

Blurring the Lines between Fiction and Reality: Utilization of Games to Achieve Personalized Learning Experiences within Engineering

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Introduction and Objectives

“Advancing personalized learning” is amongst the grand challenges identified by the National Academy of Engineering to be critical to address within the next decade.¹ The problem driving this challenge is that no two individuals learn in the same manner. Ideally, instruction should be tailored to the individual but unfortunately this cannot always occur within the constraints of our current educational system.

The objective of my work is to:

- Utilize games as a tool within the engineering classroom to help engage students in technical engineering material
- Provide a means for students to personalize their learning experience

A sub-focus of this objective specifically targets the utilization of games for the instruction of innovation and entrepreneurship content to engineering students.



Developmental History of Innovation

Games are unique teaching tools which have only more recently been seriously looked upon as a tool that could benefit education.

Games are unique because of their ability to provide players with:

- A goal
- A set of constraints (or rules) that need to be followed to reach that goal
- Immediate feedback on whether they were successful or not

Additional benefits of games are that they:

- Push players to work to the edge of their capabilities
- Provide a safe environment for players to learn through failure^{2,3}
- Are designed to allow players to build up their capabilities, essentially providing scaffolding, which will help them increase their capabilities relative to the goal they are seeking⁴

For this reason, games have the potential to serve as a platform that can allow for customized learning opportunities.

Learning Activities and Materials

Customer Values in a World Without Oil



Game prototype developed as part of the Epicenter Retreat at the Stanford Sierra Camp that teaches students about customer engagement and value propositions, identifying market opportunity and working within teams.

This game uses:

- A “doomsday” scenario to provide students with a sense of urgency in their quest
- A storyline based on a massively multiplayer foresight alternate reality game⁵
- The opportunity for students to gain points for their team (# of customers spoken to, ranking assigned and product chosen for re-design)

Nephrotex



This project is focused on the addition of customer based activities to the Nephrotex epistemic game that was developed by Dr. Shaffer and colleagues.

The current version of Nephrotex:

- Was developed surrounding the premise of traditional engineering design
- Presents students with a problem with a product (in this case a hemodialyzer)
- Provides students with possible options for what design changes could be made
- Requires students to balance stakeholder’s input when making design choices

Live Games



Collaboration with faculty at the School of engineering’s Stanford Technology Ventures Program and game designers based in New York.

The goal of this project is to provide:

- Faculty members with a tailored learning program utilizing games for innovation and entrepreneurship
- Reflection exercises which contribute to true learning gains from the exploration initiated during game play



Execution

All of these activities are going to be implemented in the ChE 214 Introduction to Chemical Product Design Class that I will be co-teaching in the Spring 2014 Semester.

World Without Oil: Students will be given the opportunity to watch a short video clip and then be provided with the game based assignment. A debrief of the activity will occur in the following class.

Nephrotex: Students will play Nephrotex for a period of 10 weeks during the semester. At the end of this time they will present posters highlighting their findings.

Live Games: Students will be led through game based activities associated with the concepts that are to be covered in class. The debrief after the game will be used to make connections between what they experienced and the course content.



Major Issues to Resolve

The utilization of games within engineering education is within its infancy although their implementation has grown exponentially in recent years.

The biggest challenges this field faces are:

- Creating a methodology to ensure consistency in the types and quality of games being used in engineering education
- Demonstrating the effectiveness of games in comparison to traditional pedagogical approaches
- Methods for measuring student engagement while participating in games (other than student self-assessment)
- Determining common goals for the application of games within engineering education

I am interested in meeting with others working in this area to see how they have assessed their implementations and whether control groups have been used.

Discussion

I am expecting to see that through the utilization of games we can get more students:

- Involved in the content that they are learning
- To become more active participants within the learning process
- To be able to make connections with content than could previously

I would like to see a consortium of individuals interested in this application within engineering education to work together in order to validate this type of pedagogical approach. The potential for this application is vast and it would be great in the future to see all students have the opportunity to learn by doing and be engaged in the process.

References

- National Academy of Engineering of the National Academies. “NAE Grand Challenges for Engineering”. <http://www.engineeringchallenges.org/cms/8996/9127.asp>. Accessed November 8th, 2012.
- Squire, K., Jenkins, H. (2003). Harnessing the Power of Games in Education. *InSight* 3, 7-33.
- Westera, W., Nadolski, R.J., Hummel, H.G.K., Wopereis, I.G.J.H. (2008). Serious Games for Higher Education: A Framework for Reducing Design Complexity. *Journal of Computer Assisted Learning*. 24(5), 420-432.
- Whitton, N., Moseley, A. (2012). *Using Games to Enhance Learning and Teaching A Beginner’s Guide*. Routledge. New York, NY.
- World Without Oil Game. 2007. About World Without Oil. <http://www.worldwithoutoil.org/>. Accessed on November 8th, 2012.

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