Training Skilled and Unskilled Workers in an Immersive Virtual Learning Environment

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ABSTRACT

There are approximately 800 deaths in highway work-zones each year; this unfortunate statistic points to a need for a re-evaluation of training methodology. This is the first in a series of papers that report on the use of virtual learning technology for work zone training of skilled and unskilled workers, with the goal to reduce accidents. This research tested the use of an Immersive Virtual Learning Environment (IVLE) simulating real-world highway work zones. IVLEs go beyond traditional visual learning by presenting images that combine a new form of visual learning and virtual-experiential learning in a way that is more congruent with an individual's visual images stored in memory, thus improving knowledge transfer and retention. The visual cues that the adult learner experiences in the virtual world are so similar to the visual cues in the real world that recall of virtual world lessons stored in memory are triggered by the same cues in the real world. Additionally, the adult learner can experiment, make mistakes, and repeat the activity as often as necessary, achieving a virtual-experiential understanding of the concept that can only be duplicated in real-world experiential learning, which is often not practical. Such immersive engagement in the learning activity will allow the adult learners to move beyond memorization of the presented concepts and into application and synthesis of the material.

A quasi-experimental design used a sample of 305 highway workers from government and private sources, who were diverse in education, socio-economic background, and propensity to use technology. Through a process of blind selection, half the sample participated in the traditional class (control) and half participated in a blended delivery method class, incorporating the virtual learning environment (experimental). Class size averaged 20 subjects per class, with a total of eight experimental and seven control classes. The subjects did not know which class they were participating in until they reported for class. Data collection instruments included pre and posttests, recording of the experimental class, and structured interviews of adult learners in the experimental class. Adult learner accuracy and response times while in the virtual learning environment were measured through the use of an embedded tracking database within the IVLE. This paper reports on the initial qualitative findings of the study. The results of the quantitative study, a more in-depth study of the emergent qualitative themes, and a longitudinal study of knowledge transfer and retention are planned for subsequent phases of this study, in order to gain an even greater understanding of this new addition to the science of pedagogy.

A significant benefit of this research will be a better understanding of how educators can employ this advanced, user-friendly, semi-transparent technology to positively affect inclusion of marginalized populations into virtual learning environments. Research revealed that many functionally literate adults fail to learn in adult, continuing education classes because they are placed back into the same learning structure (the traditional classroom) that failed them in their youth. Some predominant reasons for the failure of adult education include a feeling of intimidation, difficulty with text-based training, and discomfort with the classroom environment. The reinvention of visual learning combined with the advent of virtual-experiential learning in the virtual learning environment moves the adult learner out of the classic classroom and into an environment that diminishes this intimidation. This research will establish a solid theoretical and evidence based link between use of the virtual world learning environment and improved knowledge transfer and retention for that marginalized population that forms the bulk of the employment pool for military and industrial entry level positions. Once established, a brand new learning frontier opens in the digital world which has huge implications for the science and practice of modeling and simulation.

ABOUT THE AUTHORS

Mary Leah Coco is a doctoral candidate in the School of Human Resource Education and Workforce Development at Louisiana State University and Agricultural and Mechanical College, Baton Rouge, LA. Ms. Coco brings a strong background in adult education, distance education, and virtual learning environments to this study. Ms. Coco will complete her doctorate in August of 2011 with her dissertation entitled "Evaluation of Knowledge Transfer in an Immersive Virtual Learning Environment for the Transportation Community." In addition to working to complete her doctorate, Ms. Coco serves as the Training and Development Program Staff Manager at the Transportation Training and Education Center with the goal of assisting and enabling workforce development using principles of strategic human capital improvement.

Glynn W. Cavin is the Director of the Louisiana Transportation Research Center's Transportation Training and Education Center. Dr. Cavin served 24 years on active duty in the USAF as a logistics officer rising to the rank of full Colonel. His military honors and awards include selection as the United States Air Force Tactical Air Command Outstanding Transportation Officer, selection to the Office of the Joint Chiefs of Staff J-4 Division and graduation from the Industrial College of the Armed Forces. His service awards include the Joint Services Commendation Medal, Kuwait Liberation Medal, Vietnam Service Medal with Bronze Star, USAF Meritorious Service Medal, and others. Upon completion of his military career, Dr. Cavin returned to his home town to work in private industry and local government public works. In 2005 he was selected as the first Director of the Transportation Training and Education Center, bringing a state-of-the-art adult continuing education center online, training over 4000 adults yearly. Early in 2006 he began his successful pursuit of his doctorate, and continues research in virtual world learning in addition to his daily activities running the Center.

