Surveying Courses in Civil Engineering

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Abstract

All Civil Engineering projects such as roadway construction, building developments, bridges, dams, etc. depend on surveying measurements on the planning, design, and construction phases. Incorporating Surveying courses in the Civil Engineering curriculum is significant so students gain knowledge on how to take measurements, create and read maps (topographic, cadastral, contour and other). In this paper, the methods of instruction for a surveying course and a surveying laboratory along with the learning outcomes and students' response to the instruction (collected with questionnaires) are described. In addition, questionnaires were given to students who took the surveying courses and then got internships that required surveying skills to evaluate how useful the instruction was to their work environment.

Keywords

Surveying, internships, student perception, learning outcomes

Introduction

Over the past decade, there has been a high demand for surveyors in the United States. A study by Ambourn in 2007 estimated that the average age of a professional surveyor in the United States was 54 years and steadily increasing [1]. According to the Bureau of Labor Statistics National Society of Professional Surveyors (NSPS), there were only a couple of hundred new surveyors registered in the United States during the last year and that number dropped from previous years [2]. Also, the National Council of Examiners for Engineering and Surveying (NCEES) reports that there were 9 percent fewer Professional Licensing (PS) exams taken in the United States in 2016 (770) compared to 2015 (848) [3]. Among all the professional exams offered by NCEES, the professional surveyor's license was the only one that recorded a decrease in exams taken. Furthermore, based on data from the Bureau of Labor Statistics, there are about 43,000 surveyors comparably to 260,000 civil engineers [4]in the United States.

The downward trends in professional licensure in surveying can, in part, be attributed to minimal exposure to surveying in Civil Engineering programs across the country. A majority of Civil Engineering programs that have a surveying course, lab or both in their curriculum cover material for one semester. The Citadel is one of the very few four-year colleges in the United States and the only college in South Carolina that offers two surveying classes with labs spanning two semesters. The extended exposure to surveying material and expertise from guest speakers put Citadel students in a better position than most college students to pursue surveying solely or as part of their professional engineering licensure. In fact, the Citadel Civil Engineering program offers sufficient coursework in surveying to prepare students to take and pass the

'Fundamentals of Surveying' after completion of their bachelors' degree. With that said, the goal of this paper is to evaluate the effectiveness of the surveying classes taught in the fall semester at the Citadel through student perception surveys. In addition, the usefulness of the surveying course to students who had some surveying experience before or after taken the course is also evaluated.

Methods of instruction for a surveying course

A variety of instructional and pedagogical techniques are applied in the surveying course at the Citadel. Direct instruction is used to cover material best suited for knowledge acquisition and traditional learning. Active learning techniques such as in-class assignments and group work are used to foster the application of surveying methods, procedures and computations. Another integral part of the surveying class is getting instant feedback from students using a rapid response application called 'the plickers app' [5]. This app enables the instructor to pose a question and get instant responses from the students through the plickers phone app which shows graphical statistics of responses. The students are assigned a card with a bar code on it which serves as their unique identifier. Each side of the card represents a multiple choice (A, B, C or D) response. As the instructor scans the room with the plickers app, the side of the card facing up as students lift their card is their stored response. Instant feedback is critical on measuring the general atmosphere of the class and how far along the students are with understanding the material. Instant feedback gives both the student and instructor the opportunity to address misconceptions for better understanding of the subject being taught. Also, self-grading and self-correction of homework in class is employed for immediate feedback on homework. Additionally, students are assigned test reflection assignments to self-assess their performance after tests. This self-assessment enables student to evaluate their study and test preparation habits to be better prepared for the next test and final exam. Lastly, professional licensed surveyors are invited to give guest lectures to bridge the gap between the classroom and the professional practice.

Methods of instruction for a surveying laboratory

The surveying lab, not only compliments the surveying class (lecture) through application of the material covered in the class, but it also provides a platform for students to learn and employ new concepts and ideas in real world scenarios. Students are required to prepare for labs first by reading the lab material and completing an online quiz covering the lab for the day. On lab days, the instructor introduces the lab reiterating concepts and material covered in the surveying class and how they will be applied in that particular lab. Afterwards, the instructor goes through a practical on-site demonstration of the proper handling, setup and functionality of various lab equipment (level, total station, and others) to be used for that lab. Students, then have the remainder of the lab period to execute and complete their assigned survey for the day in already established lab survey crews (groups). Surveying labs during the semester are grouped into three (3) main themes: Leveling, Traversing and Office Processing. In leveling, differential and profile leveling is covered as well as stadia measurements. Traversing takes the form of a survey to

