Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #46733

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

Dr. Thomas SJ Kim, Minnesota State University, Mankato

Thomas SJ Kim is a Ph. D. in Building Construction. He had diverse teaching experiences in K-16 settings. His primary interests in research are class environments in teaching and performance improvements based on the team work and team alignment in cons

Prof. Namhun Lee, Central Connecticut State University

Dr. Namhun Lee is a professor of Construction Management at Central Connecticut State University. His research focuses on leveraging emerging technologies to improve construction efficiency and collaboration. He is also dedicated to advancing construction education and training through innovative technologies and pedagogical approaches.

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

Abstract

All class participants, including instructors and students, contribute to creating a unique culture or classroom environment. This environment heavily depends on interactions among participants through various class activities. The classroom environment reflects the characteristics of its participants and significantly impacts students' learning as they engage with one another. This paper presents a quantitative analysis of the classroom environment, focusing on social relationship development activities and their effects on student performance in a construction management course. In this case study, social relationship development activities are defined as pedagogical methods aimed at increasing student engagement, serving as an alternative to the traditional lecture format. A total of six social relationship development activities were evaluated by students in terms of their impact on the classroom environment. These activities included an icebreaker game, individual meetings with the instructor, a boot camp, an in-class term project, classmate tutor, and team quiz. Using exploratory factor analysis (EFA), the six activities were grouped into two latent factors. The first latent factor included four activities: the icebreaker game, boot camp, team quiz, and in-class term project. The second latent factor consists of the individual meetings with the instructor and classmate tutor. Based on the characteristics of these activities, the first latent factor was categorized as "Team," while the second latent factor was categorized as "Individual." Using structural equation modeling (SEM), the influence of these two latent factors on students' grades was analyzed. Both latent factors positively impacted students' grades, with the individual factor having a stronger effect than the team factor. This study highlights the importance of a classroom environment built on social relationship development activities for enhancing students' learning. These findings can guide educators in designing activities that improve students' academic performance and foster stronger relationships with their peers.

Introduction

Spending regular class hours with an instructor and peers is an inevitable part of college life. Being in the classroom with other participants creates opportunities for both instructors and students to develop a unique culture or class environment. This class environment begins to form not only during class sessions but also through interactions that occur before and after class. Such interactions contribute to what can be described as a dynamic social system.[25] Two different types of relationships co-exist as the relationship between the instructor and students and the relationships among peers. From a student's perspective, peer relationships are often considered more significant than their relationship with the instructor.[26] Each participant plays a vital role in shaping this environment, which positively impacts students' learning[10, 11] and helps them achieve their academic goals. College provides students with a starting point to build professional social networks, beginning with their peers and expanding beyond graduation.

However, many students fail to recognize the long-term significance of these peer relationships during their college years.[12] Interactions among class participants, facilitated by social relationship development activities, are crucial in establishing these connections.[16] Peer tutoring and mentoring are particularly impactful forms of interaction.[6] Mentoring typically occurs between an instructor and a student, while peer tutoring takes place among students. Both involve one-on-one personal relationships, which are highly effective in promoting meaningful connections. These relationship-building efforts are generally more successful in in-person classes than in online settings, as seen during the COVID-19 pandemic.[17] While online classes offer some opportunities for interaction, they often lack the depth and effectiveness of in-person engagements. Creating opportunities for social relationship development among class participants significantly enhances students' learning experiences and lays the foundation for future professional relationships.

This study explores the relations between social development activities, as measured by their influence on the class environment, and students' grades. The objectives of this study are to: 1) Identify potential latent factors using six social development activities and 2) Determine the potential association between those factors and students' grades. The literature review provides an overview of past and current research on social development activities and relationships among class participants. 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 and discussed in the results.

