The Effect of Team Conflict on Teamwork Performance: An Engineering Education Perspective*

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Our study investigates the role of team conflict in the context of student design project work. Using data collected on 55 teams enrolled in a team-based engineering design program over three time periods, our results showed that the proportion of women and the existence of multiplex ties among team members have a positive influence on team performance, while the number of subgroups and team conflict were negatively related to team performance. Implications for team-based engineering programs are drawn.

Keywords: team conflict; teamwork; gender; multiplexity; engineering design; design teams

1. Introduction

Learning to work and perform in teams is essential for engineering graduates entering the work force. Educational institutions and accrediting boards have adjusted to this development by requiring and implementing teamwork experiences in the engineering curricula [1]. For example, the Accreditation Board for Engineering and Technology (ABET), has mandated engineering courses and programs to help students develop the ability to work in multidisciplinary teams (criterion d), and the ability to communicate effectively (criterion g).

As a result, scholarly work examining teamwork experiences in engineering (design) courses and programs has increased significantly over the years, with instructors focusing on a variety of professional learning outcomes and student team behaviors. In a systematic literature review of 104 articles pertaining to studies on engineering and computer science team projects between 2007 and 2012, Borrego et al. [2] identified a broad set of categories used by instructors. Categories included leadership [3], project and time management [4], global/cultural competence [5], as well as interdisciplinary and distributed teamwork [6]. Therefore, successful teamwork is contingent upon students' (individual and team) performance and growth in these different categories. Significant discrepancies between team members could lead to potentially self-reinforcing disagreements [7] that can further impact the team's overall performance. This is especially relevant in educational contexts, where students have to balance learning the course content (e.g., engineering design) with performing in a team, relying on little to no professional experience. Team conflicts also pose some challenges for instructors, who often have to teach complex class content and coach student teams at the same time [8].

Despite the importance of understanding the effects of team conflict on student learning outcomes, studies in engineering education remain scarce with a few exceptions [9–11]. In line with the International Journal of Engineering Education's call for papers on teamwork assessment in engineering education, our study examines the role of team conflict in the context of student design project work. Specifically, we are examining how a combination of team factors such as team conflict, communication frequency, multiplexity, number of subgroups, and gender composition affect team performance. Specifically, the formation of multiplex ties (e.g., friend and project partner) between different members of a team has been shown to have a significant effect on team effectiveness [12] and therefore deserves more attention. Furthermore, as the guest editors for the special issue pointed out, more work is needed to better understand what happens during the different stages of the learning activities and/or team development. To address this challenge, our data on freshman engineering design teams was collected over multiple time points to provide a more accurate picture of the temporal developments of these variables in our teams.

Our study makes two main contributions. First, we add to the current stream of research on team effectiveness [2] in the context of team-based engineering education, with a special emphasis on team conflict and its effects on teamwork performance. Second, we also contribute to the growing literature on how different compositional variables at the team level affect student team performance [13].

This paper is structured in the following way. We start with a brief theoretical discussion covering the

main strands of literature that we interlace in our paper: team-based (engineering) education, team conflict, and the effect of other team variables (referring to compositional and dynamic aspects), on team performance. Second, we will describe the methodology applied, report our key findings as well as their implications for theory and practice. The paper will close with a discussion of future research directions.

2. Related Literature

2.1 Team-Based Learning

The use of small groups for pedagogical purposes has become an integral part of every university's educational offerings. Small-group learning provide students with the opportunity to acquire critical skills in negotiation, conflict management, collective goal setting, collective information processing and synthesis, decision-making, and networking. Two different types of small-group learning exist: (1) cooperative and (2) collaborative. Cooperative learning is generally more structured and aims for students to work together interdependently towards a common goal as a team [14]. In contrast, participants of collaborative learning structures are more loosely connected in terms of time commitment and task interdependence [15].

