Promoting Collaboration and Team Building through "Fair Game" Problem-Based Exercise

Yimesker Yihun[1] and Lena Lamei[2]
1 Wichita State University, 2 Carolina University,

Abstract

Collaboration among team members is essential for the success of semester-long projects, especially for students who are not familiar with each other, especially in their early academic years. To address this challenge, this study proposes an innovative approach called "Fair Game" for professors to facilitate relationship building, identify individual strengths, and create plans for team success. The "Fair Game" activity is a problem-based exercise that was developed to foster team connection and collaboration. The activity involved students selecting scores, either their own or their teammates', for each problem, which impacted their final grading. The score choices were influenced by students' prior preparation and their understanding of their teammates' readiness, as each student took the test independently. Our research employed both quantitative and qualitative analyses, utilizing actual performance data and feedback gathered through surveys and assessments. These analyses aimed to explore the relationship between students' self-efficacy, individual task performance, and teamwork effectiveness. The results suggest that the "Fair Game" activity can serve as a catalyst for improved teamwork, leading to enhanced project outcomes.

Keywords

Teamwork effectiveness, Individual task performance, Problem-based learning, Team-based learning

Introduction

Effective collaboration and teamwork are crucial skills for students involved in semester-long projects. However, when students are unfamiliar with their teammates, establishing effective collaboration can be challenging, especially during the early stages of their academic journey. To address this issue, professors play a vital role in facilitating team building and fostering collaboration among students. There is a growing recommendation for educators to redesign their teaching approach and incorporate team-based learning and small-group activities into their education and assessments [1-3]. Team-based learning can be implemented using various small and large teams of learners who work together to accomplish their tasks. Extensive research has shown that team-based learning significantly impacts learners' educational outcomes, academic progress, knowledge acquisition, sense of participation, collaboration, and overall engagement [4]. Anwar and colleagues (2012) conducted a study on the influence of team-based learning on students' academic performance and found that approximately 88% of students perceived a positive impact on their final grades, with a noticeable decrease in the number of failing grades [5]. Furthermore, teamwork learning has also shown positive effects on students' emotional intelligence, enhancing their ability to manage their own and others' emotions and fostering critical thinking [6, 7]. In a team-based learning environment, teamwork often outperforms individual

performance as well [8]. Educators should ensure that students have a clear understanding of the teamwork projects and goals to foster better communication and impact students' future teamwork and individual work skills [9]. One of the crucial skills that can be positively influenced by teamwork is self-efficacy, which is important for overall work performance.

The importance of teamwork in education and various settings has been well-documented and highlighted in different literature. However, strengthening teams remains an ongoing challenge. One approach that has been attempted is conducting collaborative exams to enhance team cohesion among students working on semester-long projects [10]. While this method can be beneficial, it also presents certain challenges. The collaborative exam allows team members to come together and discuss solutions, potentially leading to improved outcomes. However, there is a risk that some individuals may exploit the situation and rely solely on their teammates' work without contributing adequately. This can undermine the purpose of teamwork and result in unequal distribution of effort. Additionally, the time constraint during exams may limit the depth of discussions among team members. As they race against the clock, there might be little opportunity for thorough deliberation, leading to potential distractions for others trying to focus on their own work. Balancing the benefits and challenges of collaborative exams is essential. To make them more effective, educators could consider implementing certain guidelines or mechanisms to encourage equal participation and prevent freeloading. This might include individual assessments within the collaborative exam or encouraging each team member to present their understanding of the solutions. Moreover, providing ample opportunities for teamwork and collaboration outside exam settings can also contribute to stronger teams. In-class activities, group discussions, and project meetings can foster team dynamics and build trust among team members.

