

## **An Evaluation of a First-Year Civil Engineering Student Group Dynamics Intervention**

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# **Full Paper: An Evaluation of a First-Year Civil Engineering Student Group Dynamics Intervention**

## **Introduction**

Women and people of color are underrepresented in Science, Technology, Engineering, and Math (STEM) educational programs and careers [1]. This underrepresentation is reflected in the norms and culture existing in STEM fields. The perception of a white-men dominated environment can often result in unfair stereotypes and biases imposed on women and people of color. These students can face assumptions of inferiority and be considered as part of the STEM field only as part of a requirement or quota [2],[3],[4].

Group based project learning is a common tool used in the engineering classroom to promote the acquisition and development of skills that prepare students for engineering careers requiring significant collaborative effort. Working in groups and collaborating towards a common goal allows students to develop their communication, leadership, problem solving, and conflict resolution skills, among others. Unfortunately, research indicates that group dynamics in STEM education project groups can suffer due to both gender and racial stereotyping and bias. Multiple studies indicate that women and students of color experience higher rates of being silenced and marginalized as well as receiving tasks deemed less valuable or earning no credit from their peers for their work [2],[3],[5]. This paper evaluates first year civil engineering students' responses to a series of reflective questions based on a group dynamics intervention presented halfway through their first semester. The goal of this reflective assignment was to identify what differences, if any, there could be in students' ability to identify biases and their preferences for conflict resolution strategies based on the respondents' gender. The responses provided information regarding student awareness of gender and/or racial bias as well as their group conflict resolution tendencies. This group dynamics intervention was sponsored through a National Science Foundation (NSF) grant.

## **Description of the Group Dynamics Intervention**

The group dynamics intervention involved students watching a group conflict scenario presented in class by professional actors role-playing three college students who self-identified as a white woman, a white man, and a black man. The scenario was designed to illustrate biases that can negatively impact group dynamics –including both racial-based and gender-based biases. In the scenario, the actors portraying students were members of a Chemistry lab group that had received a low grade on the last assignment. As the scene played out several conflicts and or examples of biased behavior between group members were presented. For example, at the beginning of scene the two men were carrying on a conversation that did not include the third group member, and later the measurements made by the woman group member were called into question. As the scene ends, the woman has reached the point where she gets up from the table and leaves the group. As part of the interactive component, several students volunteered to intervene as a fourth group member to attempt to improve the group dynamic as the scenario was reenacted again. The theater activity was facilitated by a professional consulting firm, which led the students in discussing the effectiveness of different approaches taken by the student volunteers. In the week following the in-class intervention, students completed a reflection assignment by answering the following questions:

1) What types of conflicts did you see in the role-playing presentation? 2) What types of conflict resolution did you see tried in the exercise? Did you think they were good? 3) Have you

experienced team conflicts? If so, what was the source of the conflict? 4) What approach would you try to resolve team conflict?

### Qualitative Data Collection and Analysis

The qualitative analysis of the student responses consisted of coding and analyzing of the open-ended responses in a qualitative coding software, produced by QSR International, nVivo 12. The results were disaggregated by responders' self-identified sex. A total of 60 students, 19 female and 41 male students provided consent to the project out of a class of 94 students. The responses were coded for themes following a node structure developed prior to manual coding. A "node" is created in nVivo to categorize specific words, lines, or full responses. An initial pass through the responses was completed using nVivo's automatic word finding to capture the following: (1) students' awareness of gender-bias in the group dynamic scenario, (2) students' awareness of racial-bias in the group dynamic scenario, and (3) students' previous experience with group conflict. Based on this initial search, two general themes were chosen for the main node structure, gender and conflict resolution. Manual coding was completed by two graduate students, a white female studying civil engineering and a white male studying engineering education. The two students exhibited an intercoder reliability kappa score of 0.75, which demonstrates substantial agreement between coders [6]. Student responses to all 4 questions were manually coded for the gender node and only responses for question 4, regarding the students' chosen conflict resolution options, were considered within the conflict resolution node. Themes were chosen for both the gender and conflict resolution nodes and these responses within these nodes were coded again for these themes. A schematic of the nodes and themes is shown in Figure 1.