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INTRODUCTION

This research project evaluated the ability of adult learners to function in a training context using an Immersive Virtual Learning Environment. The unique aspect of this training experiment was that it was designed to evaluate a diverse adult learner population primarily consisting of non-technologically oriented, high-school or less, lower socio-economic status adults, often referred to as "blue-collar" workers. Course delivery strategy employed a blended delivery methodology, with the specific focus on the Immersive Virtual Learning Environment (IVLE) technology as the method of blended delivery. The purpose of this research study was to determine if an Immersive Virtual Learning Environment (IVLE) increased the learning transfer of the knowledge obtained in a work zone safety basic flagging procedures course for what can be considered a marginalized population of adult learners.

Scant research has occurred regarding the use of IVLE for blue-collar workers that are perceived to avoid the use of technology and dislike attendance in traditional classrooms or computer based training. However, IVLEs provide a new and powerful method to increase adult learner engagement. As Lim, Nonis, and Hedberg (2006) have stated, adult learner engagement is paramount to learning success. This project hoped to find that through the IVLE, learning engagement would be increased as the adult learners would be fully integrated into the work zone safety simulation, with a specific focus on flagging procedures, as though they were actually performing the prescribed duties in accordance with the required rules and procedures as outlined in the classroom instruction. Such engagement in the learning activity would allow the adult learners to move beyond the memorization of the presented concepts and into the application and synthesis of the material.

As supported by Kolb's Experiential Learning Theory, the IVLE allows the adult learners to move from the concrete experience (current knowledge of work zone safety flagging procedures) to reflective observation (reflection on current knowledge of work zone safety flagging procedures as it relates to new materials) to abstract conceptualization (the application of the new knowledge of work zone safety flagging procedures) and lastly to active experimentation (constructing methods for using new information on the job) (Swanson & Holton, 2001). Based on review of current literature and discussions with scholars in the field of virtual learning, *active experimentation* in work zone safety flagging procedures has never been possible prior to the creation of the implemented IVLE for the transportation community, primarily for safety reasons. This is a particularly relevant point for any training activity attempting to mimic real-world physical activity that occurs in a dangerous environment (e.g. working around heavy equipment, scuba diving, civil engineering projects, or combat).

Significance of the Study

The research will continue to contribute fundamentally to the understanding of an IVLE as it relates to the transportation community; however, the research also has broad – reaching implications in all disciplines where education and training is paramount to organizational success. Use of web 3D technology to create an IVLE in order to increase the transfer of learning has been evaluated in a number of fields, with the findings as to its success varying across the disciplines. However, the aforementioned studies were conducted with homogenous groups, and this is the fundamental difference in this research study. This project was comprised of a population that was heterogeneous on many levels (e.g. years of experience, technological proficiency, formal education, age, gender, etc.). The accessible population from which the sample was drawn comes from the transportation highway maintenance community, both public and private sector. The result of this research project has a direct impact on future training of these workers, workers in similar fields, and ultimately the safety of the general traveling public. Research conducted with an extremely diverse population leads to increased public and scholastic value as more individuals, scholars, and modeling and simulation developers are able to see themselves benefiting from this research, as well as the potential to reach out to the technologically marginalized population.

The prototype of blended learning utilized in this research project was very specific, but the knowledge gained and the technology developed from this research will have far reaching impacts for any training where realistic practice is difficult and where realism during training is invaluable. This training transcended subgroups, reducing the intergroup achievement gap, increased participation due to the similarity to massive multiplayer online games, resulting in more adult learners being better prepared for the real-world work environment simulated by the IVLE.

The IVLE also provided an avenue for increasing the knowledge level of the marginalized population. Through the use of this blended methodology, the marginalized population was presented with technological advances in the realm of education that previously may have not been within their reach. By exposing this population to this type of educational element, a decrease in training resistance may be found. If a decrease in training resistance occurs, the likelihood of learning transfer increases, thus, leading to a better-trained population.

