

Full Paper: Student Reflections on Team Experiences in a First-Year Engineering Course

Dr. Jenahvive K. Morgan, Michigan State University

Dr. Jenahvive Morgan is the instructor for EGR 100 - Introduction to Engineering Design and Academic Director of the First-Year Engineering CoRe Experience at Michigan State University. She is also currently the Director of Positions for the ASEE Women in Engineering Division, as well as an ASCE ExCEED Fellow. Dr. Morgan has a PhD and MS in Environmental Engineering from the University of Michigan, and a BS in Chemical Engineering from Michigan State University. Her interests include innovative laboratory experiments for undergraduate instruction, engineering design for first-year students, and encouraging women to study engineering. For the three years prior to teaching at Michigan State University, she taught freshman and sophomore engineering courses at Rowan University. While at Rowan University she was Co-Director of RILED (Rowan Instructional Leadership and Educational Development), the advisor for the student chapter of the Society of Women Engineers (SWE), and given the ASEE Campus Representative Outstanding Achievement Award. Her teaching experience also includes work as a graduate student facilitator and engineering teaching consultant at the University of Michigan.

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Introduction

Teamwork is an essential part of a first-year engineering course at Michigan State University. This course focuses on an introduction to engineering design, and is required for all incoming engineering majors. Learning to work on an interdisciplinary team is a core objective of the course, along with solving open-ended design problems, communicating design solutions in a professionally formatted report, and understanding the engineering profession.

While teamwork is one of the fundamental course objectives, it is also one of the most challenging areas of the course due to the interpersonal issues that arise while students are working together. To guide students through solving design problems in a team, this first-year engineering course focused on Emotional Intelligence as part of the course lecture materials. Emotional Intelligence involves understanding your emotions, as well as the emotions of others, and being able to act on this knowledge.

Students in this first-year engineering course were presented with a survey at the end of the semester to assess their team experiences, as well as their experience with the course material. 432 students answered questions on teamwork, Emotional Intelligence, and their interest in engineering as a profession.

Background

Successful teamwork requires the ability to work together while solving an open-ended design problem, and being able to overcome any obstacles that arise. These obstacles involve differing work ethics, personalities, and communication styles. Inevitably, these differences can lead to conflict, and a need to resolve disagreements within the team. These ever-present emotional aspects to working in a team are found not only in student projects, but also on the projects they will be working on once they graduate. Finding the skills as a student to successfully navigate the myriad of issues that may arise when working with others, sets student up for success in their engineering careers after graduation, as shown by Jones (1996) [1] and Seat et al. (1996) [2]. Often students who are having issues within a team, and haven't found the best course of action as of yet, are advised that in a first-year course is the best time to make these mistakes and course correct. They don't want to be learning these teamworking skills while in their first professional engineering position.

To set the students up for success, Emotional Intelligence was introduced in this first-year engineering design course. Emotional Intelligence involves recognizing the emotions you have, as well as those expressed by others, and acting upon this knowledge to create change in yourself or in your relationships with others. The four main areas of Emotional Intelligence are Self-Awareness, Self-Management, Social Awareness, and Relationship Management.

Self-Awareness is how you identify your own emotional states, Self-Management involves self-control and your ability to change your behavior, Social Awareness focuses on identifying the

emotional states of others, and Relationship Management is how you are able to successfully influence others. An interesting aspect of Emotional Intelligence is that it is malleable and can be developed, as discussed by Goleman (1995) [3]. In lecture, the students learn that once they graduate they will be competing for engineering positions with many students who have the same degree, possibly a similar grade point average, and who have a similar IQ. While it may be difficult to increase your IQ, it is possible to increase your Emotional Intelligence, making these future engineers more competitive in the marketplace [4]. An engineer with strong Emotional Intelligence will be able to handle the stress and challenges of increasingly more interdependent work environments, and the anxiety that these relationships can create in the workplace. Being able to successfully manage these relationships while fulfilling other project management responsibilities, provides these students with opportunities for advancement to leadership positions in their professional careers [5].

