

Impact of Team Formation Methodology on Team's Conflict and Effectiveness

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Abstract

Typically engineering experiments are done in teams to allow students to expand their skill sets and be well versed in team dynamics. Students may be facing an overwhelming challenge to their learning and them attaining the course outcomes. This is particularly impacted by the team dynamics. One suggested answer to this pedagogical dilemma is for educators to have a clear idea on how to form teams that are more effective.

This research addresses the following questions: What team formation method(s) has proven to be successful? Can identifying student learning styles be an effective means of forming balanced teams? This study investigated various methods typically used by educators to form teams. Examples of these would be random, self-selection, GPA, learning skills, and hybrids of these.

During the first year of this study, the students reported on their team dynamics through a weekly survey that was designed to capture two metrics; team conflict and overall team effectiveness. This was conducted in a Materials and Manufacturing in Design Laboratory course. The turnout in these surveys over five weeks since the start has been almost consistent (70% during the first week to 61% by the end of fourth week).

Initial phase of the study showed that there are considerable teams having issues. It also showed that there were few times where teams were either very ineffective or very conflict ridden. These teams can be identified, and their performance assessed and compared to other teams for a better understanding.

Preliminary results show a clear distinction between various team forming methodologies. They clearly demonstrate that not all of these methodologies are equal. This will potentially help in selecting and fine tuning the better methodology based on the course outcomes.

Data from more recent runs of the course were collected. Some changes were introduced to the course to minimize the effort requested from students. The weekly surveys were dropped and were exchanged for one peer evaluation exercise that reflected the conflicted teams. A conflict that is managed well may not need to be addressed and was phased out by the teams towards the end of the semester.

Persisting conflicts continued until the end of semester peer evaluations. Teams in the course have 30% of their grades submitted as a group. The team performance is measured by the outcome of all the team's group submissions. Analyzing these two dimensions, namely conflict and effectiveness, would help us better understand which team formation methodology is the most effective. Some methods will more likely produce effective teams but not necessarily less conflicted. Other methods show less conflicted teams that are also less effective. The selection of the methodology will affect these two dimensions, but it is up to the instructor to choose the one more suitable for the student demographics and course goals.

Introduction

Collaborative learning is an active learning technique that is an integral part of preparing students for future careers which involves two or more individuals exchanging knowledge and experiences to collectively learn something¹. Collaborative learning courses centered around the use of small project groups have shown to be widely successful in enabling students to achieve higher academic achievement, improved critical thinking skills, and developing greater teamwork and communication skills². Although, these benefits are entirely dependent upon students collaborating well with one another and being a part of a functional team³. Therefore, conflict resolution has significant implications to a team's effectiveness⁴. This study proposes that teaming method could have an impact on team dynamics.

The range of grouping approaches is vast, especially when considering combinations of one another, and it is unclear which strategies may surpass others regarding facilitating teamwork. Moreover, the issue of optimizing student assignment into groups is exponential with student count⁵. The most common team formation methods used by educators can be grouped into three categories: a) student-selected teams; b) instructor-selected teams either by randomization or based on pre-determined conditions, e.g., GPA, learning styles, personality type, major, year classification; and c) hybrid selection of the mentioned approaches^{6, 7, 8, 9}.

Student-selected teams allow students the freedom to choose their own team members. One downside for student-selected teams, however, is that it may lead to students not being selected, requiring the instructor to intervene and assign them to a group which may contribute negatively to team dynamics⁹. However, instructor-selected teams may lead to more diverse groups, allowing for varying levels of academic experience, cultural background, interpersonal skills, and skillsets. Although, aside from the randomization method, instructor-selected teams would require prior knowledge to execute the method appropriately, and sometimes this data may be difficult to obtain, unavailable, or time intensive to acquire¹⁰. In contrast, hybrid teams try to combine the advantages of two or more grouping methods.

Much is known about the need for certain skill sets and adeptness within a team, yet there remains a lack of research in identifying the best strategy/method for group formation - ensuring a high-performance outcome and group efficacy¹¹. Based on a comprehensive review study of eleven journal papers, random selection has not outperformed any methods across all studies¹². Several researchers have advocated for the use of instructor-selected teams for its role in boosting team functionality,

however, there are additional methods that have proven its ability to provide effective student teams, namely, hybrid selected methods ¹³. There are limited journal papers that have been published since the late 1970's. All reviewed publications have one of three shortcomings: short-term study, inconsistent methodologies, or a small sample size.

