SELF-AWARENESS AND EMPATHY AS TOOLS TO MITIGATE CONFLICT, PROMOTE WELLNESS, AND ENHANCE PERFORMANCE IN A THIRD-YEAR ENGINEERING DESIGN COURSE

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Abstract – Historically, students in engineering design courses learn how to resolve conflict almost exclusively through experience and with varying degrees of success, which can have ramifications on student wellness and performance [1]. Instructors can intervene by scaffolding conflict resolution, but since they are often made aware only when team conflict becomes unmanageable, proactive strategies are needed. Several strategies were implemented in a new third-year course to enhance students’ self-awareness and empathy for others when working in teams. These included personality and conflict style exercises, the generation of an approachability statement, and the reflective monitoring of team dynamics using ITP metrics’ assessments during the term [2]. Surveys gauged student satisfaction with teamwork, the frequency of team conflict, and preparedness for resolving conflicts. Overall, students felt better prepared to handle future conflict as a result of the course. However, additional accountability measures may enhance the perceived value of the interventions used.

Keywords: Self-awareness, conflict management, teamwork, peer evaluation

1. INTRODUCTION/BACKGROUND

1.1. Motivation

In the School of Biomedical Engineering’s (SBME) undergraduate program at the University of British Columbia (UBC), students specialize in one of four streams in their third year. In the design of a new third-year engineering design course in the SBME, students were directed to work throughout the term within instructor-assigned teams, with each team populated by members from all technical streams. The goal of creating diverse teams is to prepare students to work effectively in group settings and to utilize the unique skills of all group members. However, students have shown less enthusiasm working in instructor-assigned groups compared to self-assigned groups, based on results from our initial course survey.

The third-year design course was designed based on the belief that student impressions of, and comfort with group work are shaped by their prior adaptive and maladaptive experiences with conflict. Instructors of engineering design courses have historically struggled to adequately prepare students to deal with group conflict, often resorting to a brief lesson on Tuckman’s stages of group development (forming, storming, norming, and performing) [3,4] and/or by mentioning to students that they will learn how to resolve conflict through experience. Although well-intentioned and meritorious, this strategy places the burden of conflict resolution on under-prepared students. Poorly resolved or unresolved conflict can lead to unproductive stress, which can have ramifications on student wellness and performance [1]. A skilled instructor can intervene by scaffolding conflict resolution, but this can be ineffective because: 1) instructors are often made aware only when team conflict becomes unmanageable, and 2) intervention can remove a valuable learning opportunity and reduce students’ preparedness for future conflict. Therefore, we sought to implement a strategy to empower students to proactively face group conflict in order to curb potential conflict mismanagement.

In addition to conflict management, self-awareness is a desirable competency for project management. This is evident in organizational management, where high performing managers rated themselves almost identically to how their employees rated them [5]. Additionally, self and peer assessments have been argued to be fundamental to all aspects of learning since they help develop a reflective practice that promotes self-directed study, lifelong learning and transferable personal and group-work
skills [6]. Extending what is learned about the self to others in order to build empathy is a desirable practice in any industry since empathetic leaders are known to be highly effective. Such studies and theories influenced the development of tools to promote self-awareness in teams. Therefore, we hypothesized that better scaffolding of team dynamics through the promotion of self-awareness and empathy could promote more adaptive ways of dealing with conflict, which could also enhance student wellness and impressions of group work. Moreover, these strategies are in alignment with the Canadian Engineering Accreditation Board (CEAB) graduate attribute related to the development of individuals and teams.

