

Hazard Ridge: A Serious Gaming Intervention for Preventing Injury to Rural Farm Youth

The Economics of Prevention: Agricultural Injury Costs Us All!

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Abstract — Annually, an estimated 23,100 children and adolescents were injured on farms; 5,800 of these injuries were due to farm work. Teens aged 15-19 are at highest risk for agricultural injury and in Kentucky, the statistics reach 3x the national average. Closed head injuries from ATV incidents, tractor overturns, motor vehicle-farm machinery collisions and hearing loss top the list of causes. Building on a decade of research showing improved safety attitudes and behaviors, using simulation and interactive learning tools, an immersive serious game, *Hazard Ridge*, was developed to engage this at risk population and motivate them toward changed attitudes and safe behaviors. The game design and preliminary findings from a multi-state evaluation are reported in this paper.

Keywords—**Serious Games; Safety Training; Behavioral Change; Game Design**

I. INTRODUCTION

The goal of the Economics of Preventing Injury to Adolescent & Adult Farmers (EOP2) project¹ is to continue to promote more effective safety and health education among agricultural stakeholders and to reduce rates of preventable injury and death through increased use of protective equipment and other risk/hazard reduction behaviors. EOP1 project (by CDC/NIOSH Cooperative Agreement U50 OH007547) developed and evaluated online versions of the simulations and cost tools within college courses for post-secondary students preparing for careers as high school social studies and vocational agriculture teachers and as agricultural extension agents. Upon graduation, these professionals used the online program with hundreds of youths and adults enrolled in their respective educational programs. EOP2 continues and expands the use of innovative digital, interactive prevention/intervention instructional materials, specifically developing an immersive, serious game focused on agricultural safety for youth at highest risk.

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Teens aged 15-19 are at highest risk for agricultural injury and in Kentucky, the statistics reach 3x the national average [1]. Closed head injuries from ATV incidents, tractor overturns, motor vehicle-farm machinery collisions and hearing loss top the list of causes. Building on a decade of research showing improved safety attitudes and behaviors, using simulation and interactive learning tools, an immersive serious game, *Hazard Ridge*, was developed to engage this at risk population and motivate them toward changed attitudes and safe behaviors. The game design and preliminary findings from a multi-state evaluation are reported in this paper.

II. HAZARD RIDGE GAME DESIGN

A. Challenges: Extending An Effective Simulation Design Into an Immersive Adventure Game

A key challenge for the game designers was to appropriate elements and strategies from a series of simulations and interactive Excel spreadsheets (5 in all) that were designed as complimentary curriculum materials: the simulation presented a real-world story of a farm injury scenario, depicting pre-injury, injury and post injury events, the Excel cost tools pick up the story in the post-injury timeframe, coaching users through a series of worksheets that detail the extensive individual and social costs of any farm injury. For example, after the ATV injury in the simulation *Brad's Last Ride*, two boys goofing off in a field where they are repairing a fence, start racing, one diverts attention and slams into the fencing. Brad is paralyzed, and his family bears the direct costs, while it is shown that society bears the many indirect costs (lost work time for family, his life productivity, etc) as well as eventually the direct costs of a lifetime of rehab and care. Over a decade of research showed significant results in changed attitudes and safe behaviors [2,3, 4]. Thus, the game design had to engage users with realistic high end graphics, a pretext for interaction, a game quest and goals and levels that would cover similar learning goals as were achieved in the simulation/cost tool condition.

The EOP2 grant, funded by the National Institute of Occupational Safety & Health (NIOSH) in 2010 contained a basic game design --- *Hazard Ridge* – a gamescape comprised

of a small rural town where the various narratives (an ATV accident, a horse riding fall, a tractor overturn, a highway collision with farm machinery and hearing loss over years on a farm) from the simulations could ‘reside’ within the economic context of a small community effected by the consequences of these devastating injury events, as is the case in real life situations where teenagers die needless in preventable farm injury events [5].

B. Game Design & Iterative Testing

The EOP2 research team engaged the services of a the Lexington, KY game design firm *SuperSoul LLC*. Over the course of a year of collaborative team meetings the designers absorbed the approach of the simulation/cost tool interventions and developed a game design that incorporated the salient instructional elements embedded in a creative gaming scenario. The initial design decision was to focus on one simulation story and cost tool economic information located in *Hazard Ridge*. The game proposed in the grant was multi-user, but funding and time made that approach unrealistic for the current grant cycle, thus the actual design employed a single user perspective [6].

The setting for the game play is the Courthouse in *Hazard Ridge*. The user meets Elise, a farm safety researcher who is in Hazard Ridge to determine what is happening in this community, where claims are rising and. Users follow Elise as she discovers clues and information located throughout the Courthouse. The graphics provide a compelling darkness to the search through the basement records areas, various judges offices and there is a ‘time travel’ elevator where users can view various cut scenes that inform on the details of the ATV injury events in the field (reminiscent of the situation in *Brad’s Last Ride*).

SuperSoul conducted a series of iterative user tests with various college students in an Economics of Prevention class taught by the author as well as teen-aged students solicited from team members contacts at the university and in the local communities. The testing refined and honed the usability, engagement and navigation for *Hazard Ridge*.

The final game design is a compelling, intriguing Courthouse exploration that allows the user to locate and store various clues to piece together Brad’s story, and the social, psychological and economic effects of his injury on his family and community[7]. The user exits the game, leaves the courthouse, finding herself out in *Hazard Ridge* where she will no doubt encounter additional tragic mysteries to solve (as additional plots are added to the *Hazard Ridge* gamescape).

