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THE USE OF A DIGITAL GAME-BASED SAFETY PROGRAM FOR ALL-TERRAIN VEHICLES: OPERATIONAL KNOWLEDGE FOR YOUTHFUL RIDERS

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DISSERTATION

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ABSTRACT OF DISSERTATION

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Given the exposure and preference of digital natives for games, along with the proliferation of digital devices, there is a need to determine how effective digital games are in conveying operational knowledge to our youth. This quasi-experimental study examined whether a digital safety game increased high school student operational knowledge of All-terrain Vehicle (ATV) safety in contrast to conventional PowerPoint ATV safety training with commensurate information. The first treatment group consisted of “in class” students participating in the ATV game, the second treatment group was made up of “free play” students playing the game out of class, and finally the third treatment group consisted of “in class” students participating in the digital PowerPoint. A matched control group received no treatment during the study. The analysis of the results of pre- and post-test scores showed that there was no significant difference between the “in class” game and PowerPoint treatments. However, there was significant difference between the “in class” game as compared to both the “free play” game as well as the control. These findings may have been due to the lack of incentive (a grade or extra credit) for the high school students in an out of school setting. Perhaps, the interface or design of the game-based ATV may not have been conducive to digital natives who may expect more interactive games where participants have greater control. Players also noted that game availability on portable devices such as smartphones and tablets would have been desirable. This study demonstrated the effectiveness of an ATV safety game to promote operational knowledge, particularly in instructional or educational settings. School safety classes, agricultural education, ATV safety courses or FFA then may be productive venues for game-based ATV instruction. Future research might explore what additional instructional design features can elicit greater interest for the player.

This study focused on the instructional components of ATV operational safety. Additional Human-Technology Interaction (HTI) research might analyze the planning, design and use of interfaces that include usability experience (UX) other delivery devices, testing, think-alouds, and eye tracking for more detailed information about gamers' learning experiences in ATV safety games.

KEYWORDS: Game-based Learning, Instructional Design, e-learning, Operational Knowledge, ATV, Safety.

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Background and Significance of ATV Injuries

According to ATVSafety.gov, in 2010, 115,000 ATV riders required emergency room treatment. In addition, there were 317 reported ATV-related fatalities. Of those deaths, 55 were reported for children under the age of 16. In the state of Kentucky, 499 fatalities were reported from 1982 – 2010. Of those deaths, 84 were reported for children under the age of 16. The Consumer Product Safety Commission ranked Kentucky third in the nation for ATV-related fatalities from 2007-2010 (Tenenbaum, 2013).

The 2012 National Electronic Injury Surveillance System (NEISS) provided a sample of consumer product-related injuries that appeared in the NEISS emergency departments. This system provided a probability sample. Thus, when the number of injuries reported the actual number from the NEISS hospitals, the estimated number of injuries were calculated by adding the statistical weights for that specific injury. As shown in Table 1.1 below, while select emergency departments reported 5,190 ATVs, moped and mini-bike injuries (these numbers could not be teased apart), the estimated number of injuries were 226,549 for all age groups. Ages 15-24 appeared to be the group at highest risk of injury.

Table 1.1. Associated Injuries and Age Groups from NEISS Data

Age	0-4	5-14	15-24	25-64	65+
Injuries	4,597	42,690	72,420	96,925	9,918

Seventy-four percent (74%) of injuries occurred to males and 26% to females. Overall, 88% of all injuries were treated and released. The remainder were either hospitalized or dead on arrival (Schroeder, 2013).

A 2011 Morbidity and Mortality Weekly Report (MMWR) examined recreational nonfatal traumatic brain injury (TBI) for children 19 and under. The time period was from 2001 – 2009 in the US. For males from 15-19 years of age, ATVs were the fifth leading cause of TBI (CDC, 2011). The incidences of child injuries were disturbing. They over represented the remainder of the population, and their numbers were on the rise. According to the Journal of Pediatric Orthopaedics, child injuries increased 240 percent since 1997. Those children of ATV incidents were most likely to experience musculoskeletal injuries (Sawyer et al., 2012).

Despite this disturbing data, ATV riding among youth continued. Parents continued to purchase these dangerous 'toys' and thus it was crucial that safety programs for youthful ATV riders not only be provided, but that they understood what kinds of programs would both engage these young at-risk riders *and* result in their understanding of safe ATV riding practices.

Injury Prevention Models and ATV Safety Programs

Prior to 1960, many safety and injury prevention approaches focused only on the specific *result* of an unsafe practice or dangerous situation – emphasizing only the injury or fatality event itself. Thus programs designed using these approaches might result in a public information campaign with slogans such as "Just Say NO! (to drugs), 'Stop Smoking!' or 'Wear a Helmet on an ATV.' In the late 1960s, William Haddon developed an injury prevention model that expanded the consideration of an injury 'event' to include what situations or actions preceded it, the injury itself and then what happened following the injury event. His phase by factor approach, termed the *Haddon* Matrix, is a more robust and useful model for implementing injury prevention programs. As shown in Table 1.2, the phases were Pre- injury event, Injury Event, and Post- injury event. The factors he identified were Host, Agent, and Environment. The Host refers to the individual or individuals who are at risk to be injured during a given event. The Agent always refers to some type of force. This force could be the impact of the Host riding an ATV into a solid object. The Environment is the atmosphere in which the injury takes place. The Environment can be a physical entity, or a legal or social one. The Haddon Matrix allows one to look at the Host, the Agent and the Environment prior to, during and after an injury (Haddon, 1968). In fact, prevention is only possible in the pre-event situation and thus of crucial importance in designing any safety intervention programs. By noting the pre-event host, agent and environment one can see where imparting ATV safety training could have a potentially positive impact on the rider.

Table 1.2. The Haddon Matrix showing the phase (on the left column) by factor (top row) dimensions of an injury event.

	Host	Agent	Environment
Pre-event	experience, age	Pre-inspection, fuel, lights, oil, brakes	Sufficient light to ride, no brush, safe trails
Event	Helmet, gloves, goggles, long pants, long sleeves, appropriate boots	ATV design, speed limiter, weight of ATV	Clear trail, no debris, no water
Post-event	Another rider to call for help, first aid	Combustion	Distance and time for emergency personnel to arrive, type of hospital

ATV Safety Training Programs

Many types of ATV safety interventions exist. These range from online trainings, to onsite trainings to a variety of instructional interventions designed to make riders aware of the safety issues related to HOST, AGENT and Environmental factors. Delivery systems for ATV safety interventions include trainings such as hands-on, paper and pencil training, and online training.

For example, the ATV Safety Institute offers an online “ATV RiderCourse” (www.atvsafety.org), and in-person training experience with an ATV. This hands-on training is available for all ages, including riders less than 12 years of age. Riders learn about “pre-ride inspection, starting and stopping, quick turns, hill riding, emergency stopping and swerving and riding over obstacles”. One difficulty with a face-to-face training approach such as the one offered here is locating on-site training near the rider’s residence.

Another type training approach is the use of simulation. An example of a paper and pencil simulation used in the ATV training is “Brad’s Last Ride”. In this simulation, two friends, Brad and Zach, ride their ATVs on a farm. Brad misses the gate opening and crashes into the fence, resulting in long-term serious injuries. *Brad’s Last Ride* promotes critical thinking and allows students to problem solve. The emphasis is to have a rider consider the pre-injury event situation and learn to make better choices before riding and a potential Injury Event. In this simulation, one safety equipment item that could have made a difference in the outcome of Brad’s injury is wearing a helmet (H. P. Cole, 1994).

Helmets are relatively inexpensive, especially when taking into consideration the costs of injuries. A traumatic brain injury may result in hospital costs of hundreds of thousands of dollars. In addition, there could be days, months or years of productive life lost (YPLL). A helmet may reduce the risk of fatal injuries by 42% and non-fatal injuries by 64% (M. L. Myers, Cole, & Mazur, 2009). The Economics of Prevention program uses Brad’s Last Ride as a safety intervention, among other interventions, with middle and high school students. By using this narrative simulation treatment with students in counties identified as at risk, students become more aware of not just the immediate risks, but also the long-term social and financial risks to themselves, their families and their communities (Myers, Cole, Mazur, & Isaacs, 2008).

Digital gaming is another recent approach to engage youthful riders in attending to life-saving ATV safety information. *Treadsylvania* [figure 1.1] is an interactive web-based ATV safety video game geared for ages 8-18. Game designers at the New Mexico State University Learning Games Lab (http://treadsylvania.com/) developed the game. Good educational video games can hold a learner's attention. Games also employ story elements similar to simulations. Gamification elements include goals (in the form of quests), roles, and rewards. A well-documented feature of digital gaming is engagement. Games can get people to enjoy learning a range of important content principles, including a range from simple to complex concepts (Prensky, 2001), which may be particularly important in getting youthful riders to attend to life-saving safety information, a topic that might not otherwise hold their interest.

Figure 1.1 Treadsylvania Screen Capture

Digital Gaming and Safety Knowledge

Several studies exist demonstrating knowledge gains through gaming in the area of safety knowledge (Coles, Strickland, Padgett, & Bellmoff, 2007; Lynch, 2008; Rüppel & Schatz, 2011). Coles et al (2007) conducted a study entitled, “Games that ‘work’: using computer games to teach alcohol-affected children about fire and street safety”. Children with fetal alcohol syndrome were exposed to a fire and street safety game. After the treatment, the children demonstrated greater safety knowledge.

Lynch (2008) conducted a study entitled, “Delivering Food Safety Education to Middle School Students Using a Web-Based, Interactive, Multimedia, Computer Program”. Public Health professionals have declared foodborne illness to be a major safety concern. In this study, eighth grade students participated in a computerized pre-test. Next, they viewed a web video, followed by a web-based game. Finally, the students participated in a computerized post-test. The researchers were interested in cognitive and attitudinal differences. While the differences were positive and statistically significant, they were still lower than the researchers had predicted.

In a study entitled, “Designing a BIM-based serious game for fire safety evacuation simulations”, BIM, or “Building Information Modeling”, is the process of digitizing an actual building, including operation of doors, elevators, and similar structures. This project was to be the first part of a digital game called, “Serious Human Rescue Game” (SHRG). The game was to allow firefighters to learn safety skills in rescuing people in a real fire (Rüppel & Schatz, 2011). The findings of SHRG were firefighters were better prepared for incidents practiced in a virtual environment. What made SHRG different from other virtual trainers (RescueSim, Tactical Command Trainer) was its player-adaptive features. This game had the ability to collect and implement human behavior data into the game, and present to the player quickly changing scenarios.

A more complete review of the interactive games for safety training and information is presented in Chapter Two. However, digital gaming is beginning to have widespread use for engaging youth for the purposes of understanding important health & safety information.

Purpose of the Study

The purpose of this study was to explore if a digital game-based safety intervention (Treadsylvania) would be a productive intervention for high school youth to gain knowledge needed for safe ATV operation, and the use of safety equipment like helmets, gloves, and goggles.

A quasi-experimental, pre-post study design was proposed. Participants in the treatment and control groups were high school students in rural Kentucky schools that agreed to participate in the study.

Brief Overview of the Study Treatments and Conditions

The two treatments used in this study employed a PowerPoint ATV Safety Training (non-game) developed by Kent Shannon at the University of Missouri Extension in conjunction with 4-H, and the ATV video safety game Treadsylvania, developed by the New Mexico State University's Learning Games Lab through the National 4-H Council. The Treadsylvania game was delivered in two conditions – one is an in class delivery, in a high school classroom setting and the other is a non-classroom, student 'free choice' condition. In this latter condition, students were given information about the game, and instructed to use within a specified time period, but not in formal classes. The non-game, PowerPoint was also delivered in an in-class setting and there was a control condition wherein participants received no treatments but did the pre-post testing in a class setting. The specific safety knowledge measured in the pre- and posttests were commensurate in both the PowerPoint and video game. The two treatments were delivered via the Internet, to eliminate one possible source of bias; that being paper and pencil vs. electronic media. Both treatments (game and non-game) are targeted for middle and high school students.

Research Questions

The fundamental question of this research was to determine if game-based safety interventions promote improvement in ATV safety knowledge as compared to a computer delivered non-game (PowerPoint) intervention containing the same safety information. Additional questions sought to identify if additional demographic factors, such as previous ATV safety training or riding experience, enhanced or detracted from this type of learning. A quasi-experimental design was used to address these questions (Shadish, 2002).

All questions in this study were addressed by quantitative methods; those being 1) does the primary game-based intervention produce greater safety knowledge change than the control; 2) does the primary game-based intervention produce greater safety knowledge change as compared to a non-game (PowerPoint) treatment with similar safety information; 3) will prior ATV riding experience affect the knowledge change; 4) will prior ATV safety training affect the knowledge change; and 5) will prior ATV riding experience and safety training affect the knowledge change?

Research Question One:

Does the evidence suggest students exposed to the ATV safety training game treatment will demonstrate greater safety knowledge than the control group as measured by the posttest?

Hypothesis 1 –

DVs: Gaming Treatment in Class, Control.

IVs: Posttest scores on Gaming Treatment in Class and Control.

Students exposed to the gaming treatment will perform higher on posttest knowledge measures than students with no treatment.

Research Question Two:

Does the evidence suggest students exposed to the ATV safety training game treatment will demonstrate greater safety knowledge than the group exposed to the non-gaming Microsoft PowerPoint passive training as measured by the posttest?

Hypothesis 2 –

DVs: Gaming Treatment in Class, PowerPoint Treatment.

IV: Posttest scores on Gaming Treatment in Class and PowerPoint.

Students exposed to the gaming treatment will perform equally or higher on posttest knowledge measures compared to the PowerPoint group.

Research Question Three:

Does the evidence suggest students exposed to the ATV safety training game treatment with prior ATV riding experience will demonstrate greater safety knowledge than the game treatment with no prior riding experience?

Hypothesis 3 –

DVs: Gaming Treatment in Class with and without prior riding experience.

IV: Posttest scores on Gaming Treatment in Class with and without prior riding experience.

Students exposed to the gaming treatment and having prior ATV riding experience will demonstrate greater posttest safety knowledge than those exposed to the gaming treatment without prior ATV riding experience.

Research Question Four:

Does the evidence suggest students exposed to the ATV gaming treatment with prior

ATV safety training will demonstrate greater safety knowledge than those exposed to the gaming treatment without prior ATV safety training?

Hypothesis 4 –

DVs: Gaming Treatment in Class with and without prior safety training.

IV: Posttest scores on Gaming Treatment in Class with and without prior safety training.

Students who have been exposed to the gaming treatment and who have prior ATV safety training will demonstrate greater safety knowledge than those exposed to the gaming treatment without any prior ATV safety training.

Research Question Five:

Do the data show students who have been exposed to the gaming treatment and have had prior ATV riding experience and prior ATV safety training will demonstrate greater safety knowledge than any other group measured in this experiment?

Hypothesis 5 –

DVs: Gaming Treatment in Class with prior riding experience and prior safety training vs. Gaming Treatment in Class without prior riding experience and prior safety training.

IV: Posttest scores on Gaming Treatment in Class with prior riding experience and prior safety training vs Gaming Treatment in Class without prior riding experience and prior safety training.

Students who have been exposed to the gaming treatment and have had prior ATV experience and prior ATV safety training will demonstrate the greatest amount of safety knowledge.

Glossary of ATV Terms

- Active Riding – Shifting your body weight forward, backward, left, or right while riding an ATV to compensate the forces of acceleration or gravity
- ATV – All Terrain Vehicle designed for off-road riding
- Boots – Used to protect feet, and provide stability and traction when standing on the ATV footrests
- CC – Cubic Centimeters – used to describe the horsepower or engine power of ATVs
- Curb Weight – ATV weight without driver or cargo
- Gloves – Used to protect the hands from scrapes, and reduce vibration to the hand while riding an ATV
- Goggles – Protect the eyes from insects, debris and wind fatigue
- Governor – Engine component in ATVs Used to restrict the maximum speed of the ATV
- Height – Height of the handlebars
- Helmet – In addition to protecting the skull, the visor protects the eyes from insects and wind, and the helmet reduces ambient noise
- Max Load – Maximum weight allowed on an ATV by manufacturer guidelines in excess of the weight of the ATV
- Protective Clothing – Provides protection from debris. May also have padding and chest protector to protect chest, hips, elbows and shoulders. Personal Protective

Equipment (PPE) is also a term used for protective clothing or devices in the safety field.

