AC 2011-540: AN INNOVATIVE MECHANISM TO ESTABLISH POSITIVE ASSOCIATION WITHIN THE FIRST YEAR OF CIVIL ENGINEERING CURRICULUM

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An Innovative Mechanism to Establish Positive Association within the First Year of Civil Engineering Curriculum

Abstract

Retention of students after the initial year of class work is a major issue facing engineering programs today. The typical approach has been to create a common freshman or first year experience that faculty or administrators have predetermined to be positive. This technique has been criticized as lacking depth or breadth of knowledge, garnering poor retention of knowledge in students, and generally failing to create a positive enough association to thwart the attrition of students to other seemingly less challenging majors. The ubiquitous progression of technical classes which engineering students march through, coupled with the general disregard of American students towards math, science and technology appears to create a mindset in students that is quite difficult to change. Calls have been made for transformation in curriculum, both fundamental and finite although these changes garner limited returns on investment.

This project was created to provide a positive association with the declared major, civil engineering, and to create a lasting impression to get through the core curriculum requirements without loss of majors. This project consisted of a semester long, group based project document infrastructure which influenced the student's everyday life. Individual initial engagement in civil engineering was measured with a survey and reflection prior to introduction of the assignment in class. Students were allowed to co-create the course by using social networking sites as tools for documentation, updates, changes, review, and basic networking. At the end of the semester students viewed other groups' projects and the videos were placed on YouTube. Student self assessed their association with civil engineering at the end of the semester and these measures were then compared to their baseline. Results indicate a more positive association with civil engineering, and with engineering in general in students who participated in the video projects and separated civil engineering freshman course than those who were enrolled in a more traditionally structured course. Faculty effort expended was substantially greater for preparation and continued engagement than the traditional course.

Introduction

In the fall of 2009 a new civil engineering program was re-established at a primarily undergraduate university within a small engineering college. The foundational design of the department was centered on outcomes which prepared graduates to enter professional practice while gaining the leadership and innovative skills necessary to address contemporary global, societal needs. To accomplish these outcomes, while retaining declared majors as a small emerging program in an established college, innovative techniques were encouraged and applied throughout the program coursework. Of particular concern is the first year experience, or freshman year, as the first year has been cited as a critical decision making juncture for retention in Science Technology Engineering and Mathematics (STEM) (1, 2).

Completion surveys from previous students consistently pointed to the traditional common freshman engineering introductory course as lacking in engagement. Anecdotal evidence on these surveys associated this course with major changes out of engineering. To achieve retention of majors and stay competitive within an established college, the newly established department ambitiously separated the freshman engineering introductory class from the traditional, customary coursework. This was done in an attempt to provide a learning environment consisting of problem based learning using group and individual projects. Modules were created to cover a minimum of four basic areas of civil engineering with an overall, semester long group project which serves as the topic of discussion for this paper. The purpose of this paper is not to

document project based learning in the freshman year. The primary purpose of this paper is to discuss the use of social networking sites in first year coursework as an innovative mechanism to facilitate engagement in a cooperative group, semester-long videography assignment.

Description of Assignment

The approach used in this study was to utilize the technical and social networking tools which students routinely employ in their daily life in a semester-long, group based project. The intent was to gauge association and thereby engagement with civil engineering in first year students and then to compare this association with students enrolled in a traditional course. Previous colleges had attempted similar project based learning freshman engineering courses, but without the social networking aspect of this particular project (2). Freshman engineering is a one credit hour course meeting once a week for two hours in the afternoon. The class was comprised of sixteen students, four students below a more traditional freshman engineering course offered in the college. Twelve of these students were declared civil engineering majors, while four students were listed as undecided engineering majors. The assignment (Appendix A) was a group based videography assignment addressing a specific civil engineering topic. While the primary objective of this assignment was to facilitate engagement in the chosen major, the secondary objective was to generate situational awareness of the student with their surroundings and how the field of their chosen major directly impacted their everyday lives. Situational awareness could possibly facilitate engagement as students become aware of the scope of their chosen major. To assist in the process of situational awareness, the students and faculty mentor toured the urban campus on the first day of class. This tour consisted of students identifying infrastructure components followed by a discussion led by the faculty mentor of the primary purpose of each component, how well this primary purpose was met on face value, and how each piece influenced other pieces.

Each group was given a high density portable video camera and assigned the topic of "Civil Engineering in Everyday Life." The videography assignment was twofold: initially students as a group or individuals were to find and document a piece of infrastructure that influenced, either positively or negatively, their everyday life. In identifying this piece of infrastructure students were asked to answer the following questions: What was the assumed objective purpose of this piece of infrastructure? In your opinion, which are major engineering strengths? In your opinion, which are the major engineering weaknesses? Have the assumed objectives of building this infrastructure been attained? Secondly, students were to create or design an improvement upon the component of infrastructure which they chose. Two groups chose to do a group project, while two other groups chose to do a "mash-up" of individual projects along a common theme. The videos were given a time constraint of a minimum of 5 minutes with a maximum of 20 minutes. Time constraints were applied to allow the videos to be posted on social networking sites and to limit students from getting overwhelmed by an open ended project.

