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Influences of Social Relationship Development Activities on Students' Grades in Construction Engineering and Management Education: A Statistical Analysis

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Abstract

A classroom is more than just a room in which students learn class materials with their peers. It is a place as well in which class participants, both the students and instructor, interact with each other and develop their social relationships. This paper conducts a quantitative analysis of social relationship development activities and their influences on student performance in a construction management course. In this case study, social relationship development activities were defined as pedagogical methods to engage students as an alternative to the traditional lecture format. The students evaluated a total of six social relationship development activities with respect to their learning experience. The social relationship development activities were an icebreaker game, individual meetings with the instructor, boot camp, an in-class term project, a classmate tutor, and team quizzes. Using exploratory factor analysis, these social relationship development activities were grouped by two latent factors. The first factor consisted of three development activities, an icebreaker game, boot camp, and an in-class term project, while the second consists of the other three activities, individual meetings with the instructor, team quizzes, and a classmate tutor. With respect to the characteristics of social relationship development activities in each latent factor, the first represented students' team orientation, and the second their individual orientation. The two factors' influences on students' grades were defined using structural equation modeling (SEM), and two latent factors had a positive effect on students' grades, in which the individual orientation was found to have the greatest influence. It is evident that activities that develop social relationships among class participants are vital for students' learning. This outcome will help educators design social relationship development activities with the goal to improve students' learning and their relationships with peers in class.

Introduction

Students have various classroom experiences with their peers and instructor during a semester. Those experiences include, but are not limited to, achieving course learning outcomes, building relationships with their peers and instructor, and engaging in social activities in or outside the classroom. A classroom environment is a dynamic social system that includes any interactions among class participants.[19] Students build social relationships with their peers and instructors throughout their college years and their classroom experiences are one of the major components that helps students achieve these goals. From students' perspective, any social relationships with their peers are more important than those with instructors.[20] Further, many of these relationships may not end in college, but continue after graduation. It would be important for students to have these kinds of social relationships in college because it can be their base social network professionally and personally. One major fact that many people may overlook in higher education is the importance of social relationships among peers and instructors. Interactions through social relationship development activities in the class are vital to build social relationships among class participants.[12] These activities in class have positive effects on

students' learning as well. Because of the COVID–19 pandemic, many classes have been offered online in either a synchronous or asynchronous format. These circumstances have limited class participants' ability to build social relationships even though they can see and talk with each other through a computer monitor. Students influence each other enormously in class through peer tutoring and mentoring,[4] and online class formats are unable to provide these peer interactions.[13] Various interactions among class participants, both the instructor and students, occur through social relationship development activities.[12] Having/developing social relationships with peers through such activities in the class would have positive effects on students' future relationships after graduation. Thus, social development activities will influence the class participants significantly in various ways. With support of social relationship development activities, students' academic goals should be fulfilled in the class.

This study examines the relations between social development activities and students' grades. The objectives are to: 1) Identify potential latent factors using six (6) social development activities and 2) identify a potential association between those factors and students' grades. The literature review describes past and current research on social development activities and relationships among class participants used to justify this paper. Exploratory factor analysis (EFA) and structural equation modeling (SEM) are the methodologies used in this paper to identify any relation between social development activities and students' grades. Findings are presented in the results.

Literature Review

Various class activities, including those in social relationship development, have demonstrated positive effects on students' learning and class environments.[7] Some social development activities investigated were an icebreaker game, peer tutoring, and individual meetings with the instructor.[7] Students built their social relationships with their peers and the instructor through these classroom social relationship development activities. Establishing social relationships indicates that all participants share their emotions with each other. A relationship between an instructor and students is important with respect to students' experience overall, such as their learning outcomes, learning behavior, attendance, and the emotional quality of relationships, all of which have significant effects on students' satisfaction with courses.[18] Sharing emotions may be achieved through social relationship development activities both in and outside of class. One of the key factors in the instructor's and students' willingness to share emotions is their trust that they are safe in the class.[18] Without trust between a student and instructor, they cannot build a good social relationship. Any contacts between an instructor and students outside of class are correlated positively with trust and students' motivation.[6] Students feel more relaxed and comfortable meeting their instructors outside of class than in the classroom, regardless of what they need from their teacher. It helps students become closer to their teachers personally and allows them to build better social relationships than before. There are four key relationships in higher education: students with subject matter; students with teachers; students with other peers, and students with their developing selves.[15] All of these relationships are important for students' learning and ability to develop themselves. "Emotions matter in college teaching and learning as an aspect of enriching social and relational experiences that support student development" (p. 101).[15] There are three factors necessary to build positive student-instructor interactions—