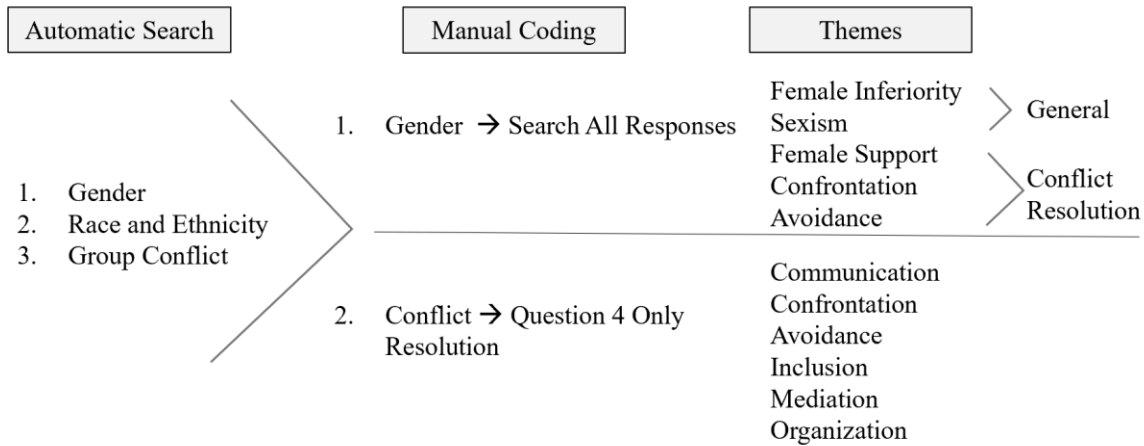


Figure 1: nVivo Coding Schematic

### Results Automatic Word Search

The results of the automatic word search query in nVivo indicated that 68.4% female students and 70.7% male students referenced gender, sex, girl, or female in their response to question 1, regarding types of conflict. In responses to question 2, regarding the conflict resolution tactics portrayed in the scenario, 57.8% of females, and 53.7% of males referenced gender, sex, girl, or female in their response. Based on these results, the male and female students were equally aware of sexism in the conflict scenarios and conflict resolution attempts in the group dynamics intervention. In the analysis of responses to all four questions, only 5.2% of females and 9.7% of

males mentioned race or ethnicity in their responses despite this bias being present in a minor manner in the scenario. This result implies that the students focused more heavily on conflict based on gender instead of race or ethnicity. In response to question 3, 80% of the first-year civil engineering students indicated they had not experienced team conflicts before.

### **Results Manual Coding: Gender**

The length and content of each student response varied for each question. The length of each manually coded segment also varied. The number of manually coded segments for the gender node are shown in Table 1 and are aggregated by occurrences in each question and for each gender. The number of gender coded segments in question 1 and 2 confirm the results of the initial automatic word search query for gender. Students were aware of gender bias in both the conflict scenarios and resolution strategies presented in the intervention. However, the fewer number of gender references in the responses to question 3 and 4 may indicate that in their own personal conflict experiences and conflict resolution strategies students do not necessarily consider gender-bias. Illustrative examples of the gender coding themes of female inferiority, sexism, confrontation, avoidance, and female support are listed below.

Female Inferiority *“Due to one of the character’s gender alone she was questioned unreasonably by another male character who perceived her as less qualified after an apparent oversight made on earlier project.”*

Sexism *“One group member was hostile and was talking down to someone because of their gender” “Some of the conflicts I saw in the role play were exclusion, sexism, and bullying.”*

Confrontation *“The ways people tried approaching this was being more assertive with the male that was causing the conflict.”*

Avoidance *“I think this was probably the best approach as to not start any more conflicts and just fix the one that was already happening.”*

Female Support *“When people went up and tried to fix the problem, some people tried letting the girl have a voice in the situation and include everyone’s thoughts and opinions, almost as a mediator.”*

The number of manually coded segments for the gender node themes are shown in Table 2 and are also aggregated for each gender. In responses to question 1, both males and females recognized the common gender conflict themes of female inferiority and sexism. In question 2, the students responded to the conflict resolution strategies they saw being utilized and discussed during the intervention. As shown in the number of coded segments for the gender coded themes (e.g. confrontation, avoidance, and female support) in Table 2, students, both male and female, recognized the conflict resolution strategy of confrontation. However, the primary strategies recognized by both males and females were those that actively tried to support the female in the scenario. However, the motivation behind the need for female support is unclear. Did students believe she was being treated unfairly or did she only require that support because she was a woman? The manually coded themes cannot directly answer that question. Avoidance was not a

main conflict resolution strategy recognized by the students but was mentioned by 2 female students in gender coded responses.

Table 1: Number of gender coded response segments aggregated by question and gender.

Coded Section	Number of Coded Response Segments		
	Female	Male	Total
Total	28	48	76
Question 1	11	25	36
Question 2	13	19	32
Question 3	3	2	5
Question 4	1	2	3

Table 2: Number of coded response segments manually coded into gender-based themes and aggregated by question and gender.