- Quad – Alternate term for ATV
- Rider-Active – See Active Rider
- Rollover – Crash where the ATV rolls forward, backward, or to the side once or numerous times
- Second Rider – An additional rider that would prevent Active Riding
- Tire Pressure– ATV tires are low pressure to handle rough and uneven terrain
- Trail signs – Provide regulations and trail information or conditions in outdoor parks, ATV parks or other natural settings
- Traversing – Crossing a sloped hill on an ATV
- Winch – Steel cable attached to ATV to pull the ATV or other ATVs when stuck

In Chapter 2, I present the conceptual framework of the study and the review of relevant literature is examined. The literature review will examine what the research says, how the research was carried out, and what gap, if any, exists. Chapter 3 articulates the methodology for this dissertation study. In Chapter 4, I present the results of the study, addressing the research questions. Lastly, in Chapter 5, I interpret the results of the findings, and propose future research based on this study.

Chapter Two: Review of the Literature

This chapter presents the theoretical framework for the study and the results of the research on ATV injuries, safety gaming and improvement in safety knowledge. On-line searches were conducted from Academic Search Premier, Dissertations and Theses (ProQuest), E-Journals, EBSCOhost, PsycINFO, and WorldCat. All databases were searched through 2013 for such terms as gamification, educational gaming, safety games, knowledge transfer, transformational play, Haddon's Matrix, cognitivism, behaviorism, culturalism, constructivism, Skinner, Vygotsky, Gee, Prensky, and All Terrain Vehicles. Information from primary research studies, books, magazines, and theses were identified and collected. The literature search was limited to having some aspect of safety, games, instructional design, ATVs, and education.

The 4-C Integrated Theoretical Framework for the Study: Culture, Cognition, Conduct and Consequences

While the three epistemological positions of behaviorism constructivism, and socioculturalism are typically considered different approaches, in point of fact safety training has employed all three approaches, each with potential to be effective. In 2002, after years of developing safety programs in fields as diverse as mining and farming, Cole (2013) developed a framework that articulated how culture, cognition, conduct and consequences all must be considerations when designing safety training programs.

Culture and Cognition: Social and Individual Safety Practices

Constructivism literally focuses on an individual’s construction of meaning. This meaning can be derived, according to Piaget, cognitively, depending on where the student resides in his or her stage of learning (Powell & Cody, 2009). Depending on that stage, the student can develop their own personal meaning.

According to Vygotsky, this meaning occurs within the student's Zone of Proximal Development (ZPD). Once students do what they can on their own, they are assisted by instructors to achieve even more, through a process of scaffolding. Scaffolding helps the student get to the next level by one or more means; the instructor, a friend, social groups, etc. (Powell, 2009; Prawat, 1999; Wang, 2012).

Socioculturalism builds upon cognitivism. Cognitivists believe different learners draw different conclusions when presented with the same information. They derive their own meaning. With socioculturalism, learners share their experiences, meanings and interpretations with each other. The result is having a shared and perhaps greater understanding (Bereiter, 1994). Lev Vygotsky discussed the "mediated mind", where collaborative construction can take place (Vygotsky, 1978). Sharing a common threaded discussion via the Internet as a source of mediation would allow individuals to share their experiences with each other.

Scaffolding: Impact on Gaming

Gaming may allow the player to build upon existing knowledge, and require additional knowledge and/or skill to reach the next level. This skill to reach the next level can have a degree of frustration. In fact, a certain degree of frustration may be necessary. Too little challenge and frustration may result in a boring game which is quickly dismissed by player. Too much frustration and challenge can result in the player likewise giving up on the game. Hitting the “sweet spot” of challenge and frustration may result in the player returning again and again to play the game. Scaffolding is one means of lowering frustration as players take on higher or more demanding levels of a game. This could be key in bridging the gap of what the player knows and needs to know, and assists in problem solving (Sun, Wang, & Chan, 2011). Attentional control can also dictate the number of scaffolds needed during serious game play (van de Sande, Segers, & Verhoeven, 2015).

Conduct and Consequences: Behaviorism and Safety Practices

B.F. Skinner explained behavior in terms of "operant conditioning". Operant conditioning is an "active behavior that operates upon the environment to generate consequences" (Skinner, 1953). It may be desirable to increase or decrease the likelihood that a behavioral response may occur. This behavior may be promoted or discouraged by one of four means; positive reinforcement, negative reinforcement, positive punishment, and negative punishment (Amabile, 1985). A stimulus was applied to a subject, be it animal or human. If the desired result was exhibited, a positive stimulus, or reward, was given to the subject (Moore, 2012). The Antecedent-Behavioral-Consequence (ABC) model explains actions in animals, from antecedent, or stimulus, to the behavior, and finally to the conditioning [Figure 2.1]. In industry, workers are constantly exposed to antecedents hoping to elicit the desired behavior. These include safety signs (personal protective equipment, slips, number of days without injuries), group safety discussions, and even monetary rewards for safety records. Positive feedback from a supervisor or co-worker on safety behavior can also reinforce this desired behavior (Miltenberger, 2012). Similarly, Southwest Airlines offered financial incentives for maintaining safety behaviors. If the employee wasn't interested in the reward, chances are some of their co-workers were. Thus the additional incentive of adhering to workplace expectations (Helmer, 2002; Peavey, 1998).

How effective is behavior-based safety? It might be difficult to assert safety interventions are effective in every circumstance. The methods used to implement an intervention are going to vary in every situation, due to environment, application, culture, and other factors. But there are enough data in the field to demonstrate when these types of programs are implemented in the workplace, the number of injuries have decreased (Sulzer-Azaroff & Austin, 2000).

The 4-C Integrated Theoretical Framework for the Study: Dealing with the Complexities of Safety Training

Safety training is a broad, encompassing subject. As discussed earlier in the paper with respect to Haddon, a comprehensive injury prevention model must include a focus on the pre-event, event and postevent. This study is concerned with safety training, or more specifically operational knowledge and knowledge of safety practices (such as wearing a helmet)

As previously mentioned, Cole (1997) developed a theoretically based model for safety training that included what he termed the four "C"s, 'Culture, Cognition, Conduct and Consequences' [Figure 2.1], that are contributing dimensions of human learning and behavior needed for effective safety programs and materials. This model is a more sophisticated framework than, for example, the ABCs of antecedent, behavior, and consequence [Figure 2.2] that would be part of a behavioral based program ('conduct' only). Culture is certainly important when trying to understand why an individual doesn't wear safety equipment, or has misconceptions from share, erroneous stories. However, culture will not be a feature of the safety knowledge interventions in this proposed study, instead the focus on the latter three Cs. Cognition takes into account a person's attitudes, knowledge, judgment and decisions. When an ATV rider encounters an unsafe situation, what will they do? In order to have an appropriate response, they need to have appropriate preparedness. Conduct accounts for how a person will behave. Knowledge can inform the rider of the appropriate behavior when coming upon unexpected obstacles on a trail. Finally, the knowledge of consequences can be useful in knowing the potential outcomes of riding on a paved road, or incorrect use of active riding.

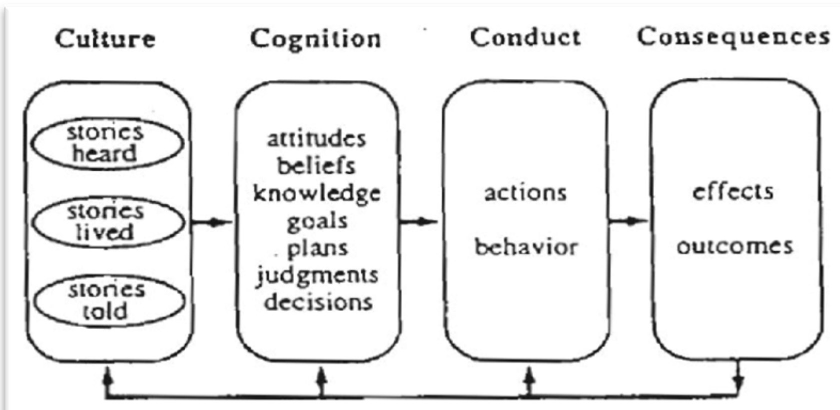

Figure 2.1: Four Cs of Safety Training (Cole, 1997)

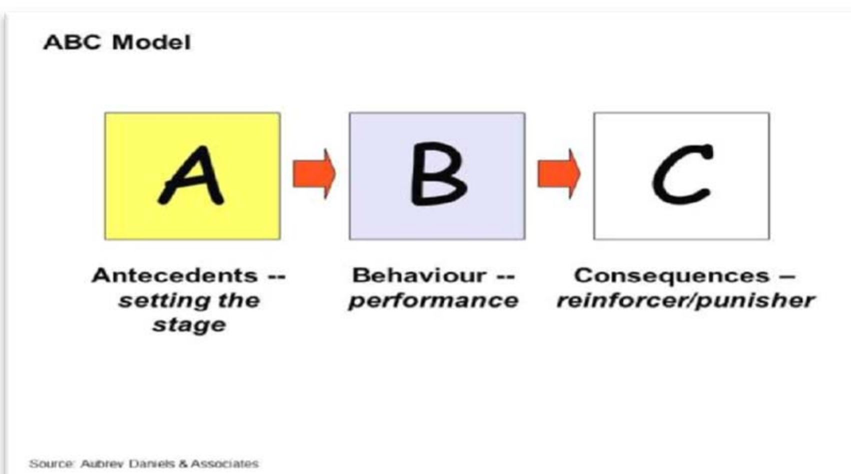

Figure 2.2: ABC Model (Daniels, 2000)

Grounding Gaming Theoretically in Transformational Play

A theoretical framework for this study must necessarily include a conceptual frame for gaming and play. Transformational play is a theory that articulates three dimensions of game play that is involved when a player engages to solve problems with educational content [Figure 3.3] (S. A. Barab, Gresalfi, & Ingram-Goble, 2010).

When individuals play a game, they typically play as the protagonist "who must employ conceptual understandings to transform a problem-based fictional context and transform the player as well (p.525)." Transformational play has core elements of context with consequentiality, a person with intentionality and content with legitimacy [figure 2.3]. In other words, if such elements are included in the game design, the game play has the potential to be transformational – to effect some change in the player's knowledge or beliefs. In an interactive game, the player makes changes within the game termed 'dramatic agency'. The story elements in games and the evolving roles of players engage them in this dramatic agency. Playing a game does not automatically cause changes to happen to you (be it attitudinal, knowledge, or otherwise). If the game is designed with a transformational goal in mind, as Treadsylvania could be, the player will feel invested, using knowledge, content and context to gain new understandings.

Figure 2.3: Transformational Play

Transformation Play, like the Four Cs, and ABCs, has a consequence as a result of play. Consequences are a motivational force. In a video game, it may be a badge, high score, or getting sent back to a lower level of the game. In the video game Treadsylvania, the ultimate reward is defeating the villain, a vampire. In order to do so, the player must ride his or her ATV correctly while accepting various challenges.

Review of Relevant Literature

Prevalence of ATV Injuries and Fatalities

According to ATVSafety.gov, in 2010, 115,000 ATV riders required emergency room treatment. In addition, there were 317 reported ATV-related fatalities. Of those deaths, 55 were reported for children under the age of 16. In the state of Kentucky, 499 fatalities were reported from 1982 – 2010. Of those deaths, 84 were reported for children under the age of 16.

The frequency and severity of these injuries occur for multiple reasons. ATVs were specifically designed as off-road vehicles. The low pressure tires of an ATV were not designed to safely navigate paved roads (Centers for Disease Control and Prevention, 2008). Most injuries occur when there is an ATV roll-over, the ATV strikes a stationary or moving object, or the driver or passenger is thrown from the ATV (All-Terrain Vehicle Injury Prevention: Two-, Three-, and Four-Wheeled Unlicensed Motor Vehicles). It is important to note passenger riders are not permitted on an ATV (All-Terrain Vehicles (ATVs) Can Pose Serious Risks, All-terrain vehicle injury in children: strategies for prevention.). Research has demonstrated the effectiveness of seat belt use in motor vehicles (Centers for Disease Control and Prevention, 2011). Seat belts are not an option with ATVs, due to the necessity of active riding. Active riding requires the rider at times to stand, lean left, right, backward, and forward to maintain balance and stability (*Guidelines for the Safe Use of Quad Bikes*). Over 50% of ATV fatalities are due to rollovers, or the vehicle flipping forward or backward. These crushing injuries are due, in no small part, to the extreme weight of the ATVs. The 2013 Kawasaki Brute Force 750 has a curb weight of 694 lbs. (www.kawasaki.com). The 2013 Honda FourTrax Rincon has a curb weight of 648 lbs. (powersports.honda.com). And the Polaris Sportsman XP 850 H.O. has a dry weight of 759 lbs. (www.polaris.com). These weights contribute to an even greater number of non-fatal crushing injuries.

Engine size is another contributing factor to ATV non-fatal and fatal injuries. The U.S. Consumer Product Safety Commission recommends children under six do not ride ATVs. Children 6-11 should not ride an ATV with an engine size greater than 70 cc. Children 12-15 should not ride an ATV with an engine size greater than 90 cc (*Standards for All Terrain Vehicles and Ban of Three-Wheeled All Terrain Vehicles*, 2006). The consumer product safety commission has designated the ATVs as Y6 (age 6-9), Y10 and

Y12 (age 10-13) and T (age 14-15). Y6 has a maximum speed of 15 mph, Y10 and Y12 has a maximum speed of 30 mph, T has a maximum speed of 38 mph, and 16 or over has no maximum speed limit (*All Terrain Vehicles (ATVs) Presentation*, 2010). A 700cc engine on an ATV may exceed speeds of 70 mph ("ATVs and Youth: Matching Children and Vehicles," 2005).

The ATV injury and fatality literature clearly points out the inherent risks of riding an ATV, especially for children and young adults. In 2009, 10.5 million ATVs were in use in the United States (*All-Terrain Vehicle Safety*, 2011). Though information wasn't available on the number of ATVs owned by children under 16 years of age; those children incurred 17% of all ATV fatalities.

I will now examine the past and present focus of games and learning.

Games and Learning

The phrase "serious games" first appeared in 1970 (Abt, 1970). Abt describes serious games as those whose primary intent is not entertainment, but rather learning. I might amend this to say while the purpose of serious games are to deal with education or real world problems, a major component of serious games for the end user is indeed entertainment, at least in the form of engagement through gameplay. Prior to the advent of computers, other media, such as board and card games, may have also been used for the purpose of learning. And still today, card and board games are used for learning, such as in the field of medicine (Bochennek, Wittekindt, Zimmermann, & Klingebiel, 2007). Today, serious games are largely assumed to take place on a computer (Schollmeyer, 2006). While games often have the connotation of an activity for children, many educational games are geared for adults (Whitton, 2011).Serious video games have been used in the areas of health (Thompson et al., 2010), fire safety (Rüppel & Schatz, 2011), vehicle safety (Backlund, Engström, Johannesson, & Lebram, 2010; Suren & Feng, 2010), and military training (Nitschke, 2012).

There is a strong interest in using video games for education (Egenfeldt-Nielsen, 2006). It is interesting to note while researchers have examined video games for educational purposes (Bergman, 2003; De Freitas, 2009; Kirriemuir & McFarlane, 2003; Mitchell, 2004), there is also a weakness in fully developed learning theories for gamification (Kirriemuir & McFarlane, 2003; Mitchell, 2004). Still, researchers are filling in those gaps, such as Barab, Gresalfi and Ingram-Goble’s Transformational Play work as well as James Gee's video game conceptual framework, in which he identifies multiple observed learning principles (Gee, 2003). For example pleasantly frustrating, information on demand, identity, customize, co-design, and cycles of expertise.