One commonly used variation of cooperative learning is Team-Based Learning (TBL), which aims to foster and guide cooperative interactions among students to achieve a common set of goals as well as enhance their social and intellectual aptitudes in a classroom environment. In engineering education, TBL adds value by combining specific learning content such as engineering design with peer education, where students collectively develop their ability to go through the different stages of the design process such as needs assessment, solution development, prototyping, and others. Through TBL, students learn that successful teams do not depend exclusively on gifted individuals, but embrace the diversity of skills and abilities of all their members [16]. In order to make TBL successful in the classroom, several elements have to be built and maintained. Firstly, systems need to be in place in order for teams to be carefully formed and managed. Secondly, individual as well as team assignments have to be designed with the goal to promote learning and team development. Lastly, instructors need to provide timely and frequent feedback or provide a network of experts or advisors that can do so [17]. A common tool to achieve accountability and provide feedback on students' team performances are self- and peer-assessments, such as the Comprehensive Assessment of Team Member Effectiveness (CATME), that uses specific types of team member contributions clustered into five broad categories [18]. Peer assessments help team members clarify their expectations, which subsequently motivates individuals to perform, improve their team skills and develop self-reflection and -management skills [19].

2.2 Team Conflict

Broadly defined, conflict is "perceived incompatibilities or discrepant views among the parties involved" ([20], p. 189). Future engineers need to grasp that complex engineering problems require the ability to manage team conflicts so that they can coordinate efforts, reduce social loafing, and subsequently increase team output [21]. Therefore, collaboration exposes engineering students to team dynamics and the need to face disagreements resulting from different working styles, personalities, and various other professional configurations [22]. With respect to theoretical frameworks regarding team conflict, research in organizational behavior has provided some guidance. For example, team conflicts have been categorized as relationship, task, and process conflicts [23]. Relationship conflict occurs when "there are interpersonal incompatibilities among group members," such as "tension, animosity, and annoyance" ([23], p. 258). Task conflict entails disagreements about the content and outcomes of the task, and process conflict is a disagreement about the logistics involved in accomplishing the task, such as delegation and responsibilities [20].

Past research examining the influence of team conflict on performance has reported mixed results. Typically, studies have found a negative influence of relationship conflict on team performance For example, while the influence of relationship conflict on team performance is primarily negative [24], the influence of task and process conflict can be both negative and positive [25]. In engineering education, Purzer [26] examined the relationship between team discourse, self-efficacy, and individual achievement by triangulating verbal exchanges and self-efficacy surveys. She found that no direct correlation between support-oriented discourse and achievement and only a moderate positive correlation between post self-efficacy and the extent to which a student engaged in support-oriented discourse. Furthermore, Rebollar et al [27] developed the Teamwork Failure Prevention questionnaire to help instructors and teams to better manage their conflicts and prevent team project failure.

2.3 Team Characteristics: Communication Frequency, Subgroups, Gender, and Multiplexity

Teamwork requires frequent and constant inter-

action and coordination between members, especially in environments characterized by uncertainty, ambiguity and time pressure, such as the practice of engineering (design). Specifically, communication and sharing information between team members is very important to define roles and assign tasks between team members. Communication refers to "the vehicle through which personnel from multiple functional areas share information that is so critical to the successful implementation of projects" ([28], p. 201). When team members communicate frequently, that is, when team communication is higher, performance also increases [28]. Moreover, high levels of team communication facilitate access to information and resources, constant contact and interaction between team members, and as such leads to team cohesion [29]. There is a reciprocal relation between team cohesion and performance, in such a way that cohesion leads to better team performance, and performance is also positively related to team cohesion [30].

When team cohesion is weak and conflict starts to form, subgroups within the team can emerge and these can weaken team performance. A study on the effects of demographic diversity on team performance showed that factions based on demographic characteristics negatively affect performance and are disruptive [31]. Specifically, studies suggest that gender composition at the team level influences individual, team and organizational outcomes [32]. A meta-analysis on the effect of gender composition on team performance showed significant differences in performance at the group level, suggesting that mixed-gender groups outperform same-gender groups, although this relationship was not significant [33].

Lastly, the nature of the relationships established between team members is an important factor that needs to be considered. Team members establish ties or connections between themselves. These ties can be formed based on the relationship established when team members work together on a task (taskwork tie), and also when they create team relations beyond the accomplishment of a task (teamwork tie) [12]. According to the social network perspective, ties established between team members can assume different levels of strength (i.e., strong or weak ties) and forms. Particularly relevant for this study is the form of the tie, which can be instrumental and affective. When team members develop a tie with both a transactional and a social component [34], they end up forming a multiplex tie. Higher levels of multiplexity are related to greater coordination and trust between team members [12], and that has a positive impact on team performance.