Through the implementation of a well-structured team-building strategy, students can effectively collaborate and harness the power of synergy. This study aimed to enhance team effectiveness by promoting interactions outside the classroom through problem-based exercises. In this approach, students were motivated to collaborate in studying and solving sets of problems and understand their teammates' strengths, as it would impact their final scores in an individual test. During the test, they had the choice to either use their own attempt or their teammates' score, but they were unaware of their teammates' actual performance as they were intentionally seated apart. This setup created a "Fair Game" exercise, allowing students various options to maximize their score during their preparation. The study delves into the implementation of these activities and provides an educational analysis of their impact. By encouraging collaboration and understanding within the team, this approach provides measurable insight for better teamwork performance and improved outcome. Our study employed a mixed-methods approach, incorporating both quantitative and qualitative analyses. We sought to investigate the subject of team building by using real performance data and gathering feedback from students through surveys and assessments to understand their perceptions.

Method

Data collection was conducted in two phases. In the first phase, in-class and take-home, group assignments and teamwork activities were employed as a part of class assignment in a junior-level undergraduate engineering course. Group problem-solving assignments, mini building prototype team activity, and semester-long group project were included in students' class assignments for this course. The goal was promoting collaborative and team-based learning. With the "Fair Game"

exercise, students were supposed to choose either their own or their teammates' score for specific problem-solving assignments. This exercise is designed to promote student collaboration outside of the classroom. In this activity, students in a team of semester-long projects are provided with a list of problems to study (ten problems) and are individually assessed in class. They have the option to choose their own score or their teammate's score for each problem (*Figure 1*). During the assessment, students are intentionally seated away from their partners, with no knowledge of their partners' performance. The activity involves solving two problems, each worth five points, within a 10-minute time limit. The first problem is selected from the study problems, while the second problem is new to the students but on a similar topic.

In the second phase of data collection, the same students were asked to complete an online survey. Twenty-seven usable responses were collected and later analyzed. The survey included three sections: demographics questions, open-ended questions, and three embedded scales (General Academic Self-Efficacy (GASE) scale, Individual Task Performance (ITP) sub-scale, and the Teamwork Effectiveness (TE) Questionnaire, which included assessing three competencies of teamwork: rational, organizational, and communication aspects).

Collected data were analyzed using SPSS and Excel. The results provided insights into college students' teamwork effectiveness, collaborative learning, and team-oriented environment in higher education. This study assessed individual task performance, students' self-efficacy, and teamwork effectiveness of students and raised awareness about challenges, advantages, and best practices regarding teamwork enhancement and development among college students.
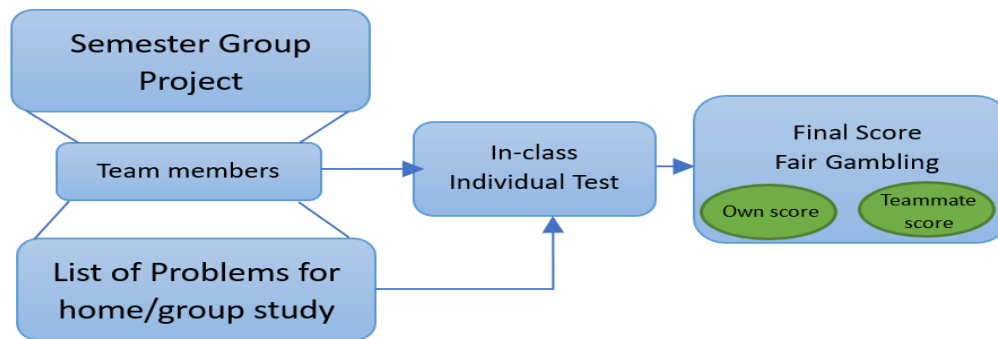

Figure 1: Fair Game-problem-based exercise approach outline

This study surveyed 35 undergraduate engineering students at a public university in a Midwestern state. Most of the students were male (70%) and juniors or seniors (63%). The most common racial/ethnic groups were White/Caucasian (55.5%), Asian (22%), and Hispanic/Latino (18.5%). About 88.5% of the students had a self-reported GPA of 3.00 and above, and all Asian students had a GPA of 3.0 or above. Only 11.5% of the students had a GPA between 2.5 and 3.00.

