



# TECHSUMMARY *May 2014*

State Project No. 10-1SS / LTRC Project No. 502

## Evaluation of Knowledge Transfer in an Immersive Virtual Learning Environment for the Transportation Community

### INTRODUCTION

Immersive Virtual Learning Environments (IVLEs) are extensively used in training, but few rigorous scientific investigations regarding the transfer of learning have been conducted. Measurement of learning transfer through evaluative methods is key for determining the likelihood of equivalent performance post-training intervention. Research has shown that immersive virtual learning environments are advantageous for training psychomotor activities and spatial activities, but it is unclear whether these environments are beneficial in memorizing a procedure. More important than the IVLE technology, however, is the ability of IVLEs to provide higher critical thinking for learners. IVLEs are often implemented through the use of game-based technology, which is argued to hold the promise for fostering critical thinking skills and other 21st century skills.

### OBJECTIVE

The objective of this study was to determine if an IVLE increased the learning transfer of the knowledge obtained in a work zone safety basic flagging procedures course.

### SCOPE

This study evaluated the efficacy of knowledge transfer of semi-skilled adult learners, who participated in a virtual learning environment (VLE) training experiment conducted at LTRC. The learners participated in a safety course designed to test the hypothesis that a virtual learning environment, which supplemented traditional course content and delivery methods, enhanced the transfer of knowledge. This research was unique because of the evaluation of the knowledge transfer across socioeconomic, race, and generational differences. The experiment explored the concept proposed by Blumel, Termath, and Haase that learners are more apt to apply the encoded instructional knowledge in the VLE because mistakes can be made without negative consequences, which encourages application and builds confidence. The research methodology consisted of a qualitative analysis of the participant's experiences, reflections, and authentic knowledge transfer of the taught abstract concepts. A thorough review of existing literature indicates that the Louisiana State University and the Louisiana Department of Transportation and Development would be the first to study the efficacy of VLE training for this previously marginalized population (semi-skilled workers), because previous pedagogical research has focused on children or young adults that are predisposed to the use of educational technology.

### METHODOLOGY

Both a qualitative and quantitative analysis was performed at the conclusion of the experiment. Consistent themes emerged from the interviews were: safety, being more engaged, increase the interactions within each event, and 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.

Demographic data for the combined treatment and control groups ( $n = 305$ ) indicated that of those responding, the majority of the sample was male (88.3%). The largest ethnic group category was African-American (64.3%); the second largest category was White/Non-Hispanic (33.4%), while there were two respondents in the Other category, and one each in the American Indian/Alaskan and Asian categories. It is interesting to note that 76.0% of the overall 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%)

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of age and had never attended a flagger course (77.4%). In regard to years working as an adult (18 years or older), the data showed that 27.0% had been working between 26 and 35 years, which was the largest group. As far as the number of years worked in highway or maintenance construction, 74.4% had worked 15 years or less, which denotes the largest group in the data. A significant number (87.0%) earned \$50,000 a year or less. The sample size in the IVLE group was 165 (54.0%); whereas, the control group had a sample size of 140 individuals (45.0%).

An independent sample t-test was used to examine the pretest and posttest scores between the control and treatment group to ascertain if there was a statistical difference between the groups prior to and post treatment. An analysis of covariance (ANCOVA) was utilized to further ensure equivalence between the control and experimental groups so the researcher could confirm there were no preexisting differences between the groups despite the randomization. The pretest was the covariate in the ANCOVA. In both the independent samples t-test and ANCOVA, the significance level was set at .05.

The posttest analysis indicated statistically significant differences between the treatment and control groups ( $t = -2.59$ ,  $p = .01$ ). The pretest score was used as covariate to examine the posttest scores. An ANCOVA was utilized to further examine this data to ensure the finding was true and that preexisting differences could not account for this finding. There was a statistically significant interaction between the fixed factor and the posttest score indicating that the slopes were not parallel, and thus, the pretest scores could not be used as a covariate ( $F_{1, 294} = 6.14$ ,  $p = .01$ ).

Using the analysis of variance (ANOVA) technique to analyze the data, results indicated no significant differences between the mean posttest scores by age groups at the .05 two-tailed level ( $F = 1.965$ ,  $p = .122$ ).

Using the independent samples t-test technique to analyze the data, results provided no significant differences between the mean posttest scores for gender at the .05 two-tailed level, with  $p = .518$ . Using the independent sample t-test to analyze this portion of the sample, a significant difference between the posttest scores of African Americans and White/Non-Hispanic groups ( $t = -3.35$ ,  $p = .001$ ).

The participants' distance integral mean scores did not decrease between Levels 28/50 or between Levels 34/51. Though the increases in their mean scores were not large between the repeating levels (the repeated levels simulated a pre/posttest), the standard deviations did get larger for each of the repeated levels. Data from Levels 35/52 and Levels 36/53 showed a decrease in the distance integral mean from Level 35 to Level 52 and from Level 36 to Level 53, with a statistically significant change. These findings indicated that participants were able to transfer their learning to the real world environmental scenario. The skewness of the data appeared to be a function of the fact that some of the participants did not complete their tasks right away in each scenario. The distance integral continued to increase at a

constant value regardless of the fact the avatar was unmoving in the scenario.

Lastly, correlation and multiple regression were utilized in this data analysis procedure. According to Hinkle, Wiersma, and Jurs (2002), multiple regression is a statistical technique that involves predicting criterion variables (posttest score) by examining the relationships between the various predictor variables (demographic variables). The demographic variables of race, educational level, gender, and previous flagging course were recoded into dummy variables prior to analysis. The possible correlations range from +1 to -1. A zero correlation indicates that there is no relationship between the variables. A correlation of -1 indicates a perfect negative correlation, meaning that as one variable goes up, the other goes down. A correlation of +1 indicates a perfect positive correlation, meaning that both variables move in the same direction together (Hinkle et al., 2002). Multiple regression can be defined as an extension of simple linear regression involving more than one independent variable (Hinkle et al., 2002). This technique was used to predict the value of a single dependent variable from a weighted, linear combination of independent variables. Consider multiple regression as a means of seeking the linear combination of independent variables that maximally correlate with the dependent variable (Hinkle et al., 2002).

## CONCLUSIONS AND RECOMMENDATIONS

This research demonstrates that an IVLE can be successful in delivering training to a marginalized population. Computer skills are not necessary for successful training in an IVLE environment as game controllers can be used and these controllers mimic the systems used to operate heavy equipment, which was utilized in daily work tasks within the accessible population. Due to the fact that each participant had an individual computer for this training, they were able to fully participate in the training without fear of judgment by others participants in the training while the application of their learning could be captured. In normal training events, only one or two individuals generally opts to participate in table top work zone scenarios, while other participants watch. Thus, the trainer is unable to measure whether or not each individual can apply his or her knowledge. This training allowed the participants to practice placement of flaggers in the construction or maintenance work zone locations without any of the risks they would normally encounter in the real world due to the traveling public, dangerous weather conditions, obstructed lines of sight, or machinery. The final conclusion for this study might be that, since this population had a positive experience with a training event in an IVLE, they likely were more apt to be open to additional training through this type of instructional delivery system.