CURRENT RESEARCH

According to Hobbs, Brown, and Gordon (2006), current practice in higher education is moving away from didactic content delivery to a adult learner-centered model with an increasing emphasis on the skills that support independent, self-directed learning. Virtual worlds provide this type of independent, self-directed learning (Hobbs et al. 2006). It is essential for educators to investigate innovative and engaging teaching methodologies to offer a more fulfilling learning experience (Cobb, Heany, Corcoran, & Henderson – Begg, 2009). Echoed by Jarmon, Traphagn, and Mayrath (2008), they indicate that the use of virtual worlds can enhance adult learner motivation and engagement, which provides for social interaction, collaboration, increased sense of shared presence, exploration, and creation. Jarmon et al. (2008) also state that few empirical studies document learning within virtual worlds. The question to be addressed regarding an IVLE is not "what can it do" but rather "what is it doing?" (Ellaway, Dewhurst, & McLeod, 2004).

The effectiveness and value of an IVLE is not inherent to the IVLE software or platform, but rather depends on its use in facilitating and mediation of the needs and activities of the instructional material (Ellaway et al., 2004). IVLE functions exist in a blended relationship with other human activities, independent of whether they are the primary delivery medium or among one of many (Ellaway et al., 2004). The rationale for using learning in an IVLE in adult education offers advantages over learning through real – life practice (Savin – Badden, 2008).

Virtual worlds seem to provide an ideal vehicle for providing adult learners with "lived experiences," while meeting the needs of individuals and society in the 21st century (Twining, 2009). Twining (2009) highlights that a virtual world will allow for the following:

- Experiencing things that would be difficult or impossible to do in the physical world – both physically and pragmatically.
- Experiences in virtual worlds suggest that these are spaces, which encourage playfulness and test boundaries.

In a study conducted by the Computing Research Association and the International Society of Learning Sciences in 2005, they highlighted that one of the main challenges facing educators is moving from the dominant view of technology being disruptive in the classroom to understanding how to utilize the benefits that technology has to offer within the classroom.

Learning in an IVLE allows for exposure to a wide range of scenarios at a time and pace convenient to the adult learner while allowing for consistent feedback. The IVLE offers the adult learner chances to make mistakes without real – world repercussions, but it allows for the virtual – world repercussions to be experienced in a non – threatening environment (Savin – Badden, 2008). An IVLE also offers an opportunity for collaboration where appropriate, as well as offering new opportunities for review of abstract concepts (Savin – Badden, 2008).

Kramer and Schmidt (2001) identify the potential role of technology in education for reconstructing education and learning:

- The same content can be presented using different media types.
- Different perspectives and access to the same topic can be used to provide cognitive flexibility.
- Different media can be synchronized into multi – modal presentations.

- Multimedia components can be networked to hypermedia learning applications according to logic, didactic, or other meaningful relationship components.
- Different customized tours can be superimposed into learning components.
- Education software development and knowledge modeling tools facilitate authoring of multimedia education material and technology.
- Interaction provides adult learners with opportunities for experimentation, context – dependent feedback, and constructive problem solving.
- Asynchronous and synchronous communication and collaboration helps bridge geographical distance.
- Virtual laboratories and environments can be used to offer near authentic situations and opportunities for hands – on experimentation and problem solving.
- Operation sequences and preferred learning paths can be recorded and evaluated.

To further support the above-mentioned points, Whitelock, Romano, Jelfs, and Brna (2000) reiterate that an IVLE allows adult learners to enter a new world that they might not otherwise get to experience. The adult learners no longer have to be passive spectators in their learning experience but can manipulate their learning environment in a number of ways (Whitelock et al, 2000).

As identified by Clark and Mayer (2003), instruction through an "e – lesson," in this study an IVLE, must guide the adult learner's transformation of words and pictures through the sensory and working memories in order for this information to be integrated into the existing knowledge base in long – term memory. For this to occur, Clark and Mayer (2003) note the following must transpire:

- Selection of the important information in the course.
- Management of the limited capacity in working memory to allow the rehearsal needed for learning.
- Integration of auditory and visual sensory information in working memory with existing knowledge in long – term memory by way of rehearsal in working memory.
- Retrieval of new knowledge and skills from long – term memory into working memory when needed later.
- Management of all of these processes via metacognitive skills.

Clark and Mayer (2003) add that for learning transfer to occur, these "e – lessons" must incorporate the context of the job by offering concrete examples to take the abstract concepts into reality. Blumel, Termath, and Haase (2009) reiterate Clark and Mayer's (2003) position as they state, "Realistically representing and precisely visualizing the operations facilitates comprehension and hones the ability to transfer practiced procedures to a real work situation."