3. Research Questions

To become both engineering experts and collaborative professionals, future engineers need to develop the ability to manage and utilize team conflicts. However, team conflicts influence and are influenced by other factors such as compositional features (e.g., gender) that can lead to role conflicts (e.g., men taking on technical roles and women taking on administrative roles). Similarly, the formation of multiplex ties can lead to a higher degree of subgroups within teams, which in turn can increase team conflict and negatively affect team performance. In summary, our study aims to examine the relationship between a set of variables that affect team performance: team conflict, number of subgroups, team communication frequency, gender composition, and multiplexity:

1. How does team communication frequency, team conflict, multiplexity, number of subgroups, and performance of student design teams change over time?
2. What are the effects of team conflict and team characteristics (i.e., gender composition, team communication, multiplexity, number of subgroups) on students' teamwork performance?

4. Methods

4.1 Participants

Data was collected from a first-year engineering design and communication (EDC) course at a mid-size private institution in the United States. EDC is a first year undergraduate design class spanning two quarters. It is a requirement for all incoming engineering students (approximately 400). EDC consists of several sections with each having about 16 students and two instructors (engineering and writing). In the first quarter, all four teams in a section work on the same project. The projects focus on universal design and come from the Rehabilitation Institute of Chicago. The course description and course objectives are shown in Table 1.

Since its inception ten years ago, EDC has been a team-based course grounded in situated learning, thus providing an ideal environment for motivating students to acquire the skills they will need later in actual practice [35]. We were particularly interested in first-year engineering students due to their lack of experience in both the engineering (design) and cooperative component, which gives us valuable insights into how engineers-in-training perform in teams and how the different team dynamics variables affect their collective performance. This decision was also driven by several pedagogical

Table 1

Engineering Design and Communication course description	Course objectives
Introduction to human-centered design. Required two-quarter course focused on teaching current design practices used in industry as well as the development of professional skills in sketching and brainstorming, creating engineering design drawings, writing technical reports, and prepare slides and posters for project fairs and public presentations.	• Study a problem from multiple perspectives. • Learn how to frame the design challenge properly. • Ideate, prototype, and iterate solutions. • Communicate their ideas clearly in design reviews, reports, and presentations. • Learn from the overall design process how to create value, prepare for their careers, and participate more fully in society.

concerns, including how to better manage teams and whether students show personal and professional growth with respect to teamwork in EDC.

4.2 Data Collection and Variable Measurement

Data was collected from 55 student teams in the Fall and Spring 2012 and 2013 courses of EDC. The teams consisted of 3–4 team members that were all engineering freshmen. Data sources included a peer evaluation and team conflict instrument, team process surveys and judge evaluations. **Team Performance** was measured through peer reviews as well as an end-of-the quarter evaluation of their design projects through a set of external judges as part of a design exhibition. To assess **peer performance** we asked students to assess themselves as well as all their team members on criteria referring to their own performance, such as how well each team member is committed to the team's overall goal, or steps up and shows initiative.

These criteria were answered on a scale with six points ranging from 1 (very low) to 6 (very high). Peer review data was collected from all 55 student teams that evaluated each member of their team for each one of the three time points, resulting in a sample of 165 at the end of the quarter. To assess the design of each team judges ranked them on six main criteria: (A) Implementation of the engineering design process; (B) Safety; (C) Adherence to customer needs; (D) Quality of support documentation; (E) Organization and appearance; and (F) Quality of team presentation. Judges rated each team on a six-point scale, from 1 (very low) to 6 (very high). The scores of each judge were averaged at the team level. For the 55 teams, we collected a total of 159 judge evaluations.