Result and Discussions

In the exercise, participants were required to tackle two problems, each valued at five points, within a 10-minute timeframe. Among the 28 students, 8 opted to use their teammate's score for the first problem (*Figure 2*), while 10 did the same for the second problem (*Figure 3*). Interestingly, some students who chose their teammate's score had already obtained the same score themselves. Upon

analyzing the students' attempted scores in this preliminary study, it was found that the average score for the first problem increased from 3.286 to 3.929 out of five, while for the second problem, it rose from 2.143 to 2.5. The "Fair Game" problem-based exercise not only acts as a valuable tool for providing quantitative feedback on students' performance in homework problems but also offers various insightful observations, as discussed below.

Trust in teammates: It was evident that many students demonstrated trust in their team members. Despite having the option to receive their individual scores, a significant number of students (eight to Ten out of the total) chose to rely on their teammate's score. This indicates a high level of confidence and trust in their peers' problem-solving abilities.

Improvement in scores: Among the students who chose to receive their teammate's score, all but one showed an improvement in their own score (*Figure 4* and *Figure 5*). This suggests that collaborative preparation for problem-solving can lead to enhanced performance, as students benefit from their teammates' insights and approaches.
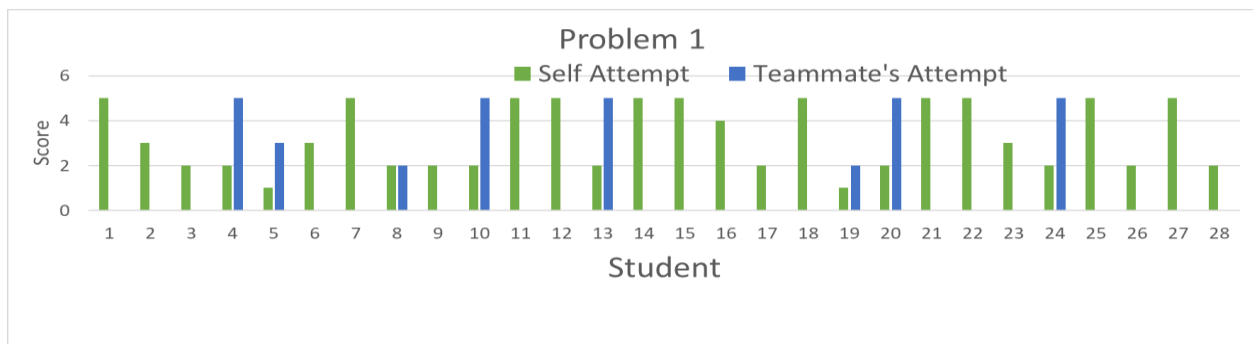

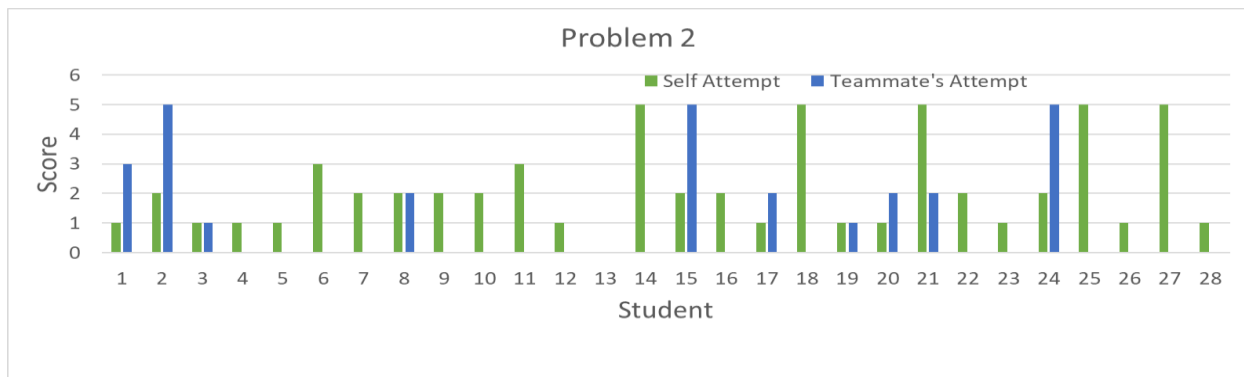Figure 2: Problem1-self-attempt and students opted to use their teammate's score.