An additional study from MIT by Engel et al. (2014) [6] is also discussed in the course, to emphasize how the ability of teams to problem solve is increased based on the amount of empathy that is found amongst the members of the team. This emotional interdependency is beneficial to not just problem solving, but also the ability of the team members to learn from one another. Other lecture material that is presented to the students and assists them with the knowledge needed to have successful team experiences involves Grit and Growth Mindset [7], [8]. In lecture the Duckworth et al. (2007) [9] and the Elliott and Dweck (1988) [10] studies are discussed with the students. Developing Grit, or having resilience despite experiencing setbacks when pursuing long-term goals, involves exposing them to the idea of Growth Mindset. When students are looking to develop Growth Mindset, to persevere to achieve their long-term goals, their failures need to be viewed as learning opportunities. This can be guided through educational mentoring to assist students through this challenging process, which can especially influence their success in a first-year engineering program.

Course Framework

EGR 100 is a required first-year engineering course that focuses on teaching students the fundamentals of engineering design. The main course objectives are to teach students to solve open-ended design problems, learn how to solve these design problems while working successfully in an interdisciplinary team, understand how to communicate the design solutions in a professionally formatted engineering report, and learn about the engineering profession as they are managing these design projects [11], [12].

The course is set up with both a lecture and a lab. The students learn material in the lectures that is focused on the main course objectives and sets them up for success in the lab design projects. In lab, the teams practice the skills that have been covered in the lecture on the two main design projects they work on. At the end of the semester, the top teams have the chance to present their designs at the College of Engineering Design Day. This event is attended by not only students and faculty from the college, but also by industry representatives that are looking to build relationships with the students that could possibly turn into future employment opportunities.

A main topic of the course involves comparing their academic experiences with their experiences on the job as an engineer, to prepare them for work in the engineering profession. What is discussed is that most of their academic experiences will be idealized, meaning that they can work on their problem solving individually, there is only one solution, and the problem is not open-ended. This is contrasted with the experience they will have on the job as an engineer. In this case, these future engineers will be faced with only open-ended problems, which have multiple solutions that need to be optimized to find the best application for the company they work for, and these are such challenging problems that they usually require multiple teams to solve them.

Teamwork is emphasized as an important part of this distinction in problem solving as engineers. EGR 100 discusses throughout the semester the prestige of the profession of engineering. This prestige comes with the responsibility that engineers have to solve society's most challenging problems. Engineers bring to fruition the society of the future. This heavy responsibility comes with an emphasis on making ethical choices that focus on the safety and human welfare of everyone involved with an engineering design and in introducing that design to society. Since this is not an easy process, it involves input from not just a team of engineers, but input from multiple stakeholders that can provide essential information needed to create both a successful and ethical design once it is implemented in society.

Course Assessment and Discussion

A survey was given to the students in the course after they completed their design projects and after lecture material regarding Emotional Intelligence and teamwork was presented. In total, 432 students responded to questions regarding their experience working in teams on the design projects, their motivation and certainty in pursuing engineering as a career, and the area of Emotional Intelligence that they excel at. When students were asked to evaluate their team experience on the design project, 348 of the 432 students responded that their team experience was positive in the course, and only 9%, or 34 students, reported a negative team experience. These responses are outlined in Figure 1.

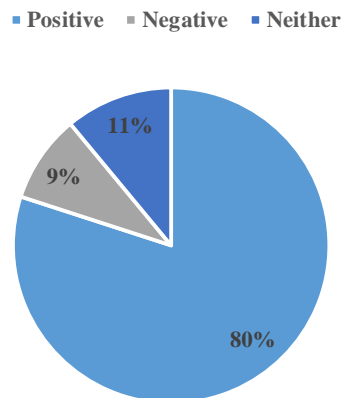


Figure 1: Student responses in evaluating their team experiences in the course design projects (N=432)

In addition to evaluating their team experience, students were also asked to reflect on their motivation and certainty about their careers in engineering. This was to inspire self-awareness in the students regarding their motivation in the course and in their future careers, and how that may influence their performance on the team design projects. Figure 2 and Figure 3 outline the students' responses regarding this evaluation. 56 of the 432 students, or 13%, responded that they aren't sure about their motivation to study engineering. In regards to their certainty in the engineering career, 25 of the 432 students, or 6%, responded as not certain about whether a career in engineering was the right choice for their future. The majority of the students responded with both certainty behind their career choice in engineering and their motivation regarding their engineering careers.