Gender Composition was measured by the percentage of women in the team, ranging from zero to 100% (1.00). **Team Communication Frequency** was measured in each time moment through the following question: "How often do you communicate with your team members every week?" referring to each member of the team. The individual student answers on this item were subsequently averaged at the team level, generating a score for the team communication frequency. To measure **team multiplexity** we asked student participants to "Describe the nature

of the relationship with each one of your team members for each team member" and coded the relationship with each one of their team members as (1) only professional or (2) professional and friendship (multiplex). We then calculated the percentage of multiplex ties. **Subgroups** within teams were determined by first creating a team network from the data collected on team communication frequency. The resulting network was subsequently analyzed and the number of statistically significant 'cliques' – defined as the maximum number of actors who have all possible ties present among themselves – was extracted using UCINET. **Team conflict** was assessed using Jehn's [23] 8-item Intragroup Conflict Scale, which asks participants to report on the amount of conflict they believe existed in their team on a 5-point Likert scale anchored by 1 (none) and 5 (a lot). Example of items are "How much tension was there among members of your group?" and "How often did people in your group disagree about opinions regarding the task being done?" The alpha reliability for team conflict was 0.83.

5. Results

5.1 Descriptive Statistics

Table 2 provides a summary of descriptive statistics for the sample. With respect to our independent variables, we found that on average, teams were composed of 29.5% women. Of the 55 teams, 23 were composed of all-male students, 7 of all-female students, 10 of an equal number of male and female students, 5 of a majority of female students, and 10 of a majority of male students. We also found that the share of multiplex ties increased over time, indicating that students formed both professional as well as affective relationships ($M_{MultiplexT1} = 33.1$; $M_{MultiplexT2} = 49.2$; $M_{MultiplexT3} = 63.4$). The data also suggests that team communication frequency between students increased over time, indicating that students participated more actively in their teams ($M_{TeamCommT1} = 3.18$; $M_{TeamCommT2} = 3.51$; $M_{TeamCommT3} = 4.2$). When examining the formation of sub groups within a team, we found that the number of subgroups increased with respect to the beginning of the course, but decreased from the midpoint (time 2) to the end of the class (time 3),

indicating that as students form more multiplex ties, the likelihood of cliques increases ($M_{SubgroupsT1}$ = 1.7; $M_{SubgroupsT2}$ = 1.9; $M_{SubgroupsT3}$ = 1.3). In addition, our results suggest that the level of team conflict was the lowest in the beginning of the program, increased the most on the middle of the program, and decreased slightly at the end of the program ($M_{TeamConflictT1}$ = 2.24; $M_{TeamConflictT2}$ = 3.09; $M_{TeamConflictT3}$ = 2.78). With respect to our dependent variable, we found that team performance increased over the three time periods ($M_{TperfT1}$ = 4.12; $M_{TperfT2}$ = 3.71; $M_{TperfT3}$ = 4.37), suggesting a positive learning trajectory on the program level.

5.2 Model Testing

To further examine the effects of gender composition, team communication frequency, team conflict, subgroups and team multiplex ties on team performance (judge and peer evaluations), we conducted a multilevel analysis. Our data set is comprised by a constant predictor over time (level-1 predictor – gender composition) and four predictors evaluated over three time points (T1, T2 and T3) (level-2 predictors – team communication frequency, subgroups, team conflict, and team multiplexity). We examined three different models, using the maximum likelihood estimation method, following the criteria suggested by Hox [36], namely the change in the -2log likelihood (-2LL) statistic; the level of significance of the coefficients; and the percentage of variance explained when new predictors are added to the model. First, we fitted an unconditional model, with no predictors (Model 1- M1). In the second model (Model 2- M2) the level-1 predictor, gender composition, was added to the model. In the third model (Model 3- M3) we added the level-2 predictors that are reported in three-time moments, team communication frequency, subgroups, team conflict, and team multiplexity. We performed these three models using team performance as a criteria variable (Table 3).