1.2. Solutions considered

There are a number of self, team and peer assessments that have been developed over the last decade that attempt to monitor the status of team dynamics and team member effectiveness. Two notable integrated assessments that have been used in engineering design courses are the comprehensive assessment of team member effectiveness (CATME) tool [7] and the suite of assessments developed by the Individual and Team Performance Metrics Lab (ITP metrics) [8]. Recently, these assessments (ITP metrics and CATME) were directly compared by Jamieson and Shaw in terms of their effectiveness in introductory and capstone engineering design courses [9]. Peer assessment in ITP metrics is based on comparative ratings, whereas CATME is a modified behaviourally anchored rating scale (BARS) with some comparative rating [9]. As mentioned by Jamieson and Shaw, and evidenced by Goffin and Olson, comparative evaluation is preferred in terms of rating structure and framework because it contains a clear reference group and aligns best with natural human tendencies of comparison [9,10]. BARS is a more arbitrary rating scale since assigning a numbered rank of behaviour without comparative context is less meaningful. Recently, Zhu and colleagues implemented the CARE model from ITP metrics in a first-year engineering course and saw an improvement in performance in fact-driven conflict, coordination, and contribution equity, compared to a control cohort [11].

In addition to valuable assessments of individuals and peers, a more proactive approach to team conflict may start with the sharing of team member reflections on past responses to conflict. Although individuals can work to change their baseline responses to confrontation and handling of difficult situations, knowledge of individual team members’ default responses could help mitigate potential misunderstandings. Such a document was termed an approachability statement, which was developed in the Centre for Student Involvement & Careers (CSI&C) at UBC.

1.3. Selected methodologies

ITP metrics was chosen as the desired team and peer assessment tool to be used for the bulk of the team dynamic scaffolding for the course due to the additional benefits it provides over CATME. ITP metrics also provides reflective surveys for students to gain awareness on their personality type and their conflict management style. Additionally, students were required to produce an approachability statement - a reflective statement which outlines how an individual would prefer to be approached in situations of conflict.

1.4. Significance of results

Our study addressed the importance of providing students with appropriate tools to assess team health and to tackle project and conflict management, all of which had a strong emphasis on self-awareness, throughout an engineering design course. More importantly, it highlighted the effect of these strategies on students’ ability and sense of preparedness for handling group conflict.

2. METHODS

Biomedical Engineering Design II (BMEG 357), a third-year engineering design course in the SBME at UBC, takes an advanced progression through the engineering design process. Students were assigned to groups to work on a real client-centred design project throughout the term. Groups were assigned by instructors to include representatives from all four technical streams of the undergraduate program: 1) cellular bioengineering, 2) bioinformatics, 3) biomechanics and biomaterials, and 4) biomedical systems and signals. Although students are guided through the design process in the course, there is a greater emphasis on team independence and reliance on healthy group function that utilizes the strengths of the diverse membership in Biomedical Engineering Design II compared to Biomedical Engineering Design I (where students had not yet specialized into their stream).

Several strategies were implemented in BMEG 357 to enhance students’ self-awareness and empathy for others when working in design teams. At the beginning of the course, students were taught about different personality types and conflict management styles using materials supplied by ITP metrics [2]. The personality and conflict management style surveys include a series of reflective questions intended to illuminate a person’s unique approach to interacting with others. These activities also helped students develop personal approachability statements - documents which describe how an individual prefers to be approached in conflict. The approachability statement guidelines were adapted from an internal document developed and utilized in the Centre for Student Involvement & Careers at UBC. Although the approachability statements were a self-reflective exercise,
students were required to share their approachability statements with their teammates to help in building empathy for their group members. Following the development of approachability statements, students worked collectively to build a written group contract, outlining explicit team rules and how those rules would be enforced. Both the approachability statement and team contract were intended to be used to help facilitate the team’s future conflict management strategy. Throughout the course, at three different checkpoints, the “health” of each design team was tracked using the CARE model in ITP metrics, which measures four important dimensions related to team function: Communication, Adaptability, Relationships and Education [8]. Teaching assistants monitored and evaluated group function during weekly mentorship meetings, managing the ITP metrics tools and ensuring that their use was adhered to and that the tools added value to the process. It was important to include both team and peer assessments so that all members took ownership of their role in the function or dysfunction of the team as a whole, while having a mechanism to provide direct, anonymized feedback to their peers. Peer assessment in ITP metrics comes with self-assessment and it was used to score student impressions of their group members in comparison to themselves on five key aspects: 1) contribution, 2) communication, 3) foundational knowledge, skills, and abilities, 4) encouraging high performance, 5) keeping the team on track. Peer assessment occurred twice in the term, once at the midpoint and again at the end of the term.