Following the tour, the class divided itself into groups consisting of approximately four students each. The four undecided majors were interspersed evenly within the groups completely of their own accord. After dividing into groups, and prior to receiving the assignment, the class introduced themselves and discussed why they chose their major. As a class, the students discussed what they thought a civil engineer was and did. In order to assess initial and final association and thereby engagement, students were asked to define what a civil engineer was and why they wanted to be a civil engineer in a reflective paper. In the reflective paper they were asked to gauge their association with civil engineering on a scale of 1-10 with 10 being the highest and 1 being the lowest. This ranking system was described in a narrative fashion to the students where 10 was a very strongly association with the major, a ranking of 5 was described as average affinity for the major, and 1 being described as minimal association with the major. On average the association at the beginning of the semester was a six for declared majors and a four for undecided students. This same procedure was

repeated at the end of the semester after the class viewed the groups' final projects. Engagement in the traditional course was assessed in similar fashion; however, a discussion regarding what it meant to be their chosen major was not performed, nor was the student asked to define what an engineer of their chosen major was.

The reflective papers from the beginning of the semester described a genuine naivety of what a civil engineer does and how a civil engineer interacts with society. For example, at the beginning of the semester one student defined a civil engineer as *"A civil engineer is a person professionally trained in the fields of math and science who enriches people's lives with the use of technologies."* The association of this student with their definition of civil engineering was self rated as a 4 with the student reasoning that they would like to pursue civil engineering as a profession because "*I am good at math and science."* Another student defined civil engineering as: *"A civil engineer is an engineer who protects the environment from human-caused destruction."* This same student rated their association with civil engineering as a 6 with the reasoning of *"My parents are architects and I like buildings but want to protect human life, so I thought civil engineering was a good fit."*

Students discussed amongst themselves topic choices and how they would accomplish their goals. Students groups initially submitted a memo documenting the topic of their study, the involvement of each student in the group, a list of tasks to complete, and a timeline for work completion. As the semester progressed, refinement occurred and topics changed for various reasons. In order to keep track of the changes, progress and to facilitate engagement in the limitations of a one credit hour class, student groups were initially encouraged by their faculty mentor to use social networking sites to post these changes and updates. There have been many questions regarding how the faculty facilitated or encouraged the use of social networking. Very little encouragement was needed; the students routinely use these services for social situations. The students adapted the technology for managing projects in class themselves. There were no assignments requiring the use of social networking sites; the students approached the faculty mentor asking to use these sites in class for the project. In the spirit of co-creation, the faculty mentor agreed with the only requirement being that all information posted, be accessible by the faculty mentor.

Social networking sites are used by approximately 85% of undergraduate students to engage in extra-curricular social connections from spoilers on their favorite television shows, club activities, class schedules, dating, and even coursework (4, 5). Science, technology, engineering, math (STEM) and business majors are more likely to use Facebook than students majoring in the humanities and social sciences (4, 5, 6). Students spend upwards of 5 hours a week on social networking sites communicating with their peers (6, 7). The use of social networking sites is not limited to students. Industry leaders in civil engineering and construction management use Twitter as mechanism for delivering concise updates to diverse teams working across the globe (4). Facebook has become a method in the professional practice of engineering for delivering updates for new features for clients, show casing new gadgets, delivering webinars for many working professionals, etc (4, 5).

The faculty mentor had no previous experience using social networking sites and was at first overwhelmed by the volume of information presented in such a limited time. To compensate for this, the faculty mentor requested that speakers, who assisted in presenting specialized in-class topics, further assist the class by providing an industrial perspective via Facebook and Twitter. Many of these industrial speakers employed Twitter and Facebook for professional and personal networking already and eagerly assumed facilitator roles.

Each group created a Facebook page and Twitter account associated with the group name of their choice. Changes to the project were succinctly proposed and posted via Twitter. Twitter also served as a project management tool for the groups as they posted updates and scheduled meetings outside of class. Facebook

accounts served as the group main depository of information, documenting what they did, who did what, and any change orders in schedule or time commitments. This method was particularly useful for groups with undecided majors who were not enrolled in the same classes as declared majors as they lacked the ability to communicate in person outside of this class. Additionally, groups who chose to do a mash-up project instead of a communal project kept track of the camera and scheduling use of equipment and video production easily using Twitter. In lieu of a final examination, the groups presented their videos for the class.