Table 2. Descriptive statistics of team data (N = 55)

Variables	Mean			Std. Dev.			Min.			Max.		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Dependent Variable Team performance[a]	4.12	3.71	4.37	0.65	0.68	0.72	2.3	1.9	2.6	4.9	4.4	5.3
Independent Variables Gender composition (in % of women)	29.5			17.7			0			100		
Team communication frequency	3.18	3.51	4.2	0.34	0.54	0.27	1.53	2.29	2.42	4.15	5.31	7.27
Subgroups within the team	1.7	1.9	1.3	0.22	0.37	0.31	1.1	1.4	1.5	2.2	2.5	2.2
Multiplex ties in a team (in %)	33.1	49.2	63.4	5.9	6.9	7.4	22	30	27	48	68	75
Team conflict	2.24	3.09	2.78	0.78	0.89	0.63	1.11	1.81	1.67	3.45	4.10	4.32

[a] Combined measure of judge and peer evaluations.

Table 3. Multilevel model predicting team performance based on gender composition, team conflict, subgroups, team multiplexity and team communication frequency

Predictor	M1 (uncond.)	M2	M3
Fixed Effects			
Intercept	6.12***	6.12***	6.12***
Gender Composition (% women in a team)		2.19*	2.72**
Team Conflict			−1.33*
Subgroups			−0.78*
Team Multiplexity			3.07**
Team Communication Frequency			0.89*
Variance Components			
Level-1	3.41**	2.57**	1.78**
Level-2	0.14	0.23	0.035
Goodness-of-fit			
-2LL	**344.778**	**337.11**	**302.82**
Deviance	–	7.668*	34.29**

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ Note: Team Level: N = 55; Time Level: N = 165.

The results of Model 2 suggest that gender composition is significantly and positively related to team performance ($\beta = 2.19$, $p < 0.05$). The change in the variance components from M1 to M2, shows that the inclusion of the gender composition predictor in the equation led to a significant reduction on the -2Log Likelihood statistic (Deviance = 7.668, $p < 0.01$). In M3 we added team communication frequency, subgroups, team multiplexity, and team conflict as predictors. The change in the -2LL was significant (Deviance = 34.29, $p < 0.01$) showing that adding these predictors to model increased the explained variance of team performance. The coefficient of team communication frequency in M3 was significant and positive ($\beta = 0.89$, $p < 0.05$). Furthermore, the existence of subgroups is negatively related to team performance ($\beta = -0.78$, $p < 0.05$), team multiplexity has a significant positive ($\beta = 3.07$, $p < 0.01$), and team conflict has a significant negative effect on team performance ($\beta = -1.33$, $p < 0.05$).

6. Discussion and Implications

In this paper, we set forth to investigate the effects of gender composition, team communication frequency, team multiplexity, team conflict and the formation of subgroups on team performance in a team-based engineering design course. The findings from our empirical analysis have implications for engineering education theory and practice in three principal areas, which we discuss in the following sections.

6.1 Team-Based Learning

Team-based learning is an essential component of engineering education. The ability to function and perform in teams is an important pedagogical outcome that deserves more attention. Our study adds to the growing body of literature in TBL, expanding existing models of how different measures of team dynamics such as team conflict affect student team performance. We found that an increasing level of team conflict negatively affects team performance, which is in line with previous studies [37]. Our results also suggest that the level of team conflict increased from the beginning of the course to its conclusion. The data on the number of subgroups formed within the team showed that their emergence is common within teams and that these cliques have a negative effect on team performance, confirming past studies on the topic [38]. This is an important issue that needs to be addressed by instructors and TBL scholars. High-performing teams require regular communication between all their individual members, and failure to do so can result in communication silos. Therefore, feedback

to student teams needs to include guidance on how to maintain a consistent and inclusive flow of communication. Lastly, we encourage the formation of multiplex ties between students, but it is also important to be cautious as to how they affect their teams' performance. The formation of too many multiplex ties can lead to more subgroups that in turn lead to lower performance. We therefore suggest that these questions should be considered for the next iteration of CATME, such that team members can report on who they communicate most frequently with.

6.2 The Effect of Team Conflict, Gender and Team Dynamics on Team Performance

In engineering education settings, conflicts often emerge when engaging in tasks with a high level of uncertainty, such as engineering design. Our results showed that team conflict can have a negative impact on team performance, supporting previous work in this area [22]. Particularly important, future research should analyze what type of conflict emerges and how that affect specific team outcomes that are relevant for engineering students. For example, prior research pointed towards a contingent relationship between task conflict and team creativity [26], which is important for design engineering. Thus, a more fine-grained analysis of team outcomes will be important to promote successful learning outcomes in engineering students.