In spite of the need for more gamification research for educational use, there is evidence of the effectiveness of digital gaming for behavioral and cognitive change. Specifically, physiological differences have been documented when playing serious games versus reading or classroom participation. MRIs have demonstrated brain activity is different among players in these differing situation. In the case of virtual serious games, the brain activity is similar to that of a person actually participating in an event (Education, 2009). A serious game developed to treat the phobia of cockroaches (Botella et al., 2011) was shown to reduce fear and anxiety. The player, using a mobile device, scores points by squishing virtual cockroaches, an instance of a person with intentionality game element that proved effective. Individuals learn by doing (Aldas, Crispo, Johnson, & Price, 2010). And by doing, humans try to resolve the problems presented in the game through transformational play (S. A. Barab et al., 2010). By taking on the role of protagonist, the player must understand the (safety knowledge) concepts and employ them to succeed in the Treadsylvania game. This role playing transforms the context of the game, as well as the gamer.

Gamification, while popular, is often lacking real and meaningful evaluation and assessment (Phillips & Popović, 2012). Typically evaluation or measurement is conducted via a verbal assessment. One researcher suggests using "Pathfinder" as a structural assessment of game knowledge acquisition by evaluating knowledge organization (Wouters, Spek, & Oostendorp, 2011). Pathfinder networks are derived from proximities of pairs of items and thus display a proximal 'neural' net that purports to represent decreasing the distance of concepts from other relevant new concepts – promoting easier and more accessible knowledge retrieval.

'Gamer' Learners

Youth today are exposed to digital games at a very young age. It is not uncommon to see a two-year old child playing with an iPad, an iPhone or other digital device for the pure purpose of play. Children are unintentionally primed for digital game learning through this early and frequent exposure to digital play (Gros, 2007). These children, those born during or after the last decade of the 20th century, are termed "digital natives". They have always been exposed to digital technology, never knowing life during the time of the rotary phone, analog radio, and the non-electric typewriter. Instead, they have been raised on a steady diet of computers, digital music and their players, and digital computer games (Prensky, 2012). Motivation, abilities and playing skills may all play a role in digital game learning (Fu-Hsing Tsai, Kuang-Chao Yu, & Hsien-Sheng Hsiao, 2012). Of course, there are other factors in how or what gamer learners may gain from the game play experience. For example, prior knowledge is also a factor in any learning situation. People construct meaning based on prior experience whether a positive or negative influence. If the person has learned correctly, this knowledge would be an asset. If the person has learned incorrectly, this kind of prior knowledge may be more detrimental as entrenched misconceptions, than a person who has no prior knowledge of the subject (Brooks, 1999). In the case of this ATV study, the researcher wants to know if an individual holds misconceptions ATV safety (such as allowing two riders on one ATV). I will solicit this information through the demographic measure.

Quest-based Learning

Motivation is a powerful influence on student learning. What if the material has traditionally been considered dry or dull? What could motivate the student not only to delve into this material, but actually get excited about it? Quest based-learning is one such way (Sandars, 2005; Squire, Halverson, & Gee, 2005; Zhi-Hong, Liao, Cheng, Yeh, & Tak-Wai, 2012). In the computer-based math game "my-pet-my-quest", Taiwanese students had the mission of keeping their virtual pet alive and happy. By succeeding on math problems, the student earned virtual coins. These coins could be used to buy food, toys and other items for their pet. A computer display would the status of their pet. Players had more empathy for their pets. Participants were willing to take on more tasks than a pure learning task (non-game).

There are certainly pros and cons to quest-based learning. Ideally learners will feel vested in the game, both mentally and emotionally. They should be compelled to complete the quest and, in doing so, allow learning to take place. The learner should be able to relate and wish to pursue the story. It is permissible to allow the learner to fail. We can learn from our mistakes. However, it takes a greater amount of time to develop quest-based learning. With greater time development, there is an associated increase in cost. The story must be engaging. The game must not be so long that the participant either loses sight of the learning objectives or totally loses interest in the quest. And finally too much failure without commensurate award can lead to frustration and giving up (Kapp, 2012).

Quest Atlantis (http://www.questatlantis.com/) is a game developed using quest based learning and transformational play. Transformational play, through consequentiality, intentionality and legitimacy, has a profound influence on the player. The person entering the game is not the same person exiting the game (Transformational Play: Using Games to Position Person, Content, and Context**)**. Quest Atlantis is geared toward children ages 9 – 16. It promotes social action. The developers wanted this quest-based game to be fun, following a story line, in a virtual world which does not promote violence. The game can be played on or off-line. The learning theory of the game can be found in the teachings of Vygotsky. Play creates the Zone of Proximal Development (S. Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Vygotsky, 1978). Treadsylvania has this socio-cognitive dimension as the play, itself, creates the ZPD.

Chris Haskell at Boise State University conducted research on using Quest-based learning, badges, achievements and awards as rewards/incentives. Dr. Haskell utilized the software 3-D Game Lab to develop his learning environment. 97 students (93%) received a grade of “A” after completing the Quest-based learning game (Baek & Whitton, 2013). 3-D Game Lab has since been used in numerous schools nationally and abroad (http://3dgamelab.org.shivtr.com/). The most impressive of his engagement findings were the additional time that students spent playing the game and exploring and extending their knowledge well after they had achieved even a grade of “A” on the content.

Instructional Design and Gaming

Surprisingly, instructional design and game design have not always been conceptually consonant approaches. Richard Van Eck attributes Marc Prensky as saying, "Whenever you add an instructional designer, they suck the fun out" (Hirumi, Appelman, Rieber, & Van Eck, 2010). The actual point of this harsh-sounding quote was that instructional designers do not know enough about gaming, gamers do not know enough about instruction design. Clearly, if games are to be educational, instructional designers and game developers should work collaboratively. Misunderstanding in both camps have hindered the merger of the two. Some gamers may interpret instructional design as linear and dull. Some instructional designers may not feel games can incorporate cognitive science. Perhaps as a result of this, or maybe in ignorance, many educational games are not incorporating instructional design theory. The efficacy of these games are questionable (Bethke, 2003). However, by using effective instructional design principles, and effective gaming principles, an effective educational game can be developed that does not have all of the fun sucked out (Hannafin, 1978). Game developers and instructional designers have since been encouraged to work together, and to understand the role of one another (Bergeron, 2006).

This researcher spoke with Dr. Barbara Chamberlin, New Mexico State University Learning Games Lab. the developers responsible for Treadsylvania’s development. Treadsylvania had been designed by instructional designers and game developers working collaboratively, as Marc Prensky suggested. Treadsylvania was funded by the ATV Safety Institute through the 4-H council.

The Treadsylvania video game begins with written narration explaining how towns and farms have fallen prey to monsters. The last remaining hold out is the town of Treadsylvania. We visit the town's Guild, where a character provides periodic information. The Guild also provides ATV safety information, such as not riding under the age of 16 without the presence of an adult [figure 2.4]

Figure 2.4 Treadsylvania – under 16 warning

The mechanic shop of Treadsylvania also provides important ATV safety information. Two such pieces of information is to ride the right sized ATV, and never to ride alone [figure 2.5].

Figure 2.5 – Mechanic Shop A map of Treadsylvania is provided in the game. It is usually located in the upper right corner [figure 2.6]

Figure 2.6 – Navigation Map

The play soon discovers the color scheme of the map. A dark gray circle indicates an area that has not been investigated. This may be because the play simply has not visited it yet, or the player is blocked from visiting the area until he or she completes a prior task. Yellow indicates the area has been visited, but there is more to do to accomplish the task. Blue indicates the task has been fully accomplished [figure 2.7]

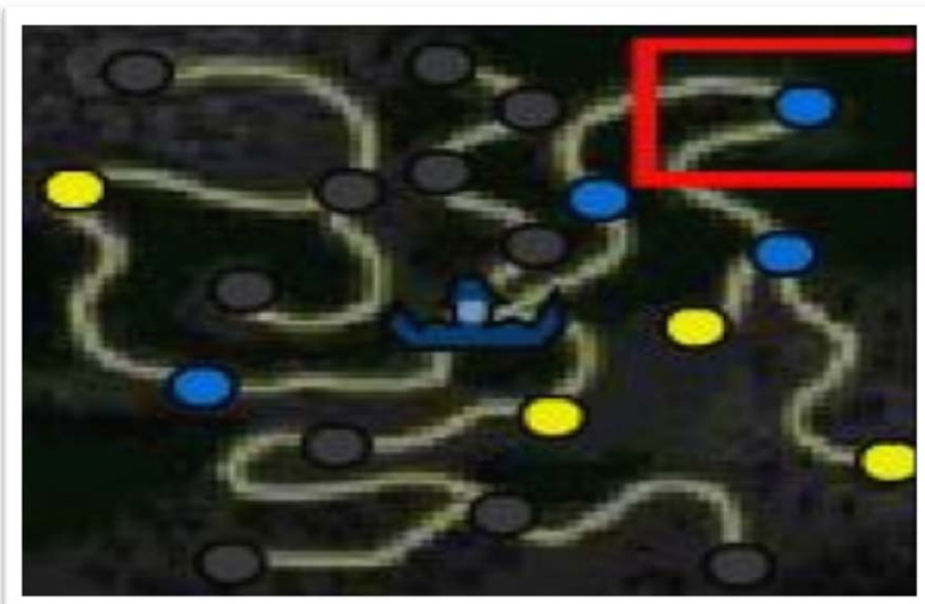

Figure 2.7 – Colored Progress Map

While the player navigates the map, he or she encounters painful debris along the trail. The game further informs the player of the importance of safety equipment, such as goggles, helmet, glove, boots, and long-sleeved clothes [figures 2.8 and 2.9]

Figure 2.8 – Encountering Hazards on the Trail

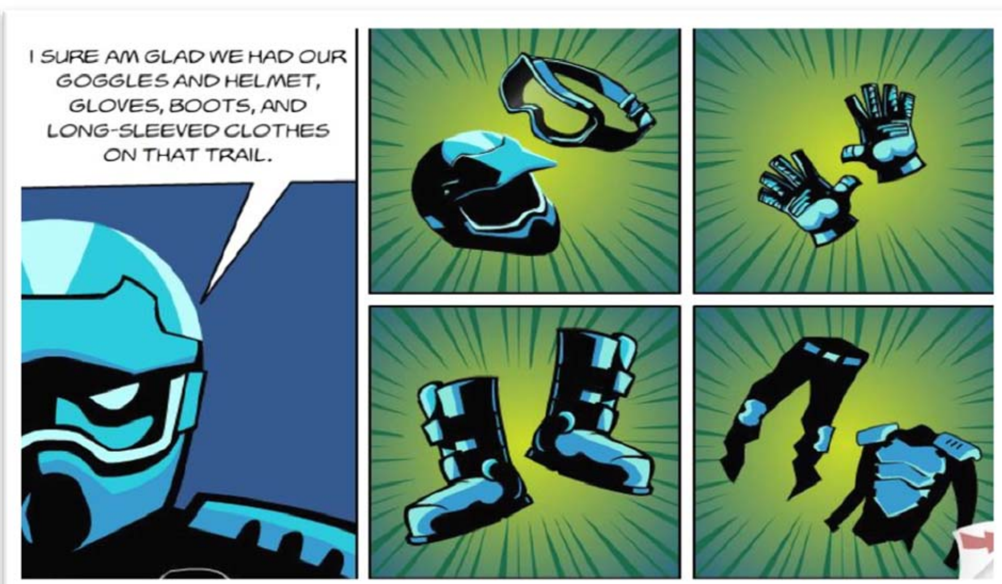

Figure 2.9 – Importance of Wearing Safety Equipment

The game may explain certain concepts first, and then have the player put the concept into practice. For instance, the game first discusses active riding, the has the player use it to complete a task [figures 2.10 and 2.11]

Figure 2.10 – Active Rider Discussion

Figure 2.11 – Active Rider Practice

The fortune teller explains the importance of only having one rider on an ATV. One of the dangers posed is preventing the ATV rider from employing active riding. The player eventually will be faced with the challenge of active riding with an unwanted passenger [figures 2.12 and 2.13].

Figure 2.12 – Fortune Teller Informs Player to Only Have one Rider on ATV

Figure 2.13 – Unwanted Second Rider Interferes with Active Riding

The player is told that, while the road might be a quicker way from one point to another, it is not safe for an ATV. However, monsters try to force the riders onto the asphalt [figures 2.14 and 2.15].

Figure 2.14 – Roads are Not Safe for ATVs

Figure 2.15 – Monsters Trying to Force the Riders onto the Road

No demographic evaluation data were collected on any of the online participants. However, between September 2010 and December 2011, Treadsylvania had 1,180 web page views, and 959 unique views of the start page. Without a Learning Management System connected to the game, it was impossible to tell how many of the viewers actually played the game, let alone played it to completion.

Some educational games can be examined through the lens of motivation, cognitivism, and socio-culturalism (Jong, Shang, Lee, & Lee, 2008). "Treadsylvania" does incorporate the first two, but lacks socio-cultural dimensions, due to the design of the game, as a single player game. If a chat or discussion board were used, or the game was a massive multiplayer online role playing game (mmorpg), it could allow for social interaction, collaboration, and group influence.

The methodology section in Chapter 3 that follows describes the quasi-experimental design, participants, measures and analytic methods for the study.

Chapter Three: Methodology

This chapter discusses the quasi-experimental design, including participants, intervention/control pre-post design, treatment materials, demographic measures, and the procedures used to collect the data.

Participants

This study is quasi-experimental in design due to the impractical nature of true randomization in naturalistic actual school settings. Rather than within school randomization, matched comparison school site groups were randomly assigned to receive one of the three treatments. Each group consisted of 50 subjects from one of four county high schools. The sample is both purposive and convenient (Hayden, 2010; "A Review of: 'Sampling: Design and Analysis, Second Edition, by S. L. Lohr.'," 2011; Ryan, Reese, Kroesen, Bernheimer, & Gallimore, 2001). It was drawn from voluntary classrooms with an interest in participating in the study, thus convenient. High school students at highest risk were also targeted, thus making it purposive. Males and females were be included in the study. The level of computer knowledge is expected to vary, as is the number of students having experience with Internet use, and students having experience with computer games.

Sampling Schools

Four county high schools were selected among 60 central Kentucky rural counties as possible sites based on three criteria. First, it was critical to ensure there would be a large enough population to participate in the study to result in acceptable statistical power. Second, the school needed to have a computer lab with individual computers to support the testing population. In addition, these computers required Internet access, a Microsoft Windows operating system, and an Adobe Flash player installed to support the treatments.

Third, the school needed to be able to allocate 45 continuous minutes for the pre-test, treatment, and post-test, including the follow up testing one week after initial testing. One school (T1) was assigned as the control with no treatment (n=59), one school (T2) participated in the PowerPoint treatment (n=56), one school (T3) participated in the "free play" Treadsylvania game treatment condition (n=52), and one school (T4) participated in the "in class" Treadsylvania game treatment (n=57).

Sample Size

Determining Sample Size

The G*Power calculator was used to determine sample size (Faul et al, 2007; 2009). In this calculation, a priori analysis was selected. It accounts for type-1 error α (incorrectly rejecting the null hypothesis when, in fact, it is true) and type-2 error β (incorrectly accepting the null hypothesis when, in fact, it is false). The a priori analysis will determine the sample size N based on the desired α, power level ($1 - \beta$), and the effect size $|\rho|$ (difference between H0 and H1).