To evaluate the efficacy of our strategies, a survey was administered to incoming students at the start of the course to gauge prior impressions of design team work. The data from the survey was intended to serve as a baseline for the study. Survey questions (found in the Appendix) focused on students’ level of satisfaction with group work, the frequency of team conflicts encountered, their sense of preparation for resolving conflicts, and strategies previously implemented to deal with challenges. At the end of the course, students completed a survey similar to that administered at the start of the course. Additional questions were included to gauge whether strategies implemented in the course were effective and overall student impression of the value of these tools.

3. RESULTS

Results from the initial and final surveys in the course indicate that third-year biomedical engineering students appreciate the value of group work (Figure 1). Prior to the start of the course, of the 42 responses to the survey statement “Group work is valuable”, 76% of students (32 students) strongly agree, and 21% (9 students) somewhat agree. Student perception of the value of group work after completing the course was similar to that before the course.

Of the 23 responses in the final survey, 70% of students (16 students) strongly agree, and 17% (4 students) somewhat agree. No students indicated that they somewhat disagree or strongly disagree with the statement that “Group work is valuable”.

Preliminary analyses of qualitative responses from the initial survey suggest that there are four common reasons for students’ perceived value of group work. These broad categories are: 1) group work is reflective of the nature of the engineering profession, 2) group work is important to developing communication and interpersonal skills, 3) group work is important for personal growth and learning, and 4) group work improves work efficiency and quality of work produced. Select examples of students’ written responses corresponding to each category are summarized in Table 1 below.

Table 1. Examples of qualitative student responses related to each of the four main reasons for their perceived value of group work.

| Reason for perceived value of group work | Select example of student responses |
|-----------------------------------------|-----------------------------------|
| Reflective of the nature of the engineering profession | “Group work is very important to the profession of engineering since most projects are done in groups” |
| Important for developing communication and interpersonal skills | “…vital for developing communication skills…” |
| Important for personal growth and learning | “Group work allows individuals to improve upon their interpersonal and personal skills…” |
| Important to personal growth and learning | “I think group work is where I grow more than just in the academic sense…” |

Figure 1. Student perception of the value of group work in undergraduate courses.
“...it promotes healthy and open conversations between people of differing backgrounds...”

Improves work efficiency and quality of work produced

“...the more people you have working on something the more ideas you get and you’re more likely to get the best possible solution”

“Working together allows for the completion of more difficult and or complex tasks...”

In addition, initial survey results show that 79% of students (33 of 42 responses) encountered 1-3 conflicts in group projects throughout their undergraduate program. Few students never encountered group conflicts (7%), and about 14% of students dealt with 4 or more group conflicts (Figure 2a). A similar pattern was observed from student responses in the post-course survey, with 70% of students (16 of 23 responses) having encountered 1-3 conflicts in group projects, and 26% of students (6 of 23 responses) never having encountered team conflict. Based on the initial survey, most students indicate that 75-100% of these conflicts were resolved rather than avoided (Figure 2b). After completing the course, an even greater proportion of students reported that 75-100% of team conflicts were resolved (83% of responses in the final survey, compared to 55% in the initial survey).

![Figure 2. Number of group conflicts encountered (a) and percentage of conflicts resolved (b).](image)

Table 2. Examples of qualitative student responses related to each of the three main strategies used for resolving group conflict.

| Strategy used for resolving group conflict | Select examples of student responses |
|-------------------------------------------|-------------------------------------|
| Communication and compromise with the group | “Listening to everyone’s side of the story and working to compromise with everyone without harming the integrity of the group/project” |
| Intervention from teaching assistant or course instructor | “Typically intervention from the teaching staff” |
| Immediacy of handling the conflict | “Address the conflict right away” |

Initial survey results show that the majority of students (76%, 32 of 42 responses) feel “somewhat prepared”, “neither prepared or unprepared” or “somewhat unprepared” for resolving conflict in a group. Of these numbers, most students (57%, 24 of 42 responses) associate with being “somewhat prepared” (Figure 3). The final survey results show that after completing the course, an even greater proportion of students (43%, 10 of 23 responses) feel “very prepared” to resolve conflict in a group, compared to results from the initial survey.
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This is consistent with students’ response to the final survey question “I feel better prepared to resolve conflict in a group moving forward based off of my experience this term” (Figure 4). Of 23 student responses, 30% strongly agree (7 of 23 responses) and 43% somewhat agree (10 of 23 responses).