knowing students' names, managing course expectations, and using technology.[16] Knowing each student's name is crucial to build any relationship between a student and a teacher. One of the best instructors' abilities is to show care and concern for their students' learning and personal growth.[14] The most influential factors in student motivation are student cohesiveness, investigation, and task orientation, and the teacher's support largely influences both students' learning goals and task orientation.[21] Having social relationships with class participants increases students' cohesiveness. There are three major factors that affect students' learning, the relationship between the instructor and students, the relationships among peer students, and team orientation.[8] Thus, social relationship development activities are important for students' learning through their relationships. "Interactions were described as supporting and warm toward one another: teacher and student would engage in conversations, joke around and help one another" (pp. 485-486).[3] Any interaction between students and an instructor plays an important role in their social relationship, as human interaction is a key in teaching.[15] Social relationships are based upon any interactions among class participants, and in the absence of interactions, it is impossible to build any types of relationships in the class and interferes with students' ability to learn the materials required in the class. A class framework has been proposed to help students fulfil their academic goals through class activities that include certain social relationship development activities.[7] This framework is based primarily upon interactions among class participants that help them build relationships with each other.

Although students' relationships with their peers are not teachers' responsibility, students' learning depends largely upon social activities,[15] and it is important to provide any opportunities for students to build peer relationships in the class. Students learn the materials better when they work as a team and feel comfortable with their peers. Certain social relationship development activities have been proposed to help develop peer relationships, such as group assignments, opportunities to get to know each other, and participating in fun team learning activities.[15] From students' perspective, it is difficult to build any kinds of relationships unless they know their peers. "The phrase 'students' engagement" has come to refer to how involved or interested students appear to be in their learning and how connected they are to their classes, institutions, and each other" (p. 38).[1] Students' engagement can increase through their interactions with their peers and instructors. Having peer mentors in the class makes students feel that they have trusted friends.[4] Further, it can improve students' social relationships with their peers and help them meet their academic needs for a course. Any efforts in and outside of class are related significantly.[10] Because they complement each other, it is critical to have both to help students build their social relationships with peers, as socializing with peers is the most entertaining aspect of school.[9]

Students and the instructor interact with each other often over a semester. The classroom provides both parties with a fair opportunity to build social relationships among class participants and ultimately meet their goals. As many researchers have addressed before, all class participants go through social relationship development activities and define their roles and responsibilities in the process. Having good social relationships among class participants plays a critical role in achieving students' learning outcomes. The focus of this case study largely addresses social relationship development activities' effects on students' grades.

Social Relationship Development Activities

This case study is based upon a statics class in a construction management department with six social relationship development activities. The class, which has approximately 25 students, meets twice a week for a total of three credit hours. Many social relationship development activities are based upon teams to provide students with real construction industry experience in college. Each team consists of three or four members. All of the social relationship development activities are designed to help class participants build their relationships with all participants. There are two types of social relationship development activities, one individual and the other a team. Individual activities are conducted alone, while team activities are conducted by members of a team. Some social relationship development activities are conducted outside of the classroom so that the instructor can interact with students more than during the given class hours.

Ice Breaker Game

The ice breaker game is played on the first day of the semester. All students are assigned randomly to a team of four or five to play this game. The students have an opportunity to introduce themselves to the entire class, including their team members. During this ice breaker game, students get to know their peers, and it is a good opportunity for the instructor to become familiar with the students as well. At the end of the game, the instructor takes pictures and videotapes of the students to memorize their names and faces.

