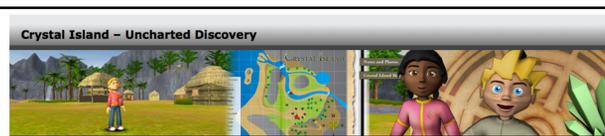


INTRODUCTION

Abstract

This study examined the role of gender on performance and transfer in a classroom game-based learning environment called CRYSTAL ISLAND – UNCHARTED DISCOVERY. The game focused on science curriculum including map models, map navigation, and landforms for 5th grade students. Students ($N = 594$) across eight schools completed a map transfer task at the end of four weeks of game sessions. A major finding was that interest in CRYSTAL ISLAND was a persistent predictor of academic and game performance and transfer for girls but not boys. This highlights the critical need of initiating interest and engagement when introducing new science concepts with elementary-aged female learners. In addition, girls scored at similar levels as boys on the transfer measure even though completing less game quests and scoring significantly lower on the posttest than boys.

CRYSTAL ISLAND – UNCHARTED DISCOVERY



Research Team

- Interdisciplinary Coordination
 - Computer Science
 - Educational Psychology
 - Curriculum & Instruction
 - K-12 students and teachers
- Infrastructure
 - Computational: Game Technology
 - Personnel: Graphic Design & Animation

A fully immersive game-based learning environment where students play the role of a student-selected protagonist who is one of several shipwrecked passengers stranded on a cluster of fictional islands trying to establish a village community. There are three distinct quests, each with two levels and then a final quest that requires skills and knowledge gained from the first six quests. The quests focus on landform identification, map navigation, and modeling (aligned state science curriculum) leveled based on difficulty. The students must successfully complete the first level of all quests before engaging in any of the second level quests. Students can seek counsel from map and landform experts from among the ship-wrecked crew as well as the player's iPad-like device equipped with note-taking tools, a camera, a log to monitor quest completion and progress, a glossary of key terms, and a problem-solving application.

Week	Planned Activities
Week 0	Pre-test in advance
Week 1	D1: Introduction, tutorial (introduce overall goal) D2: In-class landforms lesson with paper assessment D3: Game play landforms (enable landform quests)
Week 2	D1: In-class lesson maps and navigation D2: In-class lesson maps and navigation with paper assessment D3: Game play maps and navigation (enable map & navigation quests)
Week 3	D1: In-class lesson modeling D2: Game play modeling (enable modeling quests) D3: Game play modeling with paper assessment
Week 4	D1: Game play (enable multi-skill quest) D2: Lesson and work on Final Inquiry project D3: finish product and present D4: Post-test



METHOD

Participants

- 594 fifth grade students (10-11 years old; 52% female) from 8 schools in North Carolina.

Materials

- *Gaming Survey*. Items related to experience with video games and computer use (“I can do well at even the most challenging video game”)
- *Science Content Knowledge Test*: A 19-item test based upon N.C. 5th grade curriculum covering landforms, map navigation, and models.
- *AGQ (Achievement Goals Questionnaire)*: A 12-item scale to measure four factors of goal orientation (Elliot & McGregor, 2001).
- *Situational Interest*: A 10-item, 10-point Likert scale inventory
- *Science Self-Efficacy*: An eight-item, 5-point Likert scale inventory
- *Problem Solving*: An eight-item test identifying and applying problem-solving steps

Procedure & Design

- 4-week study
- Students played a tutorial to learn controls and adjust to the environment and then played CRYSTAL ISLAND – UNCHARTED DISCOVERY for six fifty-minute sessions; an additional 6 fifty-minute classroom sessions were included that aligned with game curriculum

Transfer Activity

- Students were asked to:
- draw an outline of an island on a large sheet of grid paper.
 - include seven landforms on their island that included a mountain, river, waterfall, plateau, delta, lake, and tributary.
 - consider the location of their landforms and also the accuracy of their drawings as they drew.
 - select three locations where they could hide secret treasures. However, they were instructed not to draw the treasures. Instead, they were asked to create three clues of increasing difficulty that they could give to their peers as a game (map navigation).
 - draw a small model of their island on a grid (map models), then recreate their island in smaller scale as accurately as possible to include and label symbols for landforms, treasures, and any additional landmarks that were included, and to make sure that their hidden treasures were included on their small map. This smaller map functioned as an answer key for navigation game presented to peers.



