on what is to be learned. | 5 | 4 | 3 | 2 | 1 | 0 |
| Expectations of assignments are clearly stated in my unit. | 5 | 4 | 3 | 2 | 1 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Activities are planned carefully | 5 | 4 | 3 | 2 | 1 | 0 |
| The subject content is appropriate for the delivery chosen. | 5 | 4 | 3 | 2 | 1 | 0 |
| The presentation of the subject content is clear. | 5 | 4 | 3 | 2 | 1 | 0 |
| The systems map activities enhances my learning process. | 5 | 4 | 3 | 2 | 1 | 0 |

## Appendix G: Content Knowledge Assessment

Please answer the following questions to the best of your ability. (5-10 minutes to complete)

1. What chemicals are released into the air when diesel fuel is burned?
    a. Sulfur and Nitrous Oxide
    b. Hydrocarbons and volatile organic compounds
    c. Carbon Dioxide and nitrogen oxide
    d. Mercury and Hydrogen Chloride
2. A shipping company can use a _____________ in order to remove pollution from the exhaust streams.
3. What is an advantage to having a large shipping port near a commercial/residential area?
4. While a larger port can benefit the city, sewage and wastewater can lead to harmful levels of ___________ in the city's water
5. If a town does not have a reliable or efficient power source, what can happen?
6. What are some of the advantages to having a coal power source? What are some of the disadvantages?
    a. Advantages:
    b. Disadvantages:
7. Describe the role of technology and design in reducing human impact on the environment.

**Content Knowledge Assessment Key (Answers in red)**

*Please answer the following questions to the best of your ability. (5-10 minutes to complete)*

1. What chemicals are released into the air when diesel fuel is burned?
    - **a. Sulfur and Nitrous Oxide**
    - b. Hydrocarbons and volatile organic compounds
    - c. Carbon Dioxide and nitrogen oxide
    - d. Mercury and Hydrogen Chloride
2. A shipping company can use a **______________** in order to remove pollution from the exhaust streams.
    - **a. Scrubber**
3. What is an advantage to having a large shipping port near a commercial/residential area?
    - **a. A larger port can lead to goods for local factories, more tourists visiting the area and an increased amount of trade which will boost the economy**
4. While a larger port can benefit the city, sewage and wastewater can lead to harmful levels of ____________ in the city's water
    - **a. algae**
5. If a town does not have a reliable or efficient power source, what can happen?
    - **a. The residential and commercial areas can suffer brown/black outs as a result of reliable energy sources**
    - **b. Jobs/residents will suffer due to lack of power**

6. What are some of the advantages to having a coal power source? What are some of the disadvantages?

    a. **Advantages: Reliable power source; jobs for local residents**

    b. **Disadvantages: Pollution to the local air and water sources.**

7. Describe the role of technology and design in reducing human impact on the environment.

**Answers will vary, but should include how technology can improve the environment if used wisely. Fuel scrubbers can create cleaner fuel for ships to use. Solar panels and windmill farms provide clean energy and can allow coal plants to only be used when surplus power is needed. The more we improve our technology, the better we can decrease our impact upon the environment.**

## Appendix H: Module 1 Lesson Plan

(50 Minutes)

**Read All About It! (Reading Diagrams)**
Lesson Plan adapted from materials provided from GlassLab: Institute of Play (Mission 3 Lesson Plan Part III - Read All About It! 2013)

**Lesson Description**

The Reading Diagrams Challenge gives students practice integrating information from running text and diagrams. Information in the texts is designed to support students in later learning modules. First the teacher introduces students to the tasks and how to complete the lesson. Students then complete the diagrams on their own, identifying variables in the informational texts that best complete the associated diagrams. This activity can be used as a formative assessment of students at this point in the instruction.

At the end of this session, students will share connections they notice between the content of the challenge and the issues that surfaced in the previous learning module.

**21st Century Skills**

Critical thinking and problem solving

- Use systems thinking by analyzing how parts of a whole interact with each other to produce overall outcomes in complex systems.
- Solve different kinds of non-familiar problems in both conventional and innovative ways.

**Essential Questions**

- What are the tradeoffs associated with commercial growth and pollution?
- How can advances in engineering and planning decrease environmental impact?