Boot Camp

The boot camp is designed to provide students with a team building opportunity. It takes place in the middle of the semester to help relieve the students' stress from the course and/or school. It is held in a quiz show format, and each team solves problems only with each other's help. The problems are not course related, but cover common culture, such as movies, sports, classmates, and the instructor. To solve any problems related to classmates and the instructor, the students must know both well. This experience helps the students build better relationships with their peers and instructor.

Team Quiz

There are two team quizzes during the class that serve as a motivation for teams to study together as group reward contingencies.[11] Because each team solves the problems as a group, they need to work together and/or compare their answers to reach their final answer. Whether students get their problems right or wrong, they finally learn the materials. Students like this team quiz, in which they help each other solve the problems.

In-class Term Project

The primary goal of the term project is to experience statics through a project. The term project is based upon teams as well. Each team has one month to design a straw structure to bear the weight of as many textbooks as possible, and they spend some time designing, building, and

testing their structure. Then, all teams build their straw structures on the last day of each semester. The teams must use 16 straws, eight paper clips, and a one-foot-long piece of scotch tape. No other materials, such as glue and heated tools, are allowed. Students have one extra set of materials with which to practice before the actual term project day. All teams have 20 minutes to build their structure. The instructor provides the straws, paper clips, and scotch tape, and students can bring their own tools to build their structure. It is a great practice to implement the students' knowledge of statics into a real project rather than mathematically. During these times, students rely on each other to complete their term project. The in-class term project is based solely upon their social relationships with their team members.

Individual Meetings with the Instructor

The purpose of the individual meetings is to allow the instructor to get to know his/her students. The individual meetings are held during the first three weeks of the course. Each student signs up for a meeting with the instructor that lasts for approximately 30 to 40 minutes. The meetings are more casual and are related to students' individual lives rather than the course materials. It is an excellent opportunity for both the instructor and students to get to know each other, particularly for students in the early school years when they may not be as familiar with faculty members in the department as those in the later school years.

Classmate Tutor

Classmate tutors are available during the semester as well. The instructor appoints several students who understand the course materials well, and they are available with the instructor during special weekly office hours because many students come during the office hours. If there is a demand for individual sessions, the classmate tutors help any students who need help individually based upon their schedule. It is totally voluntarily and classmate tutors are not paid for their work, but they know that teaching and helping others is the best way to learn themselves. It works very well because some students may not be comfortable asking the instructor for help and many of them are taking the same classes during the semester.

Design of the Study

To identify the associations between social relationship development activities and students' grades, student surveys are collected during eight consecutive semesters. This survey is provided on the last week of the semester. Students fill out the survey freely when the instructor is not present in the class. Once the surveys are completed, the instructor cannot access them until the students' final course grades are posted, which allows the students to complete the survey honestly. The data collected are the responses to the survey related to the six social relationship development activities' influence on class learning that are answered on a Likert scale that ranges from 1, strongly disagree, to 5, strongly agree. All students' grades are converted to a Likert scale like the survey as well. All As are converted to 5, Bs to 4, Cs to 3, Ds to 2, and Fs to 1. The six social relationship development activities are shown below.

- Activity 1: Icebreaker Game

- Activity 2: Individual Meeting with the Instructor
- Activity 3: Boot Camp
- Activity 4: Team Quiz
- Activity 5: In-class Term Project
- Activity 6: Classmate Tutor

A total of 151 students participated in the survey. Using the data in these surveys, latent factors were extracted using Exploratory Factor Analysis (EFA) and the relations among the latent factors and students' grades are identified using Structural Equation Modeling (SEM).

Data Analysis and Results

Exploratory Factor Analysis (EFA)

Before EFA is addressed, the descriptive statistics of the data are shown in Table 1 below. Activities 2, 3, and 4 have the highest means among the six activities, while the two activities with the lowest means are Activities 1 and 5. Activity 1 is the icebreaker game and Activity 5 is the in-class term project. With respect to standard deviation, the three highest are for Activities 1, 3, and 5, and the two lowest are for Activities 2 and 4. Among the six activities, both the means and standard deviations are consistent in the descriptive statistics, according to which, any activity related to the instructor is ranked highly with respect to students' learning.