Literature Review

Students spend most of their time in classes throughout their college life. Through classes, students have experienced building a relationship with an instructor and peers in addition to the course learning outcomes. Through these interactions, a classroom environment is formed, shaped by the participants' engagement. All possible factors like course subject could affect social climate both directly and indirectly.[14] Two of four important characteristics of the supported environment in a creative-oriented class are the relationship between an instructor and students and classroom activities.[5] In a supportive environment, students are more likely to engage positively with their instructors.[15] Any relationship between class participants could build up from class activities, including those in social relationship development activities. This relationship is critical in terms of students' overall experience about the course.[24] Students' perceptions of the class environment are based on differences in students' motivational tendencies.[22] Instructors' efforts on personalized education are positively related to the classroom environment. Increased interactions between the instructor and students, facilitated through diverse communication methods and class activities, help establish stronger social bonds. Students can freely express themselves in a safe classroom environment.[8] Creating a safe and supportive classroom environment is essential. Without it, students may struggle to learn or interact effectively with their peers and the instructor. Both the instructor and students are responsible for creating a supportive climate.[13] It means the instructor and students should interact with each other positively. Classroom environments help students achieve their academic goals and build their relationships with peers and instructors. Without any motivation, it is hard to achieve any academic goals. There must be a relation between the class environment and

students' motivation. Students' classroom perceptions are related to students' goal orientations and preferences.[22] "Teachers' practices and classroom norms, rules, and routines contribute to students' perceptions of goal structure" (p. 368).[19] The perceive classroom environment indirectly influences graded performance and intrinsic motivation.[3] In addition to students' supportive relationships with peers, teachers' support is statistically significant on both students learning goal orientation and task value.[27]

Students develop social relationships with peers and the instructor through various social relationship development activities in class. During this process, participants share their thoughts and emotions, allowing them to better understand one another. This exchange is fundamental for creating meaningful relationships. Social relationship development activities help all class participants express their emotions and foster connections. To have a strong relationship, the critical factor in a relationship between an instructor and students is their trust that they feel safe in the class.[24] Trusting anyone would be a solid foundation of any relationship. Any contacts between an instructor and students outside of class show positive correlation with trust and students' motivation.[9] Having any interactions with students outside of class makes students feel more comfortable than those occurring in class. The outside of class activities provides opportunities to connect with the instructor on a personal level, strengthening the social bond with students. Students with subject matters, students with teachers, students with other peers, and students with their developing selves[20] and these relationships play a critical role in 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).[20] Knowing students' names and managing course expectations are two of the three factors in building positive student-instruction interactions.[21] For the instructor, remembering students' names is a simple yet impactful way to foster better social relationships. Showing care and concern for their students' learning and personal growth is one of the best instructors' abilities.[18] The relationship between the instructor and students, the relationships among peer students, and team orientation are three major factors that affect students' learning.[11] Social development activities enhance students' learning by fostering 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).[4] Social relationships are based on any interactions between students and an instructor. It is impossible to build a relationship without any interactions. A framework was proposed to aid students in fulfilling their academic goals through class activities including social relationship development activities.[10]

Social activities in class have a positive influence on students' learning even though the instructor is not in charge of students' relationships with their peers.[20] Providing opportunities for students to build peer connections within the classroom is therefore crucial. Students often prefer working in teams and learn the material better in this situation. Through working as a team, students start getting to know their peers. Some social relationship development activities are addressed to enhance development of peer relationships.[20] "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] Interactions with both peers and the instructor play a significant role in increasing students' engagement. Peer mentors in the class make students feel comfortable with having trusted

friends.[6] Having peer mentors can improve students' social relationships with their peers and help them achieve their academic goals.

Students and instructors interact frequently throughout the semester, creating opportunities to build social relationships. The classroom serves as a space where both the instructor and students can interact with each other and work towards their individual and shared goals. Research has shown that all class participants go through social relationship development activities, during which they define their roles and responsibilities. Having strong social relationships among class participants is crucial for achieving students' learning outcomes. This case study focuses primarily on examining the effects of social relationship development activities on students' academic performance and 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 approximately has 25 students, meeting twice a week for a total of three credit hours. Many social relationship development activities are based upon teams of three or four. All social relationship development activities are designed to help the instructor and students build their relationships with each other. Social relationship development activities are grouped into two types, one individual and the other a team. Individual activities are completed independently, while team activities require collaboration among team members. Some of these activities take place outside the classroom, providing additional opportunities for the instructor to engage with students beyond the standard class hours.

