Impact Analysis of Student-Centered Activities in a Statics Course to Create Student-Engaged Learning Environments

Seong-Jin Kim\textsuperscript{1} and Namhun Lee\textsuperscript{2}

\textit{Abstract}—A classroom is a small society with many students for a period of time like semester or quarter. Every member of the class has impacts on the class environment including the instructor. How the class environments are set up is very critical for students' learning and their relationships with peers and the instructor. Especially it is very important if the class is recognized as a hard subject like statics in a non-engineering construction management program. The relationship among participants is one of many factors affecting the class environments. A relationship at freshman and/or sophomore is more critical than that of junior and/or senior because at freshman and/or sophomore students do not know each other well compared to junior and/or senior. This paper addresses how class activities help class participants create their own class environment through building relationships among participants throughout the semester. The class activities done in the class are individual meetings, special office hours, two team building activities, and team bonus points and quizzes, etc. A framework for creating their own class environment is applied to expedite the building-relationship process using class activities. Class activities focus on a relationship between the instructor and students and a relationship between peer students. A survey is conducted at the end of semester about the class environment for four consecutive semesters. The survey results show that students feel positive about their class environments, class activities and their impacts on students' learning. The outcomes of this paper are useful for practitioners to manage and design class activities to improve students learning and relationship among class participants.

I. INTRODUCTION

A classroom is where the students spend most of their time to learn new knowledge or materials and to interact with peer students and instructor. All the participants in the class create their classroom environment through various activities in the class. Since a classroom environment is a dynamic social system consisting of interactions among all participants including instructors and peer students [16], students' learning is heavily relying on the class environment. If the classroom environment is positive to students, it has huge impacts on students learning outcome [17]. Every student goes through a school system from freshman to senior year. Compared to junior or seniors, freshman and sophomore might not be familiar with the program or school in general. It is necessary for any classes with freshman and sophomore to provide more comfortable classroom environment. Besides academic goals, some of important factors defined by other researchers to be a good classroom environment are class participation [9], respect among class participants [11], and psychological safety or no emotional harm [7], and support from all class participants [5]. If students feel like they have more personal relationship with their instructor, they are proactive and positive toward their class [18]. In addition to these factors, any group activities in the class have positive impacts on students' motivation and task involvement [2]. Inclusion of group activities in class is crucial because the construction industry is based on the team work or group activities and the relationship among team members are very important for the project success at the end. To have students experienced the concept of construction industry, the class activities are designed to meeting these demand for students. A class framework based on class activities among class participants has shown differences in students learning [8]. This paper examines a case study of implementation of the framework based on class activities for a statics in a construction management program to meet the objectives of 1) Validate the framework based on class activities, 2) Evaluate the class environment to build a relationship between an instructor and students and a relationship between peer students, 3) Assess the level of class activities to create a good class environment and relationships, 4) Evaluate a role of the instructor in the class.

II. LITERATURE REVIEW

A major part of students' college life is the time they spend in class and do any class activities in and outside of classes. Students can reach their academic goals, build relationships with all class participants, and become part of a given class society. Type of school, program, and class are factors that affect social climate directly or indirectly [12]. Students' interpersonal relationships with peers and their instructors, goal-orientation of students' engagement in learning activities, and the general structure and the order of the classroom designed by the instructor are three variables in the class environment [16]. Even though any efforts on relationship, growth, and maintenance accelerates positive social and academic outcomes, a strong focus on one area could have negative or unintended outcomes [12]. Two out of four important factors of a creative class environment are a relationship between a teacher and students and classroom activities [5].