Table 1: Means and Standard Deviation of 6 Social Relationship Development Activities and Grade

Items	Mean	Standard Deviation
Grade	3.775	1.027
Activity 1: Icebreaker Game	3.841	1.020
Activity 2: Individual Meeting with the Instructor	4.318	0.859
Activity 3: Boot Camp	4.192	0.907
Activity 4: Team Quiz	4.265	0.854
Activity 5: In-class Term Project	3.934	0.999
Activity 6: Classmate Tutor	4.149	0.894

To identify the underlying factors of the six activities with respect to students learning, exploratory factor analysis (EFA) was performed. EFA is used most often in sociology and psychology because it is difficult to measure the variables' effects directly. It should be performed before structural equation modeling (SEM) or confirmatory factory analysis (CFA). EFA is a statistical technique designed to reveal factors by observed variables. Defining the associations among observed variables by latent factors is the main purpose of factor analysis.[2] These factors are referred to as 'Latent Variables.' EFA is also used primarily to reduce several variables into a smaller set of variables. All six activities are grouped by latent variables with EFA. Before the EFA is performed, the dataset's consistency is measured using Cronbach's alpha. The coefficient values must be greater than 0.6 to retain any variables.[5] The Cronbach's alpha is calculated with SPSS. The final value of Cronbach's alpha is 0.66, which exceeds the

criterion, and indicates that the data demonstrate a level of consistency sufficient for further use, and all six activities and grades can be retained.

EFA is performed using SPSS as well. The method used in this process is Principal Component Analysis and Varimax Rotation with Kaiser Normalization. The number of latent variables extracted depends upon the eigenvalue of each factor extracted. Although there are certain ways to determine the number of factors extracted, any factor with an eigenvalue of 1 or higher may be used.[5, 17] Only two extracted factors have an eigenvalue of 1 or higher. Factor loadings depict the regression slopes between latent variable and indicators.[5] The six social relationship development activities with respect to student learning are indicators and any number of extracted factors are the latent variables. Although there is no specific way to choose the number of indicators for a factor, any factor loading with 0.4 or higher is reasonable.[5] The results of the EFA are shown in Table 2. No factor loadings less than 0.4 are shown in the table.

Table 2: Extracted factors

Activity	Factor	
	1	2
1. Icebreaker Game	0.870	
2. Individual Meeting with the Instructor		0.698
3. Boot Camp	0.786	
4. Team Quiz		0.774
5. In-class Term Project	0.578	
6. Classmate Tutor		0.431

Factor 1 consists of three social relationship development activities, Activities 1 (Icebreaker Game), 3 (Boot camp), and 5 (In-class Term Project). All social relationship development activities related to Factor 1 are related strongly to relationships with peers, such as team building activities. Factor 2 consists of another three social relationship development activities, Activities 2 (Individual Meeting with the Instructor), 4 (Team Quiz), and 6 (Classmate Tutor). Although Activity 4 (Team Quiz) is one of the Factor 2 activities, the other two activities are more individual, unlike Factor 1. Because Factor 1 is related to the relationships with peers, it is referred to as team oriented. By following the same notion, Factor 2 is referred to as individual oriented. Using these results, the relations among the factors and students' grades are addressed using structural equation modeling (SEM).

Structural Equation Modeling (SEM)

The main purpose of this study is to identify the relations among social relationship development activities and students' grades. To achieve this goal, EFA and SEM are used. As addressed before, SEM is a useful tool to identify any underlying effects on variables indirectly. It is a method used to determine whether there are any relations among social relationship development activities and students' grades. All indicators are shown as rectangles and all latent variables (factors) are shown as ovals in all of the figures that follow. Figure 1 shows an initial model of this study, which consists of the six social relationship development activities, students' grades as indicator variables, and the two latent variables.