Table: 3.1: Sample Size Variables

Effect size $|\rho|$	0.50
Tails	One
α err prob	0.05
Power (1-βeδ)	3.3665016
Critical t	1.6938887
Df	32
Total sample size	34
Actual power	0.9504455

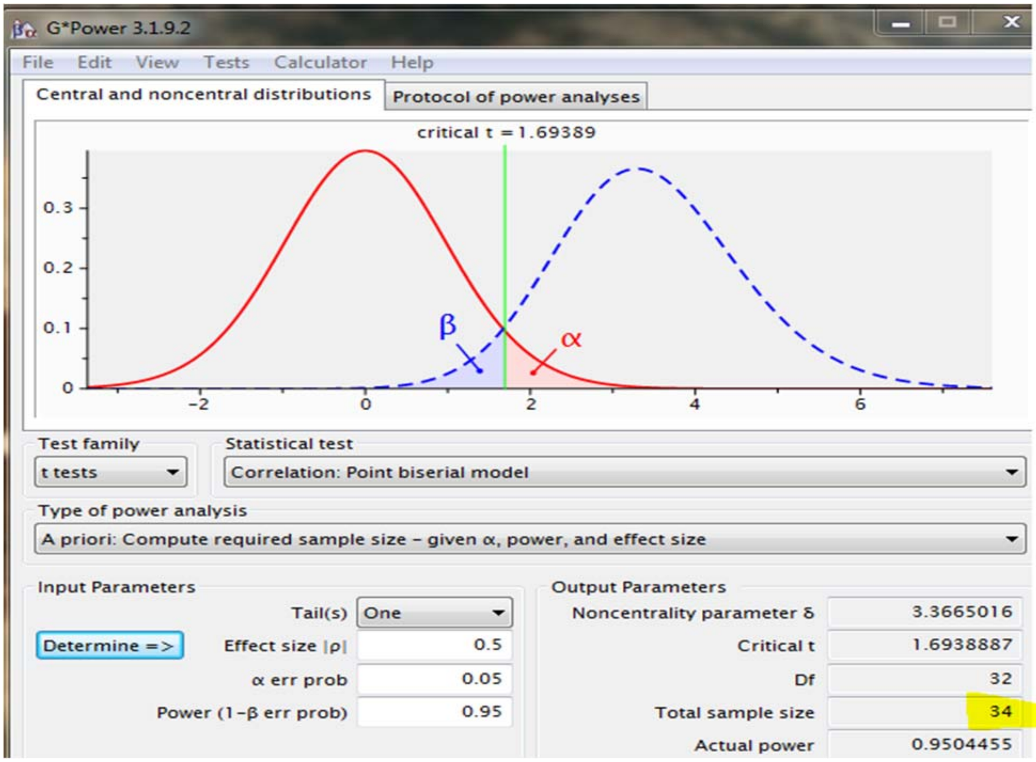

Figure 3.1: Calculating G*Power Sample Size

Therefore, a minimum sample size of 34 was required. This study used a minimum sample size of N=52.

Quasi-Experimental Design

One unique treatment was assigned to each school site. Subjects were assigned into four treatment groups: T-1 = control, T-2 = ATV safety non-gaming training PowerPoint, T-3 = ATV safety training game (free-play), and T-4 = ATV safety training game (in-class). The independent variable was the safety game, "Treadsylvania". The dependent variable was safety knowledge. There is difficulty doing controlled experimental research in real-world settings, in particular schools, where the threats to validity and confounds are numerous. For example, students in control groups are often contaminated by peers who experience other treatments, especially when computer lab time is involved.

Schools were matched for age, rural setting, and sufficient population to meet the matched grouping criteria for quasi-experimental design (Cook & Campbell, 1979). Rural high schools were selected on the premise rural areas would afford greater opportunity to ride ATVs. Subjects were selected from agricultural classes, as ATVs may be used as a work vehicle, a recreational vehicle, or both (Will III, 2009).

As shown in Table 3.1, the control county, T1, had an estimated population in 2013 of 49,947. Person under 18 years of age was 25.9%. There is 282 square miles of land. The median income for a household in the county was $47,081. The PowerPoint county, T2, had an estimated population in 2013 of 35,766. Persons under 18 years of age is 24.1%. There is 438 square miles of land. The median income for a household in the county was $22,075

The ATV game "free play" county, T3, had an estimated population in 2013 of 50,173. Persons under 18 years of age is 25.0%. There is 172 square miles of land. The median income for a household in the county was $40,096.The ATV game "in class" county, T4, had an estimated population in 2013 of 59,563. Persons under 18 years of age is 23.6%. There is 434 square miles of land in this county. The median income for a household in the county was $27,015. For comparison, two urban counties differ sharply from the rural counties selected for the study. Jefferson County had as of 2013 a population of 756,832 and the median income for a household in the county was $43,789. Fayette county had a population of 308,428 and the median income for a household in the county was $39,813. (http://www.census.gov/data/data-tools.html)

Table 3.2. County Demographics – 2013

County	Population	< 18 Years Old	Square Miles	Household Income
Scott	49,947	25.9%	282	$47,081
Whitley	35,766	24.1%	438	$22,075
Jessamine	50,173	25.0%	172	$40,096
N. Laurel	59,563	23.6%	434	$27,015

Treatment Materials

Game and Non-Game Treatments

Treadsylvania is an Adobe Flash-based game created by New Mexico State University Learning Games lab (described in detail in Chapter 2). Towns and farms have fallen victim to monsters and, behind it all, a vampire. Only Treadsylvania remains intact. The townspeople are seeking someone (the game player) to find clues that will be needed to defeat the monsters and the vampire. The monsters are metaphors for hazards or dangers. The player is the monster hunter. By exploring in town, the player receives ATV safety information. This information includes never riding alone, ride the correct size ATV, ride an ATV safety course, rocky trails may be dangerous, passengers on an ATV are a bad idea, wear the correct safety gear, use your weight to lean into turns, no riding at night, and riders in the dark are unable to see obstacles. The player needs to incorporate proper ATV safety information into their game play to defeat the monsters.

Non-game (PowerPoint Didactic) Treatment

The University of Missouri Extension ATV safety training is an Internet-based, non-game PowerPoint presentation that was presented to individual students in their school computer lab. This web-based PowerPoint training contained safety information/content commensurate with the Treadsylvania game. The safety information common to both groups includes [Table 3.1]:

Table 3.1: Safety Information Comparison between the Non-Game (ppt) presentation and the digital gaming intervention *Treadsylvania*

Table 3.3. **Safety Information Comparison between the Non-Game (ppt) Presentation and the Digital Gaming Intervention *Treadsylvania***

	Non-Game (ppt)	Treadsylvania
Helmet	X	X
Gloves	X	X
Goggles	X	X
Long pant	X	X
Long-sleeved shirt	X	X
Boots	X	X
Uphill leaning position	X	X
Downhill leaning position	X	X
Right turn leaning position	X	X
Multiple riders	X	X
Active Rider	X	X
Age required for adult supervision	X	X
Considering engine size relative to age	X	X
Paved roads	X	X
	X	X

Measures

There are three measures used for data collection in this study: a demographic measure and a pre-test knowledge measure, administered prior to treatments as well as an equivalent form post treatment knowledge measure, administered following treatments. The posttest is identical to the number of questions, as well as type of questions asked. It varies slightly in the rewording of the questions, as well as the order of the possible answers.

Demographic Measure

Demographic data were collected using a version of the *ATV Driving and Riding Experience Questionnaire survey* (ADRE), adapted from a safety demographic approach that includes both demographic and exposure data (H. Cole, Myers, M, Westneat, S, Mazur, J, 2013) as part of the pre-treatment testing. Exposure refers to the extent to which a participant may encounter hazards or safety issues associated with either ATV operation or ownership. For example, a youth who regularly rides an ATV would have more 'exposure' to ATV hazards associated with ATV operation than one who did not own, but occasionally rode on an ATV. The adapted ADRE has 18 items and includes items such as age, gender, grade level, if they own an ATV (if yes, what kind, how many etc.), prior ATV safety training, prior ATV driving experience, how often do you drive an ATV, age when first rode an ATV, how often do you use the Internet, and how often do you play computer video games. The complete questionnaire is shown in Appendix B.

Pre and Post-tests for ATV Safety Knowledge

The ATV Safety Knowledge pre-and post-tests are two forms of a 20 item equivalent measure developed from the commensurate content of both the Treadsylvania game and the non-game PowerPoint (figure 1.3) materials. Sample questions include:

Pretest –

When making a turn on your ATV, it is important to shift your weight

a. Forward
b. Backward
c. Away from the turn
d. Into the turn

Posttest –

3) Shift your weight _________________ when making a turn on your ATV.

a. Away from the turn
b. Into the turn
c. Backward
d. Forward

The pre- and post-tests were developed with attention to various threats to internal validity (Campbell, 1963). See Appendixes C and D, and Table 1.1.

Table 3.4. Campbell & Stanley's (1963) Threats to Internal Validity

History	Events, other than the experimental treatments, influence results.
Maturation	During the study, psychological changes occur within subjects
Testing	Exposure to a pretest or intervening assessment influences performance on a posttest.
Instrumentation	Testing instruments or conditions are inconsistent; or pretest and posttest are not equivalent, creating an illusory change in performance.
Statistical Regression	Scores of subjects that are very high or very low tend to regress towards the mean during retesting.
Selection	Systematic differences exist in subjects' characteristics between treatment groups.
Experimental Mortality	Subject attrition may bias the results.
Diffusion of Treatments	Implementation of one condition influences subjects in another condition.

Data Collection

Students answered pre- and post-test questions, as well as provide demographic information, using a paper-based survey instrument.

Complete data were required for each student to be included in the analysis for the study. If, for example, a student completes the pre-test but does not complete the post-test, the data for that individual were not included. Students in the control group needed to complete the pretest and posttest as well. If the pretest, treatment, and posttest could all be administered in one day, one could make the argument a posttest alone would suffice for the control group. Since this is not possible, by using the pre-post format we can infer if the independent variable, or treatment, is the only factor affecting the groups.

Protocol for Administering the Treatments

The University of Kentucky IRB approval for was granted for Dr. Joan Mazur for Increasing High School Students Awareness and Education to Prevent Tractor Related Injuries, IRB protocol 11-0592. This IRB allowed for the inclusion of ATV safety training and testing using quad bars (roll bars) and other safety practices and that protocol was used in this study.

The researcher visited each school and explained the purpose of the study, along with the procedures to be implemented during the actual testing days. The teacher or teachers for each school were informed about materials used only for the treatment in their classroom. Teachers were instructed neither to discuss the tests nor treatments until the experiment has been completed. No school had more than one treatment.

In the actual testing phase, students initially completed the pre-test and the demographics in the classroom, regardless of treatment. Forty-five minutes were allotted to complete the 18 demographics questions and the 20 safety knowledge questions. A second session consisting of the treatment and posttest was conducted approximately one week from the initial pre-test. Once again, forty-five minutes were allocated for this session per class.

Treatment 1, the control group, did not require the use of a computer room. Thus both the pre- and posttests were conducted in the classroom. Several classes were tested and oversampled to insure an N of at least 50.

Treatment 2, the ATV safety non-gaming PowerPoint required a computer room for the treatment. Each student required access to his or her own computer concurrently with the other subjects in the room.

Treatment 3, the ATV safety training game (free-play), provided a sheet with the website address of the game. Subjects were encouraged to use home computers, library computers, or other computers during a non-structured class period. The participants were encouraged to play the game as many times as they like during the next seven days. They participants were informed the researchers would return after the one-week period. Instructors were asked not to remind the students to play the game, as the subjects played of their own volition.

Treatment 4, the ATV safety training game (in-class), provided a sheet with the website address of the game during the second session in the computer lab. Each student required access to his or her own computer concurrently with the other subjects in the room. The researcher tested Treadsylvania with four teenagers to assess the amount of time required to complete the game. All four completed the game in less than 45 minutes. The post-test was immediately administered and did not require more than 15 minutes. Total time for pre-test, treatment, and post-test was 90 minutes.

For the first session, subjects the researcher provided instructions and gave the pretest to subjects in all four treatment schools (T-1, T-2, T-3 and T-4). In the second session the researcher introduced the PowerPoint for Treatment 2 and Treadsylvania (in-class) for Treatment 4. Participants in T-3 (the free choice game) were expected to complete the treatment between the dates of the pretest and the posttest, about a week's time. Post-test data collection sessions for all groups occurred after treatments were administered.   Table 3.3 shows a summary of students by school and treatment condition.

Table 3.5. Number of Students by School and Treatment Condition

High School	Students	Treatment
1. Scott County	59	Control
2. Whitley County	56	PowerPoint
3. JCTC	52	Video Game “free play”
4. N. Laurel County	57	Video Game “in class”

Procedure

All Kentucky county high schools were selected based on previous relationships built through agricultural safety programs conducted by the Southeast Center for Agricultural Health and Injury Prevention. All high schools were contacted in advance to seek approval of the superintendents, principals, and teachers. Participants provided a consent form, which required the signatures of the assenting participating youth, as well as the parent or guardian in order to participate in the study. The research met with all teachers prior to student testing. Classrooms were tested for Internet access and Flash compatibility (to run the Treadsylvania program). If Internet access had not been available at the school, this would invalidate that school as a study site. All students for T-2 and T-4 (in-class treatments) were required to have access to a computer lab or mobile classroom laptop lab for the treatment. Students participating outside the classroom, T-3(free play) would need to have access to their own computer and Internet, or use a library or school computer during non-classroom time. All pretests and posttests were delivered via the researcher in the classroom at the beginning of the class period, and retrieved by the researcher no later than the end of the class period.

Demographic Information on the High Schools

Rural high schools were selected on the premise rural areas would afford greater opportunity to ride ATVs. Subjects were selected from agricultural classes, as ATVs may be used as a work vehicle, a recreational vehicle, or both (Will III, 2009).

The control county, T1, had an estimated population in 2013 of 49,947. Person under 18 years of age was 25.9%. There is 282 square miles of land. The median income for a household in the county was $47,081.

The PowerPoint county, T2, had an estimated population in 2013 of 35,766. Persons under 18 years of age is 24.1%. There is 438 square miles of land. The median income for a household in the county was $22,075

The ATV game "free play" county, T3, had an estimated population in 2013 of 50,173. Persons under 18 years of age is 25.0%. There is 172 square miles of land. The median income for a household in the county was $40,096.

The ATV game "in class" county, T4, had an estimated population in 2013 of 59,563. Persons under 18 years of age is 23.6%. There is 434 square miles of land in this county. The median income for a household in the county was $27,015.

For comparison, two urban counties differ sharply from the rural counties selected for the study. Jefferson county had as of 2013 a population of 756,832 and the median income for a household in the county was $43,789. Fayette county had a population of 308,428 and the median income for a household in the county was $39,813. (http://www.census.gov/data/data-tools.html)

High School #1:

This high school group was the control group (T-1). A pretest was given at the beginning of the class. A posttest was given one week later at the beginning of the class. This information was used for Research Question One (RQ1).

High School #2:

This high school group (T-2) was given a pretest during the first session. An in-class ATV PowerPoint safety training, followed by a posttest, was given one week later at the beginning of the class. This information was used for Research Questions RQ2, RQ6, RQ7, RQ8 and RQ9.

High School #3:

This high school group (T-3) was given a pretest during the first session. , followed by the in-class video gamfie. Subjects were asked to play the ATV safety video game at home, school, or library during free-play. It was not taken during a structured school event. A posttest was given one week later at the beginning of the class. This information was used for Research Questions RQ1, RQ3, RQ4 and RQ5.

High School #4:

This high school group (T-4) was given a pretest during the first session. An in-class ATV safety game, followed by a posttest, was given one week later at the beginning of the class. This information was used for Research Questions RQ2, RQ6, RQ7, RQ8 and RQ9.

Table 3.6. Numbers of Students by School and Treatment Condition

High School	Students	Treatment
5. Scott County	59	Control
6. Whitley County	56	PowerPoint
7. JCTC	52	Video Game "free play"
8. N. Laurel County	57	Video Game "in class"

Table 3.7
Type of Case

Type	Frequency	Cumulative Percent	Cumulative Frequency	Percent
Control	59	26.34	59	26.34
In Class	57	25.45	116	51.79
Free Play	52	23.21	168	75.00
PowerPoint	56	25.00	224	100.00

Table 3.8. High Schools and Associated Research Questions

High School	Research Questions
1 (Control)	1, 5
2 (PowerPoint)	2, 5
3 (Game free-play)	5, 6
4 (Game in-class)	1, 2, 3, 4, 5, 6

Research Design Summary Chart

The study design included four sets of cohorts of students, one of which served as the control group (N=59), one served as the PowerPoint treatment in class (N=56), one served as the computer game treatment as free play (N=52), and one served as the computer game treatment in class (N=57). Students in the control cohorts did not receive the online program of intervention materials. However, the control cohorts and all three intervention cohorts completed the demographic and ATV safety knowledge pre-test. After the intervention groups had been exposed to the treatments, all intervention groups, plus the control group, completed the ATV safety knowledge posttest. A summary chart of the quasi-experimental design for this study of the four cohorts at the four county schools are listed in table 3.4.