Students' perceptions of the classroom environment are heavily depending on instructors' effort to pay attention to their students personally [16]. Students try to communicate...
with their instructors positively in a supportive classroom environment [13]. Since students’ preference for the class environment rely on students’ motivational tendencies [15], the environments that students prefer resemble environments most beneficial to achievement [3]. Personalized education by instructor is positively related to the classroom environment. Even though it may be necessary for the instructor to have more communications with students, it will lead to helping instructors in understanding students in terms of their perception and preference for the classroom environment. “Respect is a fundamental human value that forms the basis of character and personality. It can be considered a principle or standard and an appropriate way of acting” (p.293) [11]. To create a good classroom environment for learning and social, any respect to all class participants is vital and a key element for a respectful classroom [11]. A classroom that students can freely express their individuality without any emotional or psychological harm is called a safe classroom [7]. It is very important for students learning because students are able to possibly be themselves and shows the positive relationship with increasing students learning and/or effort and commitment [7]. The supportive climate is in relation to support by both instructors and peer students [9]. It is evident that instructors and peer students have to be supportive to each other in the class. It is required for student to perceive the existence of a supportive climate in the class [9]. All factors/elements addressed before have a positive relationship with the classroom environment and eventually learning outcomes. How to employ these factors depends on the class and instructors’ class objectives. Even though both instructors and students are responsible for the classroom environment, many students think that instructors are in charge of the classroom environment [7]. Due to this reason, it is very important for instructors to remind students that a classroom environment is created by both instructors and students.

Classroom environments have huge impacts on students learning, achieving academic goals, and their relationships with peers and instructors. To satisfy these demand, students’ motivation on them are crucial. Since students’ perceptions and preferences of the classroom environment are related to students’ goal orientation and preference [15]. “Teachers’ practices and classroom norms, rules, and routines contribute to students’ perceptions of goal structures” (p.368) [14]. The perceived classroom environment and both graded performance and intrinsic motivation are influenced directly and indirectly to each other [4]. The students’ perceptions of engaging in academic tasks and the classroom goal structure are related to the classroom environments [1]. In addition to students’ supportive relationships with their peers, teachers’ support is statistically significant on both students’ learning goal orientation and task value [17]. Like personalized education [18] [19], students want teachers to be interested in them academically and personally. And, a student-focused relationship between teacher and student shows many effective classroom relationships, and students would like to interact more closely with the teacher [5]. Even though students’ personalities influence on students’ intentions for communicating with their instructors, students’ learning outcomes are linked to their intentions for communicating with their instructors [13]. Any programs based on relationships would have more positive outcomes and so classes should be task-oriented and supportive [12]. Having a good relationship with students is very important for teachers to provide a good classroom environment and a personalized education. Although the classroom learning environments are affected by students’ personalities or characteristics, instructors’ responsibilities are larger than those of students’ [12]. Personalized concern contributes to students’ connection with teachers and success [6].

The classroom is a society in college with many on-going activities among class participants. As many researchers describe before, the classroom environment has positive impacts on many areas like students learning and relationship with instructor and peers. It is necessary to have good relationships among class participants to have a dynamic class environment with respect to type of class and material. Based on the discussion above, the case study of implementation of the framework proposed by Kim and Lee [8] for a statics class in a construction management program will be addressed. It is necessary to modify some activities of the proposed framework.

III. CLASS FRAMEWORK

The class described in this paper is a statics class for mainly sophomore. The construction management program is not an engineering program. It consists of three lecture hours in total with two meetings per week. There were approximately 25 students in the class. Most of class activities were based on teams consisting of three or four team members. In the course, the instructor had to make the students feel comfortable and proactive in the class through class activities and finally led them to the stage of getting used to the course materials and achieving academic goals. To build a relationship between the instructor and students, the instructor had to spend some extra time with students in and outside of the class. This was mainly how the instructor built a personal relationship with students and how this changed students by themselves and their perceptions in the class.

There are two types of activities as “Individual” and “Team.” Any activity done by a student represents as “Individual” and any activity done by a team represents as “Team.” There were eight in-class activities and four off-class activities. The detailed description of each class activity is followed.

