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Longitudinal Outcomes of a Redesigned Gateway Experience in Engineering Technology

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Abstract

Gateway courses play a critical role in shaping students' early perceptions of preparedness for engineering technology majors, yet these perceptions are often measured only at the end of the course, before students have experienced significant discipline-specific coursework. This study examines how three cohorts of engineering technology students' self-reported perceptions of preparedness evolved from the end of a first-semester gateway course to after completion of discipline-specific courses in an undergraduate engineering technology program. Two surveys captured students' perceptions of preparedness across academic, technical, and professional domains. Because the surveys were administered anonymously, analyses were conducted using repeated cross-sectional comparisons rather than matched longitudinal data. Quantitative results were complemented by selected open-ended student responses to provide contextual insight into observed trends. Results indicate that students' initial perceptions of preparedness recalibrate after exposure to discipline-specific coursework, with changes varying by technical domain and major. While some perceptions strengthened following additional disciplinary exposure, others declined, suggesting that end-of-course evaluations may reflect provisional judgments that shift as students gain curricular context. These findings highlight limitations of relying solely on immediate post-course student perceptions to evaluate gateway courses and suggest value in incorporating delayed assessments to better understand how early curricular experiences support subsequent learning.

Keywords: engineering technology, gateway course, student self-perception, preparedness

Introduction

Student self-efficacy has been widely recognized as an important predictor of success, persistence, and engagement in engineering and engineering technology education. Rooted in social cognitive theory, self-efficacy reflects students' beliefs about their ability to succeed in specific academic or professional contexts and has been shown to influence motivation, resilience, and academic decision-making [1],[2]. Prior research in engineering education demonstrates that self-efficacy develops early in students' academic trajectories and is shaped by initial coursework and learning experiences, making first-year gateway courses a critical leverage point for supporting students' confidence and perceived preparedness for subsequent discipline-specific study [3],[4].

As a result, student self-reports collected through end-of-semester course evaluations are commonly used to assess the effectiveness of gateway courses in promoting preparedness and confidence. These instruments provide timely feedback and are widely employed for instructional improvement, program evaluation, and accreditation purposes. However, a substantial body of research has identified limitations of end-of-course evaluations, including susceptibility to factors such as expected grades, course difficulty, and instructor likeability, as well as concerns about their validity as measures of learning or preparation [5]-[7]. For first-year students in particular, evaluations of preparatory efficacy are formed before students have experienced much (if any) discipline-specific coursework, limiting their ability to contextualize whether a gateway course has adequately prepared them for future academic demands.

Collectively, this literature underscores a tension between the acknowledged role of self-efficacy and perceived preparedness in student success and the limitations of assessing these constructs solely at the conclusion of a gateway course. End-of-semester evaluations reflect students' immediate impressions, but may not capture how those perceptions evolve after students engage with discipline-specific coursework and develop a clearer understanding of disciplinary expectations. Addressing this gap, the present study compares students' self-reported perceptions of a gateway course's preparatory efficacy at two time points: immediately following course completion and after students have acquired additional disciplinary context through subsequent coursework.

Study Context and Description

ENGT 18200 is a required first-semester gateway course for Engineering Technology students across Purdue Polytechnic and is designed to introduce students for subsequent discipline-specific coursework regardless of their selected engineering technology pathway. The course is a four-credit offering with a multi-component weekly structure consisting of two lecture sessions, one recitation, and one laboratory meeting, totaling five contact hours per week. Instructional activities emphasize broad exposure to engineering technology problem-solving, foundational technical concepts, computational tools, teamwork, and professional practices rather than discipline-specific depth. The course learning objectives of ENGT 18200 include:

- Developing an academic pathway for success in the student's selected major
- Selecting appropriate strategies and technologies to solve technical problems
- Applying foundational principles and tools of electrical, industrial, manufacturing, and mechanical engineering technology
- Applying computational tools to address technical problems
- Working in a team to solve an engineering technology problem
- Demonstrating awareness of professional standards, practices, culture, and issues in engineering technology

As a shared first-semester curricular experience, ENGT 18200 plays a central role in shaping students' early perceptions of preparedness for future engineering technology studies. This study examines how students evaluate the preparatory efficacy of this gateway course at different stages of their first-year experience by analyzing students' self-reported perceptions of how

ENGT 18200 prepared them for subsequent discipline-specific coursework. The following research questions guide the study:

RQ1. How do students' self-reported perceptions of ENGT 18200's efficacy in preparing them for future engineering technology coursework differ between the end of the gateway course and after they have completed initial discipline-specific coursework?

