Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #48533

Analyzing student motivations in joining and persisting in Engineering Project Experiences

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Work In Progress: Analyzing Student Motivations in Joining and Persisting in Engineering Project Experiences

Introduction

Voluntary out-of-classroom engineering project experiences through student organizations and competitions have been offered at universities across the world for many decades. While instructor-led "traditional" teaching approach in engineering classrooms is essential for developing analytical rigor among students, it may be insufficient for preparing them to solve complicated socio-technical problems that engineers often face in the real world [1]. As a result, project experience in college helps to develop systems-level thinking abilities that engineers need to solve open-ended problems [1]. Overall, this type of project experience has led to a higher self-perception of development of soft skills such as problem solving, creativity, critical thinking, integrity, teamwork, leadership, etc. among active members [2]. These experiences, which include design competitions such as Formula SAE and Baja SAE have been instrumental in providing students with practical experience, risk-free R&D experience and valuable interactions with industry partners [3]. The literature documents many benefits of such experiences for students. One example is that the multi-year nature of these projects leads to knowledge transfer from one year to the next, allowing students to explore iterative design methodologies followed in the industry [3]. Also, Samanes et al. and Buchal [2] [3] showed that participation in student-led engineering projects such as competition teams leads to development of these skills.

Students also perceive these projects as a useful avenue for learning and professional growth. Mariasiu and Raboca [4] explored students' perceptions about their participation in a racing competition that involved building a compressed air powered vehicle, and found that students perceive such competitions as excellent avenues to apply the content learned in courses such as control systems, mechatronics, CAD, hydraulics and pneumatics, and vehicle dynamics. Interestingly, in the same survey [4], it was reported that fundamental courses such as mathematics and physics were perceived by students to be less useful for the project. In an assessment conducted by Wickenden and Stobart in 2005 [5], more than 90% Formula SAE participants at the University of Sussex reported being able to translate academic coursework into their project work. More than 80% students students also reported improved confidence in handling a project budget [5]. The control engineering research group at the University of La Rioja, Spain organized a national competition in 2022, where 14 teams of undergraduate and graduate students were challenged to control the orientation of an Unmanned Aerial Vehicle (UAV) [6]. An anonymous survey of the participating students revealed that 85% and 77% of participants thought that the competitive nature of the event stimulated learning and motivation respectively [6].

Yet despite the many documented benefits, anecdotally, a large percent of engineering students do not participate in any out-of-class project experience. A better understanding of what motivates students to join and persist in these student project teams has the potential to help address this issue. The impact of student participation in these teams on the their social life and mental health is also under-explored.

Contributions of This Study

In this study, using anonymous self-reported data from students surveyed across various project teams, we present preliminary results on the following:

1. Quantitative assessment of student experience and satisfaction across several project teams.
2. Impact of student involvement in project teams on their lifestyle.
3. Relation between student involvement and individual professional and academic outcomes.

Methods

Students across various project teams in the College of Engineering at The Ohio State University were asked to complete an anonymous survey about their experiences with the teams they have been a part of. The survey asks students about their background, role and level of involvement and their motivation to join the project. They were asked to reflect about their experience in the project team (Figure 2). There were also questions about their perception on how well-supported they feel by team organization/leadership and faculty advisors (Figure 3). Students were asked to reflect on the impact of their involvement in the project on their social life, leisure time, and mental health (Figure 4). Additionally, they were asked questions about the outcomes of their participation, their team's performance at competitions (if applicable) and if the competition performance is a motivation for them to persist in the team for the next year.

Most of the questions were multiple choice with space given for short descriptive answers for questions related to motivation to join and what students felt like they got from participation. Students were asked to rate the extent to which they agree or disagree with a list of statements shown in the legend for Figures 2, 3 and 4 on a Likert-type scale with values ranging from 1 (strongly disagree) to 5 (strongly agree).