Table 3.9. Quasi-Experimental Design

Experimental Condition		01	Online Program Intervention Activities		02
Session	Group	Pre-Test	NGSI	Treadsylvania	Posttest
1	School 1 - Control 1	ADRE ATVK	None	None	ATVK
2	School 2 - Treatment PowerPoint	ADRE ATVK	Yes	None	ATVK
3	School 3 – Treatment ATV Game “free play”	ADRE ATVK	None	Yes	ATVK
4	School 4 – Treatment ATV Game “in class”	ADRE ATVK	None	Yes	ATVK

Legend

(ADRE) ATV Driving and Riding Experience Questionnaire survey. Demographic that includes additional ATV exposure to hazard and experience information.

ATVK = ATV Safety Knowledge Test

Tread = Treadsylvania ATV Safety Computer Game

NGSI = Non-Game Safety Instruction (a series of PowerPoint slides with content that parallels the Treadsylvania game safety content)

The control and treatment groups are not truly randomly assigned to this condition. The samples are purposive and convenient. Nevertheless the study design does allow the researcher to test the following univariate hypotheses for differences in mean scores (M).

<u>Safety Knowledge Transfer at Four County High Schools</u>

Null HO1:	County Cohort 1 (control) < County Cohort 2 (PPT) < County Cohort 3 (Treadsylvania “free play”) < County Cohort 4 (Treadsylvania “in class”)
Logic:	As the intervention becomes more interactive, the knowledge transfer will improve and the students’ mean scores on the posttests (dependent variables) will increase.
Statistical Test:	Univariate ANOVAs on students’ mean scores on each measure.
Alpha:	.05

Data Analysis

Data were logged and individual school and student ID numbers assigned to preserve confidentiality. A data dictionary was constructed and data input into SPSS and completed as data became available. Descriptive statistics were used to determine the distribution of the data and the extent to which data meet criteria for selected statistical testing.

Significance tests was calculated by one-way ANOVA, using the SPSS statistical analysis software.

A mean score percent charted the level of knowledge prior to and after treatment.

Limitation

The quasi-experimental design was not truly randomized within sites, but site were randomly chosen as either treatments or controls. This decision was intentional, as contamination within schools was thought to outweigh the benefit of randomization within sites. Regardless of the rationale, the lack of randomization within sites was a methodological limitation of the study.

Chapter Four: Results

In this chapter, I present the results of the study. First I present a snapshot of the pre- and posttest data from the four schools. Next, I present results of the data analysis to answer the six research questions for the study. Demographic data were examined to determine the relationship among independent and dependent variables. Demographics also revealed the number and types of injuries indicated by the students at the study sites.

Participant Demographics

There were 224 high school participants across all conditions. 69.6% of the participants were male. 56.5% played video game. Of those playing video games, the mean playing time was 6.9 hours per week. 5.4% had previously taken an ATV safety course. 67.3% had driven an ATV. Of those who had driven, they had done so for an average of 7 years. 78.7% had been an ATV passenger. For those who had driven or been a passenger, 47.7% had been in an ATV accident. And of those who had been in an accident, 47% had been injured.

Table 4.1. Frequency and Percentiles

	Frequency	Percent
GRADE		
Freshmen	23	10.27
Sophomore	52	23.21
Junior	67	29.91
Senior	82	36.61
GENDER		
Male	156	69.64
Female	68	30.36
PLAY VIDEO GAMES		
No	97	43.50
Yes	126	56.50
Ever Taken an ATV Safety Course		
No	212	94.64
Yes	12	5.36
Drive ATVs		
No	73	32.74
Yes	150	67.26
Even Been ATV Passenger		
No	47	21.27
Yes	174	78.73
For Drivers/ Riders, Ever Have ATV Accident		
No	91	52.30
Yes	83	47.70
Injured in ATV Accident		
No	44	53.01
Yes	39	46.99

Table 4.2. Frequency and Mean Hours

	N	Mean
Video Games	123	6.95 hours
Driven ATVS	149	7.02 hours

Item Analysis of Pretest ATV Safety Knowledge Test (ATVK)

A question item analysis was performed on pretest questions. The graph in Figure 4.1 shows the mean percent correct responses to the twenty pretest question items on the ATVK pretest from the control and all treatment groups combined.

The purpose of this analysis was to examine specific gaps in ATV knowledge across the entire study population prior to any treatment interventions.

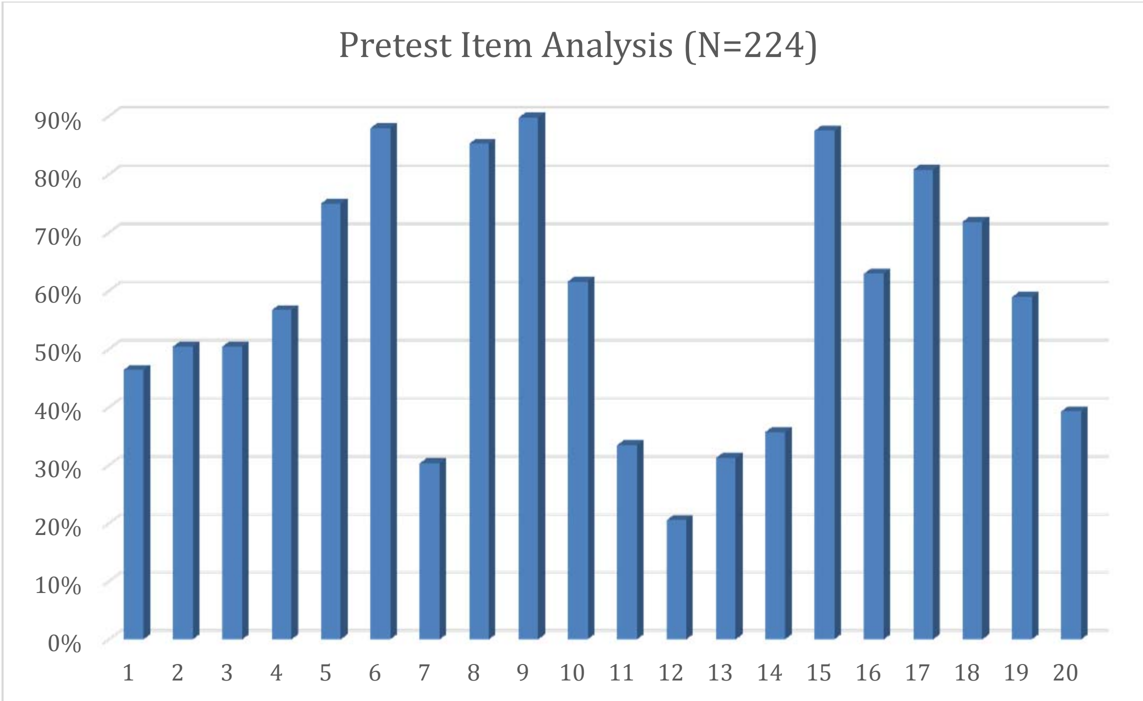

Figure 4.1. Pretest Question Item Analysis of Percentage of Correct Responses to Items. T1-T4 (inclusive)

Table 4.3 shows these data in table form. Analysis of the pretest for the control and all treatments combined provided the following information on question item analysis:

Table 4.3. Results of Question Item Analysis

Question #	% Correct
1	46%
2	50%
3	50%
4	57%
5	75%
6	88%
7	30%
8	85%
9	90%
10	62%
11	33%
12	21%
13	31%
14	36%
15	88%
16	63%
17	81%
18	72%
19	59%
20	39%

Question 12 was lower than all other questions, with 21% of participants providing a correct response.

Q 12. Joy and her friends ride up on a group of horseback riders on the trail. Joy and her friends should

a. Proceed slowly

b. Take off their helmets

c. Turn off their ATVs until the horses pass

d. Both b and c

The correct answer is D.

Questions 7, 13, 11, 14, and 20 ranged from 30% to 39% correct.

Q 7. What is the maximum number of riders allowed on one ATV?

a. 1

b. 2

c. 3

d. Depends on the size of the ATV

The correct answer is A.

Q 13. When it comes to riding your ATV on pave roads, it is important to remember

a. Do not ride at night

b. Do not ride at night or dusk

c. Only ride if your headlights and tail lights are in working order

d. Never ride on a paved road

The correct answer is D.

Q 11. The ability to shift your body weight when negotiating hills, crossing obstacles and turning is known as being a

a. Defensive Rider

b. Active Rider

c. Cautious Rider

d. Alert Rider

The correct answer is B.

Q 14. You are riding in a torrential downpour. The rain is so hard you can barely see. You should …

a. Proceed slowly
b. Ride quickly to a safe place
c. Turn off your ATV and seek higher ground
d. Head back home

The correct answer is C.

Q 20. Jaylen is 8 years old and has a speed regulator, or governor, on his ATV. He asks if you would adjust his regulator to give him more speed. You should only adjust a regulator

a. If the rider gives permission
b. If an adult gives permission
c. If a parent gives permission
d. You should not adjust the regulator

The correct answer is D.

Conversely, questions 17, 8, 15 and 6 ranged from 81% to 88% correct.

Q 17. Which item or items are essential for ATV safety?

a. Goggles, Gloves, Steel-toed Shoes and sun screen
b. Goggles and Gloves, Shirt, Safety Harness and sun screen
c. Goggles, Gloves, Boots, Long sleeved shirts and long pants
d. Goggles, Glove, Boots, Long sleeved shirts, long pants and sun screen

The correct answer is C.

Q 8. Mathew was involved in an ATV backward overturn while riding up a steep hill. This injury event occurred because he …

a. Was wearing his helmet and it protected him
b. Involved multiple riders
c. He was leaning forward on the ATV
d. He was leaning backward on the ATV

The correct answer is D.

Q 15. When riding your ATV uphill, it is important to shift your weight

a. Forward
b. Backward
c. Do not shift your weight
d. It depends on how steep the hill is

The correct answer is A.

Q 6. An ATV has a large seat because

a. Multiple passengers will be riding on the ATV
b. The rider has to move to keep proper balance and control
c. The rider needs room for safe storage of backpacks or coolers
d. When several riders are on the passengers need to have room to move

The correct answer is B.

Question 9 had the highest number of corrected responses at 90%.

Q 9. Choose the correct size ATV based on your

a. Height
b. Weight
c. Age
d. All of the above

The correct answer is D.

Influence of Gender on Pre/Post Outcomes

Gender did not influence the pretest/posttest outcomes.

Chi-Square for gender of .0006 indicates gender was not statically significant across all treatments.

Table 4.4. Statistical Hypothesis Test

Statistic	DF	Value	Prob
Chi-Square	3	17.3286	0.0006

Confidence Intervals for Control and Treatments

Examining the confidence intervals from the pretest/posttest knowledge change, there are overlaps between T2 (PowerPoint) and T4 (Game in-class). This indicates it is not statistically different. This is confirmed in the ANOVA, which demonstrated no significant difference between T2 and T4.

There is no overlap with T3 (Game free-play) with respect to T2 and T4. T3 is significantly different as compare to T2 and T4. T3 overlaps with T1 (control). These two are not statistically different.

The treatments of T2 and T4 performed higher than the control of T1 or the free-play of T3.

Table 4.5. Confidence Intervals of Control and Treatments of Pre/Posttest Gains

	Mean	Std. Error	95% Confident Interval	
Condition			Lower Bound	Upper Bound
Treatment 1 (N=59)	0.4237288	0.2283314	-0.0333262	0.8807838
Treatment 2 (N=56)	2.0357143	0.2927304	1.4490694	2.6223591
Treatment 3 (N=52)	0.3846154	0.3204374	-0.2586895	1.0279203
Treatment 4 (N=57)	2.7192982	0.3760985	1.9658823	3.4727142

Research Question One:

Does the evidence suggest students exposed to the ATV safety training game treatment will demonstrate greater safety knowledge than the control group as measured by the posttest?

Hypothesis 1 –

DVs: Gaming Treatment in Class, Control.

IVs: Posttest scores on Gaming Treatment in Class and Control.

Students exposed to the gaming treatment will perform higher on posttest knowledge measures than students with no treatment.

The Control, T1, had a mean difference of a positive 0.42 in knowledge gain. The ATV "in class" game, T4, has a mean difference of a positive 2.72 in knowledge gain. We can state the knowledge gain for T4 was highly significant when compared to T1. Therefore, the alternative Hypothesis 1 is accepted.

Table 4.6.
***Pre and Post Scores by Case Type:* The MEANS Procedure**

Variable	N	Median	Minimum	Maximum	Std Dev	Quartile Range
Presum	59	12.0677966	3.0000000	17.0000000	2.6054612	4.0000000
Presum	59	12.4915254	3.0000000	16.0000000	2.3662343	3.0000000

Type of case=control.

Table 4.7.
***Pre and Post Scores by Case Type:* The MEANS Procedure**

Variable	N	Median	Minimum	Maximum	Std Dev	Quartile Range
Presum	57	10.7368421	4.0000000	17.0000000	2.8064105	3.0000000
Presum	57	13.4561404	4.0000000	19.0000000	3.5560320	5.0000000

Type of case=in class

Research Question Two:

Does the evidence suggest students exposed to the ATV safety training game treatment will demonstrate greater safety knowledge than the group exposed to the non-gaming Microsoft PowerPoint passive training as measured by the posttest?

Hypothesis 2

DVs: Gaming Treatment in Class, PowerPoint Treatment.

IV: Posttest scores on Gaming Treatment in Class and PowerPoint.

Students exposed to the gaming treatment will perform equally or higher on posttest knowledge measures compared to the PowerPoint group.

The PowerPoint Treatment, T2, had a mean difference of a positive 2.04 in knowledge gain. The ATV "in class" game, T4, has a mean difference of a positive 2.72 in knowledge gain. We can state the knowledge gain for T4 was comparable to T2. Therefore, the alternative Hypothesis 2 is accepted.

Tables 4.15 and 4.16 examine pre-post scores for the In-class Gaming and PowerPoint (in-class) gaming groups.

Table 4.8.
***Pre and Post Scores by Case Type:* The MEANS Procedure**

Variable	N	Mean	Median	Minimum	Maximum	Std Day	Quartile Range
Presum	57	10.7368421	11.0000000	4.0000000	17.0000000	2.8064105	3.0000000
Presum	59	12.4915254	3.0000000	16.0000000	2.3662343	3.0000000	5.0000000

Type of case=in class

Table 4.9.
***Pre and Post Scores by Case Type:* The MEANS Procedure**

Variable	N	Mean	Median	Minimum	Maximum	Std Day	Quartile Range
Presum	56	11.9642857	12.0000000	4.000000	18.0000000	2.8728465	2.5000000
Presum	56	14.0000000	14.0000000	4.000000	19.0000000	3.098367	4.0000000

Type of case=power point

Research Question Three:

Does the evidence suggest students exposed to the ATV safety training game treatment with prior ATV riding experience will demonstrate greater safety knowledge than the game treatment with no prior riding experience?

Hypothesis 3 –

DVs: Gaming Treatment in Class with and without prior riding experience.

IV: Posttest scores on Gaming Treatment in Class with and without prior riding experience.

Students exposed to the gaming treatment and having prior ATV riding experience will demonstrate greater posttest safety knowledge than those exposed to the gaming treatment without prior ATV riding experience.

The ATV "in class" game, T4, with prior riding experience had a F of 0.05. The ATV "in class" game, T4, without prior riding experience had a F of 0.08. Experience approaches, but does not reach significance. Therefore, the alternative Hypothesis 3 is rejected.