A. In-Class Activities

1) Class Orientation & Q & A Session with Former Students

Class orientation was performed on the second-class day of semester. The instructor let students know about the course, guidelines of the course. A class survey form was given to students on the same day. The survey form contains questions regarding students’ name and nick name to be called, any personal information, and their academic goals in the class. The survey had to be filled and handed back to the instructor before the individual meeting. Some of former students were invited to have a Q & A session about the course with the current students about the course at a peer level.
2) **Class Socials**

There were two class socials. One was to be held on the first-class day of the semester and the other was to be held in the middle of semester. The first-class social “Break the Ice” is a game to help students get to know peer classmates. Students randomly made a temporary team of three or four to play. It provided students with an opportunity to learn their classmates. The second-class social is called “Boot Camp.” The boot camp was based on their permanent team for the class, competing as a team of three or four. The boot camp is a team building activity designed to bond their relationship with their team members. It was a quiz show but the problems given to the teams were not course related.

3) **Test & Team Quiz**

There were two midterms, one final, and two team quizzes in the class. Students in the class were informed that there were bonus points in Test 2 if the team average of Test 2 was higher than an overall class average. It was designed to encourage a team effort to improve a team performance. This is a good example of group reward contingencies [10]. The purpose of this opportunity for each team is to study together and to help each other. Even though many team studied together, one or two teams out of seven or eight teams did not meet the class average in Test 2. Students’ relationship with team members were getting closer and closer through these kinds of activities. Each team had to solve the problems as a team during the team quiz. If there was a conflict with an answer, they had to resolve the issue to have one answer. This was to increase students’ engagement for the quiz and lead team members to learning the materials [1].

4) **Term Project**

The term project was performed on the last day of the semester. Each team had to design a structure using straws that holds the most books. It required students to understand the course contents and apply their knowledge into a simple structure. A term project structure was built by 16 straws, eight paper clips, and a foot-long magic tape within 20 minutes. A team should design their structure prior to the competition and could bring any tool that cut materials but not any bond, glue or a heated tool.

5) **Self-Evaluation**

The class survey was designed to helping students set their goals and assess their goals at the end of semester. The survey was handed back to students at a final exam and every student was asked to assess their goals. It is a before-after comparison of student’s goal in the class and a great opportunity for the instructor to see how the class went from students’ perspective. Many students appreciated the way the class was organized and performed with peer students and the instructor.

B. **Off-Class Activities**

1) **Individual Meeting**

Unlike all in-class activities provided students with opportunities to understand class materials and build their relationship among students and the instructor, the individual meeting was designed to build an individual relationship with students. Each student signed up for a meeting of 30 or 40 minutes. The goals of meeting were to 1) Let students know the instructor was open to them and 2) Describe instructor’s expectation from students in the class. At these meetings, students told the instructor their personal stories to share and it was a great start to get to know each other.

2) **Extra Office Hours & Test Review**

The instructor offered extra two office hours in the library at a night before each test including the final and min. one study session per week after the class at night for two hours. These office hours make students feel safe when they studied for a test in the library through being with the instructor at the same time. The study session provided students with opportunities to study with the instructor individually. There were two test reviews available. Since any in-class test reviews were not allowed, all the reviews were done in the office individually. It was optional for the students with two bonus points in return. During the review, the way the students study, any lecture feedbacks, anything personal were discussed.

3) **In-Classmate Tutoring**

Due to the nature of statics, some of student struggled with the course during the semester. The instructor sought for voluntary in-class tutors to help those students. There were three or four in-class tutors and the instructor matched tutors up with tutees. This is an improvement of peer relationship based on students’ needs.

