

Longitudinal Study in Construction Affection through Role Playing Game

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Abstract

The authors use a game developed for incoming freshman in civil and construction engineering to distinguish between the complementary civil and construction engineering fields in an Introduction to Engineering course. The game was played by construction engineering seniors, many of whom played the game as freshmen. As freshmen, students showed an increase in excitement about construction engineering after playing. As seniors, the students played the game again and completed a survey gauging the students' self-reported technical understanding of, affinity for construction engineering, and their perception of the representation of their major in the game play. This paper presents a comparison of the freshman and seniors' perceptions of construction engineering, as well the seniors' feedback on the game.

Keywords

Construction Engineering, Gamification, Civil Engineering

Introduction

In The Citadel's engineering program the civil and construction engineering curricula share the majority of their coursework in the first two years, and then are brought back together in their second semester of the senior year of capstone for a culminating project that ties the programs together. The authors' institution requires incoming freshmen to enroll in a one credit hour "Introduction to Civil Engineering" course as a civil or construction engineering major. One of the course objectives is to familiarize the incoming freshmen with the sub-disciplines of civil engineering and includes a module on construction engineering. The construction engineering faculty developed an introductory construction engineering lecture and game to demonstrate the unique aspects of construction engineering. The short lecture on construction engineering focused on three main topics: 1.) at a high level, the contractual relationship and exchange between the owner, design engineer, and the construction engineer for a successful project, 2.) construction contracts including delivery methods, contract types, and award mechanisms with a focus on risk and profit; and 3.) utilizing LEED for high performing buildings including descriptions of the different levels of certification and valuations. The game uses risks and rewards of different contract types and varying levels of high-performance building certifications as experienced through the lens and assigned role of a design engineer, a construction engineer, and the owner as described in detail in a previous paper [1]. This research uses pre- and post-surveys of construction engineering students to examine the freshman and seniors self-reported technical understanding of and affinity for construction engineering, and the seniors' perception of the representation of their major in the game play.

Methodology

This paper combines the results of 4 years of surveys deployed to incoming civil and construction engineering freshman before and after the construction engineering module of the Introduction course, and then the initial complimentary survey deployed to seniors in construction engineering before and after they played the same game. The initial freshman survey was developed to understand the technical attributes and the emotional affinity for construction engineering gained through the module and game play as described in a previous paper by the authors [2]. Table 1 displays the statement or questions posed in the survey, the available possible responses, and to who and when the survey was administered.

Table 1: Introductory civil course and senior construction engineering class survey questions, possible responses, and whether the question was part of the pre or post survey

| | Statement or question | Possible Responses | Administered |
|------|---|--|-------------------------|
| 1. | I know what construction engineers do. | Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree | Freshman, Seniors (Pre) |
| 2. | I am excited to learn to be a construction engineer. (Seniors-I am excited to become a construction engineer.) | Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree | Freshman, Seniors (Pre) |
| 3. | I am excited to learn to work with construction engineers. | Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree | Freshman (Pre) |
| 4. | What is your major? | Civil Engineer Construction Engineer Other | Freshman (Pre) |
| 5. | Describe construction engineering as an engineering discipline. You can use bullet points, ideas, or sentences. | Open-ended | Freshman, Seniors (Pre) |
| 6a. | Do you believe you have gained a better understanding of what a construction engineer does through the construction video and class activity? | Yes No | Freshman (Pre) |
| 6b. | If yes, please describe what you have learned. | Open-ended | Freshman (Pre) |
| 7. | This game represents the differences between civil and construction engineering well. | Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree | Seniors (Post) |
| 8. | The game is a good introduction to construction engineering for engineering freshmen. | Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree | Seniors (Post) |
| 9. | I enjoyed playing the construction engineering game. | Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree | Seniors (Post) |
| 10. | Do you believe this game help engineering freshman gain a better understanding of what a construction engineer does through the game? | Yes No | Seniors (Post) |
| 10a. | If yes, please describe what you think it helps them understand about your major | Open-ended | Seniors (Post) |

The authors coded the open-ended questions, arranging the responses into themes that are reflected in the results and discussions.