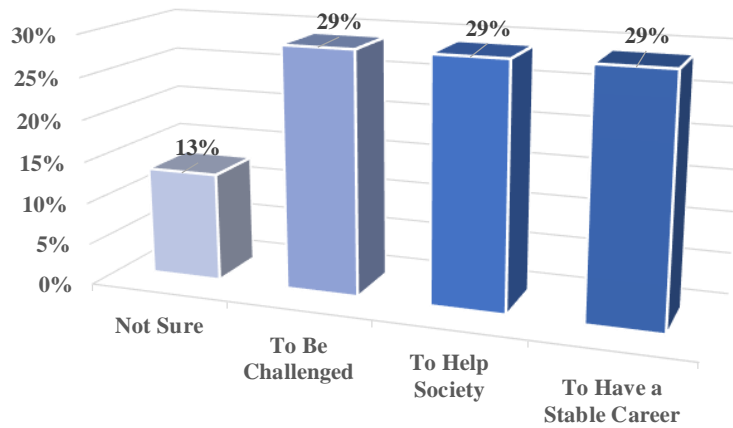


Figure 2: The responses from students regarding their motivation to study engineering (N=432)

■ Not Certain ■ Somewhat Certain ■ Certain ■ Very Certain

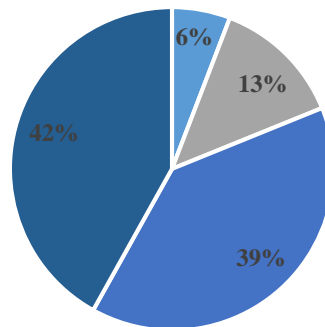


Figure 3: Student responses regarding their certainty that engineering is their career of choice (N=432)

Students also responded with a self-appraisal of the area of Emotional Intelligence that they identify as being a strength of theirs. The majority students, or 386 of the 432 students, responded that awareness and management of themselves, or empathy regarding others, were

their strong areas of Emotional Intelligence. A smaller group of 46 of the 432 students, responded with an evaluation of being able to manage others as the area of Emotional Intelligence that they excelled at. Figure 4 outlines these responses. This was discussed in the course, to see if there is any concern in managing relationships with others and how that could lead to choosing a career that they may not feel certain is right for them, or have the motivation to pursue.

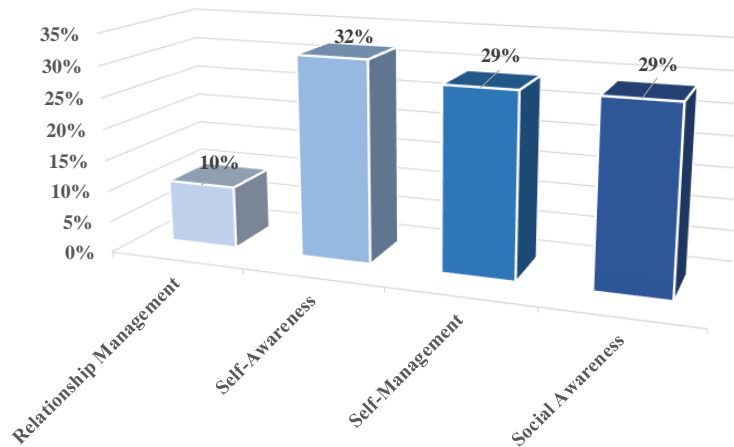


Figure 4: The responses from students regarding the area of Emotional Intelligence that they evaluate as excelling in (N=432)

Conclusion

This design course focuses on the main objectives of teaching students how to solve open-ended design problems while working in interdisciplinary teams, and communicating the design solutions in professionally formatted reports while learning about the engineering profession and their future engineering careers. Understanding and reflecting on how to successfully cooperate with their design team is an important part of succeeding in this course. Material on Emotional Intelligence and teamwork was presented in the course to assist students with this process. Students responses to the course assessment on teamwork, Emotional Intelligence, and their reflections on their career in engineering provided interesting feedback on their motivation in the course.

While the majority of the students who responded to the survey had a positive team experience and were certain in the choice and motivation towards engineering as a career, there was a smaller portion of the course that was challenged by these questions. The students were asked to reflect on how their self-appraisal of their emotional intelligence may also have influenced their participation and motivation in this engineering course and towards their careers in engineering. Overall, the course assessment provided insight in a need to look into how to reach the students who may feel that a career for engineering may not be right for them. Addressing this student population in a future study could allow these students to improve their team experiences, as well as their experiences with the engineering field.

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