METHODOLOGY

Context

The Louisiana Department of Transportation and Development (DOTD) half-day Basic Flagger Course teaches highway maintenance workers how to safely manage traffic in a temporary work zone. Adult learners learn how to use proper equipment and techniques to capture the attention of motorists; communicate with them via hand signals and signs; and then safely control their movements around construction equipment, hazards, and obstructions.

The pre-experiment four-hour course was taught by an instructor delivering the content using mixed instructional methods (lecture, videos, and PowerPoint) in a traditional classroom setting. Adult learners were provided a traditional "flatworld" two-dimensional manual filled with concepts, rules, and diagrams. Figure 1 below depicts one such diagram.

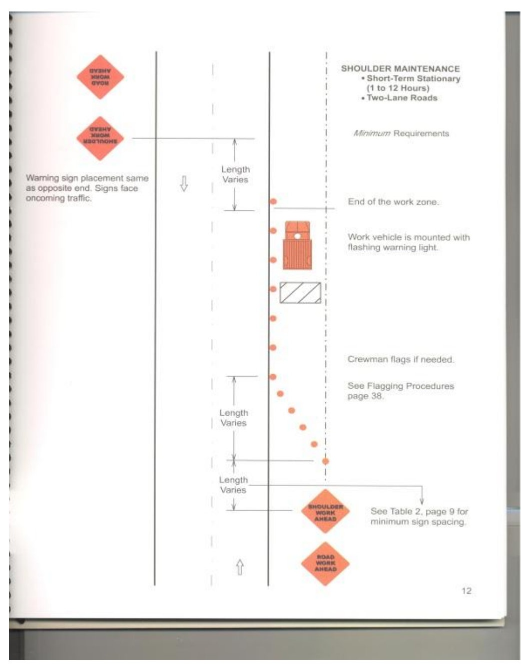

Figure 1.

Adult learners were encouraged to contribute to discussions, and volunteers were called upon during the course to demonstrate important learning points using flagger equipment. A posttest was administered to evaluate short term learning transfer. The Basic Flagger Course was chosen for this experiment because:

- It is directly related to highway work zone safety.
- It is focused on a physical rather than technical skill, with no practical method to realistically practice skills learned in class.
- The course had not been redesigned in the recent past (it was stable), was pedagogically sound, and the physical skills easily mapped into the virtual world environment.
- A large, diverse population was eligible for the class.

Collaborative Effort

Early and frequent collaboration of a number of organizations was essential to ensure success of this project. First, the project originators sought help from a distance learning and statistics scholar from the Louisiana State University School of Human Resource Education and Workforce Development (LSU/SHREWD). Course managers and instructors from the Louisiana Department of Transportation and Development/Louisiana Transportation Research Center (LTRC) then joined the team, and most importantly, the team expanded to include participation from the University of Louisiana Lafayette, Louisiana Immersive Technology Enterprise (LITE). This team examined various options, considered alternatives, and made early policy and experimental design decisions. Other interested stakeholders and research supporters participated in team meetings as the need arose.

Experimental Design

The target population for this research is public (State and local government) and private highway maintenance workers. The accessible population consisted of those workers in the greater metropolitan area of a large city in Louisiana.

This design involves an experimental and control group that are both administered pre and posttests; however, these groups are not randomly selected because they constitute naturally assembled groups (Campbell & Stanley, 1963). Adult learners received a pretest at the start of the class and a posttest upon class completion. Pretests are beneficial is this design because "they tell us about how the groups being compared initially differ and so alert us to the higher probability that some internal validity threats rather than others may be operating" (Shadish, Cook, & Campbell, 2002). Shadish, et al. (2002) went on to say that "the strong assumption is that the smaller the difference on the pretest, the less is the likelihood of strong initial selection biases on that pretest operating …" but they cautioned that other unmeasured variables that exist at the time of the pretest may influence the outcome.

First, a determination was made as to how many classes of 24 adult learners per class could be held and what days the training facilities would be available. This resulted in a total of 15 classes and would provide a training opportunity for a maximum of 360 adult learners. The research team randomly assigned experimental or control designation to each of the 15 classes, resulting in eight experimental and seven control classes. Only the researchers knew class designation (i.e. experimental or control), thus adult learners would not know if they were attending an experimental or control class prior to the start of the class. In fact, the adult learners' only prior knowledge was that they were attending a flagger safety course. This masking of assignment was useful because Shadish et al. (2002) assert that "it prevents … adult learner reactivity to [prior] knowledge of the condition …" and "efforts by those involved in assignment to influence results …."