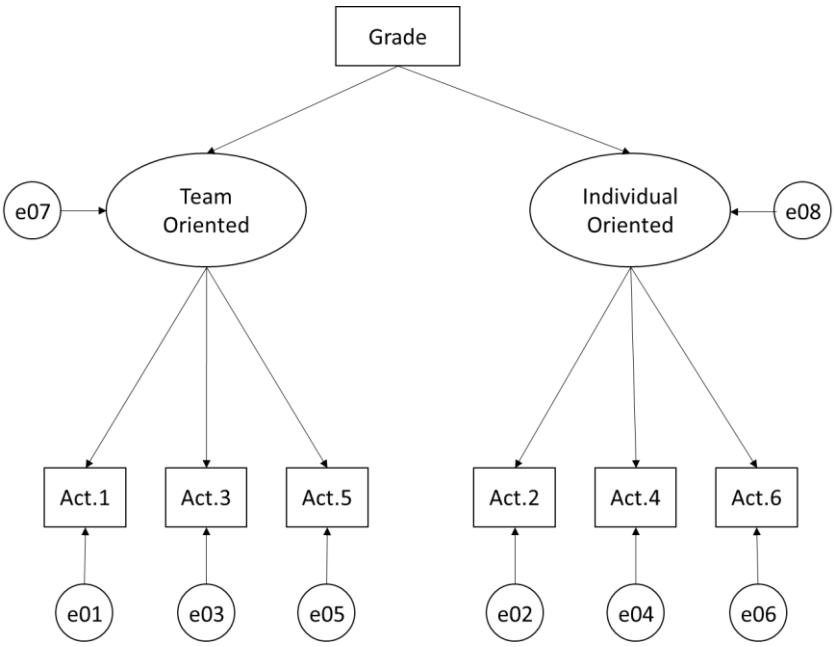

Figure 1: Initial Model

The indicator variable, Grade, is manifested by two latent variables, team oriented (Factor 1) and individual oriented (Factor 2). Grade and these two factors show a regression relation. Grade is a dependent variable, and the two factors are independent variables. This relation applies to each factor and its manifested social relationship development activities. Factor 1 is manifested by three social relationship development activities. The relation with Factor 1 and its three social relationship development activities is a regression. Factor 1 is a dependent variable, and three social relationship activities are independent variables. Each regression relation has two components, the estimate (regression slope) and variance. Estimates range from 0 to 1, and an estimate near 1 indicates a strong relation. Further, an estimate can be positive or negative. All lower case 'e' represents the variance of each variable in the initial model. This analysis is performed in AMOS.

To verify the results of the initial model, the model fit must be checked. The initial model does not demonstrate a good fit in five indices, the Chi-Square value, Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). It is recommended to review these indices and show each index's cutoff value to assess a model's fit.[2] Table 3 shows each index's cutoff value and the results of the initial and final revised model with respect to model fit. None of the indices is satisfied in the initial model. AMOS includes the function Modification Indices that shows the way to improve a model's fit. Accordingly, the initial model is revised based upon Modification Indices in order as follows:

- Factor 1 (Team Oriented) and Factor 2 (Individual Oriented)
- Activity 2 (Individual Meeting with the Instructor) and Activity 5 (In-class Term Project)
- Grade and Activity 4 (Team Quiz)

Three additional relations are added into the initial model, as shown in Figure 1 above. Factor 1 is related to Factor 2. This is logical, because team orientation is related to individual orientation. A relation between Grade and Activity 4 is logical as well. However, a relation between Activity 2 and Activity 5 is unclear. Some students ask the instructor for help with their term project. The model may suggest this perspective, although it is not there initially. The final model fit is satisfactory except for the Standardized Root Mean Square Residual (SRMR).