**Learning Objectives**

By the end of this session, students will be able to...

- Use a causal loop diagram to represent variables that make up a complex system.
- Interpret causal loop diagrams in order to describe parts of a system and the relationships between those parts.
- Locate variables in an informational text and depict their relationships using a causal loop diagram.

**Materials and Preparation**

- Overhead projector, smart board or large computer screen to display the ELA tasks.
- Paper to complete four diagrams

| **Hour 2 Time Frame** | |
|---|---|
| **Introduction** | 5 minutes |
| **Modeling the Reading Diagrams Challenge** | 10 minutes |
| **Reading Diagrams Challenge** | 25 minutes |
| **Closing** | 10 minutes |

**Introduction - 5 minutes**

Begin the class by stating the purpose of the learning module. Overview the complexities of pollution and the need for a stable power source. At the end of the module, they will be able to answer the questions "What are the tradeoffs associated with commercial growth and pollution? How can advances in engineering and planning decrease environmental impact?"

**Modeling the Reading Diagrams Challenge - 10 minutes**

Begin by showing learners the first diagram (*Figure 8*: Solar Panels) via the projector. Remind learners how information is represented in the diagram (eg. “the arrows indicate the direction of movement in the relationship, a plus sign indicates an increase effect, and a minus sign indicates a decrease effect”). Have them complete the diagram on a piece of paper at their desk.

**Reading Diagrams Challenge - 25 minutes**

Show the remaining diagrams (*Figure 9*: Diesel Fuel, *Figure 10*: Water Pollution, *Figure 11*: Growing Business) via projector, giving the students enough time to read the materials and complete the diagrams. Remind students to read through each text first before they attempt to complete the corresponding diagram. As students complete the challenge, circulate the room to check on their progress. You should reinforce the strategies that they’ve learned through the previous lessons.

**Closing - 5 minutes**

Once all students have completed their diagrams, give them a chance to share their answers and what they noticed about the issues discussed in the tasks in order to better connect the activity with the gameplay missions dealing with human impact. Encourage discussion and allow for different viewpoints to be expressed. You may want to start the conversation by asking: “What similarities did you see between the technologies and relationships described in these articles?” You will want to bring up the themes of human impact, complex systems and tradeoff.


*Figure 8*: Solar Panels


*Figure 9*: Diesel Fuel

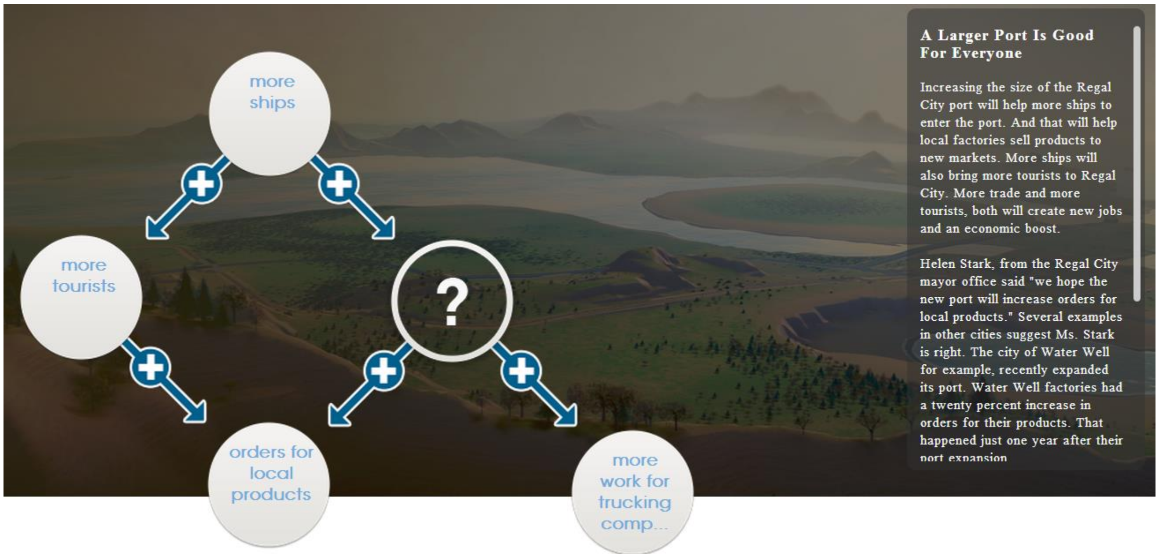


*Figure 10*: Water Pollution


*Figure 11*: Growing Business

## Appendix I: Module 2A Lesson Plan

(VGB Classroom) (45 minutes)