acquire the interior angles and lengths of sides of a 4 sided traverse or boundary employing two main traversing techniques: Occupying points and Radiation. The main tasks in the office processing portion of lab are traverse adjustment using various methods (by hand calculations, by automated spreadsheets and by using computer software) and plat creation using CAD software. The major form of assessment for on-site (outside) labs are field book data collection and formatting. Field books are graded individually accounting for group efficiency and teamwork. Also, each group submits a report covering traverse adjustment and the different methods that can be accomplished as a surveyor. Lastly, at the end of the semester, a time individual field exam is administered to test the practical knowledge and skills acquired over the course of the semester.

Student Perception Survey

A student perception survey was administered to a total of 110 undergraduate civil engineering students including sophomores (n=43), juniors (n=45) and seniors (n=22). The survey instrument, informed consent and survey protocol received approval from The Citadel's Institutional Review Board (IRB). Data was collected during Fall semester 2017. The questionnaire mainly focused on asking students their perception about the surveying course and lab they took during fall of their sophomore year and if those courses benefited them in engineering internship involving surveying or if motivated them to pursue internships that included surveying. See Table 1 for the exact survey questions. Students has to respond in a 1-5 Likert scale, with 1 being strongly disagree with the statement and 5 being strong agree.

Table 1. Survey Instrument for Student Perception of Effectiveness of Surveying Course and Lab

		Strongly Disagree = 1	**Disagree = 2**	**Unsure = 3**	**Agree = 4**	**Strongly Agree = 5**	**Not Applicable**
1.	I found the surveying class and lab during sophomore year interesting	1	2	3	4	5	N/A
2.	This course put me in a better position to obtain a surveying internship	1	2	3	4	5	N/A
3.	I will be seeking a surveying internship next summer	1	2	3	4	5	N/A
4.	I had surveying experience prior to taking this course	1	2	3	4	5	N/A
5.	I had an engineering internship that involved some part of surveying	1	2	3	4	5	N/A
6.	I had an engineering internship but did not involve any surveying	1	2	3	4	5	N/A

7.	I would like to have some surveying experience/practice/internship after taking this course	1	2	3	4	5	N/A
8.	Taking the course and lab helped me to be successful in my internship	1	2	3	4	5	N/A
9	We need to learn more in the surveying course/lab to be successful in internships involving surveying*	1	2	3	4	5	N/A

Survey Data and Analysis

Survey data was tabulated and analyzed by academic year (sophomores, juniors, and senior) and per question. Figure 1 illustrates the average responses per question and Table 2 shows the averages along with the standard deviations.