Table 4.10.
Class Level Information: **The GLM Procedure**

	Levels	Values	Median
Class	57	10.7368421	11.0000000
Type	59	12.4915254	3.0000000
Driveride	2	0	1

Table 4.11.
Dependent Variable (diffscore): **The GLM Procedure**

Source	DF	Sum of Squares	Mean Square	FValue	Pr>F
Model	3	79.0248280	26.3416093	4.47	0.0053
Error	108	636.3948148	5.8925446		
Corrected Total	111	715.4196429			

Table 4.12.
Pre and Post Scores by Case Type: **The MEANS Procedure**

Source	DF	Type ISS	Mean Square	FValue	Pr > F
Type	1	10.93750000	10.93750000	1.86	0.1759
Driveride	1	54.70605742	54.70605742	9.28	0.0029
Type*driveride	1	13.38127062	13.38127062	2.27	0.1347

* driveride is a variable consisting of both drivers and riders

Table 4.13.
Pre and Post Scores by Case Type: **The MEANS Procedure**

Source	R-Square	CoeffVar	RootMSE	DiffscoreMean
	0.110459	103.37456	2.427456	2.348214

Table 4.14.
***Pre and Post Scores by Case Type:* The MEANS Procedure**

Source	DF	Type III SS	Mean Square	FValue	Pr > F
Type	1	18.32524821	18.32524821	3.11	0.0806
Driveride	1	23.08575241	23.08575241	3.92	0.0503
Type*driveride	1	13.38127062	13.38127062	2.27	0.1347

Analysis of the data shows prior ATV experience, in conjunction with T4 (Game in class) does not have a significant difference when compared to T4 without prior ATV experience.

Research Question Four:

Does the evidence suggest students exposed to the ATV gaming treatment with prior ATV safety training will demonstrate greater safety knowledge than those exposed to the gaming treatment without prior ATV safety training?

Hypothesis 4 –

DVs: Gaming Treatment in Class with and without prior safety training.

IV: Posttest scores on Gaming Treatment in Class with and without prior safety training.

Students who have been exposed to the gaming treatment and who have prior ATV safety training will demonstrate greater safety knowledge than those exposed to the gaming treatment without any prior ATV safety training.

The ATV “in class” game, T4, had a subset of prior safety training with N=5.

The same size was too small to address this question with any accuracy. Therefore, the alternative Hypothesis 4 has too small of an N to accept or reject.

Research Question Five:

Does the data show students who have been exposed to the gaming treatment and have had prior ATV riding experience and prior ATV safety training will demonstrate greater safety knowledge than any other group measured in this experiment?

Hypothesis 5 –

DVs: Gaming Treatment in Class with prior riding experience and prior safety training vs. Gaming Treatment in Class without prior riding experience and prior safety training.

IV: Posttest scores on Gaming Treatment in Class with prior riding experience and prior safety training vs Gaming Treatment in Class without prior riding experience and prior safety training.

Students who have been exposed to the gaming treatment and have had prior ATV experience and prior ATV safety training will demonstrate the greatest amount of safety knowledge.

Research Question 3 showed no significant difference between riding experience and no prior riding experience. Research Question 4 did not have a large enough N for prior safety training. Therefore, the alternative Hypothesis 5 has too small of an N to accept or reject.

Pre-Post Item Analysis for Operational Knowledge Gain

Out of twenty pre/post questions, sixteen had a positive mean operational knowledge gain. One question had no operational knowledge gains. And three questions had a negative operational knowledge loss.

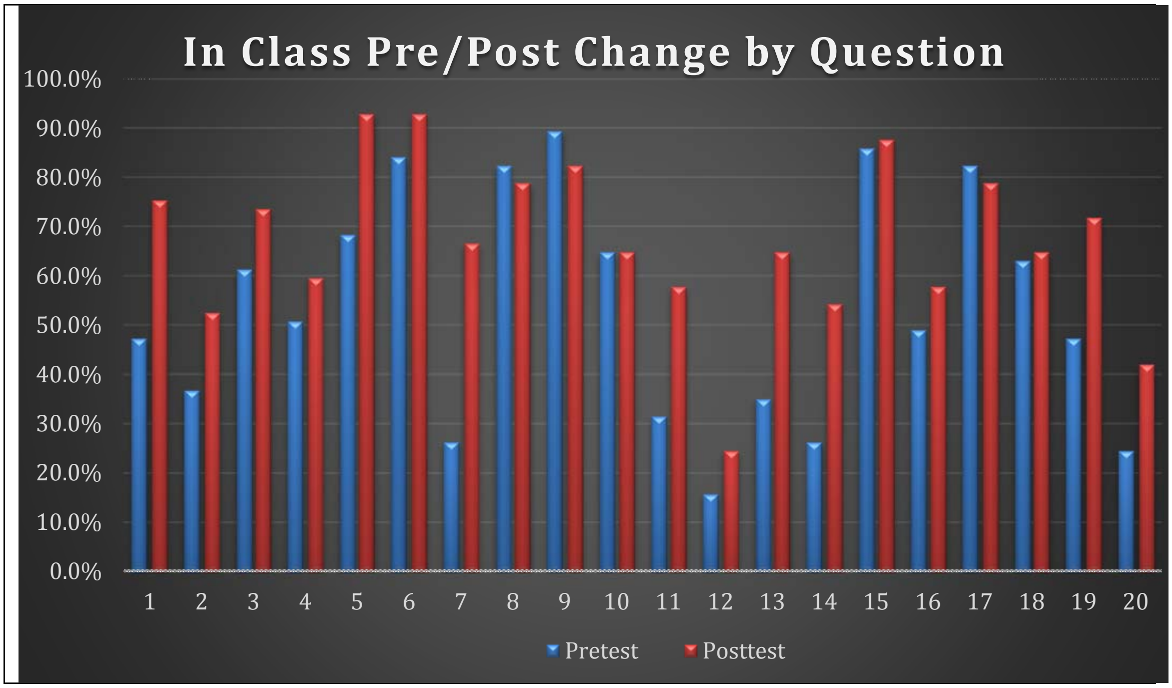

Figure 4.2. Video Game "In Class" Question Analysis

The largest of the operational knowledge gains included questions 7, 13, 1, 14, 11, 19, and 5. The three questions with the negative operational knowledge change were questions 8, 17 and 9.

Questions with zero or negative operational knowledge gains

The one question with no operational knowledge gain was question 10.

10. When riding an ATV, it is important to wear a….

a. seatbelt

b. harness

c. <u>helmet</u>

d. both a and c

While the game addressed the importance of wearing a helmet and active riding, a seatbelt was not mentioned. You cannot have active riding with a seatbelt, which you visually see in the game. Based on this data, any modification to this game should stress seatbelts are not used as they would inhibit active riding.

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8. Mathew was involved in an ATV backward overturn while riding up a steep hill. This injury event occurred because he …

a. Was wearing his helmet and it protected him

b. Involved multiple riders

c. he was leaning forward on the ATV

d. <u>he was leaning backward on the ATV</u>

A negative change occurred for this question. The game demonstrates leaning forward to go uphill, and leaning backward to go downhill. This did not translate into operational knowledge.

Interesting to note, that while a similar question (15) resulted in a positive operation knowledge gain, it was worded in a simpler question. That is, what to do as opposed to what now to do.

15. When riding your ATV uphill, it is important to shift your weight

a. Forward

b. Backward

c. Do not shift your weight

While the personal protective information did not include sun screen in the game, sun screen can indeed be considered personal protective equipment (protection from sunburn). I am not quite sure why participant would change his or her answer to include sunscreen, as this is not mentioned in the game.

17. Which item or items are essential for ATV safety?

a. Goggles, Gloves, Steel-toed Shoes and sun screen

b. Goggles and Gloves, Shirt, Safety Harness and sun screen

c. <u>Goggles, Gloves, Boots, Long sleeved shirts and long pants</u>

d. Goggles, Gloves, Boots, Long sleeved shirts, long pants and sun screen

Question 9 addresses selection of the correct ATV considering the rider. The information for the game was not commensurate with the PowerPoint.

9. Choose the correct size ATV based on your

a. Height

b. Weight

c. Age

d. <u>All of the above</u>

The game simply shows the signage below, while the PowerPoint specifies the complete information to answer the question. Operational knowledge dropped for the game, and increased for the PowerPoint treatment.

Figure 4.3 Ride the Right Size ATV

Chapter Five: Conclusions, Interpretations and Recommendations

Summary of the Findings

This quasi-experimental research examined the use of ATV video games in class, ATV video games in free play, and ATV PowerPoint instruction to affect operational knowledge of high school students. The study included 224 participants (~70% male / 30% female) from rural Kentucky high schools in grades ranging from freshmen to senior. This rural population is an at risk group for ATV injuries and fatalities.

The game-based intervention was developed by New Mexico State University's Learning lab, and funded by the ATV Safety Institute through the National 4-H Council.

The ATV pretest/posttest proved to be a useful instrument in taking a snapshot of baseline knowledge, and then comparing it to knowledge acquired after the application of the treatment. In addition, the demographic instrument provided invaluable information and insight into if ATVs were driven, if they were ridden as passengers, the duration (per outing as well as number of years) driving, prior safety training, gaming experience, accident information, as well as free text elaboration on accidents.

Analysis of the quantitative date confirmed the hypothesis ATV in-class treatment provided statistically significant operational knowledge gains compared to the control. Likewise, the data confirmed ATV in-class treatment and ATV PowerPoint treatment resulted in similar knowledge gains. The hypothesis that participants with prior riding experience and ATV in-class treatment would have a statistically significant gain over those without the riding experience was rejected. This will be addressed below in the outline for the interpretation of the results.

The operational knowledge games of the ATV “free play” treatment was shown to be no higher than the control group. Future research may have to examine the 'culture' of classrooms to address why the free choice options did not seem at all effective with this population of ATV at risk youthful riders. In chapter 2, I stated I was not intending to focus on 'culture' in the 4C framework (Culture, Cognition, Conduct & Consequences) advocated by Cole (2013). However, there seems to have been an overlay of classroom culture that may have explained why students weren't rewarded through points or other 'school work rewards' that are their expectations in schools. Also, it may have been that the Treadsylvania design/interface/quest was just not that compelling for these older students. These students stated they would have preferred a game that played on their phone, tablet and/or Xbox. Additionally, several students wished they could ride the game ATV in the first person view, as opposed to controlling another rider. It is possible taking these suggestions into account, and having a game with these ‘motivating’ features might have resulted in more positive outcome for “free play” condition.

The number of participants with prior safety training experience was very small. These demographic data were unexpected, as ATVs typically are sold with encouragements for safety training. This training may be live, video, or computer-based. If the participants purchased the ATV from a prior owner, the safety training may not have accompanied the sale. Even if the ATV was purchased new, there are no mandates in the state of Kentucky for ATV safety training. Therefore, while unexpected, it was interesting to note the very small number of participants with prior safety training. For future study, it would be interesting to conduct a focus group to discover if the training opportunities were there and, if so, why they were not taken. Manufacturers of ATVs are also a potential audience for these findings, if they are indeed committed to safe ATV operation, rather than a perfunctory provision of 'information' without any requirement for follow up.

Prior ATV Riding Experience: Not Always a Positive Factor

As mentioned earlier, one finding was that participants without prior riding experience who used the in-class game scored on a par with participants who used in the in-class game with prior riding experience. In fact, the data approached statistical significance for those without riding experience producing a greater knowledge gain. There may be compelling reasons why those without riding experience might score higher. For one, non-riders may not have learned incorrect operational knowledge of ATVs. Thus those participants might be presumed to be more receptive to new ideas and information. Another reason may have to do with an effect of participants' prior riding experience. If those participants have learned incorrect operational knowledge, it may be more difficult to unlearn an incorrect behavior or habit than to learn a new one without prior bias (poor operational knowledge). It is typical to assume that experience is always positive in a learning cycle. However, misconceptions, prior learning of poor safety practices as well as peer influences may indeed be a 'dark side of prior ATV riding experiences for the youth at high risk such as those in the present study.

The Pretest Question Item Analysis

From the pretest question item analysis, conducted on the entire sample for the pre-test data, the findings show that the youthful participants in this study had the least amount of knowledge when it came to:

Their ATVs encountering horses on a trail

- The maximum number of riders allowed on an ATV

- Riding an ATV on a paved road
- The term "Active Rider"
- Riding an ATV in a heavy downpour
- Adjusting a regulator, also known as a governor

Not understanding only one rider should be on an ATV is critical, as two or more riders interferes with Active Riding. Likewise, not understanding the dangers of riding an ATV on a paved road can potentially lead to a fatal outcome. Governors are designed to restrict the maximum speed of the ATV. Altering or removing the governor may allow the ATV to reach unsafe speeds. For a pretest, the participant is not expected to know this information. However, it does illustrate the correct questions are being asked and addressed in the treatments.

Conversely, the following question received on average a significant number of correct responses:

- Essential personal protective equipment (PPE) to be worn when riding an ATV
- Shifting weight in correct direction when riding up a steep hill
- Which incorrect weight shift riding up a steep hill would result in an ATV turnover
- Why an ATV has such a large seat

Perhaps these questions and accompanying answers were intuitive. It is impossible to state for certain why these scores were so high. One of the many things I found interesting, and a bit perplexing, had to do with three of the questions mentioned above. When asked about the maximum number of allowable rider on an ATV, the majority assumed it was greater than one. This response was incorrect as it prevented Active

Riding. However, when responding to why an ATV has such a large seat, I suspected the participants would answer it would accommodate more riders. Instead, they responded the rider has to move to keep proper balance and control. That is the definition of Active Riding. So they did not make the connection between number of riders (mean answered incorrectly), Active Riding (mean answered incorrectly), and why an ATV has a large seat (mean answered correctly). These questions are interrelated and show a clear lack of cognitive integration and critical thinking about some key elements of ATV safe operational knowledge. Perhaps case studies or case incident examples incorporated into instruction might fill these 'misconceptual' gaps in students' integrative understandings of actual ATV operation.

Limitations of the Study

The quasi-experimental study design for this research provided sufficient information to examine the research questions posed for the study. However, it did not allow for a back and forth exchange of information with study participants as a study with qualitative methods of data collection might. It would have been interesting to have a focus group to discover and understand why, if ATV safety practices are understood by some, they are still not implemented. The study was also limited by not having an actual ATV for instruction. Of course the ATV game can reach a far wider audience with virtually no cost, but one might wonder what the difference of operational knowledge learning would be with real-time, live ATVs and accompanying instruction. Or, alternatively, an actual ATV operational performance exam might have examined the transfer of operational knowledge from a game play experience to actual riding. A mechanical ATV simulator might also provide these kinds of opportunities to evaluate actual transfer of knowledge of operational best practice to the concrete riding demonstration of skill. Alternatively, a well-designed virtual simulator might also achieve that same ‘performance’ outcomes for ATV operational skill, rather than just knowledge of safe operational procedures. In a simulator, for example, a player could see that the second rider is dangerous because the second rider impedes/prevents active riding options.

Recommendations for Future Research and Instructional Design Practice

Researchers may wish to explore deeper into ATV game learning with participants with and without prior riding experience. How much influence does prior incorrect knowledge have on the learner? Does the literature address if participants who have learned a task incorrectly are at a disadvantage to novices when it comes to new training addressing that task?

Another area of study is culture. What level of risk is acceptable in these rural counties? Do participants know the risks and are still willing to forgo ATV personal protective equipment? Are there peer pressures to ignore a safety culture? One participant who had four ATV collisions and injuries relayed to me he is living on borrowed time.

Conclusions

The ATV in-class gaming treatment in this study provided similar operational knowledge as the in class non-game PowerPoint training. Instructors had a positive and keen interest in this study on the use of game-based learning. If ATV in-class game learning can be implemented successfully, what other types of learning might lend themselves to a game-based environment? Many students had suggested it would have been nice to actually ride the ATV in the game. So students may need that type of simulated riding interaction. Students also requested this game be available on smartphones and tablets. These are the types of devices students are more likely to have. By finding appropriate educational topics for gaming, making them engaging, applying instructional design that offers pleasant frustration and challenge, and making this available on devices students carry, gaming may prove to be even a more successful ATV operational safety knowledge tool than was even achieved in the current study.