**Lesson Description**

The primary purpose of the day's mission is to give students a chance to work through some of the challenges involved in reducing pollution. This mission is more open-ended than previous missions. It will require students to understand how multiple variables, such as coal plants, green technologies, factories, and non-renewable energy resources, can lead to multiple outcomes and awareness that tradeoffs are sometimes necessary when solving complex problems.

Students are introduced to the mission by first studying a map and a summary of the virtual city they will be working with. Students then complete a Pre-Game Systems Map in order to make predictions about their gameplay. Once students have completed their Pre-Game Systems Map, the teacher models how to access the game tools that they will use to complete this mission, and then students complete the scenario on their own. At the end of this session, students will apply what they learned during gameplay to create new systems maps and then share out their gameplay experiences.

**21st Century Skills**

Critical thinking and problem solving

- Use systems thinking by analyzing how parts of a whole interact with each other to produce overall outcomes in complex systems.
- Solve different kinds of non-familiar problems in both conventional and innovative ways.

**Essential Questions**

- What are the pros and cons of using different energy resources to power a big city?
- What are helpful ways to think about and make positive changes in complex systems?
- What is the role of technology and design in reducing human impact on the environment?

**Learning Objectives**

By the end of this session, students will be able to...

- Use a causal loop diagram to represent variables that make up a complex system and describe the relationships between them.
- Describe some of the trade-offs involved in eliminating sources of air pollution.
- Recognize that there are tradeoffs between the use of green power sources and coal power sources.
- Consider and intervene on multiple variables in order to create desired changes within a complex system.

**Materials and Preparation**

- One desktop PC per student.
- Overhead projector, smart board or large computer screen for displaying the mission’s city map.
- Student Log ID’s and passwords

| **Hour 1 Time Frame** | |
|---|---|
| **Introduction** | 5 minutes |
| **Modeling How to Play the Game: Sierra Madre** | 5 minutes |
| **Pre-Game Challenge: Systems Map** | 5 minutes |
| **Gameplay Session: Sierra Madre** | 20 minutes |
| **Post-Game Challenge: Systems Map** | 5 minutes |
| **Closing** | 5 minutes |

**Introduction - 5 minutes**

Have the instructor computer logged into Mission 4 and displaying the Sierra Madre city map when students enter the room where they will be working. You may wish to begin by saying something like, "In our last gameplay session, we encountered a challenge that required you to increase the city's jobs by adding new commercial and industrial zones. Today, we have another challenging puzzle that will require you to figure out what is causing a city's pollution and then come up with a solution to lower it. Let's start by looking closely at the city we will be working with today and make some predictions about how these variables relate to one another."

**Modeling the Game - 5 minutes**

Begin by modeling for students how to open the Sierra Madre game. Then read the game summary with students. Ask students to study the city map closely and consider what might be causing pollution in the city of Sierra Madre. At this point you can begin modeling for students how to access and use the maps and functions necessary for solving this challenge. These include the:

1. Pollution map
2. Pollution meter showing the level of pollution in the city and the goal

3. The bulldozing tool

4. The power plant menu

Once you have shown students the basic game features and tools, ask students to "think-pair and share" - first thinking of different objects or parts of the city that may be causing pollution, then turning to the person sitting next to them to pair up and take turns sharing out their answers.

Have a subset of the students share out their ideas with the class and then tell them that as a part of the day's gameplay, they are being asked to first create a causal loop diagram for this mission using Pre-Game Systems Map challenge tool.