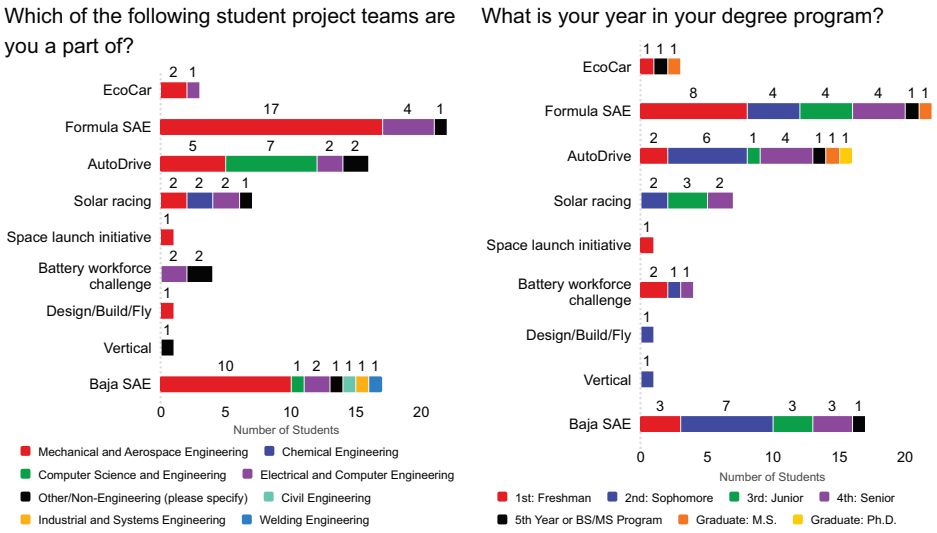
Results

The backgrounds of the survey participants are shown in Figure 1, showing that most of the data were received from undergraduate students who were part of the Formula SAE or AutoDrive Challenge teams. Figure 1 shows the student major, year in degree program, race and international student status for each project team. The dataset is predominantly composed of White and Asian students, with a majority identifying as male. Additionally, 13 students in the dataset were classified as international.

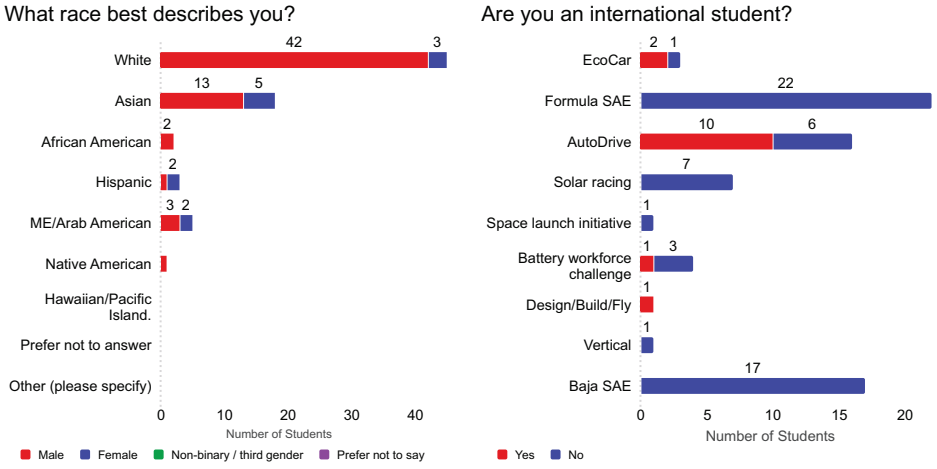
Next, students were asked about their motivation to join their project teams and their reasons fell into one of the following categories: gaining hands-on experiences through engaging in real-world problem solving, and networking and preparation for future job opportunities.

Note: Figures 2, 3 and 4 show the number of students (vertical axis) v.s. the extent to which they agree or disagree (horizontal axis) with the statements (shown in legend)

Students were then asked to reflect on their experience in project teams. They were responding through a Likert-type scale to various statements. From Figure 2, it can be observed that student



(a) Participant majors and year in degree program



(b) Participant race, gender and international student status

Figure 1. Participant demographics: Composition of surveyed project teams

experience in the teams is overwhelmingly and broadly positive for all prompts. The exception to this is that many students (21.3% out of a sample of 61 students) feel that the workload among team members is unevenly distributed. This is in line with similar surveys that the authors have administered in different engineering team settings.

Similar trends are observed in Figure 3 where students were asked to reflect on their team organization and their faculty advisor. The data shows that in general, students feel supported by the faculty, that their team is well organized, that their course work prepared them for their project, and in general are satisfied with their project work.

Students were then asked to reflect on their social life, leisure time and mental health. From Figure 4, it can be observed that for a majority of students, participation in their project teams did

