

## **The influence of percentage of female or international students on the psychological safety of team**

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# **The influence of percentage of female or international students on the psychological safety of team**

## **Abstract**

This research full paper investigates how the percentage of women or international students in a team is related to the psychological safety of first-year engineering team members.

Background: Psychological safety provides safe environment for team members to easily express their opinions and make decision without being worry about the consequences. Team composition can affect the psychological safety of teams and individual students. To promote a more inclusive classroom, faculty need advice on team formation strategies that lead to the optimum composition when the class includes gender diversity and international students.

Purpose/Hypothesis: We want to know to what extent the percentage of women or the percentage of international students in a first-year engineering team will affects the team's average psychological safety.

Design/Method: We categorized teams of a first-year engineering class based on the percent of female students in teams and conducted one-way ANOVA. We also used ANOVA to study the experience of international students.

Results: We find that there is no significant decrease in the average psychological safety of teams as the fraction of women increases. However, teams with no international students had significantly higher psychological safety than teams with 50-67% international students.

Conclusions: Regarding international students, the practice in the course studied is to avoid having more than one in a team. Our findings support this practice, showing tendency for the average psychological safety to decrease as the number of international students are increasing in a team.

Keywords Psychological safety, gender, international students, teamwork, team composition.

## **Introduction and literature review**

Engineering students should be able to work in multi-disciplinary teams [1], and engineering professions needs engineering graduates who have the teamwork skills [2]. Working in diverse teams is one of the required skills. So, engineering instructors sometimes using teams in their classrooms, but addressing the issue of diversity in the engineering classroom teams is difficult and there is a need for new practice and instruction to improve the attitude of students about working in the diverse teams [3]. Although diversity can be in term of gender, race, language, culture, nationality, etc., here we discussed the gender and international students.

Based on the research about women in undergraduate engineering teams we found some information. Although women gain confidence and improve their work qualities through collaboration and they are engaged in the collaboration more than men [4], [5], inappropriate

modes of collaboration can cause ignoring women in the teams [6]. Women are more willing than men to take the leadership role in teams and they believe in their ability to lead the team, but men believe them less [7], [8]. Engineering students 20 years ago believed that women get less respect and attention in the teams specially in the first-year engineering and they are given less responsibility compared to men [9], and recent research revealed that engineering professors often do not consider gender when they want to form teams [10].

In addition, some first-year engineering students come from other countries, so instructor should consider their experience and their effect on the experience of domestic students when designing team activities. International students, especially in the first-year of study, often participate more in educational activities compared to American students [11]. However, they need to adjust to the new environment especially if they do not have previous experience in the U.S. schools. International student adjustment is more difficult than U.S. student adjustment [12], and many are adjusting to the English language as well as a new culture [13]. This adjustment period for international students in the first-year of study could be facilitated or worsened by working in a team with domestic students.

Criterion-based team formation can improve student outcomes in teams [14], and in this work we are concerned with psychological safety. Psychological safety is a belief among team members about feeling safe for taking interpersonal risk and showing their ability without any fear about the consequence of their decisions [15], [16]. There is some evidence that psychological safety is a good predictor of team performance, cohesion, conflict, and satisfaction in engineering teams [17], [18], it also can be used to find problematic teams [19]. Psychological safety is commonly studied by management scholars and it has been shown to be related to a number of team outcomes [20]. If students do not feel psychological safe in a team, they will not ask for help when doing task, which will negatively affect their learning [21].

In this study we are going to investigate these research questions:

1. To what extent does gender composition in a first-year engineering team affect the psychological safety of the team members?
2. To what extent the does the international/domestic composition in a first-year engineering affect the psychological safety of the team members?

## **Methods**

For this study, we used one-way ANOVA to compare the average psychological safety of teams with different fractions of female students or international students. The analyses for answering our two research questions were conducted independently in this exploratory study.

## **Study Participants**

Study participants were students from a first-year engineering course in the spring semester and most students were in their first year of study (more than 91%). This data consist 1477 students worked on 409 teams. Among the participants 370 were females,1102 were males, and 5

students selected other or not prefer to answer. 1166 students were US-citizen and 311 were international. Also, 899 students were White, 338 Asian, 33 Black, 129 Hispanic, 1 Native American, and 48 “Other.” There were 29 students who declined to answer. We are focused at team-level effects rather than individual-level experiences, so we are not worried about intersectionality here, but rather the effect on the whole team experience. Race is not addressed in this study.

## Data/Variables

In this study, we used the average of psychological safety in teams as a dependent variable. This data was gathered by the CATME system. CATME is web-based tool helping instructors to form teams, collect peer evaluations, and ask survey questions about the experience of students in the teams [14], [22]. In this study, students answered the follow-up questions about the psychological safety after teamwork experience. Students responded to seven statements using a Likert-like seven-point scale to measure how they feel when working with their teams. The instrument was designed by Edmonson [21, p. 363] and was used without alteration: “if you make a mistake on this team, it is often held against you”, “members of this team are able to bring up problems and tough issues”, “people on this team sometimes reject others for being different”, “it is safe to take a risk on this team”, “it is difficult to ask other members of this team for help”, “no one on this team would deliberately act in a way that undermines my efforts” and “working with members of this team, my unique skills and talents are valued and utilized”. Some of these questions have reversed scales, so that a higher numerical response corresponds to lower psychological safety, so these scales are reversed before analysis. After calculating the psychological safety for each team member, we calculated the average psychological safety for each team as a dependent variable that is continuous and has values that can range from one to seven.