Figure 3: Problem2-self-attempt and students opted to use their teammate's score.

Lack of self-confidence: Some students displayed a lack of self-confidence during the exercise. For instance, despite achieving a perfect score (5/5) on the second problem, one student opted to receive their teammate's score, which was significantly lower (2/5) (*Figure 3*). Similarly, three students obtained the same score as their teammates, but still chose to rely on their teammates' scores. This indicates a need for students to build their self-confidence and trust their individual capabilities.
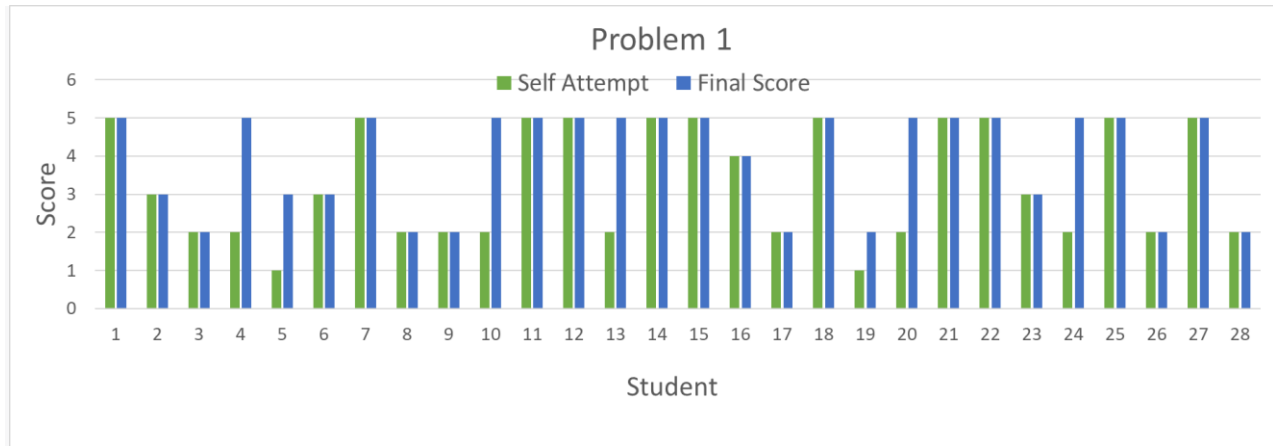
Figure 4: Problem 1 self-attempt and final score after the "Fair Game" activity is considered.
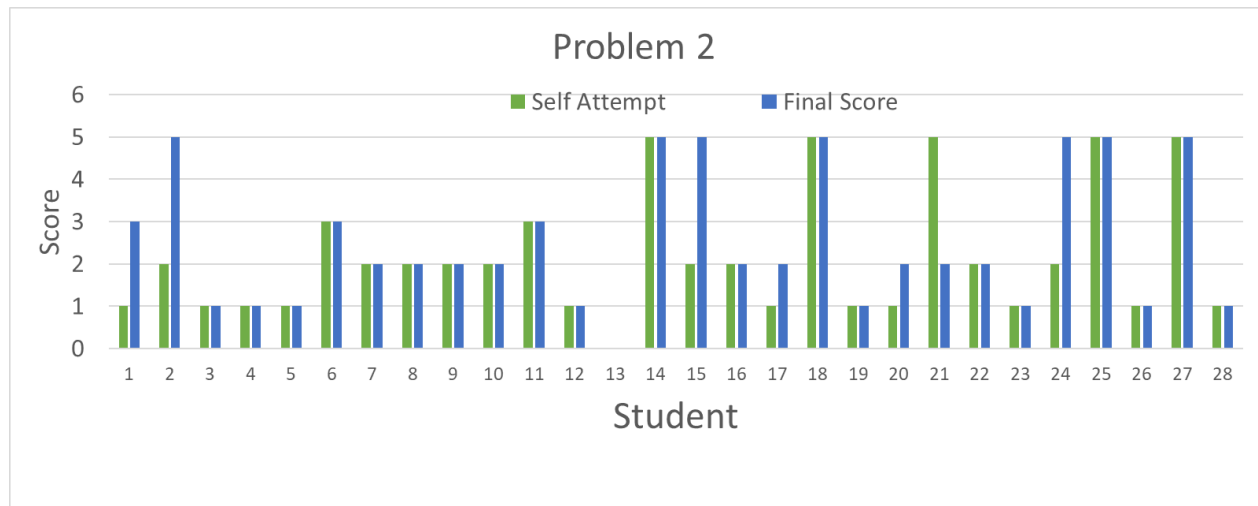