In light of the conceptual framework, more attention should be focused on culture. Are high school students in these rural counties less risk averse than students in urban high schools? Are rural students more willing to be a passenger on an ATV (75% in this study) than urban students due to cultural influences? Does culture play a part in utilizing ATVs in rural counties as a form of transportation, rather than recreation? These questions could be addressed in future research.

Another area that may be addressed is the implication for game design. Several students expressed a desire to actively control the ATV in the first person. The third-person design in the current game was stated by some students as engaging. Some students also wished to have an interactive game that allowed them to play, and possibly compete, with their friends. Selecting a role and type of ATV are also mechanisms in game design. Competing against time, incurring penalties for incorrect driving, and competing for high points on a leaderboard are all motivational tools used in game design. The actual game may benefit from cosmetic, programming and platform changes. Consideration should be given to moving the platform from a PC to a digital tablet and smartphone. Several students, during this research, asked if they could do just that. The game was not designed to run on these platforms. An alternate programming language may be considered. The game is currently written in Adobe Flash. Adobe Flash is not supported on mobile devices. One possibility is to program the game in HTML5, a mark-up language that works with some mobile browsers. Another option is to program an app for mobile devices. The programming could include tactile response, badges, leveling up, modifying an ATV, check-points for respawning, debriefing after an activity, a higher degree of realism, and higher quality audio that enhances the gaming experience.

This research demonstrated ATV safety training via PowerPoint and Treadsylvania digital game had a similar impact on ATV operational knowledge. This begs the question "why develop a digital game when PowerPoint is much more time and cost effective". This can be answered by one word – motivation. If the results of the ATV gaming experience was commensurate with the PowerPoint, imagine what impact a digital game would have with the recommendations implemented above. It is conceivable an ATV safety game could be developed that is so engaging, a student would want to play it again and again. While the players are honing their skills with repetitive game play, perhaps they could also be honing their operational knowledge.

Appendix A

Appendix Table 1: Demographic Data for Students Enrolled in the Control, PowerPoint, Game (in), and Game (free) groups

Total participants	224
Male	69.6%
Played Video Games	56.5%
If yes to video games, average hours	6.9 / week
Taken an ATV safety course	5.4%
Driven an ATV	67.3%
If yes to Drive ATV, # of years	7.0 years
ATV Passenger	78.3%
Have accident if Drive/Ride	47.7%
If accident, were you injured?	47.0%

Appendix Table 2: Cronbach Coefficient Alpha

Variables	Alpha
Standardized	0.763742

Appendix B

ATV Driving and Riding Experience Questionnaire

Name: ___________ Site ID:__/__/__ Date: ______ Personal ID Number:________\

ATV Driving and Riding Experience Questionnaire

Please complete this questionnaire. Your answers will help the University of Kentucky understand your experiences with ATVs.

1. How old are you?
2. What is your grade level? __Freshman __Sophomore __Junior ___Senior
3. What is your gender? __ Male __ Female
4. Have you ever driven an ATV? __Yes __No
5. If you answered "Yes" to #4, how old were you when you started riding? ___
6. Who taught you how to drive an ATV?
   __family member __friend __class __self-taught __other
7. If you answered "Yes" to #4, approximately how many times have you driven an ATV in the last year? ______
8. Have you even taken an ATV safety course? __Yes __No
9. If you answered "Yes" to #7, who offered the course? ______________________
10. If you answered "Yes" to #7, how long ago? ______
11. How often do you use the Internet each week __0 __1-2 _3-4 _5 or more
12. How often do play video games each week __0 __1-2 _3-4 _5 or more

Have you ever been involved in any of the following injury events? (Please check all items that apply to you.)

13. Have you ever overturned an ATV? __ Yes __No
14. Have you had an ATV overturn close call (almost overturned ATV) __Yes __No
15. Have you ever been in an ATV collision? __ Yes __No
16. Have you had an ATV Collision close call (almost had a collision) __Yes __No
17. Have you ever ridden as a passenger on an ATV? __Yes __No
18. Have you ever driven an ATV on a farm? __Yes __No
19. Have you ever driven an ATV on a paved road? __Yes __No

Appendix C

ATV Pretest

Name:___________ Site ID:__/__/__ Date: ______ Personal ID Number:________\

ATV Rider Performance Survey 1

Instructions

Thank you for your participation. Please be sure to complete all information. It is very important to answer every question, and include your name, class, and period.

Instructor:	[Type your name]	Name:	___________
Class:	[Type a class name]	Date:	___________
Period:	[Type a period name]		

1) _____ **Age when adult supervision is required to ride an ATV?**

a. Under 14

b. Under 15

c. Under 16

d. Under 17

2. John's dad has agreed to purchase an ATV for him but only after which of the following to qualify him as a safe ATV rider:

a. John turns 15 (or whatever age doesn't require adult supervision), has made enough money to purchase a helmet and has taken a safety course.

b. John turns 15, takes a safety course, buys a helmet and selects an ATV that the manufacturer rates for his age and height.

c. John turns 15, takes a safety course, buys a helmet and selects an ATV that the manufacturer rates for his age and height and weight

d. John turns 15, takes a safety course, buys a helmet and selects an ATV that the manufacturer rates for his age, height grade level and weight

3) _____ When making a turn on your ATV, it is important to shift your weight

a. Forward
b. Backward
c. Away from the turn
d. Into the turn

4. An unsafe ATV riding trail is one that …

a. does not post a speed limit

b. does not have guard rails

c. has a steep gravel bank

d. has ankle high grass

5) _____ **When riding your ATV downhill, it is important to shift your weight**

a. Forward
b. Backward
c. Do not shift your weight
d. It depends on how steep the hill is

6. An ATV has a large seat because

a. Multiple passengers will be riding on the ATV

b. The rider has to move to keep proper balance and control

c. The rider needs room for safe storage of backpacks or coolers

d. When several riders are on the passengers needs to have room to move.

7) _____ **What is the maximum number of riders allowed on one ATV**

a. 1
b. 2

c. 3

d. Depends on the size of the ATV

8. Mathew was involved in an ATV backward overturn while riding up a steep hill. This injury event occurred because he …

a. Was wearing his helmet and it protected him

b. Involved multiple riders

c. he was leaning forward on the ATV

d. <u>he was leaning backward on the ATV</u>

9) _____ **Choose the correct size ATV based on your**

a. Height
b. Weight
c. Age
d. <u>All of the above</u>

10. When riding an ATV, it is important to wear a….

a. seatbelt

b. harness

c. <u>helmet</u>

d. both a and c

11) _____ **The ability to shift your body weight when negotiating hills, crossing obstacles and turning is known as being a**

a. Defensive Rider
b. <u>Active Rider</u>
c. Cautious Rider
d. Alert Rider

12. Joy and her friends ride up on a group of horseback riders on the trail. Joy and her friends should

a. proceed slowly

b. take off their helmets

c. turn off their ATVs until the horses pass

d. <u>both b and c</u>

13) _____ **When it comes to riding your ATV on paved roads, it is important to remember**

a. Do not ride at night
b. Do not ride at night or dusk
c. Only ride if your headlights and tail lights are in working order
d. <u>Never ride on paved road</u>

14. You are riding in a torrential downpour. The rain is so hard you can barely see. You should …

a. proceed slowly

b. ride quickly to a safe place

c. <u>turn off your ATV and seek higher ground</u>

d. head back home

15) _____ **When riding your ATV uphill, it is important to shift your weight**

a. <u>Forward</u>
b. Backward
c. Do not shift your weight
d. It depends on how steep the hill is

16. Upon returning home, you discover the creek you crossed earlier now has fast moving water. You should …

a. not cross the creek

b. cross the creek at a diagonal

c. ride slowly through the creek

d. ride quickly through the creek

17) _____ **Which item or items are essential for ATV safety**

a. Goggles, Gloves, Steel-toed Shoes and sun screen
b. Goggles and Gloves, Shirt, Safety Harness and sun screen
c. Goggles, Gloves, Boots, Long sleeved shirts and long pants
d. Goggles, Gloves, Boots, Long sleeved shirts, long pants and sun screen

18. Gabriela is heading home when she sees a bear in the distance on her trail. She should …

a. proceed slowly to make the bear move

b. beep her horn and yell loudly

c. abandon her ATV

d. turn her ATV around and proceed in the opposite direction

19) _____ **If you and your ATV encounter an unsafe trail**

a. Ride the trail slowly
b. Only ride the trail with another companion
c. Walk the trail before proceeding with your ATV

D. Do not ride the trail

20. Jaylen is 8 years old and has a speed regulator, or governor, on his ATV. He asks if you would adjust his regulator to give him more speed. You should only adjust a regulator

a. if the rider gives permission

b. if an adult gives permission

c. if a parent gives permission

d. <u>you should not adjust the regulator</u>

Appendix D

ATV Posttest

Name: ___________ Site ID: __/__/__ Date: ______ Personal ID Number: ________\

ATV Rider Performance Survey 2

Instructions

Thank you for your participation. Please be sure to complete all information. It is very important to answer every question, and include your name, class, and period.

Instructor:	[Type your name]	Name:	
Class:	[Type a class name]	Date:	
Period:	[Type a period name]		

1) _____ **What age is required for adult supervision to ride an ATV?**

a. Under 17
b. Under 16
c. Under 15
d. Under 14

2. John's dad has agreed to purchase an ATV for him but only after which of the following to qualify him as a safe ATV rider:

a. John turns 15 (or whatever age doesn't require adult supervision), has made enough money to purchase a helmet and has taken a safety course.

b. John turns 15, takes a safety course, buys a helmet and selects an ATV that the manufacturer rates for his age and height.

c. John turns 15, takes a safety course, buys a helmet and selects an ATV that the manufacturer rates for his age and height and weight

d. John turns 15, takes a safety course, buys a helmet and selects an ATV that the manufacturer rates for his age, height grade level and weight

3) _____ **Shift your weight _________________ when making a turn on your ATV.**

a. Away from the turn

b. Into the turn

c. Backward

d. Forward

4. An unsafe ATV riding trail is one that …

a. does not post a speed limit

b. does not have guard rails

c. has a steep gravel bank

d. has ankle high grass

5) _____ **Shift your weight ______________________ when riding your ATV downhill.**

a. Backward

b. Forward

c. It depends on how steep the hill is

d. do not shift your weight

6. An ATV has a large seat because

a. Multiple passengers will be riding on the ATV

b. The rider has to move to keep proper balance and control

c. The rider needs room for safe storage of backpacks or coolers

d. When several riders are on the passengers needs to have room to move.

7) _____ **The maximum number of riders allowed on one ATV is**

a. Depends on the size of the ATV

b. 3

c. 2

d. 1

8. Mathew was involved in an ATV backward overturn while riding up a steep hill. This injury event occurred because he …

a. Was wearing his helmet and it protected him

b. Involved multiple riders

c. he was leaning forward on the ATV

d. he was leaning backward on the ATV

9) _____ **The correct size of ATV should be selected based on your …**

a. Age
b. Weight
c. Height
d. All of the above

10. When riding an ATV, it is important to wear a….

a. seatbelt

b. harness

c. helmet

d. both a and c

11) _____ **Negotiating hills, crossing obstacles and turning while shifting your weight is known as being a**

a. Cautious Rider
b. Alert Rider
c. Defensive Rider
d. Active Rider

12. Joy and her friends ride up on a group of horseback riders on the trail. Joy and her friends should

a. proceed slowly

b. take off their helmets

c. turn off their ATVs until the horses pass

d. <u>both b and c</u>

13) _____ **The important thing to remember when it comes to riding your ATV on paved roads is**

a. Do not ride at night or dusk
b. Do not ride at night
c. <u>Never ride on a paved road</u>
d. Only ride if your headlights and tail lights are in working order

14. You are riding in a torrential downpour. The rain is so hard you can barely see. You should …

a. proceed slowly

b. ride quickly to a safe place

c. <u>turn off your ATV and seek higher ground</u>

d. head back home

15) _____ **It is important to shift your weight _________ when riding your ATV uphill.**

a. Backward
b. <u>Forward</u>
c. It depends on how steep the hill is
d. Do not shift your weight

16. Upon returning home, you discover the creek you crossed earlier now has fast moving water. You should …

a. not cross the creek

b. cross the creek at a diagonal

c. ride slowly through the creek

d. ride quickly through the creek

17) _____ **ATV safety items which are considered essential are**

a. Goggles, Gloves, Steel-toed Shoes and sun screen
b. Goggles and Gloves, Shirt, Safety Harness and sun screen
c. Goggles, Gloves, Boots, Long sleeved shirts, long pants and sun screen
d. Goggles, Gloves, Boots, Long sleeved shirts, and long pants

18. Gabriela is heading home when she sees a bear in the distance on her trail. She should …

a. proceed slowly to make the bear move

b. beep her horn and yell loudly

c. abandon her ATV

d. turn her ATV around and proceed in the opposite direction

19) _____ **If you and your ATV encounter an unsafe trail**

a. Only ride the trail with another companion
b. Ride the trail slowly
c. Do not ride the trail
D. Walk the trail before proceeding with your ATV

20. Jaylen is 8 years old and has a speed regulator, or governor, on his ATV. He asks if you would adjust his regulator to give him more speed. You should only adjust a regulator

a. if the rider gives permission

b. if an adult gives permission

c. if a parent gives permission

d. <u>you should not adjust the regulator</u>

21) How much did you enjoy playing the video game, Treadsylvania?

a. not at all

b. somewhat

c. pretty good

d. great

22) How difficult was it to play the video game, Treadsylvania?

a. very difficult

b. somewhat difficult

c. mostly easy

d. extremely easy

23. Would you tell your friends about the video game, Treadsylvania?

a. Yes

b. No

24. What was most memorable about the video game?

25. If you were the game designer, what would you add to the video game?

26. If you were the game designer, what would you remove from the game?

Please answer these two questions ONLY if you played the Treadsylvania video game at HOME.

27. How many days did you play Treadsylvania?

28 How many hours would you estimate you played the game over the week at home?

Appendix E

Student Assent and Parental Consent to Participate in a Research Study

Increasing High School Students' Awareness and Education to Prevent ATV Injuries

Invitation – We invite you to take part in a research project about preventing ATV injuries. Students who volunteer to participate will do so during a 2 to 3 week period sometime between January 2014 and March 2014. You are invited because (a) you live in a rural community, and (b) are in the age group at highest risk for these types of injuries. Mark Schneider, a doctoral student from the University of Kentucky is conducting the study.

Purpose – To help you (a) become more aware of the ATV injuries; and (b) how to prevent these types of injury.

What You Are Asked to Do – First you will complete a short set of questions about your age and ATV experiences, if you have any. Then you will complete 20 questions regarding ATVs. Next you will complete a computer interaction that teaches ATV safety. On a separate day, you will be asked to complete another set of ATV safety questions. That would complete your participation.

Why You Should or Should Not Participate – Your participation in this activity is part of a supervised school educational experience planned in cooperation with and to be completed under the direction of your teacher and a University of Kentucky graduate student. You may choose to participate or <u>not</u> to participate in the project activities. When you and your guardian or parent sign this form you grant permission to UK researcher Mark Schneider to receive and analyze your answers to questions about your ATV experience, and your answers to the question forms. Your responses to the survey and question forms will help the researcher to evaluate effectiveness of ATV safety training methodologies.

If you decide to take part in the project, it should be because you really want to. There are no penalties if you choose not to participate. At any time during the project you may withdraw your permission to allow Mark Schneider to have your completed forms and other data. All you need to do is tell your teacher you don't want the University of Kentucky to have your forms. In that event the teacher will <u>not</u> give your forms to the researcher.

Payment – Each class will have one of their participants randomly selected to win a $25 iTunes card.

Confidentiality – If you agree and your parent or guardian agrees to allow Mark Schneider to have the data from your project activities you and your parent or guardian must sign this form. If you choose to allow Mark Schneider to have your data, you will write your name, your teacher's name, the school name, and the date on a cover page attached to each form. When your teacher gives us your completed forms we will assign you a random number and write that umber on each form. Then we will tear off and shred the cover page where you listed your name. Your date will then be entered into a computer file that lists only that random number and <u>not</u> your name. Your data then will be pooled with the responses from all the other students who participate in project activities. You will remain anonymous and not be identified in any of the documents or reports about the project.