Ice Breaker Game

The icebreaker game is played on the first day of the semester, with students randomly assigned to teams of four or five. This game provides an opportunity for students to introduce themselves to their team members and the entire class. During the game, students become familiar with their peers, and the instructor gains the chance to get to know the students as well. At the end of the game, the instructor takes photos and videos of the students to help memorize their names and faces.

Boot Camp

The boot camp is designed to offer students a team building opportunity. Scheduled midway through the semester, it aims to help students lighten stress from the course. The activity is conducted in a quiz show format, where each team works collaboratively to solve problems. The questions are not course-related but focus on general topics such as movies, sports, classmates, and the instructor. This experience improves the relationships among students and promotes a better connection with their instructor.

Team Quiz

This quiz is designed for teams to solve problems collaboratively rather than individually. The team quiz allows students to work together to develop a collective answer, providing valuable group work experience. Regardless of the outcome, students learn the material by solving problems as a team. Two team quizzes are provided over the course of the semester.

In-class Term Project

The primary goal of the term project is to provide students with a hands-on opportunity to apply their knowledge of statics. This team-based project spans one month, during which each group designs, builds, and tests a straw structure capable of bearing the weight of as many textbooks as possible. In the last class of the semester, all teams construct their straw structures. Each team is limited to using 16 straws, eight paper clips, and a one-foot-long piece of Scotch tape. Other materials, such as glue or heated tools, are prohibited. For a practice run, students are provided with one extra set of materials prior to the final run. Teams have 20 minutes to build their structures. The instructor supplies the required materials, but students may bring their own tools to assist with construction. This term project allows students to apply their understanding of statics in a practical setting. It emphasizes teamwork, requiring students to collaborate and rely on their peers to complete the task successfully. The success of the in-class term project depends heavily on the strength of the social relationships within each team.

Individual Meetings with the Instructor

The purpose of the individual meetings is to allow the instructor to get to know students. The individual meetings take place during the first three weeks of the course. Each student signs up for a meeting with the instructor and the meeting lasts for approximately 30 to 40 minutes. The conversations are casual and focus on the students' personal lives rather than course content. These meetings provide an excellent opportunity for both the instructor and students to build connections, particularly for students in the earlier years of college who may not yet be familiar with faculty members in the department.

Classmate Tutor

Classmate tutors are available throughout the semester to provide additional support. The instructor selects students who have a strong understanding of the course material to serve as tutors. These tutors join the instructor during special weekly office hours, which tends to attract many students seeking assistance. If there is a need for individual sessions, classmate tutors accommodate students based on their availability. Participation as a tutor is entirely voluntary, and tutors are not compensated for their work. However, they recognize that teaching and assisting others is an excellent way to reinforce their own understanding of the material. This system is highly effective, as some students may feel more comfortable seeking help from peers rather than the instructor. Additionally, many students share the same classes, which fosters a supportive learning environment.

Design of the Study

To examine the associations between social relationship development activities and students' grades, student surveys were conducted over eight consecutive semesters. The survey was administered during the last week of each semester, with students completing it freely in the absence of the instructor. To ensure honesty, the instructor could not access the surveys until after the students' final course grades were posted. The survey collected responses regarding the influence of six social relationship development activities on class environment, with answers recorded on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Students' final grades were also converted to a Likert scale for analysis. 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 evaluated in this study are detailed 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 150 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 presented in Table 1 below. Among the six activities, Activities 3 and 4 have the highest mean scores, while Activities 5 and 6 have the lowest. Activity 5 is the in-class term project and Activity 6 is the classmate tutor. Regarding standard deviation, Activities 2 and 5 have the highest values, while Activities 1 and 3 have the lowest. Among the six activities, both the means and standard deviations are consistent in the descriptive statistics, according to which, any activity related to the social team building activity is ranked highly with respect to impact on the class environment.