Due to the availability of a large student sample, as well as a consistently available course (offered in Fall & Spring), there is exciting potential for the implementation of a long-term research study with a concentrated topic. The most common strategies/methods will be tested, with the addition of under-researched methods that have shown promise for success in past research (i.e., hybrid methods). A sample size of over 250 students across 15 concurrent sections, enrolled in a required junior-level engineering lab course, participated in this study during the Fall 2019. Multiple runs were done during the following Fall and Spring semesters of 2020, 2021 and 2022. The latest post-COVID run was during the Spring of 2022 with 350 students, where other hybrid options were adopted. The results of the latest run will be omitted from this paper and are being considered for another publication. The methods tested in this study are presented in Table 1. These include, 1) Student self-selection; 2) Instructor selection based on GPA; 3) Instructor selection based on randomization; 4) Hybrid: Instructor selection (Random) and student self-selection; and 5) Student self-selection. This research seeks to assess the impact of the aforementioned team formation methods on two performance metrics, namely, conflict management and team effectiveness.

Table 1. Team formation methodologies and their associate sections including number of students.

Teaming Method	Sections with (number of students)
1. Skills	3, 4, and 5 (48)
2. GPA	10, 14, and 15 (43)
3. Random	7, 8, and 16 (42)
4. Hybrid (self-select & random)	1, 11, and 12 (48)
5. Self-Selection	2, 6, and 9 (48)

Methodology

The developed survey had 12 questions which attempted to measure the team effectiveness and conflict in each team. This survey had questions such as:

- Are you confident you could work effectively with your team members?
- Did your team successfully change the regular meeting time, if needed?
- Are you familiar with other team members' roles?
- Have your team members displayed a positive level of cooperation this week? etc.

Each of these questions is either effectiveness-based, or conflict-based while few could go both ways. In total, the survey has 6 effectiveness-based questions, 4 conflict-based questions and 2 questions that could go both ways.

Weekly surveys were administered for the first run of the study, where students were questioned on conflict resolution, time management, task management, team contribution and team performance. The turnout in these surveys for 8 weeks (about 2 months) has been almost consistent (70% during

the first week to 61% by the end of fourth week).

During later iterations of the study, some changes were introduced to the methodology to minimize the effort required from students. A low score would explain a team's inability to manage conflicts which meant team performance was hindered. On the other hand, a high score would not necessarily mean the team was conflict ridden, rather, it would explain the team's proficiency in managing conflict while maintaining team effectiveness and functionality.

The weekly surveys were replaced with one peer evaluation exercise at the end of each semester. The peer evaluation scoring provided insight on the same two dimensions; namely, conflict management and effectiveness. These changes are discussed in the later part of this paper.

Scoring the survey responses

The responses to these surveys were scored based on if they are effective/non-effective or conflict/non-conflict based. A score of 1 is awarded when a response is either effective or non-conflict inducing and a score of -1 is awarded to a response when it is ineffective or conflict inducing. If for any questions, a student's response is neutral, the question is voided. For example, if a student answers neutral for an effectiveness-based question, the total effectiveness-based questions would decrease from 6 to 5. At the end of scoring, if the total score is greater than 80% it is identified as a good score and if it is less than or equal to 79%, it is identified as a poor score. It is to be noted that, if there are 2 conflicts, the score will be less than 80%.

Results

Based on the good/bad scores; green and red represent good and bad (poor), respectively, as depicted in Figure 1. Graphs were plotted for each section to better understand the dynamics of each team. These plots show us the number of good(s)/bad(s) each team accrued based on the responses. Figure 1 shows that most of the teams have good scores than bad. Although results from a single week do not report much about the team dynamics, subsequent results from more weeks help to better understand the team dynamics.

Figure 1 represents the "Scoring" combined with the team performance which provides more insight. For example, a team might be performing poorly and might not be serious about these dynamics within the team. Since, the final aim of this study is to determine the most effective team formation methodology, it is important to look at the team performance. Figure 1 shows the average score of all the teams in a section, for a total of 15 sections.

