Using Community and Gaming Concepts in Projects to Improve Student Learning

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Abstract

Educating engineering undergraduates in community projects and gaming through experiential learning is essential to creating a new generation of engineers that are essential for science citizens of the global world. To meet the technical, social, and cultural challenges of the 21st century, it is vital that student learning involving community projects and gaming needs to be incorporated into the engineering canon. Companies such as Apple, Google, Amazon, and Coca-Cola are pioneers in positioning design thinking as a key contributor to innovation. These creative companies, along with others, are emphasizing the role of community involvement and constructing maps that show the path to innovation. A case study conducted from interdisciplinary students through a community design project in a sophomore systems course is considered in this paper and presented the outcomes and student reflections. Further analysis is required to see how the approach may affect student learning and beliefs.

Keywords

Gaming Concepts, Community Projects, Experiential Learning, Design Thinking, Case Study

Introduction

Community projects and gaming through experiential learning provides an engaging approach for educating engineering undergraduates and is essential to creating a new generation of engineers that are essential for science citizens of the global world. Community-based projects, also termed as Project-based Service Learning (PBSL) offers a great experience for students to learn and appreciate the theory/topics learned in class-room as well as engagement. Forsyth and Hesson, [1] discusses the benefits and challenges involved in community based multidisciplinary projects. Even though PBSL has been implemented in many capstone design projects [2], very limited studies has been reported in sophomore courses. PBSL has been shown to contribute to learning in a variety of ways in engineering education in particular, including practice toward mastery of concepts and skills, and offering hands-on experiences. This paper presents a preliminary study conducted in a sophomore systems course in mechanical engineering dealing with a community design project. The community project and the game design are briefly described below.

Community - Project Oasis and Design Problem

Oasis is a community near Athens, Georgia with a mission to help underprivileged children to improve in their schoolwork and allow better opportunities for success and growth in their future. Oasis is a nonprofit organization funded by outside donations, run by volunteers, and set in an underprivileged community. In addition to administration efforts, the Oasis location brings forth a slew of problems for which they do not have the resources to solve. Sister Marguerite, the head administrator of Oasis, a nonprofit organization created to help underprivileged children with their schoolwork, Sister Marguerite faced a number of challenges including that their facility had serious issues with drainage.

The Oasis site lay on a natural flood plain. The steep hills surrounding the site allowed rain to freely flow where it pleased, submerging a large portion of the area where the kids had their recess. The inconsistency in the smoothness of the grass and terrain also posed a problem, given that water takes the path of least resistance when it flows. This meant that anywhere where the ground created natural pockets would result in the pooling up of water, making certain areas of the ground unusable. Moreover, there were few to no natural barriers on the site to help push the water back and lessen the overall flooding, making even the eating area and parking lot susceptible to flooding. This problem prevented the children from getting the exercise they needed, in addition to affecting the day-to-day operations of the program.

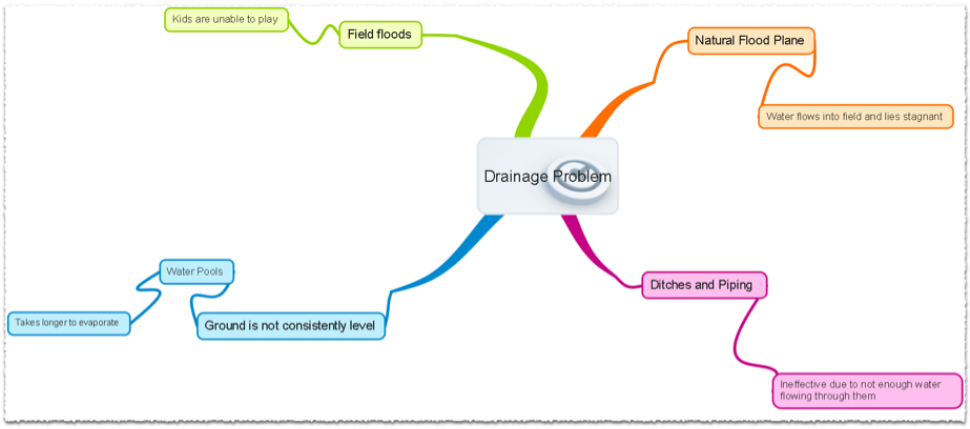
Solution Approach

UGA students from mechanical engineering systems course and from media/journalism collaborated in a project to solve society's problem related to Athens community. The group of students decided that a holistic approach was very important, given that, though each individual issue required a specific solution, the entire problem of flooding couldn't be solved without fixing every issue. They also greatly took into account issues of cost, feasibility, and disruptiveness, considering the resources available to them and Oasis Tutors, as well as the need for the program to continue operating. Additionally, they addressed concerns related to sustainability in the form of social, economic, and environmental impact.