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

Items	Mean	Standard Deviation
Grade	3.787	1.021
Activity 1: Icebreaker Game	4.287	0.806
Activity 2: Individual Meeting with the Instructor	4.173	0.954
Activity 3: Boot Camp	4.487	0.766
Activity 4: Team Quiz	4.333	0.902
Activity 5: In-class Term Project	4.133	0.946
Activity 6: Classmate Tutor	4.153	0.925

To identify the underlying factors of the six activities in relation to students' learning, Exploratory Factor Analysis (EFA) was conducted. EFA is widely used in fields such as sociology and psychology, where directly measuring the effects of variables is often challenging. It is typically performed before methods like Structural Equation Modeling (SEM) or Confirmatory Factor Analysis (CFA). EFA is a statistical technique designed to uncover latent factors underlying observed variables. The primary objective is to define associations among observed variables through latent factors, also referred to as "Latent Variables."[2] EFA is commonly used to reduce a large set of variables into a smaller, more manageable set. Using EFA, all six activities were grouped by latent variables. Before performing EFA, the dataset's internal consistency was assessed using Cronbach's alpha. A coefficient value of 0.6 or higher is required to retain variables.[7] The Cronbach's alpha was calculated using SPSS, yielding a final value of 0.65. This value exceeds the threshold, indicating sufficient consistency in the data to proceed. As a result, all six activities and associated grades were retained for further analysis.

EFA was conducted using SPSS, employing the Principal Component Analysis method with Varimax Rotation and Kaiser Normalization. The number of latent variables extracted is determined by the eigenvalues of the factors. While several methods exist for selecting the number of factors, only factors with an eigenvalue of 1 or higher are typically retained.[7, 23] In this analysis, two extracted factors had eigenvalues of 1 or greater. Factor loadings represent the regression slopes between latent variables and their indicators.[7] For this study, the six social relationship development activities related to the class environment served as indicators, while the extracted factors represent the latent variables. Although there is no strict guideline for determining the number of indicators per factor, factor loadings of 0.4 or higher are generally considered acceptable.[7] The results of the EFA are summarized in Table 2, which only includes factor loadings of 0.4 or higher.

Table 2: Extracted factors

Activity	Factor	
	1	**2**
1. Icebreaker Game	0.788	
2. Individual Meeting with the Instructor		0.707
3. Boot Camp	0.826	
4. Team Quiz	0.482	
5. In-class Term Project	0.578	
6. Classmate Tutor		0.824

Factor 1 consists of four social relationship development activities, Activities 1 (Icebreaker Game), 3 (Boot camp), 4 (Team Quiz), and 5 (In-class Term Project). These activities are strongly associated with peer relationships and mainly focus on team building. Factor 2 has two social relationship development activities, Activities 2 (Individual Meeting with the Instructor) and 6 (Classmate Tutor). All social relationship development activities in Factor 2 are more individual, unlike Factor 1. Given the nature of these factors, Factor 1 is labeled "Team," as it emphasizes peer interactions and team building. Similarly, Factor 2 is labeled "Individual," reflecting its focus on one-on-one interactions and personalized support. Using these results, the relations between the factors and students' grades are analyzed through Structural Equation Modeling (SEM).

Structural Equation Modeling (SEM)

The main purpose of this study is to explore the relations among social relationship development activities and students' grades. To accomplish this goal, both EFA and SEM are employed. As addressed before, SEM is an effective method for identifying underlying effects on variables indirectly. It is useful for examining the relations between social relationship development activities and students' grades. All indicators are represented as rectangles, while all latent variables (factors) are depicted as ovals. Figure 1 illustrates the initial model of this study, which includes the six social relationship development activities, students' grades as indicator variables, and the two latent variables.