Our independent variables are team composition as the percentage of female team members for the first research question, and as the percentage of international team members for the second research question. In Table 1 and Table 2, we summarize the frequency of the observed values of these variables.

**Table 1.** Team frequency based on the percentage of female students

Team	Number	Percent of teams in this configuration (%)	Average psychological safety
No females	232	56.72	5.918
33.33% female	13	3.18	5.967
50% female	104	25.43	5.815
67.67% female	27	6.60	5.893
75% female	29	7.09	5.916
100% female	4	0.98	5.916
Total	409	100	5.891

**Table 2.** Team frequency based on the percentage of international students

Team	Number	Percent of teams in this configuration (%)	Average psychological safety
No international students	147	35.94	5.975
25% international students	152	37.16	5.876
33.33% international students	59	14.43	5.809
50% international students	36	8.80	5.789
66.67% international students	4	0.98	5.582
75% international students	9	2.20	5.944
100% international students	2	0.49	5.608
Total	409	100.00	5.891

## Results

We checked the assumptions for our analysis and conducted one-way ANOVA for both research questions. For the first research question, we conducted a one-way ANOVA to compare the percent of female students in teams and the average psychological safety in teams. There was no significant effect ( $F(5, 403) = 1.086, p = 0.367$ ).

For the second research question, we conducted another one-way ANOVA to compare the percent of international students in teams and the average psychological safety in teams. There was significant effect ( $F(6, 402) = 2.591, p = 0.018$ ). So, we ran post-hoc pairwise comparison and teams with no international students had significantly higher average psychological safety ( $M = 5.97, SD = 0.37$ ) than teams with 25% international students ( $M = 5.87, SD = 0.39$ ), teams with 33.33% international students ( $M = 5.81, SD = 0.40$ ), teams with 50% international students ( $M = 5.79, SD = 0.47$ ), and teams with 66.67% international students ( $M = 5.58, SD = 0.17$ ). Also, the effect sizes (Cohen's  $D$ ) are 0.26, 0.43, 0.44, and 1.44 respectively. The effect size between team with no international students and teams with 66.67% is very strong and more than one standard deviation.

## Discussion

We found no significant result relative to the percent of female students in a team and the team's average psychological safety. This is encouraging to the extent that it means that the practice of trying not to isolate female students with only male teammates as recommended by other research [24] has no negative effects on the average psychological safety of teams.

It is less clear how to form teams in courses that enroll domestic and international students. While it might seem best to avoid isolating international students for similar reasons, putting multiple international students on a team could result in a team deficit where communication is important and where the international students' native language is very different from English. If multiple international students within a team had native languages very different from English and different from each other, communication within the team would be almost certainly be troubled. If the international students shared a common native language that was very different

from English, the team would most likely divide into cliques by language. Our finding here adds to the discussion. Based on the summary in Table 2, it is clear that the criteria for team formation discouraged the formation of teams with multiple international students, which account for only 12.5% of team configurations. Teams with no international students had the highest psychological safety and as the percentage of international students increased, the team's average psychological safety significantly. To the extent that we might have anticipated that adding an isolated international student would result in a drop in psychological safety simply because the international student felt psychologically unsafe, we might also have anticipated that putting additional international students on a team to avoid that isolation would have improved things, but that is not the case. The decrease in psychological safety worsens until the percent of international students reaches 66.67 percent (and it is likely that the small number of teams with a larger fraction prevents statistical comparison). Thus, our finding also supports the practice in this course of trying to ensure that no team has more than one international student. This practice helps ensure that as many domestic students as possible have the experience of working in a multicultural team. Evidence suggests that the experience of both domestic students and their international teammates improves with repeated experience in multicultural teams [25]. Since this data is gathered in the second semester, the rift in psychological safety might be worse in their first semester when they are just beginning to adjust to the campus, higher education, and American culture and language. This result also highlights the importance of continuing to develop culturally relevant curriculum that connects with international students and improves the inclusiveness of the engineering classroom.

### **Conclusion, limitation, and future works**

In this study, we explored the relationship between percent of female and percent of international students and the team's average psychological safety. The data were collected from a second-semester first-year engineering course. The practice in the course studied is to avoid isolating women. We find that there is no significant decrease in the average psychological safety of teams as the fraction of women increases, so this practice does not harm this outcome at the team level. Regarding international students, the practice in the course studied is to avoid having more than one in a team. Our findings support this practice as well, showing tendency for the average psychological safety to decrease as international students are added to a team. This decrease has a large effect size. Whereas engineering instructors should always monitor team dynamics, these general practices are supported by our findings. Our results also highlight the importance in monitoring and facilitating the experience of international students, which also represents an important area for further study.

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