RESULTS

Students who played CRYSTAL ISLAND – UNCHARTED DISCOVERY showed a statistically significant increase in content knowledge after gameplay (pretest $M = 11.93$, $SD = 3.97$; posttest $M = 13.81$, $SD = 3.52$; Cohen's $d = .71$).

The role of gender:

- Both boys and girls showed significant increases in science content knowledge; No differences between genders on posttest knowledge when controlling for pretest scores
- Boys completed more game quests even after controlling for game time ($p < .001$; $\eta_p^2 = .03$)
- No significant differences on the transfer task

Multiple Regression by Gender

Prediction Variables: Pretest Content Knowledge, Self-Efficacy, Mastery Approach, Performance Approach, Interest, Problem Solving, Video Game Self-Rating

Outcome Variables: Science Content Knowledge, Quests Completed, Transfer

Significant Predictors:

GIRLS:

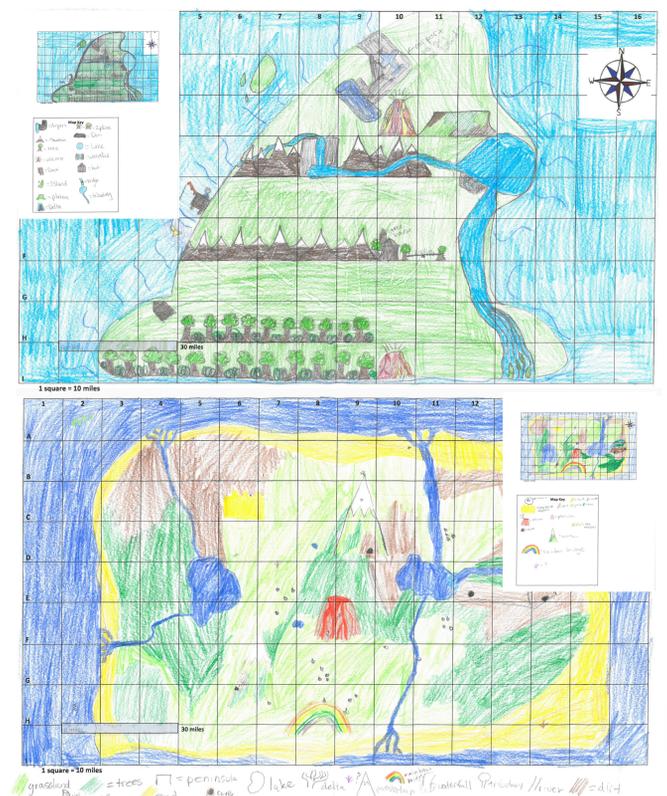
Science Content Knowledge ($R^2 = .60$): Pretest ($p < .001$), Self-Efficacy ($p = .03$), Mastery Approach ($p < .001$), Interest ($p = .04$), Problem Solving ($p < .001$)

Quests Completed ($R^2 = .26$): Pretest ($p < .001$), Interest ($p = .03$), Problem Solving ($p = .04$)
Transfer ($R^2 = .08$): Interest ($p = .04$)

BOYS:

Science Content Knowledge ($R^2 = .59$): Pretest ($p < .001$), Mastery Approach ($p = .04$), Problem Solving ($p = .01$)

Quests Completed ($R^2 = .26$): Pretest ($p < .001$), Problem Solving ($p = .008$)
Transfer ($R^2 = .08$): Pretest ($p = .003$), Self-Efficacy ($p = .05$)



Implications and Future Directions

- Students as a whole showed a significant increase in science content after playing CRYSTAL ISLAND. Boys scored significantly higher than girls on both the pre and posttest, however the differences in posttest scores disappeared when controlling for the pretest measure.
- Girls performed as well as boys on the transfer task even though they completed less game quests and had significantly lower posttest content scores.
- Interest was a consistent predictor of performance for girls but not boys. Therefore, future research should investigate this relationship and consider interventions to increase interest and relevance in science activities for girls.
- Regression models were systematically less able to predict performance going from content knowledge to game performance to transfer.