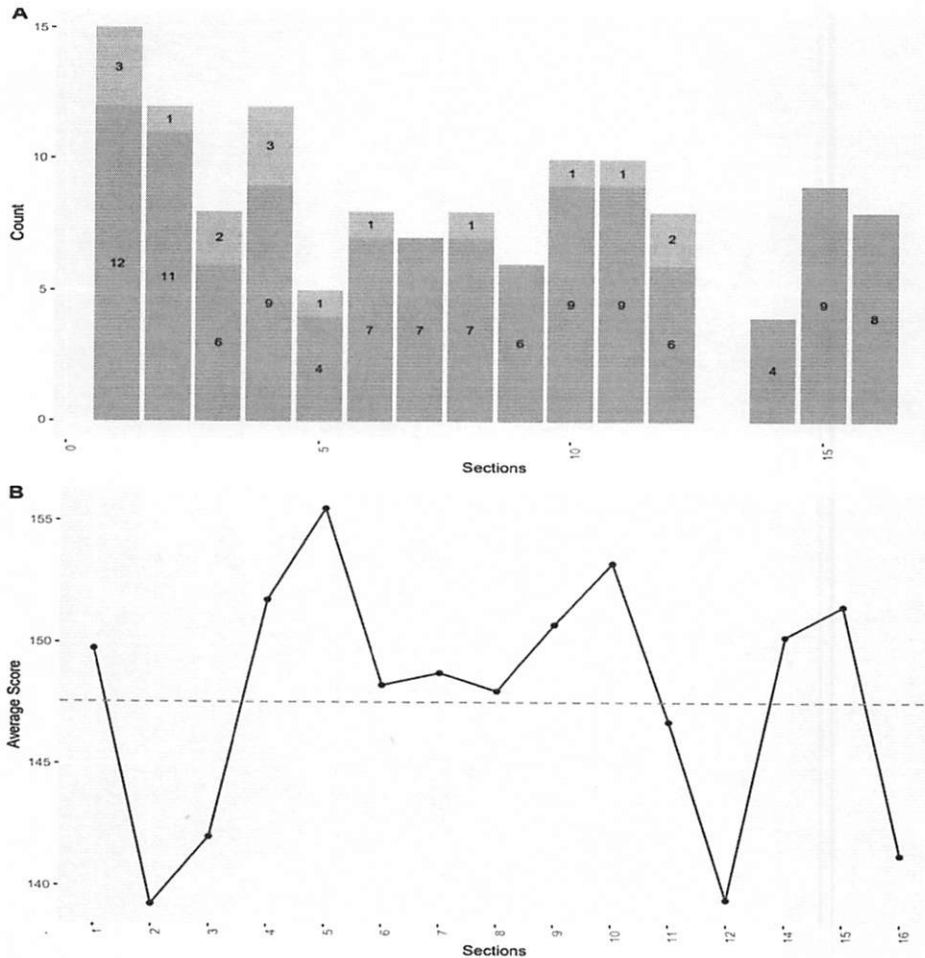


Figure 1. Sample "Scoring" plots for one out of eight weeks of the study. (A) Bad; "red", and Good, "green" counts per week for each section. (B) Average score per section for the same week. Dashed line represents the average score for all 15 section.

While the results plotted and discussed in Figure 1 are only for a week, research was done for results obtained from subsequent weeks. This consistency would help us decide if a certain team methodology works in favor as far as effectiveness and performance measures are concerned.

Figure 2 represents the average score per section. The dashed lines representing the averages show that some sections were showing above average scores that belong to the same grouping method while some section under the same teaming method could be less than the average. These are due to various personal differences between team members as well as variables that were not included in this study such as demographics.