Results and Discussion

The preliminary survey results are presented in three sections corresponding to three areas of question: 1.) does the proportion of construction engineering students that self-report they know what a construction engineer does increase from freshman to senior years? And does the descriptors they use to describe construction engineering change? (Questions 1 and 5), 2.) do students report a propensity to be excited to learn about or become a construction engineer after playing the game (Question 2), and 3.) the feedback the seniors gave after playing the game (Questions 8 and 10).

The majority of construction engineering seniors (92%) and freshmen (96%) stated they knew what construction engineers do (Fig. 1). Both groups had a small number that somewhat disagreed with the statement. The same themes emerged from the seniors and freshman when coding the open-ended prompt to describe construction engineering. In all cases, except safety, a larger number of seniors included descriptions of each coded theme (Fig. 2). As a senior they can

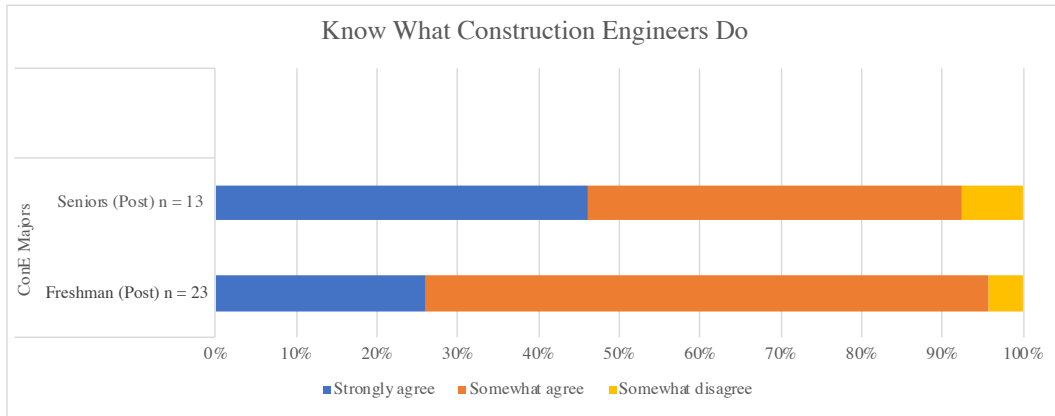


Figure 1: Post-game survey responses to Likert scale statement (Table 1): I know what construction engineers do.

