

Virtual Reality Games Promoting Metacognitive and Systematic Problem Solving Skills

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Abstract

As radical and transformative technological revolution significantly changes the way of science and engineering practice, bringing these changes into engineering classroom becomes a need. This project presents such a conduct that designs a virtual reality (VR) theme-based game system as a replacement of traditional laboratory activities in two fundamental electrical and computer engineering courses: digital design and circuit analysis. The goal is to strengthen students' engineering literacy and problem-solving skills since the lack of effective reading and problem-solving strategies in our students poses significant barriers to their learning. With digital design and circuit analysis as the themes and engineers solving real-life problems as the scenes, the games immerse students in actual engineering design challenges where a selection of metacognitive reading and problem-solving strategies are unfolded. This project falls into the categories of teaching leading knowledge and project based learning.

Introduction and Objectives

1. Improve students' active reading and thinking of ECE concepts.

2. Strengthen the ability of students to apply general principles to solve multi-step problems.

3. Increase students' cyberinfrastructure knowledge and skills of using games, simulation, modeling and collaborative learning tools

4. Promote retention and recruitment of ECE students

Developmental History of Innovation

- Although engineering faculty always strive to effectively teach problem solving, it seems that a deeper and underlying cause of the inefficacy is students' reading comprehension. Students cannot solve a problem is because they don't know what the problem is asking for.
- The ECE curriculum is fully packed with the contents ranging from math to electrical engineering, and to computer engineering, leaving no space to add additional courses or contents without deleting others.
- This project develops a non-intrusive approach that infuses metacognitive reading strategies into fully packed ECE curriculum through virtual reality games
- The games are being developed and implemented in two ECE core courses: Digital logic design and Circuit Analysis, where games are used as the replacement for their traditional labs.

Learning Activities and Materials

- *Infuse metacognitive reading interventions*
 - *Road Map training*



- *What I Know-What I Want to Know-What I have Solved (KWS)*



- *Think-Aloud-Share-Solve (TA2S) training*



Learning Activities and Materials (cont.)

--- Sample Games

• Escape

- Designed from a first-person perspective, the game starts in a dark room where the player character wakes up and realizes that he is locked in the classroom. The game then asks him to solve different DC analysis problems to be able to move from a room to another until the player escapes from the building.



• Need for Power

- This game provides students the ability to design and run a simulated electric car around a track with the goal of designing a circuit which will allow the car to reach the finish line with minimum pit stops.



• The Mystery of Traffic Lights

- This game is an application of digital logic in a traffic light control, where students utilize fundamental design techniques to regulate the traffic lights.



Discussion

- Games in general are attractive to students
- The Road-map intervention is helpful as a study guide
- The KWS intervention is seldom being used during the implementation because students do not want to type
- The social media is good if they are distance away. Given the students are in the same lab oratory room, the function did not get to use to the extent that we want them to use.

Things remained to be learned

- What is the best way to measure students' learning difficulty during the lab session (through games)
- What is the best way to help students when they have difficulty since students are left alone while playing game labs

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