Figure 5:Problem 2 self-attempt and final score after the "Fair Game" activity is considered.

Varied investment in test preparation: The exercise also shed light on students' differing levels of investment in test preparation. It was intriguing to discover that only a small fraction (four out of 28 students) chose to view their teammate's score for both problems. This suggests that some students either did not allocate sufficient time to prepare for the test or placed excessive confidence in their teammates' abilities. This observation highlights the importance of individual preparation while acknowledging the value of collaborative problem-solving. To address this issue, professors can introduce a system where students are given a limited number of opportunities (let's say two chances per semester) to participate in a "Fair Game" activity. In this activity, students can utilize these chances for any problem or test they deem necessary. This way, they will only utilize their chances when they truly need them, and the limited options will motivate each student to adequately prepare for the tests. By implementing this approach multiple times throughout the semester, professors can ensure equal opportunities for all students.

Furthermore, the exercise facilitated an assessment of the students' grasp of the concept. Analyzing the average score of the second problem, which was not part of the study material, revealed that students need further practice to fully comprehend the concept and expand their knowledge base to solve similar problems effectively. This finding emphasizes the importance of continuous learning, reinforcing the need for students to engage in additional practice and broaden their understanding of the subject. Students' perception towards the activity is shown in
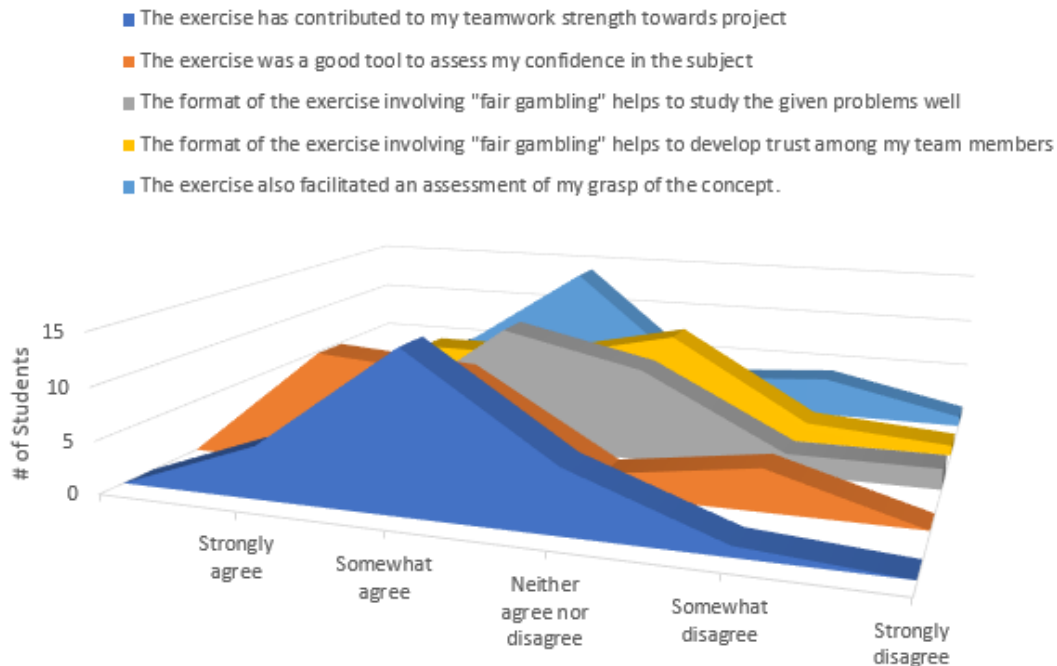

