

# CAN DRIVING IN GAMES TRANSLATE TO DRIVING IN REAL LIFE? A STUDY OF GAME BASED TRAFFIC EDUCATION

Qing Li  
Towson University  
li@towson.edu

## ABSTRACT

*The main purpose of this research is to examine the effect of game based learning on knowledge acquisition and retention of road rules. This quasi-experimental study employed pretest – posttests design involving 42 participants, randomly selected from people in Alberta, Canada. The participants took a pretest, played a game specifically designed to help players learn road rules, and then 2 posttests. The results show that gaming not only can improve players’ knowledge of road rules and road safety, but also can help players retain such knowledge.*

## INTRODUCTION

Each year, traffic accidents are costing about 1.2 million people’s life worldwide, according to a World Health Organization report (Toroyan, 2009). The fatality rates, even in developed countries, remain high in about 10 vents per 100,000 people. It has been discovered (Parker, West, Stradling, & Manstead, 1995) that drivers’ violation of road rules is a major cause of traffic accidents. This strong correlation between unsafe driving behavior and traffic accidents logically points to the problem of drivers’ lacking adequate knowledge of road rules and safety.

A review of the current literature on driving education, however, indicates that our typical approaches to traffic education is ineffective, as exemplified by some systematic review studies (e.g. Masten & Peck, 2004; Vernick, Li, MacKenzie, Baker, & Gielen, 1999). For example, Vernick and colleagues’ (1999) meta-analysis of previous studies found that the existing driving education programs in high schools had no significant effect on reducing crashing accidents while another meta-analysis (Masten & Peck, 2004) showed that traffic incident reduction was not correlated with distributing educational or informational material.

The conventional approach for people to acquire road rules and safety knowledge, in North America for example, is by reading the Driver’s Handbook published by the local government. This approach is not only unattractive to learners including younger drivers, but also likely leads to a high level of knowledge decay after drivers obtained their drivers’ license. This calls for more innovative approaches to teaching road rules to effectively train current and potential drivers.

Digital gaming, which is becoming increasingly ubiquitous in this digital world, is a promising means for traffic education. People, especially younger generations, are often found to be interested in playing games. Game based learning provides a new approach that may contribute to reducing drivers’ violations and crashes for it not only can help novice drivers learn

the road rules and retain this knowledge after passing their driver tests but also may encourage licensed drivers to update their knowledge. This study, therefore, examines the effect of a game on people’s learning of road rules.

## RELATED LITERATURE

Rapid technological development is profoundly changing our economy, culture, and society. The appeal of gaming has become not only a common phenomenon, but also a defining feature of our digital generations of learners. Unfortunately, most of the driving games available today focus on the thrill of speeding and other risky driving behaviors instead of road safety. Nonetheless, the power of contemporary games to provide a more attractive mode of learning and induce deeper learning can be harnessed to address this important social issue.

The value of gaming and its compelling educational potentials are derived mainly from its provision of an authentic and engaging learning in a safe environment (Becker, 2007; Dede, 2005; van Eck, 2006). Games can enhance learning by increasing students’ interest in the subject matter and by more effectively meeting students’ needs and habits (Kiili, 2007; Prensky, 2001). Also, games are “immersive, require the player to make frequent, important decisions, have clear goals, adapt to each player individually, and involve a social network” (Oblinger, 2006,p.2).

A few studies have explored gaming in relation to driver training (Sitzmann, 2011; Vogel, Vogel, Cannon-Bowers, Bowers, Muse, & Wright, 2006). Although limited, these studies covered a range of gaming and simulation (Backlund, Engstrom, Johannesson, & Lebram, 2010; Lee, Young, & McLaughlin, 1984; Zeedyk, Wallace, Carcary, Jones, & Larter, 2001). In an early study (Lee et al., 1984) of a simple simulation to give children practical experience in road safety demonstrated that the game provided a valuable assistant to help young children learn safety rules. Zeedyk et al. (2001) conducted a study in the UK to teach 4-5 years old students road safety rules. This study compared three methods of teaching: 1) simulated traffic play mat, 2) board game, and 3) talks with posters and flipcharts. The results showed that there was no significant difference among the approaches. All approaches led to increased knowledge in the children. Another study explored the effects of game-based learning on a particular at-risk population: prenatal alcohol-affected children (Coles, Strickland, Padgett, & Bellmoff, 2007). The researchers studied 32 children, aged 4-10, diagnosed with Fetal Alcohol Syndrome (FAS) in US. The participants showed an improved safety behavior after playing the game.

Taking these evidences together, we can see that game-

based learning could potentially increase learners' knowledge on road rules and road safety. Knowledge of road rules acquired through game-based approach will enable learners to associate the rules with contextual information about the driving environment that is lacking in conventional learning sources like the Driver's Handbook. It can also provide a safe environment in which to acquire more experience in applying safe driving principles and increasing learners' hazard perceptions and risk management skills.