Findings

At the final presentation each group introduced their project and then presented the video for the class to view. By this time each group had "friended" the other groups' Facebook pages and the groups were comparing projects and suggesting changes or sharing ideas amongst themselves and with industrial facilitators. During the final, the videos were anonymously assessed by their peers as to whether or not the videos answered the initial questions posed and how useful proposed improvements were. Additionally, the groups peer assessed themselves by dividing a limited number of points for the project among team members and indicating why they felt each team member should be given a certain number of points for their contributions. At the end of viewing the videos, individual students were again asked to write a reflective paper defining what a civil engineer was and why they wanted to pursue civil engineering as a profession. At the end of the reflective paper they were to self assess their association with that definition on the same scale of 1-10, with one being the lowest and ten being the highest association. On average the class self assessed their association with civil engineering as an 8.5, with no distinction between declared and undeclared majors.

Student Type	Students Enrolled by Discipline	Assessed 1st Rating	Assessed 2nd Rating	Retention Percentage
Separate Freshmen Class – Declared Majors	12	6	8.5	100%
Separate Freshmen Class – Undeclared Majors	4	4.5	8.5	75% / 1 declared following course
Traditional Freshmen Class – Declared Majors	107	5.0	5.0	85%
Traditional Freshmen Class – Undeclared Majors	8	5.0	4.9	50%

Comparing the original definition of a civil engineer with the final definition of a civil engineer shows an expansion in that characterization. The same student who originally thought they wanted to be a civil engineer because "*I'm good at math and science*," now felt that they wanted to be a civil engineer because "*I want to help develop more sustainable systems in society in reference to water and energy infrastructure. I also want to apply myself to other areas that fall under the civil engineering umbrella such as environmental operational design and the conservation of natural resources including sustainable water planning and design.*" This student self rated their association with civil engineering as a 9, and defined a civil engineer as *"A civil engineer is an engineer that can flourish in many different areas of expertise across disciplines... There is no aspect of society that is not influenced by civil engineers. Civil engineers create a better, safer*

life for everyone and the infrastructure we create saves lives every day. Moreover civil engineering is fun because it uses technologies in practice that I use for recreation." While the majority of civil engineers may not use social networking sites as a tool in their professional practice, Twitter has become more commonly used in construction management as a tool for uniting diverse groups scattered across the globe. The students in contact with professionals practicing in the industry started following the Twitter accounts of the industry mentors facilitating the course. In doing so, the students emulated the Twitter style of the professionals when using Twitter for their class projects. By emulating this style, words were completely spelled out as opposed to vowels dropped or the common "text speak" (i.e. imho, gtg, idk, etc.). Additionally, the class stopped adding in social comments and pursued just the project mission in their Tweets.

Students also started documenting where they think they fit into that description of civil engineering by defining it in terms of a specific area. For example, the student who stated that they wanted to be a civil engineer because "*My parents are architects and I like buildings but want to protect human life, so I thought civil engineering was a good fit;"* now stated that *"I want to be a civil engineer because I want to help develop a more sustainable system in society because I want to help to make people's lives better…A system relies on every component and each component affects the others in that system. If one component is not sustainable, then the system is not. Infrastructure does not stand alone; it all must work cohesively to perform as a system…I had the idea that I could design buildings when I started this class. Now, I want to design systems…"* This student appears to have expanded their situational awareness in that they are more aware of how structures interact with the surrounding infrastructural components. This student defined a civil engineer as "*A trained professional who designs, maintains, and implements renewable resource projects. They are aware of the urban, environmental and economic impacts of their work and consider all aspects before design. A civil engineer is someone who betters the lives of others whether it is in Africa or the United States."*

Not all students felt that the group based project was a good use of their time, as one student spontaneously provided feedback in their reflection say *"I feel as if we were limited by our knowledge base on designs of things. I know this is an engineering class and that we are supposed to be innovative but quite frankly I came here to learn not to explore. I wish that we had spent a little more time in books..."* This student went on to explain *"I know it is a 101 course but I really looked forward to coming here each week. This is the one class I felt that the information I learned could be used in everyday life because that is what a civil engineer does, make their innovations become real. I am very pleased with everything I have learned and the only negative thing I could say is that the course was too short! I think anyone interested in engineering of any kind would like this 101 course not only because it is hands on but because the information they learn can be used in everyday situations."* Interestingly, this student self associated with civil engineering very strongly at 10 out of 10 compared to the beginning of the semester which was self assessed as a 3 of 10. This student later declared civil engineering as a major, switching from a science.