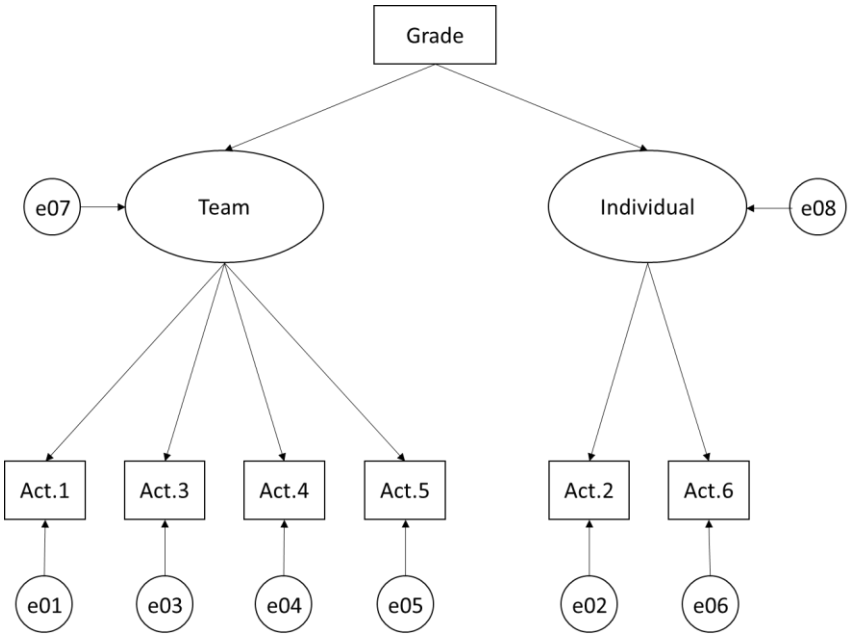

Figure 1: Initial Model

The indicator variable, Grade, is manifested by two latent variables, Team (Factor 1) and Individual (Factor 2). The relation between Grade and these two factors is modeled as a regression, where Grade serves as the 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 four social relationship development activities. The relation with Factor 1 and its four social relationship development activities is a regression. Factor 1 is a dependent variable, and four social relationship activities are independent variables. Each regression relation has two components, the estimate (regression slope) and variance. Estimates range from 0 to 1, with values closer to 1 indicating a stronger relationship. Estimates can also be positive or negative, reflecting the direction of the relation. The variance of each variable in the initial model is represented by a lowercase 'e.' This analysis is performed in AMOS.

The model fit was performed to verify the results of the initial model. This paper uses five model fit 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). The

initial model does not demonstrate a good fit in all five indices. It is recommended to evaluate these indices and present each index's cutoff value to assess a model's fit effectively.[2] Table 3 shows each index's cutoff value and the results of the initial and final revised model with respect to model fit. Only one index is satisfied in the initial model. The function Modification Indices built in AMOS that shows the way to improve a model's fit. Accordingly, the initial model is revised based upon Modification Indices as follow:

- Factor 1 (Team) and Factor 2 (Individual)

One more relation is added into the initial model, as shown in Figure 1 above. Factor 1 is related to Factor 2. This is logical, because Factor 1 (Team) is related to Factor 2 (Individual) or vice versa. Changing the direction of relation between Factor 1 and 2 does not make a difference in the model fit after all. The final model fit is satisfactory as presented in Table 3 and the revised model is shown in Figure 2 below.

Table 3: Summary of model fits

Index	Cutoff Value	Initial Model	Revised Model
Chi-square	> 0.05	0.000	0.342
Standardized Root Mean Square Residual (SRMR)	< 0.08	0.081	0.045
Root Mean Square Error of Approximation (RMSEA)	< 0.10	0.071	0.028
Comparative Fit Index (CFI)	> 0.95	0.910	0.987
Tucker-Lewis Index (TLI)	> 0.95	0.855	0.978