Training managers from public and private organizations in the region were briefed ahead of time that the Basic Flagger Course was being offered, and were told that some classes would supplement the existing instruction with the new training technology of Immersive Virtual World Learning and that others would not. The training managers were assured that the overall quality of either type of class would not suffer and they were asked not to discuss the different delivery methods with class adult learners.

The training managers were provided a schedule of the classes and asked to appoint adult learners to the classes on a first-come, first-serve basis. One of the senior researchers confirmed attendance with the training managers and then sent a reminder of the schedule approximately 72 hours prior to the class.

The lecture was presented by the same individual for all classes, thus removing the variance associated with the instructor. Computer skills (fluency) of the adult learners were minimal; adult learners operated within the IVLE using one simple input device, similar to those commonly utilized with serious games (e.g. PlayStation 3®, Xbox®). The adult learners were engaged in the IVLE through the use of avatars as they performed specific flagging training tasks. A robust tracking system was embedded in the software to track the spatial (x-y-z coordinates) and temporal movement of the avatar of each adult learner. Development of the data storage and retrieval protocols took place early in the design phase and considered data integrity as well as report generation requirements.

Although this paper reports solely on the initial qualitative findings, the research design includes ongoing studies of the quantitative data, a more in-depth study of the emergent qualitative themes, and a longitudinal study of knowledge transfer and retention which will be presented in subsequent papers.

IVLE Design

The research team and the immersive technology team began by carefully reviewing the existing Basic Flagger course and gaining a thorough understanding of the abstract concepts, desired teaching outcomes, adult learner characteristics, instructor requirements, and subject matter expert opinions. Then the portions of the course content that would best match the teaching advantages of the virtual learning environment were chosen. Once that was completed, the immersive technology team developed "story boards" to illustrate virtual world design and planned functionality for each scene and presented those to the research team and instructional team for approval. A working IVLE prototype was developed and tested by a pilot group; minor problems and suggested improvements emerged and the immersive technology team then perfected the IVLE, incorporating those suggestions that enhanced the IVLE. Figures 2 and 3 below represent sample screen shots of two of the levels participants were immersed in. The task in figure 1 requires the participant to select the proper way to signal cars to proceed. In the activity depicted in figure 2, participants witness the negative outcome of careless horseplay when a vehicle approaches and the avatar backs into the path of the oncoming car.

Figure 2.

Figure 3.

DATA COLLECTION

The data collection instruments and methods used (and those approved by the Louisiana State University Institutional Review Board) are as follows:

1. Literature Review
2. Demographic Survey
3. Pre Test
4. Post Test
5. IVLE Telemetry
6. Video Recording of Experimental Classes
7. Structured Interviews

Literature Review

There is little research regarding the science of implementing an IVLE with a diverse group of adult learners, a great deal of published research existed for IVLEs in general, pedagogy in the virtual world, children and young adults learning in the virtual world, and virtual world design.

Demographic Survey

The demographic survey instrument was intentionally brief, and gathered pertinent information such as age, gender, ethnicity, education level, socio-economic status, organization type, and current job title.

Pretest/Posttest

The pretest and posttest were equivalent. The purpose of the pretest was to reveal pre-training baseline understanding of flagger techniques and abstract concepts.

IVLE Telemetry

A robust tracking system was embedded in the software to track and measure every one-tenth of a second the spatial (x-y-z coordinates) and temporal movement of the avatar of each adult learner. A highly precise and redundant telemetry data storage system (both hardware and protocol) was developed to allow easy retrieval of the working data for subsequent statistical analysis use by the researchers only. At time of publication of this paper, the data has not been analyzed and results from this analysis will be presented later.

DEPLOYMENT

At the beginning of each class, one of the senior researchers would welcome the adult learners and explain the compelling safety need for the course. The researcher then briefly described the instruments that would be administered. All subjects were advised that participation was strictly voluntary, that anyone could leave at any time, and that full completion, partial completion or refusal to complete the instruments at all was permissible. All subjects were assured that all data would be summative, and that all instruments would be treated as confidential and protected in compliance with the Louisiana State University Institutional Review Board.