We also examined the effects of gender composition and found that the number of female students in a team has a positive effect on the team's performance. This result is aligned with prior research. For example, teams that consist of mainly women tend to be more generous and equalitarian [39], decreasing the likelihood of unproductive team conflict and the emergence of subgroups. In addition, we also found that teams with a higher percentage of women communicate more frequently and have fewer subgroups or cliques, which might be related to lower levels of team conflict. Overall, our results are encouraging and empirically support past research [40] that has demonstrated the beneficial effects of more gender diverse teams on overall performance. We therefore think that future research streams need to pay more attention on gender composition and how instructors can encourage more gender-balanced teams.

Our results showed that multiplexity and the formation of subgroups can also impact team performance. Although we found that multiplexity was positively related to team performance, it is not unusual for students to form teams with their friends or previous cooperation partners. Although this approach seems intuitive for students, it can have detrimental effects such as an increase in free

riding, reduce idea generation and decrease project quality. Therefore, more research needs to reveal the possible link between social loafing [2] and the formation of multiplex ties.

7. Limitations

There are several limitations that need to be discussed. First, our measurement of team conflict was based on self-report surveys which come with some inherent constraints on information depth. We recognize that a large share of participants might not report conflict, but that does not necessarily mean that there is not any conflict present. The exact dynamics of what conflicts do on the positive and negative side for a team's performance and competencies [41], requires a more in-depth observational approach. Such an approach will help researchers better understand what interventions could be successful and how we can train students to overcome their biases and have more productive conflicts. Secondly, the implications of this study are limited to a specific educational setting. We encourage future research to explore the role of that team composition and dynamics play on the performance measures of engineering teams from a wide variety of engineering disciplines as well as seniority levels. Can we expect a significant change in conflict behaviors and strategies from more mature students? If yes, which processes within the engineering curriculum are most beneficial to develop students' conflict management expertise?

Overall, we make two contributions to the engineering education literature. First, we expand conceptual and empirical work on teamwork and conflict in engineering student teams. In doing so, we integrate recent work on team conflict [25] with teamwork in engineering education [42]. The successful development of team-based engineering (design) comes with many challenges such as recruitment of students, advisors and other stakeholders as well as finding the right balance between content and experiential learning. Our study can help decision makers to implement the necessary assessment tools and metrics to help manage and develop engineering (design) teams

8. Conclusions

This study suggests that conflicts between students are an important factor in determining their team's performance. Such conflicts can be a source of idea generation and refinement or lead to more factions and less coordination. Two compositional elements, the share of females on a team and the presence of multiplex ties, play a key role in the relationship between conflict and performance. As shown in past research on gender diversity in teams, female members can help coordinating tasks and provide a differing perspective that can help realign team priorities. The presence of multiplex ties can lead to an increase of trust, which in turn can accelerate the formation of constructive team processes. For these reasons, engineering educators need to implement a more varied approach in measuring student design teams, including metrics that represent different aspects of how team members form relationships with each other. However, further work needs to be conducted to explore what factors determine these relationships and how they affect team processes and performance. While work in the direction is more common in other fields, little has been done in team-based engineering design classes. Thus, future work has to further explore these issues conceptually and empirically.