**Pre-Game Challenge: Systems Map - 5 minutes**

Show students how to access the Pre-Game Systems Map challenge for this mission. Explain that they are being asked to show what may be causing air pollution and jobs in this mission. Create at least one more node so that you can link them with an arrow and select a +/- sign for the relationship. Quickly demonstrate the features of the systems map tool, such as the ability to change the +/- sign, reverse the arrow, delete a connection, and delete a node (see the video for an overview). Then 'read' the diagram aloud, reminding students that they worked with these same diagrams in the previous lessons.

Ask for students' questions and then instruct them to begin creating their own systems maps. Ask students to load the Pre-Game Systems Map challenge and give them 5 minutes to complete it silently.

**Gameplay Session: Sierra Madre - 20 minutes**

As students play through Sierra Madre, circulate the room checking on their progress, making sure students are able to access the game's information sources (summary and tips) and the bulldozing and the power plant creation tools. As students play, they may also need to be reminded of the problem they are trying to solve in Sierra Madre.

If a student is struggling to reduce pollution levels, you might ask, "Were you able to reduce pollution levels in a previous scenario? Do you remember how you did it? What buildings do you think are causing a lot of pollution?" and show them how to use the pollution map to check.

Be sure to keep track of the time as you will want to reserve 10 minutes for the Post-Game Systems Map challenge at the end. Provide students with a 5 minute warning to tell them the game play session is almost over. Students will want to wrap up what they are doing in the game and check their star rating which provides feedback on how well they met the mission's goals.

This game deliberately causes students to fail relatively quickly if they reach a power deficit in the city. If this occurs, students can restart the game without penalty. If students are frustrated by this you might ask, "How is power supply important to a city?" or "How can you create new power sources without causing the city to go dark?" Students will need to add green energy capacity before they shut off the fossil fuel power supplies, just like they would in the real world.

**Post-Game Challenge: Systems Map - 5 minutes**

Ask students to return to the Student Dashboard. You might say something like, "Now that you have worked to solve pollution problems in Sierra Madre, show whether your ideas have changed or stayed the same since you started playing the game. Open up the Post-Game Systems Map tool. Use the map tool to describe what you learned from playing the mission about what may be causing air pollution and jobs." Students should then load the Post-Game Systems Map challenge, complete a new causal loop diagram, and save their work.

**Closing - 5 minutes**

As time permits, lead students in a general discussion about their strategies for beating this mission. For a more targeted discussion, you might also ask, "Did anyone make changes to their diagram? If so, could you tell us what changes you made and why?"

## Appendix J: Module 2B Lesson Plan

(Traditional Classroom) (45 minutes)

Lesson Plan adapted from materials provided from GlassLab: Institute of Play (Mission 4 Lesson Plan – Pollution Problems)

**Lesson Description**

The primary purpose of the lesson is to give students a chance to debate several different scenarios involving pollution, power sources, the local economy and city funding management. The worksheet will serve as a guide for the students as they argue their positions.

This debate will require students to understand how multiple variables, such as coal plants, green technologies, factories, and non-renewable energy resources, can lead to multiple outcomes. They should have awareness that tradeoffs are sometimes necessary when solving complex problems.

Students are introduced to the worksheet by the instructor who will explain the scenario and expectations to them. Students will complete an informational worksheet about each of the power sources and list the pro and cons for each source. After they completed the worksheet, the students will be split into teams and be given roles within the city. They must argue their points using the knowledge they have learned up until that point.

**21st Century Skills**

Critical thinking and problem solving

- Use systems thinking by analyzing how parts of a whole interact with each other to produce overall outcomes in complex systems.

- Solve different kinds of non-familiar problems in both conventional and innovative ways.

**Essential Questions**

- What are the pros and cons of using different energy resources to power a big city?
- What are helpful ways to think about and make positive changes in complex systems?
- What is the role of technology and design in reducing human impact on the environment?

**Learning Objectives**

By the end of this session, students will be able to...

- Describe some of the trade-offs involved in eliminating sources of air pollution.
- Recognize that there are tradeoffs between the use of green power sources and coal power sources.
- Consider and intervene on multiple variables in order to create desired changes within a complex system.