Regarding students’ perception of the usefulness of the ITP metrics tool, the majority of students answered favorably (Figure 5). In response to the final survey question “I found the ITP metrics assessments useful”, 48% somewhat agreed (11 of 23 responses), while 9% strongly agreed (2 of 23 responses).

Unfortunately, most students did not find the approachability statement useful, with a majority of students answering neutrally (neither agree nor disagree) or negatively (somewhat or strongly disagree) to the question “I found the approachability statement useful” (Figure 6).

A final component of the surveys involved gauging self-awareness by probing the frequency of student reflection on their emotions and behaviors and whether they often feel misunderstood in conflict. Results (shown in Figure 7) suggest that third-year biomedical engineering students are reflective of both their emotions and behavior and that this high level of reflection remained consistent at the end of the course.
Figure 7. Student responses to the survey questions “I often reflect on my emotions” (top) and “I often reflect on my behaviors” (bottom).

In response to the statement “When in conflict with someone, I often feel misunderstood”, (shown in Figure 8) 38% and 30% of students answered favourably (either somewhat or strongly agree) in the initial and final surveys, respectively. This demonstrates some positive movement towards feelings of being understood during the course.

Figure 8. Student responses to the survey question “When in conflict with someone, I often feel misunderstood”.

4. DISCUSSION

One important result that arose from student responses in both the initial and final course surveys was their overwhelming recognition of the value of group work in their academic program. The most commonly mentioned justification is that group work is essential to the nature of their future profession. Additionally, students recognize that working in teams can improve work efficiency and the quality of work produced, particularly when solving complex problems. Students’ appreciation of the value of group work is, in fact, aligned with instructor goals and suggests that students may be intrinsically motivated for various reasons to improve their ability to resolve group conflict.

The vast majority of our third-year biomedical engineering students entering the course encountered few group conflicts (1-3 times) throughout their academic program, and reported that most of these conflicts (75-100%) were eventually resolved instead of avoided. Still, students expressed some level of discomfort when working with instructor-assigned groups versus self-assigned groups (results not shown). This is consistent with students’ rating of their overall level of preparedness in handling group conflict. Although 24% of students associate themselves with being “very prepared”, the remaining students feel moderately prepared at most. After completing the academic term, an even greater proportion of students perceived themselves to be “very prepared” to handle group conflict. This may be due, in part, to the use of the ITP metrics assessments. According to the final survey question regarding the usefulness of the ITP metrics assessments, the majority of students found the tool either “somewhat useful” or “very useful”. However, from our study we cannot decouple the value added by advancement in an engineering program (and new group experience)
from the implementation of self and team awareness strategies when investigating student preparedness to handle conflict. Investigation of the true effectiveness of our strategies necessitates longer-term studies with multiple cohorts of students. Another limitation is the fact that student surveys were completed anonymously and voluntarily. Although we achieved a response rate of 46% for the final survey, it is difficult to decipher whether we have representation of the full spectrum of potential respondents in the class. As part of the final course survey, students were given the opportunity to elaborate on their perception of the usefulness of the ITP metrics assessment tool. Negative student comments (data not shown) were primarily related to the length and time-involvement of completing the assessment, as well as the lack of motivation for team members to review assessments after they were complete. As with many courses that involve group assignments, frustration with a lack of accountability of team members was noted by some students.

In the qualitative descriptions of strategies employed to handle group conflict from the initial survey, students most commonly described the importance of effective communication to reach a compromise within the group. However, few student responses gave concrete examples and/or tools used to communicate effectively in the group. A smaller percentage of qualitative responses also mentioned the importance of handling conflict immediately, as opposed to allowing the conflict to worsen with time.