RQ2. How do students' perceptions of preparedness change, over time, for preparedness domains aligned with their selected engineering technology major?

Study Methods

Participants and Data Collection

Data for this study was collected using two anonymous surveys administered to undergraduate engineering technology students enrolled at Purdue University's New Albany statewide campus. The Discovery survey was administered at the conclusion of the fall semester, immediately after students completed ENGT 18200 Gateway to Engineering Technology. The Follow-Up survey was administered at the conclusion of the subsequent spring semester, after students had gained additional disciplinary context through discipline-specific coursework.

The study includes three academic-year cohorts. Discovery survey data was collected in Fall 2022, Fall 2023, and Fall 2024, while corresponding Follow-Up survey data were collected in Spring 2023, Spring 2024, and Spring 2025. Surveys were administered electronically and participation was voluntary. Because surveys were anonymous, individual student responses could not be matched across time points.

Survey Instrument

Both the Discovery and Follow-Up surveys included five-point Likert-scale questions designed to measure students' self-reported perceptions of ENGT 18200's efficacy for preparing them for subsequent coursework. Students were asked to indicate the extent to which they agreed that ENGT 18200 prepared them for several areas relevant to engineering technology education. The surveys included items assessing perceived preparation for:

- Academic success in the student's selected engineering technology major
- Electrical-based courses, topics, and/or activities
- Mechanical-based courses, topics, and/or activities
- Industrial or manufacturing-based courses, topics, and/or activities
- Programming-based courses, topics, and/or activities
- Professional standards, practices, culture, and expectations in engineering technology

These areas reflect the multidisciplinary scope of ENGT 18200 and align differently with subsequent EET, IET, and MET coursework. The Follow-Up survey included the same core preparedness items as the Discovery survey, allowing direct comparison of student-reported perceptions across time points. In addition to preparedness items, students reported their intended or current major which was used to stratify analyses by disciplinary pathway.

Analysis Approach

The analysis was organized directly around the two research questions. To address RQ1, responses from the Discovery surveys were grouped together and compared with responses from the Follow-Up surveys for the same survey questions. For each preparedness item, student ratings of ENGT 18200 were examined at the two time points. Specifically, the analysis included:

- Compiling response counts for each Likert-scale option at each time point
- Comparing percentage response distributions between majors at each time point

These comparisons were used to examine whether students reported the preparatory efficacy of ENGT 18200 differently after completing subsequent coursework.

To address RQ2, survey responses were examined within each engineering technology major to assess changes in students' perceived preparedness between the Discovery and Follow-Up surveys. Analyses focused on preparedness domains aligned with students' selected major and for which students had corresponding discipline-specific coursework during the follow-up period. For each applicable domain, percentage distributions of Likert-scale responses were compared across the two survey administrations within each major. Preparedness domains that did not correspond to coursework taken during the follow-up semester were not included in the analysis.

Results and Discussions

Demographics

Table 1 summarizes participant demographics for the Discovery and Follow-Up surveys after data cleaning. Responses from students who were under 18 years of age at the time of survey administration were removed prior to analysis. Although students in the Discovery survey reported a range of intended majors at the end of ENGT 18200, Follow-Up survey responses were obtained only from students enrolled in Mechanical Engineering Technology (MET) and Electrical Engineering Technology (EET) programs. To ensure comparability across survey administrations, all analyses were therefore restricted to MET and EET respondents. The Follow-Up survey yielded a smaller sample size than the Discovery survey, reflecting expected attrition between semesters and lower response rates during the follow-up administration. Additionally, counts may not sum to total N due to item-level nonresponse.

Table 1. Survey Demographic Response Data

Characteristic	**Discovery Survey (N=62)**	**Follow-Up Survey (N=22)**

Age		
18-19	31	13
20-21	13	2
22-25	11	5
Over 25	0	0
Gender Identity		
Male	53	18
Female	5	3
Non-binary / other	0	0
Race/Ethnicity		
White or Caucasian	49	18
Black or African American	3	1
Other	6	2
Multiple Races	2	1
Current Major		
MET	38	9
EET	23	10
Dual Major EET/MET	1	3

Research Question 1: Perceptions of Preparedness Across Time Points

RQ1 examined how students' self-reported perceptions of ENGT 18200's efficacy for preparing them for subsequent engineering technology coursework differed between the end of the gateway course (Discovery survey) and after completion of initial discipline-specific coursework (Follow-Up survey). Response distributions for each preparedness area are reported as percentages with counts to account for differing sample sizes across survey administrations.