Risk and Discomforts – There are no major discomforts or risks for participating in this study. The computer-based training will teach you how to safely ride ATVs. It includes only photos of ATVs and ATV safety features and no pictures of injured people.

Benefits – You may benefit in three ways. You will learn how to prevent ATV injuries to yourself and others. Your work on this project will be part of a supervised community service project. By participating you are part of a larger effort to prevent costly fatal and disabling ATV injuries. When the study results are compiled by Mark Schneider, he will write a report and distribute copies to the teachers and school administrators.

If You Have Questions – Please ask questions when we explain this assent/consent form to you. If you have questions at any time before, during or after the project please contact the investigator, Mark Schneider at 859-323-2764. If you have questions about your rights as a volunteer in this research, contact the University of Kentucky Office of Research Integrity at 859-257-9428 or toll free at 1-866-400-9428.

Please list your age in the blank at the right.   I am ___ years old

If you are age 18 years or older you can sign on the first line below and don't need a parent or guardian signature.

If you are less than age 18 years both you and your parent or guardian must read and sign. In either case sign two copies of this document. Give one copy to your teacher. Keep one copy for yourself.

____ _______________________

Signature of student agreeing to take part in the study Date

____ _______________________

Printed name of student agreeing to take part in the study Date

____ _______________________

Signature of parent or guardian agreeing to have his or her child participate in this study Date

____ _______________________

Signature of person providing information to the student Date

____ _______________________

Investigator signature Date

Appendix F

Slides

PowerPoint Treatment

Slide 1

ATV Safety

Kent Shannon
Extension Ag Engineer
University Outreach and Extension

Slide 2

An ATV is…

- An all-terrain vehicle
- A motorized, four-wheel vehicle
- Ridden by straddling the seat and steered using handlebars
- For one person to ride
- For off-road use
- For recreation or work

Slide 3

An ATV is not . . .

- A toy
- For taking passengers
- For riding on paved surfaces – like sidewalks, driveways, parking lots, or streets
- For riding on public roads
- For damaging the environment

Slide 4

Size of ATV and Age of Rider

- 50cc engine – at least 6 years old
- 80cc engine – at least 12 years old
- 125cc engine – at least 16 years old
- 350cc engine – at least 16 years old and some manufacturers require a rider to be at least 18 years old

Slide 5

Pre-Ride Check

- Check Your ATV
- Check Your Gear
- Check the Golden Rules

Slide 6

Check Your ATV

- Things to Check
  - Tires & Wheels
    - Air pressure
    - Condition of tire treads
    - Axle or lug nuts
  - Controls & Cables
    - Controls
    - Throttle and other cables
    - Brakes
    - Shift lever(s)

Slide 7

Check Your ATV

- Things to Check
  - Lights & Electrics
    - Ignition
    - Engine stop switch
    - Lights
  - Oil & Fuel
    - Oil & fuel levels
    - Vents
    - Air filter
    - Fuel supply valve
  - Chassis
    - Drive shaft and/or chain
    - All nuts, bolts, belts

Slide 8

Check Your Gear

- Things to Check
  - Helmet
    - Fits snug
    - Can be securely fastened
    - Carries a safety label, such as Department of Transportation (DOT) or the Snell Memorial Foundation
  - Goggles or (Face Shield)
    - Are free from scratches
    - Can be securely fastened
    - Won't fog
    - Have the standard markings VESC8 (or V-8) or z87.1, or are made of a hard-coated polycarbonate

Slide 9

Check Your Gear

- Things to Check
  - Long-Sleeved Shirt
    - Covers your arms and chest
    - Is durable
    - If you like, add shoulder pads and a chest protector for more protection
  - Gloves
    - Are off-road style
    - Are weather resistant
    - Are padded over the knuckles
    - Are durable
  - Long Pants
    - Cover your legs fully
    - Are durable like jeans

Slide 10

Check Your Gear

- Things to Check
  - Boots
    - Are strong
    - Cover your ankles
    - Have low heels to prevent your feet from slipping off the footrests

Slide 11

Check the Golden Rules

- ATV Size
  - Choose the right ATV for your age
- Supervision
  - If you're under 16, always have adult supervision
- Protective Gear
  - Wear protective gear
- No passengers
  - Do not take any passengers

Slide 12

Check the Golden Rules

- No public roads
  - Do not ride on public roads
- No paved surfaces
  - Always avoid paved surfaces
- Hands-on Training
  - Take hands-on training course. Call 1-800-887-2887 or 1-800-342-3764 (Polaris models) for more info.

Slide 13

Know Your ATV

- Skills to Review
  - Mount
  - Posture
  - Start the ATV
  - Begin the Ride
  - Brake
  - Park
  - Dismount

Slide 14

How to mount…

1. Stand on the left side of the ATV.
2. Set the parking brake.
3. Grab the closet footrest with your left hand.
4. Step on the closest footrest with your left foot.
5. Lean and grab the other handlebar with your right hand.
6. Swing your right leg over the seat and onto the right footrest.
7. Use a similar technique when mounting from the other side.

Slide 15

How to sit (posture)…

1. Head and eyes looking forward.
2. Hands on the handlebars.
3. Shoulders relaxed.
4. Elbows slightly out.
5. Knees in.
6. Feet on the footrests, toes pointing straight ahead.

Slide 16

How to start…

1. **B**RAKES – Set the parking brakes
2. **O**N – Open the fuel cap vent, Turn the fuel valve to OPEN, Turn the ignition key to ON (if equipped).
3. **N**EUTRAL – Set transmission to NEUTRAL.
4. **E**NGINE – Set the engine stop switch to RUN or START.
5. **C**HOKE – If the engine is cold, set the choke to ON. Start the engine (check the operator's manual). When the engine is warm set the choke to NORMAL.

Slide 17

How to begin to ride…

After mounting and starting the ATV:

1. Apply the rear brake.
2. If you have a manual transmission, shift into gear (check the operator's manual).
3. If you have an automatic, shift into forward or reverse.
4. Release the parking brake.
5. Release the rear brake and SLOWLY apply the throttle.

Slide 18

Tips - Shifting

- If your machine has a manual transmission:
  - Slowly apply the throttle. Too fast, and you could lose control.
  - Learn the sounds of your engine – it'll tell you when to shift.
  - When you shift into reverse, look behind for obstacles or people.

Slide 19

How to brake…

1. Release the throttle.
2. Shift to a lower gear (the engine will slow the ATV).
3. Apply both the front and rear brakes evenly (if equipped).
4. Keep head and eyes up.

Slide 20

Tips - Braking

- Don't brake too much while turning.
- Do most of your braking before the turn.
- On slippery surfaces, apply both brakes lightly.
- Always look ahead while braking, not at the ground in front of you.

Slide 21

How to park…

1. Shift into NEUTRAL or PARK.
2. Stop the engine with the engine stop switch.
3. Turn off the ignition switch (if equipped).
4. Set the parking brake.
5. Turn the fuel valve off.

Slide 22

How to dismount…

1. Set the parking brake.
2. Stop the engine using the engine stop switch.
3. Turn off ignition, fuel valve, and fuel cap vent (if present).
4. Keep your hands on the handlebars for balance.
5. Swing your right leg over the left side of the seat.
6. Step to the ground on the left side of the ATV.
7. Use a similar technique when dismounting from the other side.

Slide 23

Rider-Active Skills

- Skills to Review
  - Turns
  - Stops
  - Swerves
  - Obstacles
  - Hills

Slide 24

Turns - Wide

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Slow down before the turn.
4. Move forward and shift your weight to the inside of the turn.
5. Keep looking in the direction of the turn.

Slide 25

If the wheels come off the ground:

- Reduce your speed.
- Shift your weight more to the side that is lifting.
- Straighten the handlebars to make the turn wider.

Slide 26

Turns - Sharp

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Slow down before the turn.
4. Move forward and shift your weight to the inside of the turn.
5. Keep looking in the direction of the turn.
6. **You'll need to shift your weight much more than in a wide turn.**

Slide 27

If the wheels come off the ground:

- Reduce your speed.
- Shift your weight more to the side that is lifting.
- Straighten the handlebars to make the turn wider.

Slide 28

Tips – Sharp Turns

- Sharp turns require active weight shifts.
- Look ahead and allow the ATV to move underneath you.
- Adjust your speed for the weather and trail conditions.

Slide 29

Stops - Basic

1. Keep your feet on the footrests.
2. Keep your hands on the handbars.
3. **Gradually apply your brakes until the ATV stops.**

Slide 30

Stops - Quick

1. Keep your feet on the footrests.
2. Keep your hands on the handbars.
3. **Apply your brakes quickly and evenly until the ATV stops.**

If your wheels lock, “pump the brakes” or release the brakes and reapply.

Slide 31

How to swerve…

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Slow down before the obstacle.
4. Look and turn the handlebars in the direction of the swerve.
5. Shift your weight to the inside of the swerve.

When swerving, DO NOT BRAKE.
Wait until the swerve is over and you’re moving in a straight line.

Slide 32

How to cross obstacles with 2 wheels…

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Slow down and approach the obstacle head on. (Maintain enough momentum to clear the obstacle.)
4. Come up off the seat.
5. Apply a little throttle as the front tires make contact with the obstacle.
6. Lean forward and release the throttle as the front tires clear the obstacle.

Slide 33

How to cross obstacles with 1 wheel…

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Slow down and approach the obstacle head on. (Maintain enough momentum to clear the obstacle.)
4. Come up off the seat.
5. **Don't apply the throttle.**
6. **Lean into the obstacle as the tire clears the obstacle.**

Slide 34

When clearing an obstacle:

- Don't pull up on the handlebars to lift the front wheels.
- If the ATV starts tipping, shift your weight to the high side, or the side that is lifting.

Slide 35

How to ride uphill…

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Shift into a lower gear and speed up BEFORE the hill.
4. Lean as far forward as possible.
5. For steeper hills, stand on the footrests and lean forward.

Slide 36

Tips – Riding Uphill

- Some hills are too steep for your abilities.
- Some hills are too steep regardless of your abilities.
- If you can't see what's on or past the top of the hill, slow down and keep to the right.

Slide 37

If the engine lugs:

- Shift to a lower gear.
- Release the throttle while shifting (so your front tires don't lift).

Slide 38

How to ride downhill…

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Keep your speed low.
4. Shift your body weight back.
5. Lightly apply the brakes.

Slide 39

When riding downhill

- Choose the straightest and most obstacle-free path.
- Take it easy on the brakes so you don't flip.

Slide 40

How to traverse a hill…

1. Keep your feet on the footrests.
2. Keep your hands on the handlebars.
3. Keep your speed low and consistent.
4. Shift body weight on the uphill footrest.
5. Support your weight on the uphill footrest.
6. Steer like you're driving into the hill with the wheels turned slightly uphill.

Slide 41

Traversing a hill

- If the ATV begins to tip, turn the front wheels downhill.
- If the ATV continues to tip, stop and get off on the uphill side.

Slide 42

Tips - Traversing a hill

- Use your traversing skills when a hill is too steep.
- Avoid traversing slopes with slippery, rough, or loose surfaces.
- Avoid sudden throttle changes.

Slide 43

What to do if you stall on a hill…

1. Keep your body weight shifted forward.
2. Apply the brakes carefully.
3. Shift to NEUTRAL.
4. Shut off the engine.
5. Set the parking brake.
6. Get off the ATV on the uphill side.
7. Follow the procedure in the operator's manual.

Slide 44

- If the ATV stalls, don't ride it backward.
- If the ATV rolls backward, don't apply the brakes too quickly – the ATV could flip.
- If the ATV won't stop rolling backward, get off on the uphill side immediately.

Slide 45

Safety First

- Skills to Review
  - Which ATV?
  - Golden Rules
  - Plan Ahead
  - Trail Signs
  - Laws & Regulations
  - Respect (TREAD Lightly)
  - Places to Ride

Slide 46

Choose an ATV that …

- Is right for your age:
  - Under 70 cc for 6 years or older
  - 70-90 cc for 12 years or older
  - Over 90 cc for 16 years or older

Slide 47

Choose an ATV that …

- Allows you to use the controls comfortably:
  - Can you turn the handlebars all the way to the right and left?
  - Can you work the brake pedal and gearshift lever easily?
  - Can you use the throttle and brake levers while holding onto the hand grips?
  - Can you stand on the footrests and have 3 inches of clearance from the seat on the ATV?

Slide 48

Follow the golden rules…

- Choose the right ATV for your age.
- If you're under 16, always have adult supervision.
- Wear protective gear.
- Do not take any passengers.
- Do not ride on public roads.
- Always avoid paved surfaces.
- Take a hands-on training course.
- Call 1-800-887-2887 or 1-800-342-3764 (Polaris models) for more info.

Slide 49

Plan ahead…

- Inspect your ATV.
- Always ride in a group.
- Be aware of weather conditions and how they may change.
- Bring warm clothing, a waterproof survival kit and first aid kit.
- Tell someone your route and plans.
- If you're under 16, always have adult supervision.
- Limit your trip distances to avoid fatigue.
- Don't use alcohol or other drugs.
- Be careful with prescription or over-the-counter drugs. They may affect your judgment.

Slide 50

Survival Kit

Your survival kit should contain at least:

- Trail food
- Water
- Water purification tablets
- Shock-resistant compass
- Waterproof matches or lighter
- Emergency space-blanket
- Ground-to-air signal chart
- Small flashlight and extra batteries
- An area map
- Small signal mirror
- 25 feet of sturdy rope
- 5 feet of rolled duct tape
- Pencil/pen and paper
- Hand axe
- Signal flares

Slide 51

First Aid Kit

- Your first aid kit should contain at least:
  - Aspirin or Ibuprofen
  - Six adhesive strips
  - Two 2-inch compresses
  - Four 4-inch compresses
  - One roll of 2-inch gauze
  - One roll of 1-inch gauze
  - One roll of 1-inch adhesive tape

Slide 52

Know the trail signs …

- Trail signs will:
  - Help you anticipate conditions
  - Tell who’s sharing your trail
  - Show areas that are restricted
- If there aren’t any trail signs, always know and respect local laws and regulations.

Slide 53

Know ATV laws and regulations…

- Many states require ATV registration.
- Some states use registration fees to maintain ATV trails.
- When riding in another state of locale, learn that area’s laws and regulations.

Slide 54

Practice respect…

- **T**RAVEL – Travel only where motorized vehicles are permitted.
- **R**ESPECT – Respect the rights of hikers, skiers, campers, and others.
- **E**DUCATE – Educate yourself by obtaining maps and regulations from public agencies. Obey signs and barriers. Ask for owner's permission to cross private property.
- **A**VOID – Avoid streams, lake shores, meadows, muddy trails, steep hillsides, wildlife, and livestock.
- **D**RIVING – Driving (riding) responsibly means protecting the environment and riding respectfully.

Slide 55

Where to ride…

- Check out:
  - Your ATV dealer
  - ATV clubs & associations
  - State maps (topographical and feature)
  - Snowmobile clubs
  - American Motorcyclist Association Trail Guide
  - US Forest Service
  - Bureau of Land Managment

Slide 56

How do you become a safe rider who can handle trails? Use SIPDE!

Slide 57

SIPDE

- S – Search
- I – Identify
- P – Predict
- D – Decide
- E - Execute

Slide 58

Search

- Keep looking around
- Search the terrain and the environment
- Avoid fixating on any one point

Slide 59

Identify

- Pick out problems like:
  - Trail surface
  - Narrow trails
  - Other trail users and wildlife
  - Stationary objects

Slide 60

Predict

- Think of consequences
- Consider riding techniques
- Predict results

Slide 61

Decide

- Choose to:
  - Reduce your risk
  - Stay within your abilities
  - Stay within the capabilities of your ATV

Slide 62

Execute

- Choose one or more:
  - Adjust your technique
  - Slow down
  - Pick the best path

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