A simple game controller (figure 4 below) was chosen as the input device, minimizing adult learner apprehension about the use of a keyboard and mouse.

Figure 4.

In order to simplify use, only the number keys and the two mini-joysticks were activated. Additionally, once the keyboard and mouse were used for initial log-in by the participants in the experimental classes, they were then placed out of the way of the adult learner.

At the beginning of each experimental class, use of the game controllers (shown in figure 5 below) was carefully explained to the adult learners.

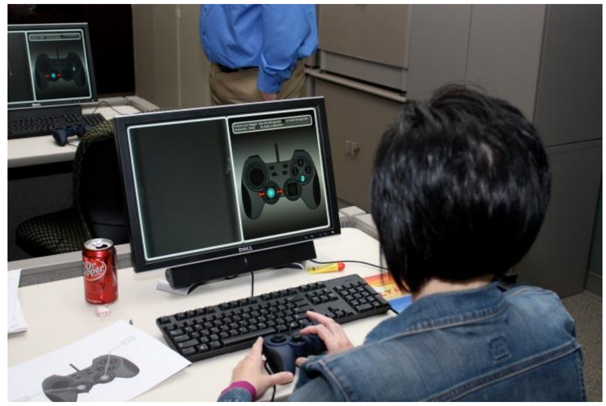

Figure 5.

Two IVLE events then began which allowed each adult learner to choose their avatar, followed by time to practice movement of their avatar, as seen in figure 6.

Figure 6.

After completion of these events, instruction began, mixing IVLE events into the course delivery at appropriate times. The 13 IVLE events required the adult learners to complete one or more tasks. Although no time limit was embedded in each event, the instructor could end an event and proceed with training at his discretion.

At the conclusion of each class, both experimental and control, the adult learners were thanked for their participation and reminded of the importance of what they had learned as it related to work zone safety. Although all adult learners were asked to discuss the lessons learned about safety, experimental class adult learners were asked not to discuss the IVLE technology after leaving the training facility. Also, four to five adult learners from each experimental class volunteered to participate in structured interviews.

FINDINGS

Demographic data for the combined treatment and control groups (n = 305) indicated that of those responding, the majority of the sample was African-American (64.3%) and that 88.3% were males. It is interesting to note that 76% of the sample had a high school degree, GED, or less, and that the largest group of individuals was between the ages of 46 to 64 years (46.6%) of age and had never attended a flagger course (77.4%). A significant number (87%) earned $50,000 a year or less.

Qualitative

The researchers for this study were trained on observational techniques prior to the commencement of the study. Thus, each researcher understood both the research project and the treatment they would be observing. This allowed for stronger creditability of the findings. There were always two or more observers for each experimental class, which allowed for more detailed observations of the class. There were eight experimental classes with a combined total of 24 observers. The camera that recorded the experimental class could scan the classroom for better viewing of the adult learners.

The experimental class was videotaped in order to provide the researchers with the opportunity to observe body language during the treatment and not intrude on the actual study. There was a room located in the training site that allowed researchers to remotely view the experimental class in real-time; eliminating what could have been perceived by the adult learners as an intrusive presence in the classroom. Viewing the experimental class in real-time thus enabled the researchers to take copious notes on the body language of each adult learner from the minute they stepped into the class and saw the computers until they left the class at the conclusion of the training session. The researchers were careful to note whether any of the adult learners had any type of smart phone with them.

The researchers noted that various adult learners were apprehensive as they stepped into the training room and found themselves faced with rows of computers, as evidenced by the visible stiffening of their bodies and markedly slowness to their steps. The observers noted that the adult learners spoke among themselves about the computers and what kind of training awaited them. As expected, the first adult learners to arrive chose seats in the back of the classroom and the later arrivals were forced into the front of the class. The observers also noted that the adult learners seemed surprised to see a game controller.

There were several research assistants in the classroom to help the adult learners log on to the computers with their pre-assigned logon id and password. One of the senior researchers explained to the adult learners that the game controller's operation was very similar to that of a joystick in the heavy equipment that they may operate on the job, such as a "trackhoe". That bit of advice seemed to help many of the adult learners with the operation of their game controller. Many of the adult learners expressed concerns that they had never worked on a computer before and were quite concerned.