References

1. National Science Board, *Science and engineering indicators 2018*, National Science Board, Arlington, VA, 2018.
2. M. Borrego, J. Karlin, L. D. McNair and K. Beddoes, Team effectiveness theory from industrial and organizational psychology applied to engineering student project teams: A research review, *Journal of Engineering Education*, **102**(4), pp. 472–512, 2013.
3. R. McQuade, E. Ventura-Medina, S. Wiggins and T. Anderson, Examining self-managed problem-based learning interactions in engineering education, *European Journal of Engineering Education*, pp. 1–17, 2019.
4. M. Eggermont, R. Brennan and T. Freiheit, Improving a Capstone Design Course through Mindmapping, *Advances in Engineering Education*, **2**(1), p. n1, 2010.
5. R. H. Mohtar and A. E. Dare, Global design team: A global service-learning experience, *International Journal of Engineering Education*, **28**(1), p. 169, 2012.
6. S. Sarker, M. Ahuja and S. Sarker, Work–life conflict of globally distributed software development personnel: An empirical investigation using border theory, *Information Systems Research*, **29**(1), pp. 103–126, 2018.
7. T. A. O'Neill, M. J. McLarnon, G. C. Hoffart, H. J. Woodley and N. J. Allen, The structure and function of team conflict state profiles, *Journal of Management*, **44**(2), pp. 811–836, 2018.
8. D. R. Bacon, K. A. Stewart and W. S. Silver, Republication of 'Lessons From the Best and Worst Student Team Experiences: How a Teacher Can Make the Difference,' *Journal of Management Education*, **43**(5), 2019.
9. X. Neumeyer and A. McKenna, Conflict Behavior and its Influence on Engineering Design Teams, in *2010 ASEE Annual Conference & Exposition*, Louisville, Kentucky, 2010.
10. E. Dringenberg and Ş. Purzer, Experiences of First-Year Engineering Students Working on Ill-Structured Problems in Teams, *Journal of Engineering Education*, **107**(3), pp. 442–467, 2018.