**Materials and Preparation**

- Writing materials
- Case-study worksheets

| **Hour 1 Time Frame** | |
|---|---|
| **Introduction** | 5 minutes |
| **Worksheet: Sierra Madre** | 10 minutes |
| **Debate** | 40 minutes |
| **Closing** | 5 minutes |

**Introduction - 5 minutes**

When students enter the classroom, pass out the worksheet and pieces of blank paper. Instruct them by saying "Today, we will each take on challenging roles involving pollution and power supply management within a town. As a group, you need to figure out what is causing a city's pollution and then come up with a solution to lower it while staying within a certain budget. The solution cannot cause a blackout in power at any time."

**Worksheet - 10 minutes**

Students will complete the worksheet, listing the pros and cons for each power source. In the meantime, the instructor should split them into four small groups and assign them the following roles:

- Mayor: Wants to be re-elected in the upcoming term, so does not want to make controversial decisions involving job availability. Will argue and support the local coal power plant.
- Renewable Energy Entrepreneurs: Are influenced by the amount of pollution in the city, and several well-known and very vocal groups support them (local wildlife preservation groups, health and wellness committees, etc). They have several grants available to install solar panels in select businesses throughout the city. Panels will not be sufficient to replace all of the power available. Businesses must follow certain guidelines in order to receive the free panels.
- City Financial Planner: The financial planner is all about numbers. There is only so much money in the budget for new energy sources ($35,000).

There are currently three coal power plants. One specifically exports energy (5mw to another city in exchange for funding that supports local public schools). Planner only cares about balancing the books.

- City Residents: Mixed opinions. They are complaining about the high amount of pollution. Asthma and colds are on the rise. But jobs are a hot topic; a lot of the citizens work for the coal power plants or are miners. Either way, they demand solutions.

**Debate – 40 minutes**

Students will formulate their arguments and state their primary position. While playing their roles, they must come up with a solution that reduces the pollution in the city, maintains current power levels, while staying within the budget and not drastically reducing jobs. There must be a solution at the end of the debate!

**Closing - 5 minutes**

As time permits, lead students in a general discussion about the debate and the solution they agreed upon. Ask about the trade-offs they made in order to reduce pollution.

## Appendix K: Module 2B Worksheet

(Traditional Classroom) (25 minutes)

**Situation**

Complete the pros and cons for the following power sources. Use this worksheet in order to help you argue your position within the debate.

| Power Plant Statistics | |
|---|---|
| Small wind power plant<br>Cost: $8000<br>MW per day: 4.3 (in 10 mph winds)<br>Pollution: None | Large wind power plant<br>Cost: $15,000<br>MW per day: 10 (in 10 mph winds)<br>Pollution: None |
| Small solar power plant<br>Cost: $22,000<br>MW per day: 9 (peak hours)<br>Pollution: None | Large solar power plant<br>Cost: $23,500<br>MW per day: 12 (peak hours)<br>Pollution: None |
| Coal Power plant<br>Cost: $10,500<br>MW per day: 9 (4.3 tons of coal a day)<br>Pollution: High | |

**Questions: Comparing Energy vs Pollution**

Name one pro and one con for each power source.

**Coal Power Plants**

PRO: ____________________________________________________________

____________________________________________________________

____________________________________________________________

CON: ____________________________________________________________

____________________________________________________________

____________________________________________________________

**Solar Power Plants**

PRO: ________________________________________________________________

________________________________________________________________

________________________________________________________________

CON: ________________________________________________________________

________________________________________________________________

________________________________________________________________

**Wind Power Plants**

PRO: ________________________________________________________________

________________________________________________________________

________________________________________________________________

CON: ________________________________________________________________

________________________________________________________________

________________________________________________________________

## Appendix L: Module 2B Worksheet Debate Roles

(Traditional Classroom) (25 minutes)

**Student Debate Roles**

- **Mayor**: Wants to be re-elected in the upcoming term, so does not want to make controversial decisions involving job availability. Will argue and support the local coal power plant.
- **Renewable Energy Entrepreneurs:** Are influenced by the amount of pollution in the city, and several well-known and very vocal groups support them (local wildlife preservation groups, health and wellness committees, etc). They have several grants available to install solar panels in select businesses throughout the city. Panels will not be sufficient to replace all of the power available. Businesses must follow certain guidelines in order to receive the free panels.
- **City Financial Planner:** The financial planner is all about numbers. There is only so much money in the budget for new energy sources ($35,000). There are currently three coal power plants. One specifically exports energy (5mw to another city in exchange for funding that supports local public schools). Planner only cares about balancing the books.
- **City Residents:** Mixed opinions. They are complaining about the high amount of pollution. Asthma and colds are on the rise. But jobs are a hot topic; a lot of the citizens work for the coal power plants or are miners. Either way, they demand solutions.