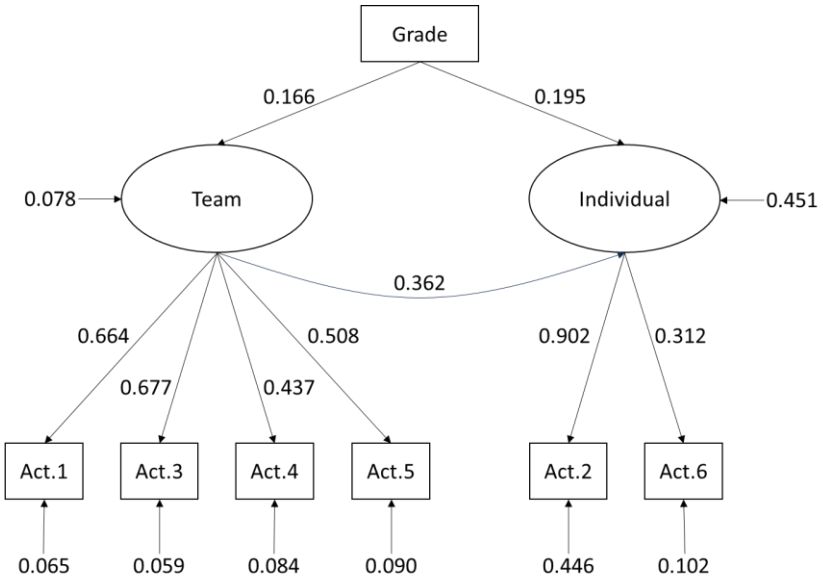

Figure 2: Revised Model with Estimates and Variances

Figure 2 shows the final revised model, including standardized estimates and variances. All estimates are positive, which indicates that all associations between variables are constructive. Factor 1 demonstrates a strong association with Activities 1 and 3, while Factor 2 has a

significant relation with Activities 2. Each factor is influenced by one or two dominant activities that have the greatest impact on it. Additionally, Factors 1 and 2 are related positively. Relations between students' grades and the two latent variables are also positive. Although both Factors 1 and 2 have similar effects on Grade, Factor 2 depicts a slightly higher influence on Grade. Although achieving good grades in class largely depends on an individual student's effort and determination, teamwork also positively influences students' academic outcomes. Moreover, even though these social relationship development activities are primarily evaluated based on their impact on the class environment, they all contribute positively to students' grades and learning.

Conclusions

This paper examines the relations among six social relationship development activities and students' grades, as measured through students' evaluations of the class environment. Exploratory (EFA) and Structural Equation Modeling (SEM) are used to uncover 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. Factor 1 consists of four social relationship development activities. Activities 1 (icebreaker game), 3 (boot camp), 4 (team quiz), and 5 (in-class term project) fall in Factor 1, while Activities 2 (individual meeting with the instructor) and 6 (classmate tutor) fall in Factor 2. Each factor is influenced by dominant variables, such as Activities 1 and 3 for Factor 1, and Activity 2 for Factor 2. Furthermore, Factors 1 and 2 are positively correlated. The relation between Factors 1 and 2 and students' grades is positive. Factor 2 demonstrates a stronger influence on Grade than Factor 1, stressing the significance of individual-oriented activities in fostering academic success. While achieving academic goals primarily depends on students' effort and determination, this study highlights the role of social relationship development activities in creating a positive class environment and supporting academic achievement. These activities enhance students' academic motivation through peer and instructor interactions, indirectly contributing to their success. This paper offers valuable insights for educators and practitioners aiming to help students achieve their academic goals by emphasizing the importance of fostering meaningful social relationships within the classroom.

Bibliography

1. Axelson, R. D., & Flick, A. (2011). Defining Student Engagement. *Change*, 43 (1), 38 – 43

2. Brown, T. (2006). Confirmatory Factor Analysis for Applied Research. Guilford Press, New York.

3. Church, M. A., Elliott, A. J., & Gables, S. L. (2001). Perceptions of Classroom Environment, Achievement Goals, and Achievement Outcomes. Journal of Educational Psychology, 93 (1), 43 – 54

4. Claessens, L.C.A., Tartwikj, J., Want, A.C., Pennings, H.J.M., Verloop, N., Brok, P.J., & Wubbels, T. (2017). Positive teacher-student relationships go beyond the classroom, problematic ones stay inside. *Journal of Educational Research*. 110 (5), 478 – 493

5. Cole, D. G., Sugioka, H. L., & Yamagata-Lynch, L. C. (1999). Supportive Classroom Environments for Creativity in Higher Education. *Journal of Creative Behavior*, 33 (4), 277 – 293

6. Colvin, J. W. & Ashman, M. (2010). Roles, Risks, and Benefits of Peer Mentoring Relationships in Higher Education. *Journal of Mentoring & Tutoring: Partnership in Learning*, 18 (2), 121 – 134

7. Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. (1998). Multivariate Data Analysis. Prentice-Hall, Englewood, New Jersey.