The students found that a number of measures would have to be taken to address the discrepancies in the terrain. First, the ground would have to be leveled, as this would improve the area in terms of allowing kids to have more activities as well as eliminating the problem of small pools of water forming. Next, a brick wall would be constructed to help stop the flow of water in target areas, especially around the eating area and the parking lot. Finally, in order to correct for the elevation of the area, a small ditch would be dug both inside and outside the wall to catch water across increasing and decreasing gradients. The ditches would slope down slightly to a PVC pipe that would take the water off-site. It was determined that the key variables involved in the system were the amount of annual rainfall on the location, the capacity for natural water runoff, the amount of funds available for expenditure, and the natural landforms of the site.

The students created a mind map (shown in figure right) to organize their thoughts about solutions. After determining that the site was in a natural floodplain, the students figured that the problem

was exacerbated by the fact that the ground at the site wasn't level. The existing framework for a drainage system involves the construction of a shallow ditch at the bottom of the hill to stop some of the runoff, and some underground piping exists to divert the water. This system isn't nearly large enough, however, to effectively control floodwaters, and the remaining water takes a long time to evaporate into the ground. This creates an area those floods quickly which is a serious concern.



The students determined that a three-pronged solution of leveling the land, erecting a wall, and creating a channel system would solve the drainage problem in the most effective way. The group, in addition to solving a pressing problem, learned a number of valuable lessons through the project, including the importance of communication, organization, and analysis in situations like these. The students saw the project as a great example of how engineering and systems thinking can be used to change the world, as well as how engineering can work with other disciplines, in this case media, to solve complex problems.

Game Design

The idea of introducing the game as part of the project is to illustrate the concepts of systems thinking in holistically addressing the community problem and prompt the students into design thinking for possible solutions. Ms. Destini Billins, Media and Journalism student developed a preliminary game working with mechanical engineering design team. The game length is around 3-5 minutes to play.

Figure 1. A series of snapshots showing various aspects of the game

The game begins (see Fig. 1) with a musical score and short "animation" (compromised of slides) featuring the words OASIS. After clicking continue, a short introduction explaining what Oasis is and the problem that needs to be designed, there is a prompt that asks for the participant to click an object they think will solve the design problem.

Upon clicking the "wrong" answer, they see a short animation of an area of Oasis that floods and are given the opportunity to go back and select again.

Upon clicking the "right" answer, they see a short animation of an area of Oasis that floods and are given the opportunity to go back and select an addition solution that will solve the design.

Upon clicking the second "right" answer, they see a congratulations screen, a short slideshow of areas around Oasis, and a screen that gives additional solutions.

Student Reflections

The following are the student reflections: "Looking back at this project, our group had a realization… This project was a great example of the reason why we all want to become engineers: to help others and improve life for people around the world. While working with the Oasis staff, we developed empathy towards both the workers and children, and we wanted to do our best to find a solution to the flooding problem. It was also good for us to have to work with a student from a drastically different major than mechanical engineering. This allows us to practice relating to people who may not be engineers and interpret information in a different way than we do. This is very important when working with groups. We came up with a solution that we felt was the best way to go about solving the problem and hopefully they will look into our analysis of their problem and our ideas towards a solution. Ideally, we have begun to make positive changes to solve their issue and aid their organization as a whole."

Concluding Remarks

The Oasis project highlights the need for engineering undergraduates to be educated in experiential learning through community projects and gaming aspects. When applied on a large scale, this kind of education is essential to creating new generation of engineers that are essential for science citizens of global world. To meet the technical, social, and cultural challenges of the 21st century, it is vital that student learning involving community projects needs to be incorporated into the engineering canon.

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Dr. Pidaparti received his Ph.D. degree in Aeronautics & Astronautics from Purdue University, West Lafayette and currently, he is a Professor in the College of Engineering at the University of Georgia. Pidaparti's research interests are in the broad areas of multidisciplinary design innovation, and STEM education. He is a Fellow of American Association for the Advancement of Science; Fellow of Royal Aeronautical Society; Fellow of American Society of Mechanical Engineers; Associate Fellow of American Institute of Aeronautics & Astronautics; and member of American Society of Engineering Education.