Females made up 31% of the class and while gender does not appear to effect the association felt with the declared major, the narrative reflections indicate the presence of gendered patterns in student approaches to self-reflection. In general, the reflections submitted by women tended to be more analytical in that they reviewed how they themselves appeared in the definition of a civil engineer and why. At least one of the following self identifying words "I, me and us" appear in all of the female definitions of a civil engineer. In general the reflections submitted by men students did not cite evidence for rationale but provided blanket statements. Only one of the male definitions incorporated the self identifying terms "I, me or us," in their definition of a civil engineer. However, while it is important to note this difference; it may or may not be significant given the relatively small population of the class. Additionally, all students' definitions of civil engineering, regardless of gender, expanded well beyond the basic definitions. While there is no gender partiality connected with association, understanding why women preferentially defined themselves within the

confines of what an engineer is may preliminarily suggest future methods for attracting female engineering students and possibly retaining them in engineering.

Conclusions

Overall the association with the major for the separate, non-traditional freshmen engineering class increased substantially as rated by their self assessment. There were no losses of declared majors and all declared students have been retained at the time of submission of this paper. The association with students in the common year course with their declared major was on average a 5 for all majors across the college. This association did not change significantly after the traditional common year of freshman engineering. While this was a pilot venture, the intent is to continue to offer this course separately from the traditional year.

The use of social networking sites appears to be an innovative and workable mechanism for retention of engineering students when applied through project based learning. While social networking may not be the actual causation of retention, it does appear to allow students new to the university system but familiar with social networks a tool to use that they have previously mastered. The faculty mentor in this case had never used any of the social networking sites previously. Initial time commitments sorting through extraneous information was substantial. In order to allow guided co-created design, the faculty created rules for answering updates and scheduling questions. Such rules included limiting when and how often the faculty mentor would engage in social networking. Additionally, the faculty mentor requested that industrial mentors, who gave brief lectures on specific topics throughout the year, participate in the project by "friending" the groups and supporting discussion. The industry professionals used the sites to provide their own analysis and insight using their company's Facebook pages. This allowed specific expertise to be used appropriately and lessened the burden on the faculty mentor. Once these rules were created, the time commitment experienced by the faculty mentor was greatly reduced. The industry networking on Facebook alone was rated as key to achieving the videography project outcomes by the students and they further rated it as key for meeting the outcomes of the class. Allowing the students to co-create the course and the tools used appears, at least on face value, to have created an environment that students were comfortable exploring.

While the faculty mentor was hesitant due to lack of expertise in social networking sites and concerns for time commitment, allowing this exploration appears to have created a strong association with the major and perhaps long term retention among freshmen. Additionally, it appears that industry professionals provide key sources of expertise information for students and allow some of the time commitment burden to be placed on willing mentors. Given the success of this project, and the mounting evidence that students are very comfortable using these sites, it appears that creating curriculum using social networking as a tool to create positive association and engagement is viable and achieves the outcomes for this project.

Future work will include creating modules for both the individual and traditional common freshmen year course which incorporate the assignment of the use of social networking sites for group based project tools. Evaluating the difference from year to year including how assignment of the use of social networking sites, as opposed to freedom to use social networking sites, affects usage is planned. Some educators have attempted to harness the use of social networking sites within traditional curriculum and have found consistent resistance by colleagues, administrators, and even students. The lack of packaged curriculum modules appears to encourage this reticence of faculty to utilize social networking as a method for learning. Also, many faculty who teach the traditional freshmen course are hesitant due to inexperience with the technology. Creating packaged curriculum using group based projects for other majors is now being explored by faculty in the common year traditional course. Similar future group based projects utilizing social networking sites for junior level courses are also being evaluated.

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Appendix A

Civil Engineering in Your Everyday Life – Due December 17th

As you walk through campus and go through your daily routine, think about the involvement of infrastructure on your daily life. From the roadways you take to get here, the buildings you take classes in, to how you get water out of the tap civil engineering impacts almost every aspect of your life. Most of the time we take this infrastructure for granted until it inconveniences us like road construction causing traffic flow problems, the sidewalk being closed to fix water lines, or a natural disaster causing widespread destruction of buildings, cars, roadways, etc.

Infrastructure is designed by a civil engineer with an immediate goal in mind; i.e. the client needs a 500 car, three level parking garage and this is the spot I have to build it in. The immediate goal may not take into consideration the unique situation of the surrounding buildings. This assignment is for you to document through video an aspect of your everyday life that is influenced by civil engineering infrastructure. The infrastructure doesn't have to be negatively affecting your life; and it can be something you think has solved a major societal need or averted a further problem.

- **The project can be done independently or as a group. A group project should show significantly more effort than an individual project. Individual projects will be mashed up into a group cohesive documentary.**
- **Videos must be a minimum of 5 minutes in length with a maximum of 20 minutes in length.**
- **The video must show the following: the infrastructure you are concerned with, the reason you are documenting it, a design or improvement upon the component of infrastructure you chose.**
- **Questions to answer: What was the assumed objective purpose of this piece of infrastructure? In your opinion, which are major engineering strengths? In your opinion, which are the major engineering weaknesses? Have the assumed objectives of building this infrastructure been attained?**