The survey questions used to gauge self-reflection show that the majority of students often reflect on their emotions and behaviours. Since most students entered the course with some degree of self-reported reflective practice, which was promising, it was important to consider where students may have blind spots and how self-awareness may impact conflict management or performance. A modest decrease in the percentage of students feeling misunderstood may indicate better awareness, empathy, and communication between students during the term. Reducing misunderstandings should have a positive effect on increasing the number of conflicts that are resolved, which we observed, although this was correlational. ITP metrics gives us some ability to assess differences in student performance with an “adjustment factor” - a calculation of the participant average divided by the group average assigned across the five key performance areas. Students that had an adjustment factor of 0.9 or less were identified as “underperformers” relative to their peers (5 out of 50 students in the class fit in this category). We investigated the discrepancy between adjustment factors that did or did not incorporate self-assessment in the calculation. Interestingly, all of the underperformers overestimated their performance compared to their peer assessments, potentially showing a deficiency in their self-awareness and/or a desire to inflate their contribution to avoid any perceived grade penalty. In future work it would be interesting to target these underperformers and implement strategies that could enhance their self-awareness and accountability to their team.

The approachability statement exercise was intended to act as a resource for students to utilize when approaching others in their team - particularly in instances of conflict. Unfortunately, students did not find the statement useful. However, many noted that they did not refer to the statement, but perhaps could have done so and that it may have aided in conflict resolution. In future iterations of the course, scaffolding a formal return to, or revision of, the approachability statement may be a valuable strategy that would enhance its utility for students.

These results indicate that introducing a formal tool like ITP metrics in a third-year design course can help students monitor team health and facilitate a response to group conflict in a timely and proactive manner. Although this tool can equip students to identify and discuss concrete aspects related to team health, additional consideration must be given to how students will value the time spent on these proactive strategies. Introducing more accountability measures to ensure that these positive strategies are applied more consistently among students in the class may further improve student preparation for conflict by reinforcing the proactive behaviour.

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7. **APPENDIX**

Introductory survey questions

1. How comfortable are you with group work?

|     | extremely uncomfortable | somewhat uncomfortable | neither comfortable nor uncomfortable | somewhat comfortable | extremely comfortable |
|-----|-------------------------|------------------------|----------------------------------------|-----------------------|----------------------|

2. How comfortable are you with group work when you can’t choose your own group mates?

|     | extremely uncomfortable | somewhat uncomfortable | neither comfortable nor uncomfortable | somewhat comfortable | extremely comfortable |
|-----|-------------------------|------------------------|----------------------------------------|-----------------------|----------------------|

3. What influences your comfort in a group setting?

Open field

4. How frequently have you encountered conflict in group projects?

|               | Never 1-3 times | 4-6 times | 7-9 times | more than 10 times |
|---------------|-----------------|-----------|-----------|--------------------|

5. Of your encounters with group conflict, what percentage of these conflicts were resolved (vs. avoided)?

|               | 0 %  | < 25% | 25-50% | 50-75% | 75-100% |
|---------------|------|-------|--------|--------|---------|

6. How prepared do you feel to resolve conflict in a group?

|               | very unprepared | somewhat unprepared | neither prepared nor unprepared | somewhat prepared | Very prepared |
|---------------|-----------------|--------------------|--------------------------------|------------------|---------------|

7. What strategies have you used to resolve conflict in group work?

Open field

8. I often reflect on my emotions.

|     | strongly disagree | disagree | neither agree or disagree | agree | strongly agree |
|-----|-------------------|----------|---------------------------|-------|----------------|

9. I often reflect on my behaviours.

|     | strongly disagree | disagree | neither agree or disagree | agree | strongly agree |
|-----|-------------------|----------|---------------------------|-------|----------------|

10. When in conflict with someone, I often feel misunderstood.

|     | strongly disagree | disagree | neither agree or disagree | agree | strongly agree |
|-----|-------------------|----------|---------------------------|-------|----------------|

11. Group work is valuable.

|     | strongly disagree | disagree | neither agree or disagree | agree | strongly agree |
|-----|-------------------|----------|---------------------------|-------|----------------|

12. Please elaborate on your response to “Group work is valuable”

Open field