Figure 6: Students' perception towards the "Fair Game" activity

The second part of the data collection involved an online survey. The survey included embedded assessment questions related to three scales: (a) General Academic Self-Efficacy Scale (GASES) by Nielsen et al. [11], with five items measured on a 5-point Likert scale. (b) The Individual Task Performance sub-scale (ITP) [12], comprising seven items measured on a 6-point Likert scale, assessing overall task performance. (c) Teamwork Effectiveness (TE) in Team-based Projects Questionnaire [13], adapted and shortened for assessing students' teamwork effectiveness. The study investigates the relationship between students' general academic self-efficacy (GASE) and their individual task performance (ITP), as well as their teamwork effectiveness (TE) in semester-long projects. The regression analysis indicates a direct but not significant relationship between GASE and ITP ($R^2 = .075$), with GASE not being a predictor of ITP. For TE, GASE explains 11% of the variance ($R^2 = .105$), but it was not a predictor. The study also examined the influence of gender and race/ethnicity on GASE, ITP, and TE through One-Way ANOVA. Results showed significant differences in TE and ITP scores based on race/ethnicity, but not in GASE scores. Furthermore, the regression analysis indicated that both GASE and ITP together predict 27% of the variance in TE. Lastly, students' perception significantly predicts teamwork effectiveness in the semester-long project activities. Findings revealed students' positive perception of learning in a collaborative and team-based environment. The results also highlighted the importance of students' self-development in teamwork, better preparation, communication, relationship building,

trust, and adaptability. In addition, the findings of this study explored students' challenges in embracing and developing teamwork. Students expressed how differences in teammates' culture, language, individual personalities, lack of commitment and time management, unbalanced workload, teaming with incompatible individuals, and lack of understanding of their roles and responsibilities impact on teamwork effectiveness and the team success.

Conclusion

The "Fair Game" problem-based exercise is a vital tool for promoting collaboration and team building. The findings of this research contribute to the existing literature on educational research by shedding light on the significance of teamwork in academic performance and offering practical strategies to improve collaboration among college students. Major limitation of this study was a small sample size. Future research should expand the scope of this study, in a larger and more diverse sample size, in different higher education programs or educational levels to increase the generalizability of the results. Additionally, further investigations are recommended regarding the relationship between different teamwork activities and strategies to improve students' decision-making and commitment to their team and tasks. Studies about teamwork in higher education would be more beneficial when readiness of both educators and learners for a team-oriented learning environment has been developed

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Dr. Yimesker Yihun is an Associate Professor at Wichita State University (WSU) in the Mechanical Engineering Department (ME). His research focuses on integrating human anatomical variations and physiological responses into robotic systems and human-robot interface designs. As the director of an independent robotics and control research lab, he leads various projects in mechanism synthesis, robot-based rehabilitation, control system design, and Human-Machine Interface. His research has received funding from organizations like NSF, NASA, Kansas Board of Regents, and WSU. Dr. Yihun is dedicated to enhancing the ME curriculum, particularly in the areas of Design, Robotics, and Control. He also conducts educational research to improve instructional methods, promote experiential learning, self-directed learning, and engineering research. Dr. Yihun is the recipient of the Wichita State University College of Engineering Wallace 2020 Outstanding Educator Award toward Excellence in Teaching.

Dr. Lena Lamei is Assistant Professor at Carolina University (CU). She is teaching in both colleges of business and educational leadership. Her research focuses on organizational management, organizational citizenship behavior, team building, mind conditioning, toxic leadership, executing effective leadership in higher education and organizations, online learning, and hybrid work environment. Dr. Lamei's educational and professional background is in communications, business development, management, and educational leadership. She is also serving as a member of the academic integrity committee, students' career development, and the Vice Chair of the Institutional Review Board (IRB) for Carolina University.