8. Holley, L. C. & Steiner, S. (2005). Safe Space: Student Perspectives on Classroom Environment. Journal of Social Work Education, 41 (1), 49 – 64

9. Jaasma, M. A. & Koper, R. J. (1999). The Relationship of Student-Faculty Out-of-Class Communication to Instructor Immediacy and Trust. *Communication Education*, 48 (1), 41 – 47

10. Kim, S. J. & Lee, N. (2016). Team Building for Collaborative Learning Environment in Construction Education. *American Society for Engineering Education (ASEE) Annual Conference & Exposition*, June 26 – 29

11. Kim, S.J. & Lee, N. (2019). Key Factors in Construction Engineering and Management Education to Facilitate Student Engagement and Collaborative Learning. *Associated Schools of Construction (ASC) Annual Conference*, Denver, CO. April 10 – 12

12. Kim, S. J. and Lee, N. (2022), "Influences of Social Relationship Development Activities on Students' Grades in Construction Engineering and Management Education: A Statistical Analysis." 2022 American Society for Engineering Education (ASEE) Annual conference, Minneapolis, MN. June 26 – 29

13. Landau, J. &Meirovich, G. (2011). Development of Students' Emotional Intelligence: Participative Classroom Environments in Higher Education. Academy of Educational Leadership Journal, 15 (3), 89 – 104

14. Moos, R. H. (1980). Evaluating Classroom Learning Environments. *Studies in Educational Evaluation*, 6 (3), 239 – 252

15. Myers, S. A. & Claus, C. J. (2012). The Relationship Between Students' Motives to Communicate with Their Instructors and Classroom Environment. Communication Quarterly, 60 (3), 386 – 402

16. Oakes, J. (1982). Classroom Social Relationships: Exploring the Bowles and Gintis Hypothes. *Sociology of Education*, 55(4), 197 – 212 https://doi.org/10.2307/2112672

17. Pabian, S., Erreygers, S., Vandebosch, H., Van Royen, K., Dare, J., Costello, L., Green, L., Hawk, D., & Cross, D. (2018). Arguments online, but in school we always act normal: The embeddedness of early adolescent negative peer interactions within the whole of their offline and online peer interactions, *Children and Youth Services Review*, 86, 1 – 13 https://doi.org/10.1016/j.childyouth.2018.01.007

18. Paolini, A. (2015). Enhancing Teaching Effectiveness and Student Learning Outcomes. *Journal of Effective Teaching*, 15 (1), 20 – 33

19. Patrick, H., Kaplan, A., & Ryan, A. M. (2011). Positive Classroom Motivational Environments: Convergence Between Mastery Goal Structure and Classroom Social Climate. Journal of Educational Psychology, 103 (2), 367 – 382

20. Quinlan, K. (2016). How emotion matters in four key relationships in teaching and learning in higher education. *College Teaching*, 64(3), 101 – 111

21. Solis, Oscar J. & Turner, Windi D. (2017). Building Positive Student-Instructor Interactions: Engaging Students through Caring Leadership in the Classroom. *Journal on Empowering Teaching Excellence*, 1 (1), 23 – 37

22. Tapola, An. & Niemivirta, M. (2008). The Role of Achievement Goal Orientations in Students' Perceptions of and Preference of Classroom Environment. British Journal of Educational Psychology, 78 (2), 291 – 312

23. Thompson, B. (2004). Exploratory and Confirmation Factor Analysis: Understanding Concepts and Applications. American Psychological Association, Washington, DC.

24. Tormey, R. (2021). Rethinking student-teacher relationship in higher education: a multidimensional approach. *High Education*, 82, 993 – 1011 *https://doi.org/10.1007/s10734-021-00711-w*

25. Trickett, E. J. & Moos. R. H. (1973). Social Environment of Junior High and High School Classrooms. *Journal of Educational Psychology*, 65 (1), 93 – 102

26. Tu, J. C. & Chu, K. H. (2020). Analyzing the Relevance of Peer Relationship, Learning Motivation, and Learning Effectiveness—Design Students as an Example. *Sustainability*. 2020; 12(10):4061. https://doi.org/10.3390/su12104061

27. Velayutam, S. & Aldrdge, J. M. (2013). Influence of Psychosocial Classroom Environment on Students' Motivation and Self-Regulation in Science Learning: A Structural Equation Modeling Approach. Research in Science Education, 43 (2), 507 – 527