11. J. Baughman, L. Hassall and X. Xu, Comparison of student team dynamics between nonflipped and flipped versions of a large-enrollment sophomore design engineering course, *Journal of Engineering Education*, **108**(1), pp. 103–118, 2019.
12. E. R. Crawford and J. A. LePine, A configural theory of team processes: Accounting for the structure of taskwork and teamwork, *Academy of Management Review*, **38**(1), pp. 32–48, 2013.
13. J. A. Coller, M. P. Su and R. Fowler, Disagreement in Engineering Student Teams: Analyzing the Impact of Gender and Conversational Medium, in *2018 ASEE Annual Conference & Exposition*, Salt Lake City, Utah, 2018.
14. M. J. Van Ryzin and C. J. Roseth, Cooperative learning in middle school: A means to improve peer relations and reduce victimization, bullying, and related outcomes, *Journal of Educational Psychology*, 2018.
15. R. G. Qiu, A systemic approach to leveraging student engagement in collaborative learning to improve online engineering education, *International Journal of Technology Enhanced Learning*, **11**(1), pp. 1–19, 2019.
16. R. van Veelen and E. G. Ufkes, Teaming Up or Down? A Multisource Study on the Role of Team Identification and Learning in the Team Diversity–Performance Link, *Group & Organization Management*, **44**(1), pp. 38–71, 2019.
17. L. K. Michaelsen, A. B. Knight and L. D. Fink, *Team-based learning: A transformative use of small groups*. Praeger Publishers, 2002.
18. B. Beigpourian, D. M. Ferguson, F. C. Berry, M. W. Ohland and S. Wei, Using CATME to document and improve the effectiveness of teamwork in capstone courses, in *2019 ASEE Annual Conference and Exposition Proceedings*, 2019.
19. L.-H. Hsia, I. Huang and G.-J. Hwang, Effects of different online peer-feedback approaches on students' performance skills, motivation and self-efficacy in a dance course, *Computers & Education*, **96**, pp. 55–71, 2016.
20. K. A. Jehn and C. Bendersky, Intragroup conflict in organizations: A contingency perspective on the conflict-outcome relationship, *Research in organizational behavior*, **25**, pp. 187–242, 2003.
21. B. Meyer, C. C. Schermuly and S. Kauffeld, That's not my place: The interacting effects of faultlines, subgroup size, and social competence on social loafing behaviour in work groups, *European Journal of Work and Organizational Psychology*, **25**(1), pp. 31–49, 2016.
22. X. Neumeyer and A. F. McKenna, Engineering students' perceptions of team conflict and high–performance teams, *International Journal of Collaborative Engineering*, **1**(3), pp. 274–297, 2014.
23. K. A. Jehn, A multimethod examination of the benefits and detriments of intragroup conflict, *Administrative science quarterly*, pp. 256–282, 1995.
24. C. E. Thiel, J. Harvey, S. Courtright and B. Bradley, What doesn't kill you makes you stronger: How teams rebound from early-stage relationship conflict, *Journal of Management*, **45**(4), pp. 1623–1659, 2019.
25. T. A. O'Neill and M. J. McLarnon, Optimizing team conflict dynamics for high performance teamwork, *Human Resource Management Review*, **28**(4), pp. 378–394, 2018.
26. S. Purzer, The Relationship Between Team Discourse, Self-Efficacy, and Individual Achievement: A Sequential Mixed-Methods Study, *Journal of Engineering Education*, **100**(4), pp. 655–679, 2011.
27. R. Rebollar, I. Lidon, J. L. Cano, F. Gimeno and P. Qvist, A tool for preventing teamwork failure: The TFP questionnaire, *International Journal of Engineering Education*, **26**(4), pp. 784–794, 2010.
28. M. B. Pinto and J. K. Pinto, Project team communication and cross-functional cooperation in new program development, *Journal of Product Innovation Management: An International Publication of the Product Development & Management Association*, **7**(3), pp. 200–212, 1990.
29. A. G. Tekleab, A. Karaca, N. R. Quigley and E. W. Tsang, Re-examining the functional diversity–performance relationship: The roles of behavioral integration, team cohesion, and team learning, *Journal of Business Research*, **69**(9), pp. 3500–3507, 2016.
30. J. E. Mathieu, M. R. Kukenberger, L. D'Innocenzo and G. Reilly, Modeling reciprocal team cohesion–performance relationships, as impacted by shared leadership and members' competence, *Journal of Applied Psychology*, **100**(3), pp. 713–734, 2015.
31. D. B. Veltrop, N. Hermes, J. B. M. Postma and J. De Haan, A tale of two factions: Why and when factional demographic faultlines hurt board performance, *Corporate Governance: An International Review*, **23**(2), pp. 145–160, 2015.
32. H. Song, M. Restivo, A. van de Rijt, L. Scarlatos, D. Tonjes and A. Orlov, The hidden gender effect in online collaboration: an experimental study of team performance under anonymity, *Computers in Human Behavior*, **50**, pp. 274–282, 2015.
33. W. Wood, Meta-analytic review of sex differences in group performance, *Psychological Bulletin*, **102**(1), p. 53, 1987.
34. S. Ferriani, F. Fonti and R. Corrado, The social and economic bases of network multiplexity: Exploring the emergence of multiplex ties, *Strategic Organization*, **11**(1), pp. 7–34, 2013.
35. J. E. Colgate, A. McKenna and B. Ankenman, IDEA: implementing design throughout the curriculum at Northwestern, *International Journal of Engineering Education*, **20**(3), pp. 405–411, 2004.
36. C. J. M. Maas and J. J. Hox, Sufficient sample sizes for multilevel modeling, *Methodology*, **1**(3), pp. 86–92, 2005.
37. J. S. Karn and A. J. Cowling, Measuring the effect of conflict on software engineering teams, *Behavior Research Methods*, **40**(2), pp. 582–589, 2008.
38. R. Marion, J. Christiansen, H. W. Klar, C. Schreiber and M. A. Erdener, Informal leadership, interaction, cliques and productive capacity in organizations: A collectivist analysis, *The Leadership Quarterly*, **27**(2), pp. 242–260, 2016.
39. M. Dufwenberg and A. Muren, Gender composition in teams, *Journal of Economic Behavior & Organization*, **61**(1), pp. 50–54, 2006.
40. X. Neumeyer and S. C. Santos, A lot of different flowers make a bouquet: The effect of gender composition on technology-based entrepreneurial student teams, *International Entrepreneurship and Management Journal*, pp. 1–22, 2019.
41. S. C. Santos, M. H. Morris, A. Caetano, S. F. Costa and X. Neumeyer, Team entrepreneurial competence: multilevel effects on individual cognitive strategies, *International Journal of Entrepreneurial Behavior & Research*, 2019.
42. C. R. Zafft, S. G. Adams and G. S. Matkin, Measuring leadership in self-managed teams using the competing values framework, *Journal of Engineering Education*, **98**(3), pp. 273–282, 2009.

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