Although numerous games such as racing games exist that imitate driving, most of them focus on the thrill of speeding and other risky driving behaviors. The limited existing games aiming to teach road safety are focused on young children (i.e. age 10 or under). In an attempt to bridging this gap, this study examines the effect of game-based learning on young adults and adults. In particular, this research answers the following questions: Does game-based learning intervention affect participant knowledge on road rules and road safety? Do males and females differ in their knowledge acquisition of road rules via game based learning?

## METHODS

### Research Design and Sample

This quasi-experimental study employed pretest – posttest design with no control group in an attempt to explore the intervention effect on participants' knowledge. The participants took the first posttest immediately after learning by gaming and a second posttest six to eight weeks after undertaking the intervention. The first posttest was given in order to see the immediate effect of the intervention. The second posttest was given in order to gauge the participant knowledge retention.

Before taking the game based learning intervention, the participants completed a questionnaire survey on their beliefs about road safety. The survey covered the participants' opinions about speeding, traffic signs and driving & drinking behavior. After taking the game based learning intervention, the participants took another survey on their beliefs about learning by gaming. This survey covered participants' perception about their engagement, immersion and doing on the learning activity they took part in.

This study involved 42 participants consisting of 21 males and 21 females. Amongst them, 34 (16 males and 18 females) participants completed all the surveys and tests. Since previous research (Blunt (2007) indicated that the age threshold of effective game-based learning was 41 years old, we intentionally

chose our participants to be between 14 – 35 years old. One third of the participants had no driver license yet at the time they took the game based learning intervention.

### Data and Analysis

To test the effect of game intervention, quantitative data were collected from road safety knowledge tests. The participants took a total of three knowledge tests: a pretest, the 1st posttest and the 2nd posttest. Each knowledge test consisted of 30 items. The knowledge tests were modified from the practice tests available on the provincial government's website. Question format and level of difficulty remained consistent amongst the three knowledge tests, covering the same materials such as traffic signs, traffic tickets, speeding, drinking & driving, and driving behavior (e.g. changing lanes, entering highway).

To answer the research question, three paired sample t-tests of the knowledge tests (i.e. pretest vs. 1st posttest, pretest vs. 2nd posttest, and 1st posttest vs. 2nd posttest) were conducted to examine the effect of the intervention on participants' knowledge. The paired sample t-test on pretest vs. 1st posttest was conducted to explore immediate knowledge gain, while the paired sample t-test on pretest vs. 2nd posttest investigated long-term knowledge gain. The paired sample t-test on the 1st posttest vs. 2nd posttest analyzed participants' knowledge retention.

## RESULTS

The paired t-tests were conducted examining possible participants' knowledge gains. Three t-tests were conducted on: (1) pretest to the 1st posttest score difference; (2) pretest to the 2nd posttest score difference; and (3) 1st posttest to the 2nd posttest score difference. The test results were reported in Table 1. The results showed that after "learning by gaming", participants' knowledge on road rules and road safety had increased.

First, there was a statistically significant difference between the pretest and the 1st posttest scores [ $t(41) = 3.44, p = 0.001$ ; pretest  $M = 21.91, SD = 5.54$ ; 1st posttest  $M = 24.41, SD = 4.36$ ;  $d = -0.49$ ]. Our results showed that the participants achieved significantly higher scores in their 1st posttest than in their pretest. This result suggested that participants acquired significant knowledge gain after they took the game intervention.

Second, there was also a significant difference between the pretest and the 2nd posttest scores [ $t(33) = 3.04, p = 0.005$ ; pretest  $M = 21.91, SD = 5.54$ ; 2nd posttest  $M = 24.35, SD = 4.07$ ;  $d = -0.64$ ]. Again, this finding indicated that the participants'

**TABLE 1**  
**PARTICIPANTS' KNOWLEDGE GAINS**

	Mean Difference	95% CI of Difference		t	P
		Upper	Lower		
1st Posttest – Pretest	2.58	4.08	1.06	3.44	0.001
2nd Posttest – Pretest	2.44	4.08	0.81	3.04	0.005
2nd Posttest – 1st Posttest	-0.06	1.38	-1.5	-0.08	0.934

2nd posttest scores on road rules were significantly higher than their pregame knowledge test scores.

Third, there was no significant difference between 1st posttest and 2nd posttest scores [ $t(33) = -0.08$ ,  $p = 0.934$ ; 1st posttest  $M = 24.41$ ,  $SD = 4.36$ ; 2nd posttest  $M = 24.35$ ,  $SD = 4.07$ ;  $d = -0.13$ ]. Therefore, the participants' knowledge on road rules remained consistent between the 1st posttest and the 2nd posttest, indicating good knowledge retention.

## GENDER DIFFERENCES

To examine possible gender differences, three independent t-tests were conducted. The results of the tests showed that there were no statistically significant gender differences in participants' knowledge gain on road rules and road safety.