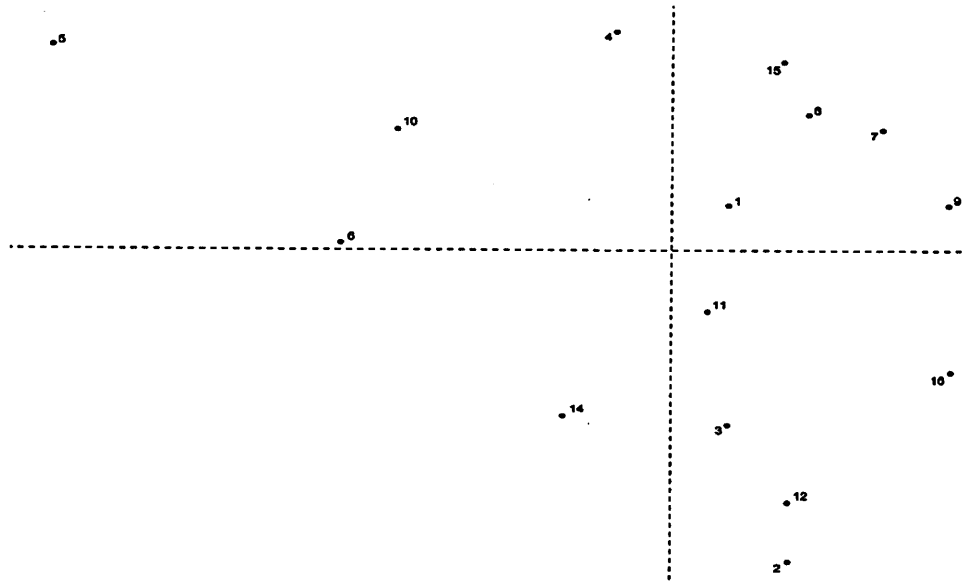


Figure 2. Normalized section performance based on the Conflict Management, x-axis and Effectiveness, y-axis. Dashed lines represent the class averages. Each number represents the reported section as presented in Table 1.

Figure 3 represents the average score per teaming method. The dashed lines representing the averages. Surprisingly the random teaming method showed above average scores in both effectiveness and conflict management directions. The Skills and GPA methods can be more prone to an effective team but not a conflicted team dynamics.

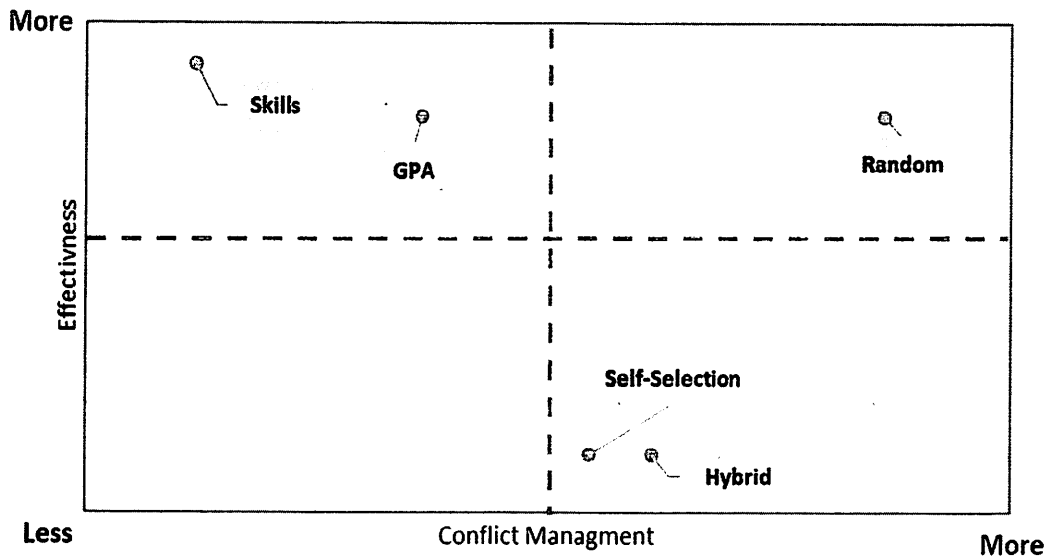


Figure 3. Normalized weekly team formation methodology performance, week 7. Dashed lines represent the class averages. Each method represents the reported data for 3 sections, as presented in Table 1.

Future Work

One of the issues we noticed while conducting this study over few semesters was the survey fatigue from the students' point of view. The study required students to have a weekly survey and students reported that this was overloading them. Another aspect of this was the weekly data capturing and analysis. The study team had to resort to automation in terms of collecting and analyzing the data. One concern we had was that the frequency of a weekly survey may provide us with a microscopic view of the team's dynamics but could also be overwhelming in trying to deduce lessons out of it. For example a conflict reported in first week may be resolved by week 4 but it would be still reported as a "bad" scenario for weeks 1-3.