As shown in Figure 1, the user begins with the Hazard Ridge town sign, showing a recent change in population. After starting, the user is in the foyer of the Courthouse, with a note to Elise tacked to the security scanner – no one is around. Navigation instructions are available, but an experienced user can navigate in all directions with the mouse and aswd keystrokes, beginning in the basement record room as clues to the town’s tragic secrets are revealed through court documents, e-mails and other interactive clues.



Figure 1: Screen shots from the *Hazard Ridge* game.

III. MULTI-STATE EVALUATION: PRELIMINARY FINDINGS

Agricultural education programs in Kentucky, North Carolina and Arkansas used *Hazard Ridge* with their pre-service agricultural education students. The outcome measures included change in attitudes, safe behavior (ATV safety in this case) and knowledge of the economics of preventing farm injury.

An intervention-control repeated measures experimental design was used. Students in the control cohorts will not receive the online program of intervention materials. However, the control cohorts and all intervention cohorts will complete the pre-intervention Farm and Rural Life Experiences (FRLE) demographic measure, and at the end of the semester, all intervention cohorts will also complete three dependent variable measures, the Thinking and Talking and Acting Safety (TTSA), Stages-of-Change measure, the Farm Safety and Economics (FSE) test, and the final examination for the course in which they are enrolled. The TTSA was a new measure that was developed as part of an EOP1 extension grant. The revised measure was designed to provide greater sensitivity in measuring specific actions that demonstrate farm safety practices. For example, if someone reports buying an approved ATV helmet post-treatment. An additional source of data are a back-end tracking utility implemented by the SuperSoul developers for the express purpose of an indepth examination of user gameplay.

Control data were collected in 2012 from agricultural education and agricultural economics students in Kentucky and Mississippi. The control groups (n=120), in this study used the simulation and cost tools, the rationale being, the researchers wish to ascertain the extent to which the game is as effective as the previously validated simulations and cost tools. In Fall 2013

and Fall 2014 agricultural education students in KY, NC and AK used *Hazard Ridge* in their classes (n=70). A second round of testing is planned for 2014-15 with these same sites.

Data collection for year one was completed in May 2014 and only preliminary data are available. Below are the results from between-group intervention-control comparisons of pre-post data for the TTSA, and the knowledge measure, FSE. The user tracking analytics are currently under review and not yet available. We are interested in the specific paths, time of use and other actual performance data that will be integrated with outcome measure performance post-use of the *Hazard Ridge* game.

A. Demographics & Exposure to Farm Hazards

The sample was 67% male. Age of subjects ranged from age 19-35 years; 90% were between ages 20-26.

Data from the FRLE indicate that across all study subjects:

Exposure to Farm Hazards:

- 48% of subjects have lived on a farm.
- 70% have worked on farms.

Injury Surveillance:

- 30% reported a tractor overturn involving self, family, or friend (11% of whom were the study subjects).
- 8% reported a highway MV and farm equipment collision for self/family/friend, with 69% involving study subjects.
- 28% reported a self/family/friend head injury from a fall, 25% of which were to the subjects, with ATV, motorcycle, horseback riding falls most prevalent.
- 68% of the sample reported a temporary hearing loss to self/family/friend from exposure to loud noise; 44 (15%) reported permanent hearing loss from loud noise.
- 30% reported an injury that resulted in financial loss, with 20% of those experiencing that loss personally.

B. Changes in Attitudes and Behavior Proxy Measure (TTSA)

Pre-post testing showed significant changes in the extent to which users think and talk about safety, a proxy measure for behavioral change. Statistically significant increases in the TTSA scores were found for intervention students compared to the controls as measured by the TTSA. A GLM composite analysis that pooled total scores across the thinking and talking portions of the TTS found that the treatment group (M = 27.99) scored significantly higher ($p < .05$) than the controls (M = 23.05).

C. Knowledge of Farm Safety Economics (FSE)

Pre-post testing showed significant improvement in knowledge of the economics of farm safety. Statistically significant increases in the FSE scores were found for intervention students compared to the controls as measured by

the TTSA. A GLM composite analysis that pooled total scores across the thinking and talking portions of the TTS found that the treatment group (M = 27.99) scored significantly higher ($p < .05$) than the controls (M = 23.05).

IV. CONCLUSIONS AND IMPLICATIONS

These preliminary findings are encouraging. We have demonstrated the *Hazard Ridge* game at various conferences where at-risk farm youth are participants. In Louisville, KY in February 2014, hundreds of FFA students (Future Farmers of America) stopped by the Southeast Ag Center Booth where the *Hazard Ridge* game was displayed with a laptop projecting on a large screen. Kids and teachers were intrigued, crowding around a single player to make suggestions and watch the game play, attesting to the engagement power of immersive games. If the preliminary results from the year one data collection for the EOP2 project hold through the year two data collection, a serious gaming solution will no doubt prove more compelling and engaging than the previously used simulations and cost tools. As we explore the data from the user tracking analysis tool, we will also have more information on how long users spend in the game, what features and challenges are most engaging and to develop pedagogical strategies to support a productive and robust integration of serious game to prevent farm injury to at-risk rural youth.

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² Note: a login for the game is still required for the data collection process. Please use the generic login: jmazur@uky.edu/pw=password.