Table 3: Summary of model fits

Index	Cutoff Value	Initial Model	Revised Model
Chi-square	> 0.05	0.000	0.418
Standardized Root Mean Square Residual (SRMR)	< 0.08	0.421	0.256
Root Mean Square Error of Approximation (RMSEA)	< 0.10	0.137	0.013
Comparative Fit Index (CFI)	> 0.95	0.744	0.998
Tucker-Lewis Index (TLI)	> 0.95	0.586	0.996

Figure 2 shows the final revised model and its estimates and variances, all of which are standardized. All estimates are positive, which indicates that all associations are positive. Factor 1 has a strong association with Activities 1 and 3, while Factor 2 has a strong relation with Activities 2 and 6. Each factor has at least two dominant variables that affect a factor. There are three additional relations. Grade is associated directly with Activity 4. Factors 1 and 2 are related positively. This is an additional finding in this study. The relations between Activities 2 and 5 are unclear in this case study and should be clarified in further study. All of the relations between students' grades and the two latent variables are positive. Both Factors 1 and 2 have similar effects on Grade. Factor 2 (Individual Oriented) has a stronger association with Grade than Factor 1 (Team Oriented). Although having a good grade in class depends heavily upon an individual student's will or effort, any team work also has positive effects on students' grades.

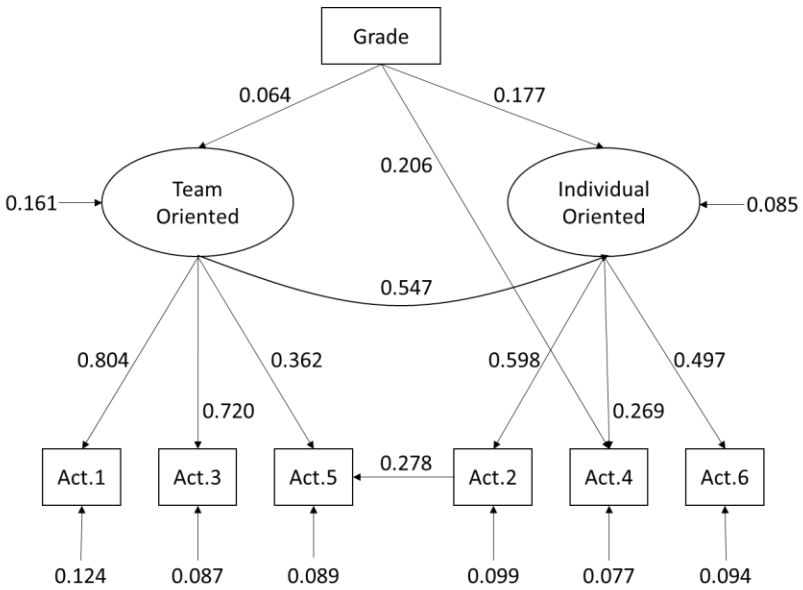

Figure 2: Revised Model with Estimates and Variances

Conclusions

This paper shows the relations among six social relationship development activities and students' grades measured with students' evaluations. EFA and SEM are used to identify these relations. All six social relationship development activities are grouped by two latent variables using EFA. Factor 1 is team oriented, and Factor 2 is individual oriented. Factors 1 and 2 consist of three social relationship development activities. Activities 1 (icebreaker game), 5 (boot camp), and 10 (in-class term project) fall in Factor 1, while Activities 2 (individual meeting with the instructor), 4 (team quiz), and 6 (classmate tutor) fall in Factor 2. Each factor has its dominant variables, such as Activities 1 and 3 in Factor 1, and Activities 2 and 6 in Factor 2. Factors 1 and 2 are related to each other. Activities 2 and 5 are related as well, although they are not part of the same factor. Grade and Activity 4 are related directly, and the relation between Factors 1 and 2 and students' grades is positive. Factor 2 has a stronger influence on students' grades than Factor 1, indicating that social relationship development activities have some level of positive effects on students' grades. Achieving academic goals is important to students and is influenced by many factors. One of these factors is students' will or effort to achieve their academic goals directly. This paper shows that in addition to students' effort, social relationship development activities help students learn in class and have positive effects on fulfilling academic goals. This stresses the importance of social relationships among class participants that help students reach their academic goals both directly and indirectly. Students maintain their academic motivation through various interactions with their peers to achieve their academic goals. This paper is beneficial to practitioners whose goal is to help students meet their academic goals in class.

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