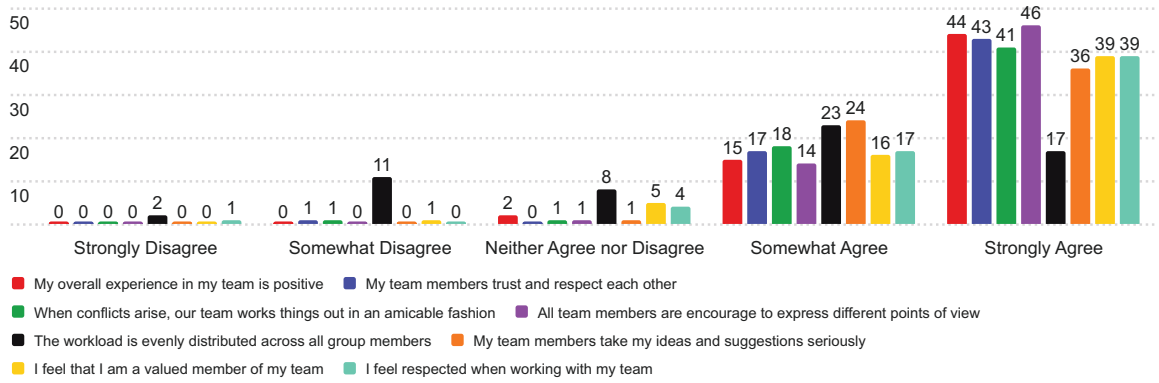


Figure 2. Reflection: involvement in the project team. Total responses = 61

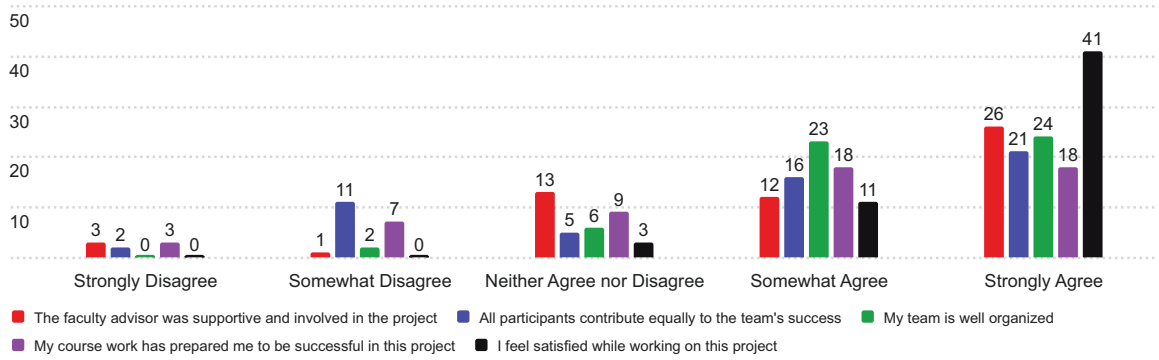


Figure 3. Reflection: team organization and faculty advisor's role. Total responses = 55

not lead to negative repercussions for their class attendance, leisure/personal time, social life and sleep. Moreover, most students reported that they interacted with their team members in social settings and that participation in their project team improved their mental health. In order to better understand whether the number of hours per week spent by students on the project had any impact on their class attendance, leisure time, social life and sleep, each prompt in Figure 4 was broken down by the number of hours spent by a student on their project. This is shown in Figures 5a and 5. It can be observed that students who self-report spending more than 15 hours per week on their project teams have negative effect on their sleep and leisure time. However, these students also report that they socially hang out with their peers, and team's culture has a positive on their mental health.

Lastly, for project teams that had a competition the data showed that the team's performance at the competition event (if applicable) did not have a conclusive effect on the students' decision to persist in their teams as shown in Figure 6.

Conclusion

This paper contains preliminary results from an anonymous survey that was sent to students who were part of engineering project teams at The Ohio State University. Given that the dataset