WORKSHEET ANSWER KEY

**Coal Power Plants**

PRO: They produce large amounts of energy for a small upfront cost.

CON: They produce high amounts of pollution for neighboring residents. Destroying a coal power plant can reduce jobs and also cause black outs if there are not back-up sources of energy being provided.

**Solar Power Plants**

PRO: They can produce large amounts of energy with no pollution for neighboring residents

CON: It is costly to install Solar Power Plants and they do not provide energy during non-peak hours (when the sun is not out). This can cause black-outs if there are not back-up sources of energy being provided.

**Wind Power Plants**

PRO: They produce high amounts of energy with no pollution for neighboring residents

CON: In order to generate 10 mw or energy, large wind power plants must be placed in areas that produce winds 10mph or higher.

**Critical Thinking Questions**

How is power supply important to a city?

*A city relies upon power in many ways. Citizens need power in order to live in their homes and use the facilities needed to live. Refrigerators would turn off, causing food to spoil. Hot water tanks would go cold and citizens would need to find creative ways to heat their food without an electric source. Business and Industries rely upon power in order to function. Citizens rely upon businesses and industries for goods and for employment. Without power, a city would fail.*

What causes black outs to occur in a city?

*Black outs occur when there is not enough MW being produced in order to power the city.*

What are the different ways you can create new power sources without causing black-outs?

*Building new renewable (solar/wind) power plants before you start to take out heavy polluting coal plants can avoid power black outs in the city (causing it to go dark). You must make sure that enough energy has been accumulated before destroying or turning off other sources of power.*

What would happen if you used one power source during the day and another at night? What are the pros and cons of using this solution?
*One could chose to use solar power (or wind power) during peak hours and turn off coal power plants at this time.  During non-peak hours (nighttime), the coal plants would run in order to avoid black-outs.  This would reduce pollution somewhat, and would decrease the amount of jobs lost.  However, it would be expensive for the city to maintain the increased amount of power plants, and the pollution would still be an issue.*

Which type of energy did you decide to use to help solve the pollution problem? What are your reasons for choosing it?
*Variety of answers can be found here.  A solution that produces enough power but decreases pollution is desired.*

## Appendix M: Descriptive Statistics

Table 24

*Scale I: Access VGB*

| Descriptive Statistics: Video Game Based Environment | | | | |
|---|---|---|---|---|
| Access | N | Mean | S.E.M. | Std. Deviation |
| Q1ACC | 6 | 3.50 | .224 | .548 |
| Q2ACC | 6 | 4.17 | .307 | .753 |
| Q3ACC | 6 | 4.00 | .365 | .894 |
| Q4ACC | 6 | 3.67 | .558 | 1.366 |
| Q5ACC | 6 | 4.17 | .307 | .753 |
| Q6ACC | 6 | 4.00 | .365 | .894 |
| Q7ACC | 6 | 4.00 | .258 | .632 |

Table 25

*Scale II: Interaction VGB*

| Descriptive Statistics: Video Game Based Environment | | | | |
|---|---|---|---|---|
| Interaction | N | Mean | S.E.M. | Std. Deviation |
| Q1INT | 6 | 3.67 | .422 | 1.033 |
| Q2INT | 6 | 4.67 | .211 | .516 |
| Q3INT | 6 | 4.50 | .342 | .837 |
| Q4INT | 6 | 3.67 | .422 | 1.033 |
| Q5INT | 6 | 4.50 | .342 | .837 |
| Q6INT | 6 | 2.83 | .833 | 2.041 |