Manually Coded Themes	Number of Coded Response Segments							
	Question 1		Question 2		Question 3		Question 4	
	Female	Male	Female	Male	Female	Male	Female	Male
Female Inferiority	6	20	0	2	2	0	0	0
Sexism	7	17	0	1	1	0	0	2
Resolution: Confrontation	0	0	6	6	0	1	1	0
Resolution: Avoidance	0	0	2	0	0	0	0	0
Resolution: Support Female	0	0	11	16	1	0	0	1

### Results Manual Coding: Conflict Resolution

Manual coding for conflict resolution was completed for question 4, where students described approaches they would use to resolve group conflict. From the question 4 responses, the conflict resolution themes of avoidance, communication, confrontation, inclusion, mediation, and organization were chosen. Illustrative examples of the conflict resolution themes are listed below. The number and percent of manually coded segments for the conflict resolution node are shown in Table 3 and are aggregated by gender. The percent of coded segments was calculated based on the number of female and male responses to question 4.

Avoidance *“These approaches would not be something that I would do because I am not the head-on type. I would prefer more of a calm and concise approach.”*

Communication *“I feel that if everyone communicates together as a team that we can create better decisions, and no one would feel left out.”*

Confrontation *“If that isn’t enough, I would resort to confronting the person causing the conflict and call them out on their behavior.”*

Inclusion *“My approach to resolving team conflict is to level the playing field, so no one feels underrepresented and no one person has complete power.”*

Mediation *“To resolve this kind of conflict I would step up and ask all the members of the group what they think should happen so that everyone’s ideas are heard.”*

Organization *“Splitting up tasks is an important aspect because if everyone has a small part to do, the project will be done sooner, and nobody can blame one person for a mistake. This also helps everyone learn about the project and be able to understand the material better.”*

As shown in Table 3, preferred group conflict strategies for female students were relatively equally spread across all 6 themes, with the largest percent recorded for the mediation theme strategy (~42%) and the lowest recorded as avoidance (~21%). The equality across all themes illustrates that many of the female student responses contained references to multiple different group conflict strategy themes. However, a larger disparity is seen in the strategies of the male students. Male students appeared to favor the inclusion (~44%) and confrontation (~44%), at only a slightly higher percentage as the female students.

The largest differences between male and female students in the coded conflict resolution strategy themes were recorded in the avoidance and communication themes, with the mediation and organization themes also showing large differences. Female students referenced these themes at a greater frequency than male students, at ~19% for the avoidance theme, ~20% for the communication theme, ~18% for the mediation theme, and ~17% for the organization theme. This result may indicate that more female students prefer calmer interactions in the event of group conflict, relying more heavily on avoiding conflict or feeling more confident in their abilities to communicate, mediate, or organize rather than confront the conflict directly. Male student preferences for a combination of confrontation and inclusion may reflect a more paternal behavior in a group conflict scenario.

Table 3: Number and percent of coded response segments manually coded into conflict resolution-based themes and aggregated by gender.

Manually Coded Themes	Number of Coded Response Segments		Percent of Coded Response Segments	
	Female	Male	Female	Male
Avoidance	4	1	21	2
Communication	7	7	37	17
Confrontation	7	18	37	44
Inclusion	7	18	37	44
Mediation	8	10	42	24
Organization	7	8	37	20

## Conclusion

This study indicated that a majority of the first-year civil engineering students recognized the gender aspects of the group conflict scenarios presented. However, a majority of students indicated that they had not yet witnessed a gender-bias conflict during their group work. Although 80% of the first-year students indicated in question 3 that they had not encountered group conflict yet in their studies, their responses to question 4 indicate that outside of the group conflict intervention, the students have already formed opinions on what group-work skills they value as important. Both male and female students presented multiple group conflict resolution strategies, such as organization or communication, that were not specifically mentioned in their responses to questions 1 and 2 regarding what strategies they had seen during the presentation. The lack of personal experience of these first-year students with group conflict may indicate that as group projects become a larger part of first-year engineering courses, students' understanding of team dynamics and group conflict strategies should be a central theme incorporated into first-year engineering group projects. The differences in the group conflict resolution strategies suggested by female and male students may also indicate that multiple types of group conflict resolution strategies should be specifically presented to the students during a team development intervention to increase awareness of the possible options. Regardless of the intervention and the students' awareness of the strategies, further study is required to understand whether the students can actively use these strategies in actual group conflict situations.

## Acknowledgments

This material is based upon work supported by the National Science Foundation under Grant No. 1726268. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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