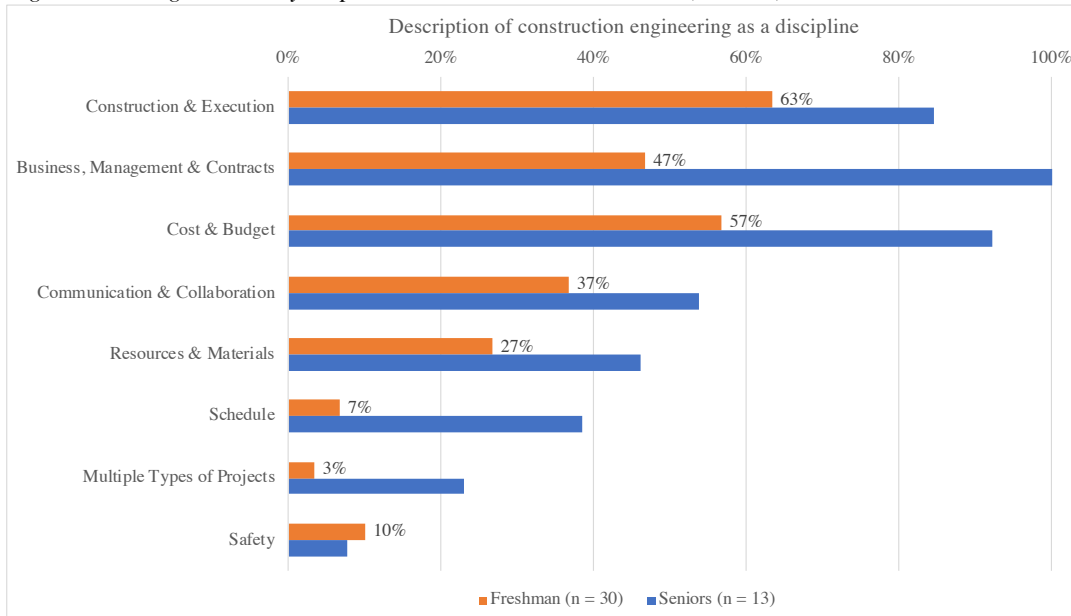


Figure 2. Post-game survey responses, coded, to open-ended prompt 5 (Table 1): Describe construction engineering as an engineering discipline.

be expected to understand the intertwined responsibilities of a construction engineer through the courses they have completed in their discipline specific degree program.

All seniors agreed they were excited to become a construction engineer, with 69% strongly agreeing with the statement (Fig. 3). The majority of freshman were excited to learn to become a construction engineer, with 65% strongly agreeing with the statement, and 4% somewhat disagreeing with the statement.

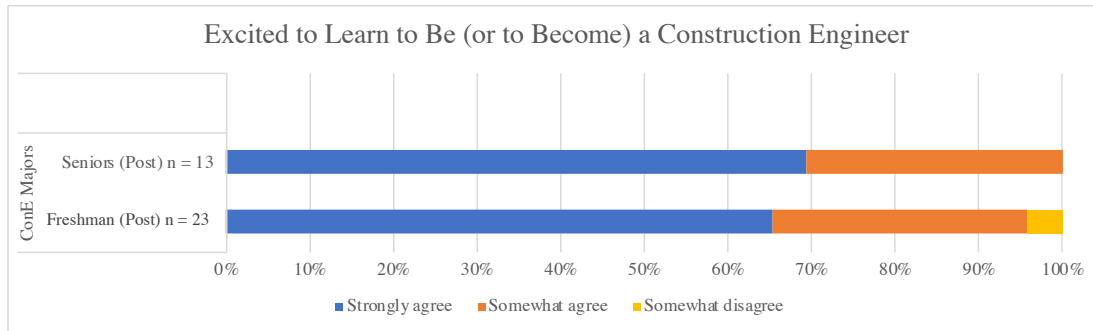


Figure 3: Post-game survey responses to Likert scale affinity statement 2 (Table 1): I am excited to learn to be a construction engineer (or for seniors excited to become a construction engineer)

All seniors enjoyed playing the game. All respondents believed the game helped the freshmen gain a better understanding of construction engineering. 75% strongly agreed the game was a good introduction to construction engineering for the freshmen, 25% somewhat agreed.

Limitations of the Research and Future Work

Further research is required to expand upon the effectiveness of the game through comparison with what students might learn about construction engineering without the game. This will be implemented by giving the full survey prior to the module, following the guest lecture, and at the conclusion of the game play and module.

This research was implemented at the inception of a construction engineering degree program with strong ties to a long-standing successful civil engineering degree program. These programs combine the first 2 years of the degrees, and then bring the student back together for a final semester culminating event that ties the programs together through a capstone project. Additional data will continue to be collected from the construction and civil engineers in the freshman introductory class, and in the construction engineers' senior year.

References

- 1 Batouli, Mostafa B., Burke, Rebekah D.; Wood, Timothy. *Gamification of Student Advising: Helping Students Decide Between Civil and Construction Engineering*. in *ASEE-Southeastern Section Conference*. 2019. Raleigh, NC.
- 2 Burke, Rebekah D.; Wood, Timothy; Batouli, Mostafa B. *Gamification of Construction Engineering Inaugural Experience*. *ASEE National Conference*. 2021. Virtual.