III. DESIGN OF THE STUDY

To measure the effectiveness of this framework focusing on class activities and their impacts on class environment, students’ surveys were collected from four different semesters in a row. The survey was performed on the second last day of the semester. Since students were instructed to write down their name on the survey, the instructor could not be in the class during the survey and could not get the survey back until the instructor placed students’ final course grade. It is very fair for student to answer the survey question more honestly. The data were students’ evaluation on four questions using Likert scale of five points, one yes or no question on the instructor role in the class, and some essay questions about the course. In terms of Likert scale, 1 is strongly disagree and 5 is strongly agree. The four questions students were asked to answer using Likert scale are below:

- Q1: The class environment is good enough for learning the material
- Q2: The class environment is good enough for developing of a relationship with peer students
- Q3: The class environment is good enough for development of a relationship with an instructor
- Q4: Activities performed in the class aid in creating good class environments for learning and building relationship with peer students and an instructor

All data sets were from the same class and the instructor taught the same course for four semesters in a row through the implementation of the framework. There are 91 students in
A descriptive statistics was used to measure the effectiveness of the framework.

IV. DATA ANALYSIS AND RESULTS

A descriptive statistics was computed using SPSS. The means of four questions in the survey is shown in Table 1. Question 1 has the lowest mean by 4.099 with the highest standard deviation as 0.9435 and Question 2 has the highest mean by 4.560 with the lowest standard deviation as 0.5814. Question 3 and 4 are the second and third highest respectively in terms of mean. With respect to coefficient of variation, it has the same results as mean and standard deviation. Question 1 has the highest value of coefficient of variation as 0.230 and Question 2 has the lowest value of coefficient of variation as 0.127.

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.099</td>
<td>0.9435</td>
<td>0.230</td>
</tr>
<tr>
<td>2</td>
<td>4.560</td>
<td>0.5814</td>
<td>0.127</td>
</tr>
<tr>
<td>3</td>
<td>4.516</td>
<td>0.6212</td>
<td>0.137</td>
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<tr>
<td>4</td>
<td>4.341</td>
<td>0.7777</td>
<td>0.179</td>
</tr>
</tbody>
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Even though the mean and standard deviation of Q1 is lowest for mean and highest for standard deviation, all mean values of four questions are higher than 4.0. It implies that the class environment is statistically good enough to develop relationships among class participants and cause activities have positive impacts on class environments. This depicts that the class with this framework makes a difference in class environments for students learning and building relationships among class participants. Regarding the instructor’s role in the class environment, 68 students said that the role of instructor in the class was good enough to create the class environment, five students said “No” to the question, and 18 students did not answer this question.

V. DISCUSSION AND CONCLUSION

This paper addresses a class framework based on the class activities for the sophomore construction management statics class. As a non-engineering degree seeker, a statics course might not be a just regular class due to the level of confidence in math and physics. To increase students’ confidence in the course material and their academic goals, an implementation of the framework based on class activities among class participants was necessary. With respect to the characteristics of the construction industry, many class activities were designed to provide the students with 1) A better environment for their motivation and learning in the class 2) Opportunities to build relationships among class participants, and 3) Opportunities for communication with peers and acknowledgement of peers through class activities. It was also an opportunity for the instructor to get to know students better and help the instructor create a better class environment with students and their inputs. At the end of survey, students were asked to write down any other comment. The top two comments were 1) personal interest and 2) family-oriented environment. Many students liked instructor’s interest in them personally. Unlike other classes they were in, students pointed out that everybody in the class knew everybody and it made them comfortable in the class. These might be some of the most positive outcomes of this framework. The overall output of this case study of the implementation of the framework was positive in class environments and students learning. The self-evaluation done by students was a way to review what student had done in the class and their achievement. The course evaluation instructed by the school was high with positive comments about the course. A unique class environment was created by class participants with different activities. Even though students provided positive feedback about the framework including class activities, it is necessary to assess influences of these activities on class environments by activity and also the relationship between class environment and students’ grade should be defined. The results of descriptive statistics with the coefficient of variation support the positive impacts of the framework with activities done on the students’ performance in the course. Regarding some free riders among the teamwork, this is the instructor’s role to manage these types of problems within this framework. The instructor and students built a good relationship based on trust. The relationship built on trust is the most influential factor to motivate students in the class.

REFERENCES