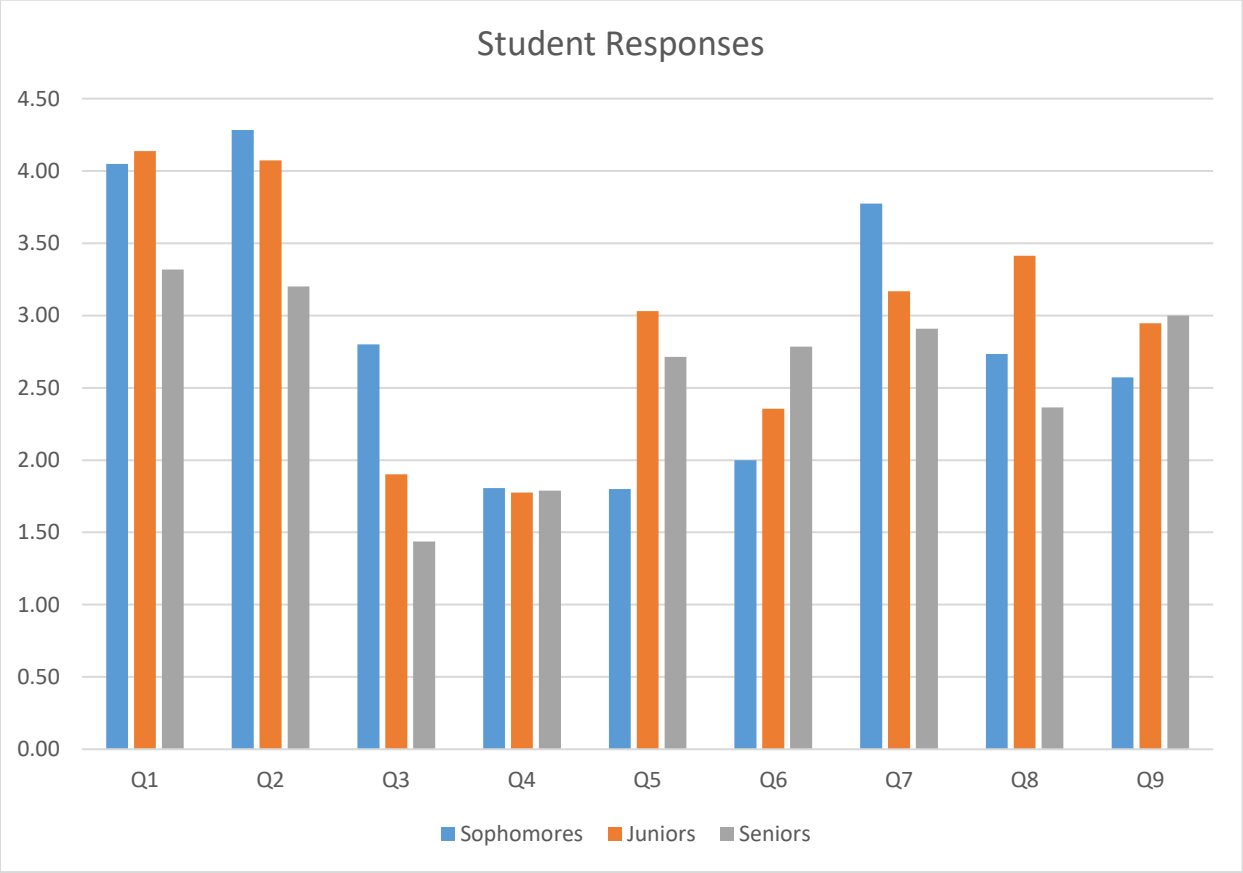

Figure 1: Student responses per question per academic year

Table 2: Averages and standard deviations of student responses per question per year

	Sophomore Summary		Junior Summary		Senior Summary	
	Average	Standard Dev	Average	Standard Dev	Average	Standard Dev
Q1	4.05	0.74	4.14	0.73	3.32	1.09
Q2	4.28	0.69	4.07	1.01	3.20	1.01
Q3	2.80	1.16	1.90	0.89	1.44	0.63
Q4	1.81	1.26	1.78	1.31	1.79	1.27
Q5	1.80	1.29	3.03	1.70	2.71	1.82
Q6	2.00	1.44	2.35	1.56	2.79	1.67
Q7	3.78	0.97	3.17	1.29	2.91	1.27
Q8	2.73	1.44	3.41	1.30	2.36	1.36
Q9	2.57	1.17	2.95	0.98	3.00	0.97

The majority of the students found the surveying class and lab interesting and believe that they are in a better position to obtain a surveying related internship after taking the course. However, the majority of the students stated that they will not necessarily seek an internship in surveying and the scores dropped as the students were closer to graduation and further from taking the surveying course. Also, the majority of students did not have surveying experience before taking the surveying course. Furthermore, the data shows that juniors more than sophomores and seniors had internships that involved some aspects of surveying. It seems that students did get internships with surveying after their sophomore year. As expected, more seniors replied that had internships than the sophomores and juniors. Another interesting thing we observed was that students taking the surveying course were more willing to get internships and field experience that involved surveying than students that had taken the course one or two years ago. From the students who had internships in surveying, the majority were unsure if taking surveying helped them be successful in the internship they had as well as if they needed to learn more in the surveying course/lab to be successful in internships involving surveying.

Summary of Findings

Results from the student perception survey showed that students found the surveying course and lab interesting and as they were closer to having taken the course they were more motivated to have an internship that involved surveying. However, senior students were less excited about having a surveying internship. Overall, it was observed that students enjoy learning about surveying and proves to be helpful to the ones who are able to secure an internship in that field.

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Kweku Brown is an Assistant Professor of Civil and Environmental Engineering at The Citadel-The Military College of South Carolina. He received his Civil Engineering Master’s degree from the University of Connecticut and his Doctoral degree at Clemson University. He is active in the transportation engineering communities including South Carolina Department of Transportation, Institute of Transportation Engineers, and Transportation Research Board. His research focuses on transportation safety utilizing geographic and spatial analysis methods