Table 26

*Scale III: Response VGB*

| Descriptive Statistics: Video Game Based Environment | | | | |
|---|---|---|---|---|
| Response | N | Mean | S.E.M. | Std. Deviation |
| Q1RSP | 6 | 3.67 | .333 | .816 |

| | | | | |
|---|---|---|---|---|
| Q2RSP | 6 | 4.50 | .342 | .837 |
| Q3RSP | 6 | 3.83 | .307 | .753 |
| Q4RSP | 6 | 3.50 | .428 | 1.049 |
| Q5RSP | 6 | 3.83 | .401 | .983 |
| Q6RSP | 6 | 4.17 | .401 | .983 |
| Q7RSP | 6 | 2.67 | .919 | 2.251 |

Table 27

*Scale IV: Results VGB*

| **Descriptive Statistics: Video Game Based Environment** | | | | |
|---|---|---|---|---|
| Results | N | Mean | S.E.M. | Std. Deviation |
| Q1RES | 6 | 3.50 | .764 | 1.871 |
| Q2RES | 6 | 3.33 | .715 | 1.751 |
| Q3RES | 6 | 4.00 | .365 | .894 |
| Q4RES | 6 | 4.17 | .307 | .753 |
| Q5RES | 6 | 3.67 | .760 | 1.862 |
| Q6RES | 6 | 3.00 | .730 | 1.789 |
| Q7RES | 6 | 3.50 | .500 | 1.225 |
| Q8RES | 6 | 3.50 | .500 | 1.225 |

Table 28

*Scale I: Access Traditional*

| **Descriptive Statistics: Traditional Environment** | | | | |
|---|---|---|---|---|
| Access | N | Mean | S.E.M. | Std. Deviation |
| Q1ACC | 4 | 3.00 | .707 | 1.414 |
| Q2ACC | 4 | 3.75 | .479 | .957 |
| Q3ACC | 4 | 3.50 | .645 | 1.291 |
| Q4ACC | 4 | 3.25 | .750 | 1.500 |
| Q5ACC | 4 | 3.50 | .289 | .577 |
| Q6ACC | 4 | 3.75 | .750 | 1.500 |
| Q7ACC | 4 | 4.50 | .500 | 1.000 |

Table 29

*Scale II: Interaction Traditional*

| **Descriptive Statistics: Traditional Environment** | | | | |
|---|---|---|---|---|
| Interaction | N | Mean | S.E.M. | Std. Deviation |
| Q1INT | 4 | 2.75 | .750 | 1.500 |
| Q2INT | 4 | 3.25 | .479 | .957 |
| Q3INT | 4 | 3.00 | .577 | 1.155 |
| Q4INT | 4 | 3.50 | .289 | .577 |
| Q5INT | 4 | 4.00 | .408 | .816 |
| Q6INT | 4 | 2.75 | .946 | 1.893 |

Table 30

*Scale III: Response Traditional*

| **Descriptive Statistics: Traditional Environment** | | | | |
|---|---|---|---|---|
| Response | N | Mean | S.E.M. | Std. Deviation |
| Q1RSP | 4 | 3.00 | .913 | 1.826 |
| Q2RSP | 4 | 3.50 | .645 | 1.291 |
| Q3RSP | 4 | 3.50 | .645 | 1.291 |
| Q4RSP | 4 | 3.25 | .250 | .500 |
| Q5RSP | 4 | 4.00 | .408 | .816 |
| Q6RSP | 4 | 3.75 | .629 | 1.258 |
| Q7RSP | 4 | 2.50 | .957 | 1.915 |

Table 31

*Scale IV: Results Traditional*

| **Descriptive Statistics: Traditional Environment** | | | | |
|---|---|---|---|---|
| Results | N | Mean | S.E.M. | Std. Deviation |
| Q1RES | 4 | 3.50 | .866 | 1.732 |
| Q2RES | 4 | 4.25 | .250 | .500 |
| Q3RES | 4 | 3.25 | .854 | 1.708 |

| | | | | |
|---|---|---|---|---|
| Q4RES | 4 | 3.25 | .479 | .957 |
| Q5RES | 4 | 4.00 | .408 | .816 |
| Q6RES | 4 | 3.00 | 1.080 | 2.160 |
| Q7RES | 4 | 3.50 | .645 | 1.291 |
| Q8RES | 4 | 3.50 | .645 | 1.291 |