To try to avoid these issues and to streamline the process, a new approach was introduced to measure the team effectiveness and conflict management. The first dimension was simply correlated with the team overall score in the team portion of the course. The conflict management was linked to the self and peer evaluation that we do at the end of the course. The rationale behind this that a conflicted team will still have issues at the end of the team work period and will report that in their peer evaluations. Teams that managed their conflicts well will simply normalize by the time they finish the course.

Figure 4 shows the teaming method scores based on this newly suggested approach. Some of these method still showed above average scores, such as random method, while others showed different scores that flipped from below average to above average as in the case of GPA method on the conflict management dimension.

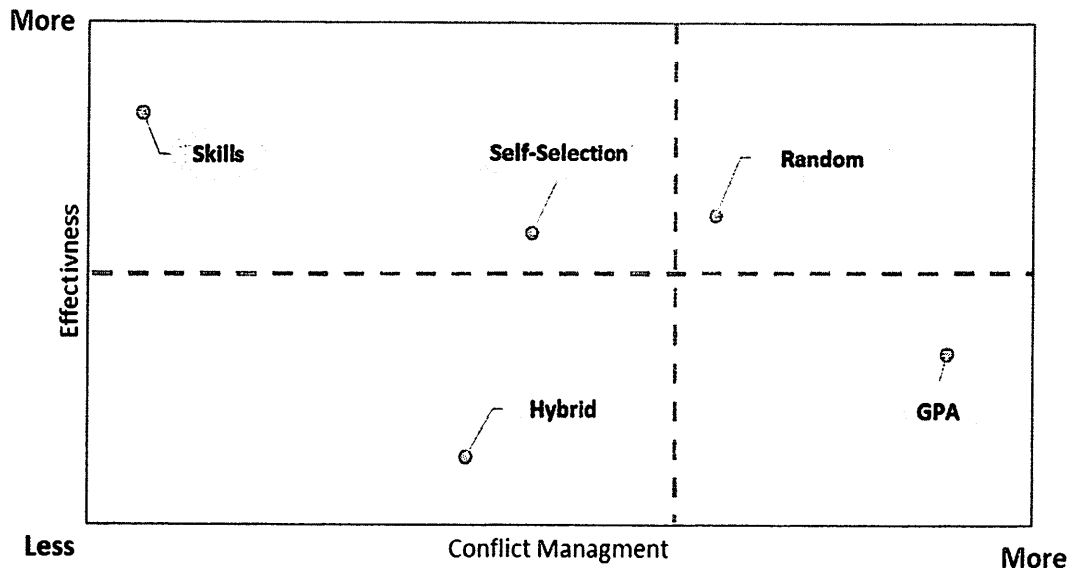


Figure 4. Normalized team formation methodology performance based on end of class peer evaluations and team grades. Dashed lines represent the class averages. Each method represents the reported data for 3 sections, as presented in Table 1.

Data from other sections are also being collected to further increase the demographic. This would help us better in concluding which team formation methodology is the most effective over a longer period of time.

Table 2 represents the ranking of the various methods under the original weekly survey and the newly adopted methodologies. It is worth mentioning that some of these methods did not change the rank between both methodologies which in turn provides a consistent team dynamics measure between these methodologies.

Table 2. Comparison between weekly survey method and the semester peer evaluation method.

<i>Method</i>	Conflict Management Ranking		Effectiveness Ranking	
	<i>Weekly Survey</i>	<i>Peer Evaluation</i>	<i>Weekly Survey</i>	<i>Peer Evaluation</i>
	Skills	5	5	1
GPA	4	1	3	4
Random	1	2	3	3
Hybrid	2	4	5	5
Self-Selection	3	3	5	2

1 highest
5 lowest

Summary and Conclusions

In summary, we have introduced an attempt to analyze teaming methods based on two dimensions, namely conflict management and team effectiveness. The study helped us understand which team formation methodology is the most effective. Skill-based methods will more likely produce effective teams but not necessarily less conflicted ones. Random methods show less conflicted teams that are more effective. The two methodologies described in this study can help instructors choose which method is suitable for the student demographics and course goals. A freshman class may require less team conflicts for the retention and inclusion purposes while a senior course is more focused on the team effectiveness. Future and more detailed studies are needed to check on various teaming methods and to expand the hybrid approaches. The random method, being the easiest to implement still provides teams with a meaningful experience.

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