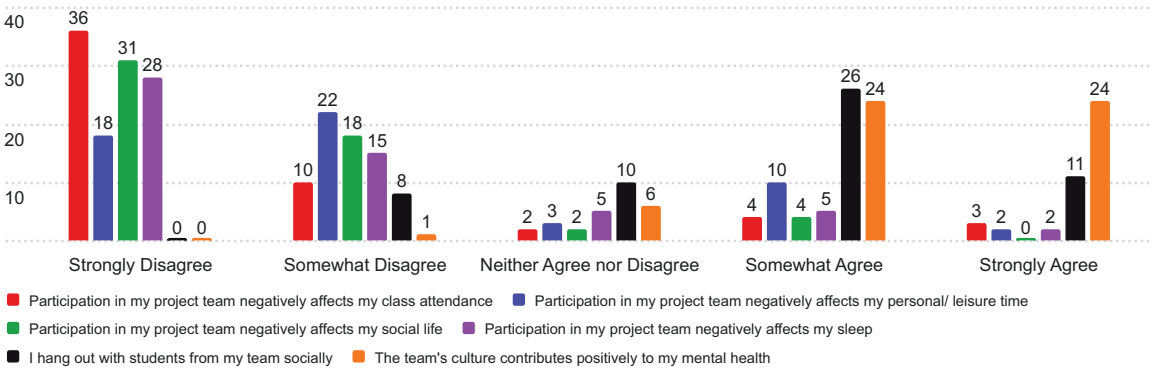
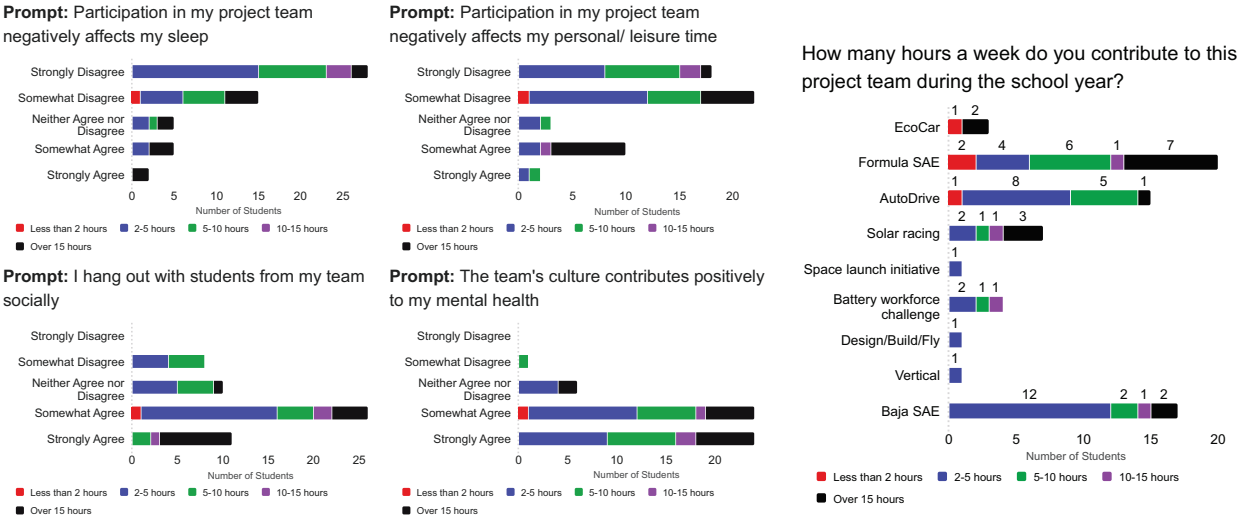


Figure 4. Reflection: impact of participation on other aspects of a student's life. Total responses = 55



(a) Impact on student's life. Total responses = 55

(b) Self-reported hours/week

Figure 5. Impact of participation on students' life: Break out with respect to hours/week

consists of only 61 student responses taken from a single year, some caution must be taken before general conclusions are made. Some preliminary conclusions can be made based on the available data. Demographically, students who participate in these project teams are predominantly White or Asian and identify as male. More efforts should be made to encourage women and Under Represented Minorities (URMs) to participate in these teams. Students predominantly join these projects for hands-on learning opportunities and for the potential to gain future employment. These can be highlighted by faculty and student leadership as they advertise their project teams. Students seemed to have positive feelings about their experience in their teams, about their fellow teammates and how they work with each other. Students felt that the workload was not evenly distributed among team members. Students felt supported by the faculty and student leadership and by their coursework. By and large, students reported that participation had minimal negative impact on their social life, class attendance, leisure time and sleep. The team's performance at the

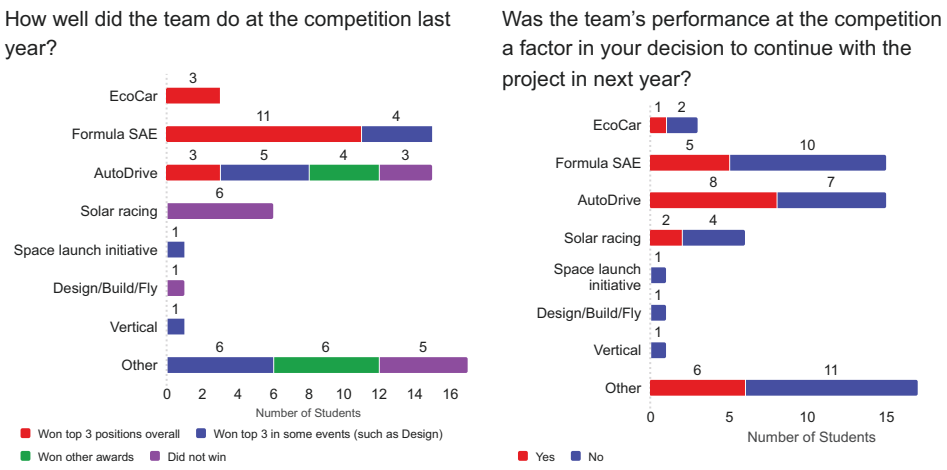


Figure 6. Impact of team's performance at the competition on participant retention for next year of the project.

competition, if applicable, did not seem to have an impact on student motivation on persisting in their teams. While it is possible that these results will be validated by a larger dataset in the future, a more thorough analysis is needed. Specifically, data collected over multiple years is necessary since most student project teams surveyed work on multi-year projects with the possibility of evolving team dynamics over the years. This is expected to be done over the next few years.

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