The participants' initial knowledge on road rules and road safety was not statistically significant different ( $t(40) = 1.52$ ,  $p = 0.14$ ) between male and female groups. After the game, the test scores on both groups increased and showed long-term knowledge gain. Yet, there were no significant gender differences ( $t(40) = 0.26$ ,  $p = 0.78$ ) in the 1st posttest and the 2nd posttest. Lastly, there was no statistically significant gender difference in knowledge six to eight weeks after the intervention.

## DISCUSSION

The most important finding of this study was that gaming could not only improve players' knowledge on road rules and road safety, but also helped players retain such knowledge. Recent research (e.g. Tay, 2010) found that less than 12% of licensed drivers passed a practice road rule test, indicating that pre-licensing learning often resulted in short term memory of the knowledge. After successfully passing driving tests and obtaining their driving licenses, drivers tended to forget much of their knowledge on road rules, which could potentially result in risky driving behaviors and road crashes.

Other studies of traffic education found little or no positive effect of road safety education intervention, both for traditional classroom-based high school programs (e.g. Vernick et al., 1999), and for the use of media products like videos at home or schools. Contrary to these earlier studies, we found that gaming improved drivers' knowledge acquisition as well as retention with relatively high effect sizes. The results from this study suggested that the game served an effective educational function, both short term and long term, as evidenced by the remarkable effects of gaming on players' achievement gains.

Our finding is consistent with other game-based learning studies which demonstrate that learning by gaming has a positive effect on cognitive skills and knowledge acquisition (Sitzmann, 2011; Vogel et al., 2006). Experiential learning throughout the game moderates meaning and knowledge development (Gee, 2008). Yet, a unique contribution of our study is that it also suggests long term educational affects of gaming as reflected in the players' knowledge retention of road rules and road safety. Considering the problem of conventional traffic education with evidences demonstrating that learners only acquire short-term knowledge of road rules (Poulter & McKenna, 2010; Tay, 2010), our results are significant because it directly

tackle this problems by enabling learners to improve long term knowledge retention.

Note: Some preliminary results of this work were presented at the annual conference of AERA, 2014, and in Li, Q. & Tay, R. (2014). Improving drivers' knowledge of road rules using digital games. *Accident Analysis and Prevention*, 65, 8-10.

## REFERENCES

- Backlund, P., Engstrom, H., Johannesson, M., & Lebram, M. (2010). Games for traffic education: an experimental study of a game-based driving simulator. *Simulation & Gaming*, 41(2), 145-169.
- Becker, K. (2007). Digital game-based learning once removed: Teaching teachers. *British Journal of Educational Technology*, 38(3), 478-488.
- Coles, C. D., Strickland, D. C., Padgett, L., & Bellmoff, L. (2007). Games that "work": Using computer games to teach alcohol-affected children about fire and street safety. *Research in Developmental Disabilities*, 28(5), 518-530.
- Dede, C. (2005). Planning for Neomillennial learning styles: Implications for investment in technology and faculty. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net Generation* (pp. 15.11-15.22). Boulder, Colo: EDUCAUSE.
- Gee, J. (2008). *What video games have to teach us about learning and literacy* (2nd ed.): Palgrave Macmillan.
- Kiili, K. (2007). Foundation for problem-based gaming. *British Journal of Educational Technology*, 38(3), 394-404.
- Lee, D. N., Young, D. S., & McLaughlin, C. M. (1984). A road-side simulation of road crossing for children. *Ergonomics*, 27(12), 1271-1281.
- Masten, S. V., & Peck, R. C. (2004). Problem driver remediation: a meta-analysis of the driver improvement literature. *Journal of Safety Research*, 35(4), 403-425.
- Oblinger, D. (2006). Simulations, games, and learning. *Educuse, May*, 1-6.
- Parker, D., West, R., Stradling, S., & Manstead, A. S. (1995). Behavioural characteristics and involvement in different types of traffic accident. *Accident Analysis & Prevention*, 27(4), 571-581.
- Poulter, D., & McKenna, F. (2010). Evaluating the effectiveness of a road safety education intervention for pre-drivers: An application of the theory of planned behaviour. *British Journal of Educational Psychology*, 80, 163-181. doi: 10.1348/014466509X46821
- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1-4.
- Sitzmann, T. (2011). A meta-analytic examination of the instructional effectiveness of computer-based simulation games. *Personnel Psychology*, 64(2), 489-528.
- Tay, R. (2010). Alberta Drivers' Knowledge of the Road Rules. Edmonton, AB.: Alberta Motor Association Traffic Safety Foundation.
- Toroyan, T. (2009). Global status report on road safety: time for action. Geneva: World Health Organization.

- van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE review*, 41(2), 16-30.
- Vernick, J. S., Li, G., MacKenzie, E. J., Baker, S. P., & Gielen, A. C. (1999). Effects of high school driver education on motor vehicle crashes, violations and licensure. *American Journal of Preventative Medicine*, 16(1), 40-46.
- Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research*, 34(3), 229-243.
- Zeedyk, M. S., Wallace, L., Carcary, B., Jones, K., & Larter, K. (2001). Children and road safety: Increasing knowledge does not improve behaviour. *British Journal of Educational Psychology*, 71(4), 573-594.