## Appendix N: Case Summaries

Table 32:

*Scale I: Interaction Case Summaries*

| **Case Summaries** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Research Number | Module | Q1INT | Q2INT | Q3INT | Q4INT | Q5INT | Q6INT |
| 492978 | 2A | 3 | 5 | 3 | 3 | 5 | 3 |
| 560115 | 2A | 5 | 5 | 5 | 5 | 5 | 5 |
| 270067 | 2A | 3 | 4 | 5 | 3 | 4 | 0 |
| 719523 | 2A | 3 | 4 | 4 | 3 | 3 | 3 |
| 357549 | 2A | 5 | 5 | 5 | 5 | 5 | 5 |
| 249477 | 2A | 3 | 5 | 5 | 3 | 5 | 1 |
| 551724 | 2B | 4 | 4 | 4 | 3 | 5 | 3 |
| 482835 | 2B | 1 | 3 | 2 | 4 | 3 | 0 |
| 335789 | 2B | 2 | 2 | 2 | 3 | 4 | 4 |
| 786406 | 2B | 4 | 4 | 4 | 4 | 4 | 4 |

Table 33:

*Scale II: Access Case Summaries*

| **Case Summaries** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Research Number | Module | Q1ACC | Q2ACC | Q3ACC | Q4ACC | Q5ACC | Q6ACC | Q7ACC |
| 492978 | 2A | 3 | 3 | 4 | 5 | 4 | 3 | 4 |
| 560115 | 2A | 4 | 5 | 5 | 5 | 5 | 5 | 4 |
| 270067 | 2A | 3 | 4 | 5 | 4 | 4 | 4 | 4 |
| 719523 | 2A | 3 | 5 | 3 | 2 | 3 | 3 | 3 |
| 357549 | 2A | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 249477 | 2A | 4 | 4 | 3 | 2 | 5 | 5 | 5 |
| 551724 | 2B | 5 | 5 | 5 | 2 | 3 | 5 | 5 |
| 482835 | 2B | 2 | 3 | 3 | 5 | 4 | 2 | 3 |
| 335789 | 2B | 2 | 3 | 2 | 2 | 4 | 3 | 5 |
| 786406 | 2B | 3 | 4 | 4 | 4 | 3 | 5 | 5 |

Table 34:

*Scale III: Response Case Summaries*

| Case Summaries | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Research Number | Module | Q1RSP | Q2RSP | Q3RSP | Q4RSP | Q5RSP | Q6RSP | Q7RSP |
| 492978 | 2A | 3 | 5 | 4 | 3 | 3 | 5 | 1 |
| 560115 | 2A | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 270067 | 2A | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 719523 | 2A | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| 357549 | 2A | 4 | 5 | 4 | 4 | 5 | 5 | 5 |
| 249477 | 2A | 4 | 5 | 3 | 2 | 3 | 3 | 1 |
| 551724 | 2B | 5 | 5 | 5 | 3 | 4 | 5 | 2 |
| 482835 | 2B | 1 | 3 | 3 | 3 | 5 | 4 | 0 |
| 335789 | 2B | 2 | 2 | 2 | 3 | 3 | 2 | 4 |
| 786406 | 2B | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

Table 35:

*Scale IV: Results Case Summaries*

| Case Summaries | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Research Number | Module | Q1RES | Q2RES | Q3RES | Q4RES | Q5RES | Q6RES | Q7RES | Q8RES |
| 492978 | 2A | 4 | 4 | 3 | 5 | 4 | 4 | 3 | 5 |
| 560115 | 2A | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 270067 | 2A | 5 | 4 | 5 | 3 | 4 | 2 | 2 | 3 |
| 719523 | 2A | 0 | 0 | 3 | 4 | 0 | 3 | 3 | 3 |
| 357549 | 2A | 4 | 4 | 4 | 4 | 5 | 0 | 3 | 3 |
| 249477 | 2A | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 2 |
| 551724 | 2B | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 |
| 482835 | 2B | 1 | 4 | 3 | 3 | 4 | 0 | 2 | 3 |
| 335789 | 2B | 4 | 4 | 1 | 2 | 3 | 3 | 3 | 2 |
| 786406 | 2B | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |