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Work-in-Progress: Understanding Teamwork: A Thematic Analysis of Student Experiences in Robotics Courses

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ABSTRACT

This Work-in-Progress (WIP) work presents initial analysis of student teamwork experiences in core undergraduate robotics courses. Robotics, as an interdisciplinary field, brings together students from diverse backgrounds to work in teams on designing and implementing robotic systems capable of sensing, reasoning, acting, and interacting. Investigating students' teamwork experiences provides valuable insights that can help instructors foster collaboration and enhance learning outcomes.

We present thematic analysis results from student feedback in two different upper-level core robotics courses at a large Midwestern university. The first course emphasizes hands-on mobile robotic projects, involving assembly, construction, and software implementation of path planning and navigation algorithms. The second course focuses on human-robot interaction, centering on participant studies and the dynamics of communication between humans and robots. Using Tandem, an online platform that supports student teams, we collected both qualitative and quantitative feedback through student reflections and peer reviews at multiple milestones across the semester.

A thematic analysis was performed on the student self- and peer- assessments. Our analysis explores factors related to effective collaboration and teamwork experience. We specifically address the following research questions: (1) Do students attribute achievements and challenges to themselves or to their team, and how do these attributions differ between self and peer assessments? (2) How are technical and non-technical skills, including effort, reflected in student feedback, and do these patterns differ between technically focused versus communication-oriented courses? Through thematic coding, frequency analysis, and interpretation of qualitative teamwork feedback data, we conducted analysis on several aspects of teamwork experience including technical and communicative skill development, course logistics and office hour schedules, and singular versus plural contribution ("I" vs. "we"). We observed some initial patterns of the students primarily attributing activities to themselves ("I") in both self and peer assessments, and the technical efforts were emphasized more strongly in the more technically focused course. We hope the findings of this study help educators understand the factors that promote the student team experience and inform the design of future multidisciplinary robotics courses.

INTRODUCTION

Robotics is an interdisciplinary field that brings together students from diverse backgrounds to design and implement innovative systems. Various robotics programs and curricula have extensively explored how robotics involves interdisciplinary efforts and fosters increased interactions among students from diverse expertise and academic focuses [1], [2], [3], [4]. These expertises and skills include both the "traditional" technical disciplines including mechatronics, mobile robotics, and programming, to name a few, as well as communication-oriented areas including human-robot interaction, user experience study and design, etc.

Effective collaboration and teamwork is a major component in robotics both in industry and academic programs. For example, "an ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives" and "an ability to communicate effectively" are both part of the ABET (Accreditation Board for Engineering and Technology) student outcome objectives [5]. Various factors related to teamwork have been studied in the literature. For example, Ref. [6] studies the effect of intervention such as collaborative tools and associated instructional scaffolds on teamwork competencies, given student prior experience as covariates. Ref. [7] conducted Likert-scale survey on collaborative skills in student self and peer assessments in terms of team goal, role clarity, communication, attitude, and behavior. Ref. [8] analyzed industry multidisciplinary teamwork through interviews and highlighted the needs and requirements of best preparing our students for professional careers. Ref. [9] summarized "best practices" across multiple academic institutions on a program-, team-, and individual-level regarding multidisciplinary project team learning and performance.

This work investigates student teamwork experience through the lens of two upper-level undergraduate robotics courses at a large Midwestern university. One course focused on hands-on assembly and software for autonomous navigation, and another centered on human-robot interaction and communication-oriented projects. Using Tandem, an online platform for student reflections and peer assessments, we collected and analyzed qualitative and quantitative feedback throughout the semester. A thematic analysis examined factors impacting team effectiveness, coding responses on mastery, collaboration, confidence, and performance. We seek to explore the ways students attribute achievements and challenges in teams (e.g., through self- and peer assessment), and to evaluate how technical and non-technical skills reflected in feedback differ across different course focuses.

TEAM PROJECT STRUCTURE AND CONTENT

In this work, we look at the student teamwork results in two third-year hands-on robotic courses at a large Midwestern public research University, both with a heavy team collaboration component. Both are core courses in the robotics curriculum, offered at the undergraduate-level, with primarily junior-standing students participating. *Course A (Localization, Mapping, and Navigation)* covers full-stack autonomous navigation and mapping for mobile robots, where the students build, develop, and implement both hardware and software parts on the robot to achieve autonomous navigation functionalities. *Course B (Human Evaluation of Robots)* covers human-robot interaction, metrics and analysis for human studies of robots, measuring human performance in the context of robotic systems, and exploring how robot behaviors are perceived by humans. Both courses last approximately 15 weeks (one semester).

Both courses have a team project component as well as individual assignment in the form of an individual exam that assesses the individual student's knowledge mastery. As this study focuses on student teamwork, we specifically look at only the team project component in both courses. *Course A* has three team-based major project milestones. The first project involves building the robot, and tuning control parameters for driving the robot in a given trajectory. The second project involves mapping a maze environment using LiDAR (Light Detection and Ranging) sensor data as mounted on the robot, localizing where the robot is inside the maze environment. The third project involves implementing autonomous navigation and path planning functions (e.g., A-star search algorithm) on the wheeled robot. Each project takes around 3-4 weeks each, with a report deliverable for each project. Students submit and are graded based on a project report that includes fundamental understanding (e.g., explain the concepts of simultaneous localization and mapping), tables of parameters (e.g., spread of particle filters), and robot driving videos and mapping and localization accuracy (hands-on demo, with quantitative accuracy measurement - higher accuracy/lower error corresponds to higher grades). Throughout all three projects, students form into teams (typically, the same team throughout), and work together to build the hardware and debug the software to implement the aforementioned functionalities. Project time typically involves writing code, debugging, parameter tuning, and testing robots in a maze environment. Figure 1 shows a storyboard illustration of a typical scenario in *Course A* group work. As shown, the teamwork occurs in a robotic lab with open floor space. Students work on workbenches and tables to discuss and code, and then test running the robot in a floor maze environment. The group size was 3 students per group.

Course B also has a heavy team component, but was formulated as weekly structured labs for the first half of the semester (until midterm) and one final open-ended project for the second half of the semester. In weekly structure labs, students work in larger groups (typically, 5-7 people per group). The lab projects involve human robot interaction scenarios, including designing robot emotion (e.g., design a "happy" or "sad" robot routine), group conversation and dynamics (e.g., how do humans converse with a Miko[1] social robot?), and assessing human preference and trust (e.g., do humans trust faster or slower Roomba[2]-style mobile robot?). For the second half of the

[1] https://miko.ai/
[2] https://www.irobot.com/

semester, students form 3-4-person groups and complete an open-ended project, where they go through project proposal, design review, study update, and run a real-world participant study on human robot interaction. Students submit and are graded based on a project report that includes fundamental understanding (e.g., linking lecture concepts in the study design), and their human-robot interaction user study design (e.g., how they set up the scenario, how they choose the appropriate metrics to measure the performance, and the study response and analyses based on the measurement data). Figure 2 shows a storyboard[3] illustration of a typical scenario in *Course B* group work for the weekly structure lab setting. As shown, the teamwork happens in a robotic lab with tables. Students work on workbenches and tables to discuss and design their user study, but may walk around to conduct user study (e.g., interviews) with their own group and other group members, and then conduct analyses and reflections.

Both courses have their similarities and differences. Both courses are core robotics curriculum and serve a similar student population (third-year). Both courses involve real-world robots and team-based projects. However, the expectation and project assignments for the team-based work are different. The majority of the *Course A* tasks involve hardware assembly and software implementation. Thus, we expect the student teams to work on coding, debugging, test-run and tuning. On the other hand, *Course B* has a much stronger emphasis on evaluation and user study. The student teams are assigned communicative and interactive tasks, conducting a survey or a questionnaire with their group members, completing voice and facial expression analysis, providing thoughtful responses to open-ended reflection and discussion questions, etc. Compared with *Course A*, *Course B* has less assembly and programming (moderate hardware setup and coding is needed, but not as complex as in *Course A*), but a higher emphasis on technical writing, open-ended reflection, and human-human and human-robot interaction. In this study, qualitative data was collected from both courses and we are interested in investigating how students' self and peer assessment differ between the two courses, and how technical and non-technical skills pattern differ between the technically focused *Course A* (here, "technically" specifically refers to programming and hardware technical abilities) and the more communication-oriented courses (here, "communication" means both the lab interaction focuses on human-human and human-robot communication, as well as the lab assignments focus on technical communication and writing).

The learning goals are that the students understand the fundamentals of autonomous robot navigation (Course A) and selecting appropriate measures for various human-robot interactions (Course B), as well as gaining confidence and knowledge in the core robotics concepts (building, debugging, and evaluation).

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[3] Storyboard figures were created using Story Tribe, an online storyboard maker, edited by the authors with course-specific demonstrations (robot and mazes). https://storytribeapp.com/

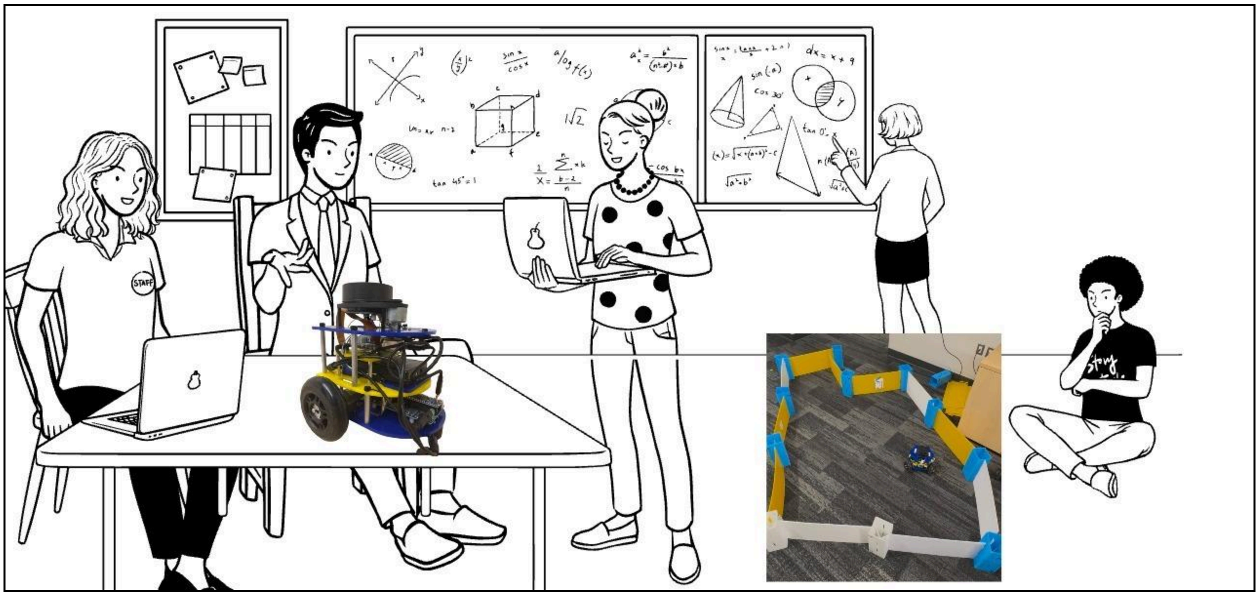

Figure 1. *Course A* team project scenario storyboard. It shows a typical robotics lab setting, where groups of students are discussing and implementing software on a two-wheeled mobile robot. The student on the right is testing the robot functions in a floor maze. There may also be math and programming questions that the students work on (e.g., on whiteboards). The final deliverable is a working robot system with accurate localization, mapping, and navigation functionalities.

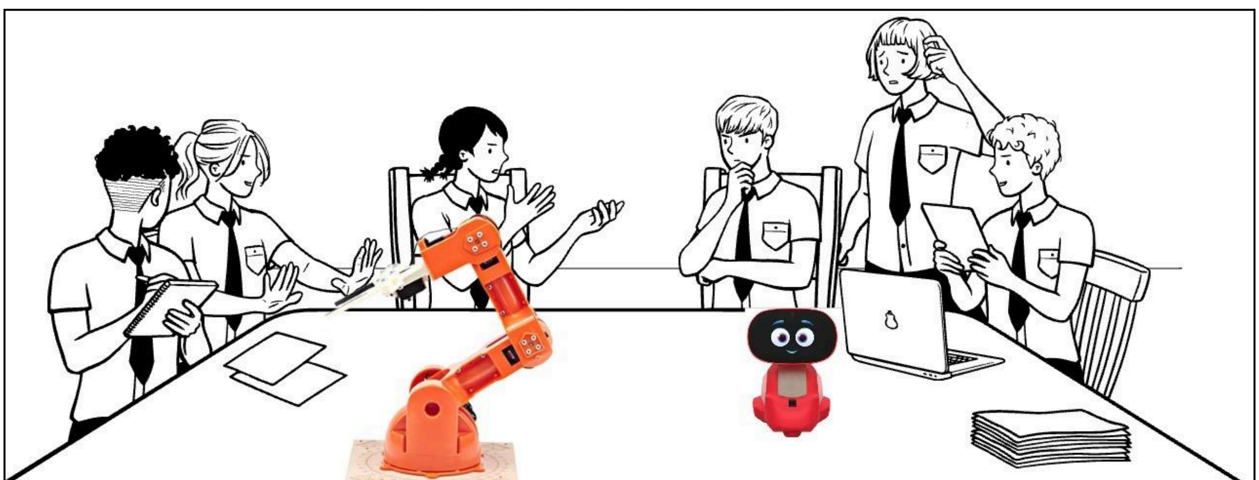

Figure 2. *Course B* team project scenario storyboard. It shows a typical robotics lab setting, where groups of students are interacting with different robot platforms including the Braccio robot arm (orange, left) and the Miko social robot (red, right). Students may be placed into “roles”. For example, one student may be the “observer” or “logger” and the other may be the “participant”. Students are encouraged to switch roles and. Their final deliverable is a report detailing their studies and analyses of participant data, as well as open-ended reflection questions. The figure was created using Story Tribe, an online storyboard maker, with author edits and robot platform illustrations (Miko robot and Arduino Braccio robot arm).

RESEARCH QUESTIONS

In this study, we investigate the following research questions.

RQ1: Do students attribute achievements and challenges to themselves or to their team, and how do these attributions differ between self and peer assessments?

RQ2: How are technical and non-technical skills, including effort, reflected in student feedback, and do these patterns differ between technically focused versus communication-oriented courses?

RQ1 addresses the self- and peer- assessment in teamwork. As students work in teams and complete tasks, they may recognize their own strengths and areas for growth. They may also rank their teammates' strengths and areas for growth as part of the peer evaluation. We study the students' qualitative feedback and investigate patterns in their self- and peer- evaluation. We are particularly interested in whether students tend to use singular first-person pronouns ("I") or plural pronouns (e.g., "we") when discussing teamwork, as these choices reveal how students perceive and express their contributions to facilitating collaborative efforts.

RQ2 addresses the technical and non-technical skills mentioned in the teamwork peer evaluation feedback, and aims to understand the influence of technical and non-technical skills on the two courses. As previously mentioned, both courses incorporate technical robotics content alongside varying levels of technical communication components including technical writing for open-ended reflection questions and submitting reports. However, the project assignments differ in their current offerings: Course A places a strong emphasis on "traditional technical" skills, including programming and mobile robotics concepts, whereas Course B integrates a significant communication-oriented component, reflecting its human-robot interaction learning objectives. We are interested in whether students recognize and emphasize technical or non-technical skills in their self- and peer evaluation for both courses. We also seek to identify whether there are other themes and patterns in factors that were reflected in student feedback related to teamwork in both technically-focused and communication-oriented courses.

METHOD

In this work, we leverage Tandem, an educational tool designed to support student teams. We look at course offerings from Fall 2024 to Fall 2025 for both courses (Course A has 51 students in Fall 2024 semester, Course B has 25 students in Winter 2025 semester and 26 students in Fall 2025 semester). The data available to this study includes the beginning-of-the-semester ("begin"), mid-term ("mid"), and end-of-the-semester ("end") surveys about their self and peer evaluation related to their teamwork for both Course A and Course B. For both courses, the students complete a beginning-of-the- semester, mid-term, and end-of-the-semester survey about their self and peer evaluation related to their teamwork experience. Tandem collects both quantitative scores (e.g., how well the team is doing on a scale of 1-9) as well as qualitative responses. We primarily focus on the qualitative responses only in this work. We analyze comments in both the self and peer assessments from the courses, and perform a thematic analysis on the teamwork corpus. The main goal is to identify and interpret patterns and themes in this teamwork self and peer assessment feedback data, and perform an initial analysis on these patterns. Use of this de-identified data was deemed exempt by the Institutional Review Board [HUM00207597].

Figure 3 shows an illustration of the thematic analysis process for teamwork analysis in this work. Thematic analysis has long been used as a standard qualitative research method [10] [11]. Thematic analysis is a qualitative analytic method that can be used to identify patterns in written information (in this study, the written student self- and peer assessment responses). This work uses "codebook" thematic analysis [12] [13]. The process of codebook thematic analysis includes transcribing and reading the data (text of written responses), identifying themes and coding (highlighting and organizing the text data segments into thematic "codes"), and reporting the thematic analysis results (including codebook, analytic narrative and data extracts). We chose to use codebook analysis for this study as we are interested in exploring qualitative student teamwork data and aims to uncover, examine, and report patterns in the data to address our research questions in understanding the self-attribution and technical and non-technical skills.

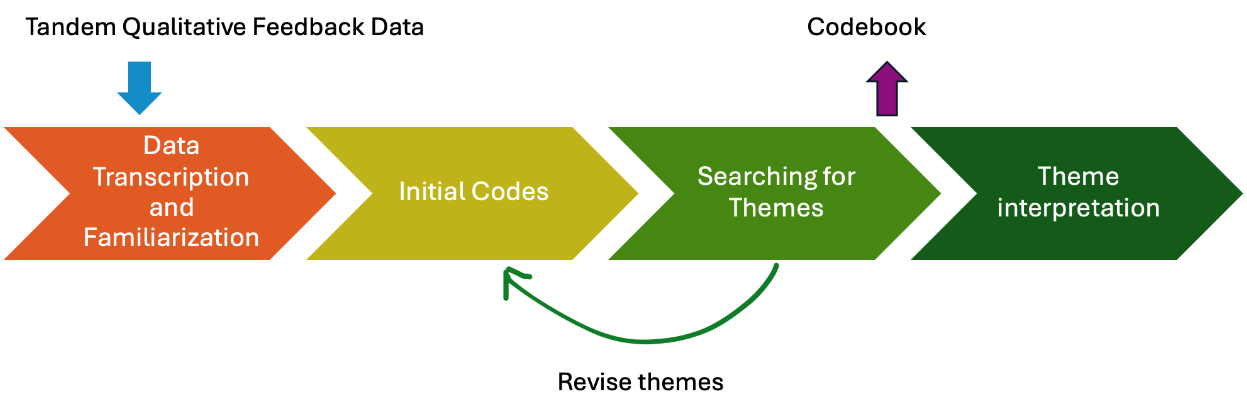

Figure 3. Thematic analysis process diagram for teamwork analysis.

Given Tandem qualitative feedback data from the students' self and peer assessment, the researchers in this study gathered the data, transcribed them in Word, Excel, or PDF format. Then, a Python program was used to extract only the interested fields in the de-identified data. The data fields used in this study include "SelfProud" and "SelfGrowth" (self-assessment of strength and areas for growth), and “ProudOther” and “DiffOther” (peer assessment of what another team member should be proud of, and what they can do differently). These data were pulled as text file and Taguette[4], an open-source qualitative data analysis tool, was used to code the data. The project team read through the text corpus, and did a round-table discussion of initial codes, did a pass of labeling, and revised the themes. The outcome of the thematic analysis process includes the finalized codebook, and the interpretations of the theme patterns.

Codebook

Table 1 shows the finalized codebook, encompassing three categories and eight themes. The first category, “pronouns”, addresses RQ1 by looking at single-person or plural group-level responses in terms of contribution to teamwork (“I” vs. “we”). The second category, “skill development”, addresses RQ2 by investigating the general technical skills, communication-related skills, and teamwork skills. The third category, “other”, groups other factors that we observed in the corpus, including specific project or algorithm details, course logistics items related to instructional aides and office hours, and tone of the text responses.

Table 1: Thematic codebook Result for Tandem feedback analysis.

Category	Themes	Examples	Code
Pronouns	I	• Single person	I
	We	• Plural group-excl (exclusive, not including writer) • Plural group-incl (inclusive, includes writer)	W
Skill Development	General technical skills (fundamental robotic technical skills, such as debugging, coding, implementation and testing, learning skills, etc.)	• “contributed debugging help” • “Do more testing on my own bot. We usually used XYZ's bot and as such I didn't set up my robot fully for some of the projects.” • “coding/software” • “Hardware” • “Human-robot interaction” • “Statistical analysis”	GT

[4] https://www.taguette.org/

	Technical communication efforts (writing, reports)	● Writing ● Presentations ● Data visualizations	Wr
	Other teamwork skills	● Teamwork-planning ● Teamwork-communicatio n ● Teamwork-ideas ● Teamwork-effort	TS
Other	Specific projects in the course	● The A* [algorithm]	SP
	Instructor Aid/Office Hours	● "I feel I should have gone to office hours more" ● "I wish we had asked for more help in office hours instead of spending so much time tuning on our own and struggling"	OH
	Sarcasm/tone	● "...contribute anything substantial to the project"	S

RESULTS AND DISCUSSION

We present our analytical results and data segment examples under the codebook. First, we report a frequency analysis on the utterances associated with each code category. Then, we present analysis and examples to address our two research questions.

Thematic Frequency Analysis

Table 2 shows the number of utterances coded for each theme and the *self* assessments for each course. Here, "utterances" refer to the text data segments coded under each theme. The total number of utterances are comparable between the two courses (Course A total: 417, Course B total: 423). We observe that, in self assessment, there are generally more "I" than "we" responses, which is expected as the students generally describe "I did …" as part of the self-assessment. There are more general technical skill-related responses ("GT") than technical communication and writing-related responses (Wr) in both courses, and significantly more responses related to teamwork skills as part of the self-assessment of strength and areas for growth.

Table 2: Number of utterances coded for each code for Course A and Course B on the self assessment data. "*Perc*." refers to decimal percentage, for example 0.2326 means 23.26%.

		Course A		**Course B**	
		n	*perc.*	*n*	*perc.*
Pronouns	**I**	97	0.2326	138	0.3255
	W	15	0.0360	15	0.0354
Skill Development	**GT**	96	0.2302	39	0.0920
	Wr	11	0.0264	14	0.0330
	TS	151	0.3621	173	0.4080
Other	**SP**	27	0.0647	26	0.0613
	OH	13	0.0312	0	0
	S	7	0.0168	18	0.0425

Table 3: Number of utterances coded for each code for Course A and Course B on the peer assessment data. "*Perc*." refers to decimal percentage, for example 0.13 means 13%.

		Course A				**Course B**			
		midterm		**end-of-term**		**midterm**		**end-of-term**	
		n	*perc.*	*n*	*perc.*	*n*	*perc.*	*n*	*perc.*
Pronouns	**I**	37	0.13	50	0.17	49	0.18	52	0.17
	W	12	0.04	9	0.03	34	0.13	1	0.00
Skill Development	**GT**	96	0.33	91	0.31	4	0.01	29	0.10
	Wr	5	0.02	16	0.05	3	0.01	15	0.05
	TS	84	0.29	93	0.32	172	0.63	171	0.57
Other	**SP**	31	0.11	18	0.06	0	0	21	0.07
	OH	13	0.04	7	0.02	0	0	0	0
	S	9	0.03	6	0.02	1	0.00	9	0.03

Table 3 shows the number of utterances coded for each theme on the *peer* assessment data conducted in the middle and end of the course semester. No "beginning-of-the-term" is reported as there was no peer assessment in the beginning of the term survey (team projects have not started yet). We observed that in the peer assessment data, there are still more "I" than "we" responses, but we see an increased "we" response. For skill development, Course A sees more responses in general technical skills (e.g., specific comments on coding or programming skills), whereas the majority of the Course B skill-related peer assessment feedback involves teamwork skills (e.g., making time to meet, project deadline and team communication, etc.)

RQ1 Analysis ("I" vs. "We" attribution)

As seen in Table 2, in the self assessments, students primarily attributed team activities to themselves (coded as "I") compared to the team in general (coded "W"). In course A self-evaluations, 87% of attributed activities used first-person singular pronouns; in course B, it was 90%. This demonstrates that regardless of the course structure or content, students primarily discuss the activities that they felt they had ownership over. This aligns with the fact that these were self assessments and students were primarily discussing what they completed from their own point of view.

As seen in Table 3, in the peer assessments, students still primarily attributed activities to themselves (coded as "I") compared to the team in general, but less so as compared to those in the self assessments. For course A, 76% of attributions were first-person singular at the midterm and 85% at the end-of-term. A small deviation in this trend is seen in course B at the midterm, where there are less first-person singular attributions (59%) as compared to course A at other timestamps; however, it rises to 98% at the end-of-term. This could be due to two factors. For both courses, students stay in the same group throughout the semester. After a semester's time together, the students may have stronger sense and deeper reflection on themselves and their teammates' contributions. In other words, students may start to be really clear "I did ABC part" while my teammate did XYZ part. There is also a sense of "summarization" at the end of semester, where students generally describe the "I did …. [task]" or "I think that I put a lot of work into the project". Students may also be more aware that near the end of the semester grades are assigned, and this could be a way of declaring their own contribution.

RQ2 Analysis (technical vs. communication skills)

As shown in Tables 2 and 3, one of the most substantial differences between Course A and Course B is under the theme "GT" (general technical skills). In self assessments in Course A, 23% of all coded utterances discuss some form of technical skills, e.g.,"I have experience with robot perception methods," "I feel proud of my debugging work," etc. In comparing across the three skill development themes, 37% relate to technical skills, only 4% relate to technical communication, and 59% relate to teamwork. For peer assessments, at the midterm, 52% of skill development utterances relate to technical skills, 3% to technical communication, and 45% to teamwork. At the end of the semester, these proportions shift slightly to 46%, 8%, and 46%, showing that students are focusing less on technical skill contributions and more on technical communication skill contributions at the end of the term. In comparing self assessments to peer assessments for course A, it appears students discuss technical skills more often and teamwork less often for what their peers are doing as compared to themselves.

On the other hand, Course B has a lower proportion of total utterances (9%) about technical skills. The technical skills discussed in the Course B feedback typically involve "art and design concepts" and "different softwares, programming skills", both part of the human-robot interaction course content and objectives. In comparing across the three skill development themes, 17% relate to technical skills, 6% to technical communication, and 77% to teamwork. For peer assessments, at the midterm, 2% of skill development utterances relate to technical skills, 2% to technical communication, and 96% to teamwork. At the end of the semester, these proportions shift to 13%, 7%, and 80%, showing that students are focusing more on technical skill and technical communication skill contributions as compared to teamwork contributions at the end of the term as students complete a final technical project. There are also increased utterances regarding technical communication ("writing") in the end of the term when students work together more on the technical writing aspects of the assignments (e.g., completing a project report). In comparing self assessments to peer assessments for course B, it appears students discuss technical skills and technical communication skills more often in reporting what their peers are doing as compared to themselves. There were also a large number of responses discussing teamwork skills in peer assessment, with praising statements including "[Name] communicated well", "timeliness", "creativity", and suggestions for improvements including "could take more initiative and take on more of a leadership role in group settings".

One interesting observation is on the office hour theme("OH"). Even though this code theme is mainly related to teamwork in project time (primarily lab and class time), as Course A is more implementation-based and demanding, student teams did attend office hours much more frequently. For Course B, the office hours were mainly used for make-up sessions as the students did not necessarily need a separate lab room to complete their lab assignments (for example, if a student group did not finish a participant study interview session, they could make-up for it after lab at any time and location of their choosing, as long as it worked for their group and possible participants/users). Due to this, there were zero entrances that discuss office hours for Course B in relation to Teamwork. This is a small observation, but this may have insights on the scheduling and staffing of robotic courses, based on project assignment design and logistics. There were more utterances of “tone”, including “Our experience would have been better without [other], he never really contributed to the team despite our invitation”, “yeah fine”. This could possibly be due to as part of Course B setting, more interactions are needed both as part of the project assignments and labs. Course B also included many interactive sessions as part of the classroom experience, which may lead to the students feeling more comfortable sharing their “tone” or emotions. This also, in a way, reflects the need in ensuring that the teams are well communicated to enhance teamwork satisfaction and effectiveness.

DISCUSSIONS, LIMITATIONS, AND FUTURE WORK

This work-in-progress thematic study between the two courses revealed expected differences in skill emphasis. The technically-focused course demonstrated a stronger orientation toward technical mastery and problem-solving, while the communication-oriented course drew more comments about collaboration, interpersonal communication, and teamwork effort. These patterns reflect different pedagogical focuses and suggest that course design meaningfully shapes which forms of skill development and teamwork students identify and value. Most students attributed achievements and efforts primarily to themselves, both in self and peer evaluations, with subtle shifts toward more individualized reflection as the semester progressed. This highlights both the importance of ownership in team-based learning and a possible increase in self-awareness over time.

We wish to acknowledge the limitations of this work. So far, the above study only focuses on the data in Years 2024-2025 offering (most recent offerings of both courses). If resources allow, longitudinal study on more students and multiple offering of both classes through multiple years could be beneficial to study how students’ perceptions of teamwork evolve. We conducted a previous study [14] on quantitative assessments of student teamwork feedback. In this work, we echo some of the previous observations, such as the self-attribution (“Self-Proud”) may be relevant to the team confidence, and the “instructional aides/office hour” theme is relevant to course logistics, which we previously found was one of the biggest factors that impact teams “working well”. This work-in-progress thematic study took the first step in analyzing the qualitative feedback data, and future work can include integrating both quantitative and qualitative data and performing mixed method analysis (e.g., correlate the themes with the quantitative teamwork effectiveness and confidence values and draw additional observations) for more comprehensive understanding of variables impacting student teamwork in robotic classes. Additional attributes and tools, such as women’s perspective in multidisciplinary engineering teams [15] and team intervention strategies [16], can also be studied and applied as part of the analysis for the teamwork feedback. Additionally, some of the observations and responses may be relevant to the current course design. Imagine if Course A updated the project assignments to involve more technical communication aspects, or if Course B integrated more programming or building assignments, the student teamwork responses may change. The current course design is based on the robotic undergraduate curriculum and learning objectives. As robotics continue to develop as a field, there may be room for future improvements and adjustments. One example could be introducing robotic swarms to Course B as part of the robot-robot interaction and robot-human interaction, which brings more “traditional” technical requirements (e.g., building and programming the robotic swarm), or including language-drive mobile robotics in Course A, thus enhancing the communicative aspects of the course while maintaining the technical content and quality.

CONCLUSION

This study provides insight into how undergraduate students experience and evaluate teamwork in core robotics courses, contrasting a technically-focused course (autonomous navigation) with a communication-oriented course (human-robot interaction). Through thematic analysis of self and peer assessments using the Tandem platform, we observed distinct patterns emerging regarding how students attribute accomplishments and challenges, and how they recognize technical versus non-technical skills. The findings suggest that encouraging explicit reflection in both self and peer evaluation can enhance not only technical and communication skill development but also students’ awareness of their own roles in collaborative work. For instructors, fostering opportunities that highlight both individual and collective contributions may further support effective teamwork and student confidence across multidisciplinary robotics curricula. We also hope that future robotics courses may be able to build upon these insights by balancing technical rigor with structured opportunities for communication and reflection, thereby cultivating both the engineering and interpersonal skills vital for the next generation of roboticists.

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