Once each adult learner was logged on and the treatment began the observers could see that some adult learners struggled with their game controllers as they completed the initial simulation levels (events). Individuals that appeared to read the on-screen instructions slowly, also seemed to take the most time to complete events. Their uncertainty of the game controller and their slowness to complete events were noted. Adult learners that struggled in the class were occasionally assisted by their fellow adult learners, who in a few cases actually completed the event for them. The observers were able to note this external adult learner assistance, and those instances will be included in both quantitative and qualitative future analyses to ascertain if there was any impact on the results.

Age was not a variable that could be used to categorize the adult learners on their behavior in the treatment class. Some individuals that were older completed the events more quickly than younger adult learners. Race was not a discriminating factor during observations either. There were limited observations on female adult learners due to the relatively small number of women in the class.

As the adult learners gained experience by completing events, the observers reported a notable change in body language; adult learners visibly leaned forward in their chairs and competed with their neighbor as to how quickly they could complete an event. Adult learners seemed to become more animated as the events continued.

It was interesting to note that even though many of the adult learners were initially very apprehensive about participating in computer based training, almost 95% of the adult learners were found to have some type of smart phone. During the actual training, many of the adult learners were observed using their smart phones in various fashions: texting, scanning email, sending text messages, and reviewing websites.

At the completion of the training, another call for interview volunteers was mentioned and generally a minimum of four individuals volunteered.

Interviews

Doctoral and Master's degree candidates who completed various courses in research methods, including qualitative methods such as how to compose good follow-on probing questions, conducted the interviews. Interviewers consisted of various races and nationalities. The interviewers took notes and audio-taped the interviews for later transcription. All the interviewers used carefully designed initial questions all adult learners interviewed. Interviews were conducted with a representative cross-section of the experimental sample, to include race, age, socio-economic status, and educational level. The initial review of the transcripts (which formed the basis of this paper) clearly revealed the richness of the responses, and as response coding continues in subsequent phases of this study, the data will yield a great deal of information about the reaction of the adult learners to the immersive learning environment.

The interviews took place in a quiet room and the adult learners gave permission for the interviews to be taped. Questions asked ranged from why they chose a particular avatar to how realistic did this training appear to them. Every adult learner interviewed stated that this was a new and engaging way to have training. Approximately 40% of the adult learners had never used a computer before but almost 80% had used a game controller in some fashion prior to this training.

ANALYSIS

Consistent themes emerged from the interviews:

- Safety,
- Being more engaged,
- Increase the interactions within each event,
- Lack of details on the trucks.

The safety issue was consistent in all of the interviews; every adult learner felt they walked away with an understanding about the need to increase their safety in their workplace. They felt they needed to be more careful on curves and making sure they are watching traffic closer, especially since more people are texting while they are driving.

This was a pilot study and though the simulation scenes were realistic they were limited in road conditions and complexity of roadway (rural two lane road and only during the daytime). Most of the adult learners wanted to increase the complexity such as being on a four-lane highway with construction going on in one lane and the traffic having to be diverted into another lane. Adult learners felt much more engaged in their learning than the traditional class that consists of a PowerPoint presentation. These adult learners had participated many times in the traditional flagger course and felt that it was boring and a waste of their time. They really enjoyed being an active adult learner and felt they learned more as well.

Many of the adult learners noted the lack of details on the trucks – such as lack of rotating lights and no people actually in the cars and a lack of diversity of vehicle type.

CONCLUSIONS

In summary the data from this pilot study does indicate that the adult learners perceived that they benefited more from engaged learning treatment than from the traditional classroom. For several of them this is the first time they had attended a flagging training and felt that because they actually got to place themselves in the simulations they would be able to transfer this knowledge to the workplace much better than if they had just read a training book.

The simulations did heighten their concern for their safety and did seem to leave them with a need to pay more attention to their flagging and their own safety. The adult learners indicated that one of the simulation events did have a situation in which a flagger is severely injured during horseplay and that it would help remind everyone to take their job seriously.

The concern that was expressed throughout this project that individuals with limited education and computer skills could not learn in this environment was unfounded. Regardless of age or education level or familiarity with computers each individual was able to complete the training after spending some time familiarizing themselves with the controller. Concerns regarding simulation on computers can be put to rest if the program developers use game controllers instead of keyboards. This simple change opens up simulation training to a whole new population and allows for active learning which is critical for knowledge transfer and usability.

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