Perceptions related to preparedness for academic success and professional standards are summarized in Table 2 using Likert response categories (Strongly Disagree = SD, Somewhat Disagree = D, Neither Disagree nor Agree = N, Somewhat Agree = A, Strongly Agree = SA) reporting both overall counts as well as percentages for each category. For academic success, Discovery survey responses indicated a high level of agreement, with 90.3% of respondents selecting an agreement response and 9.7% selecting a neutral or disagreement response. In the Follow-Up survey, agreement remained high at 81.8%, although the proportion of neutral or disagreement responses increased to 18.2%. This pattern suggests that while most students continued to perceive themselves as academically prepared after progressing into discipline-specific coursework, a larger share expressed neutral or negative perceptions relative to the Discovery survey.

For professional standards and practices (Table 2), agreement responses were similarly prevalent in both surveys. In the Discovery survey, 85.2% of respondents selected an agreement response, compared to 14.8% reporting neutral or disagreement responses. In the Follow-Up survey, agreement remained stable at 85.7%, with 14.3% of responses falling into the neutral or disagreement category. Unlike academic success, perceptions related to professional standards showed little change between survey administrations when responses were examined using collapsed categories.

Table 2. Academic and Professional Preparedness

Preparedness Area	Survey	SD	D	N	A	SA
Academic Success	Discovery	3 (4.8)	1 (1.6)	2 (3.2)	21 (33.9)	35 (56.5)
	Follow-Up	1 (4.5)	2 (9.1)	1 (4.5)	9 (40.9)	9 (40.9)
Professional Standards	Discovery	4 (6.6)	2 (3.3)	3 (4.9)	20 (32.8)	32 (52.5)
	Follow-Up	1 (4.8)	1 (4.8)	1 (4.8)	8 (38.1)	10 (47.6)

Distributions for technical preparedness by domain are presented in Table 3. For electrical-based and mechanical-based coursework, Discovery survey responses were strongly skewed toward positive perceptions of preparedness. In the Discovery survey, approximately 79% of respondents reported positive preparedness for electrical-based coursework and 87% for mechanical-based coursework, indicating that most students entered the program perceiving ENGT 18200 as contributing meaningfully to preparation in these areas. Neutral or negative responses accounted for a relatively small proportion of responses in both domains.

In the Follow-Up survey, perceptions of preparedness in these domains remained predominantly positive. Electrical-based preparedness declined modestly to approximately 73% positive, reflecting a small increase in neutral or negative responses relative to Discovery. In contrast, mechanical-based preparedness increased slightly, with 100% of Follow-Up respondents selecting Agree or Strongly agree. Together, these patterns suggest that students continued to view ENGT 18200 as contributing to preparation in electrical and mechanical domains, while subsequent coursework may have led to refinement or recalibration of perceived preparedness, particularly in electrical topics.

In contrast, perceptions of preparedness for industrial-based, manufacturing-based, and programming-based coursework exhibited greater dispersion across response categories in the Discovery survey. While a majority of Discovery respondents still reported positive preparedness in these domains (approximately 77% for industrial-based, 84% for manufacturing-based, and 56% for programming-based), neutral or negative responses were more prevalent than in the electrical and mechanical domains, particularly for programming-based coursework.

In the Follow-Up survey, preparedness perceptions for industrial-based and manufacturing-based coursework shifted toward stronger agreement, with approximately 90% and 95% of respondents, respectively, reporting positive preparedness. Programming-based preparedness also increased to approximately 43% positive; however, this domain continued to show substantial neutral or negative responses, accounting for more than half of Follow-Up responses. Compared to electrical and mechanical domains, these results suggest greater variability in how students evaluate ENGT 18200's preparatory role for domains that may be encountered less uniformly or in greater depth later in the curriculum.

Table 3. Technical Preparedness by Domain

Preparedness Area	Survey	SD	D	N	A	SA
Electrical-based	Discovery	2 (3.2)	4 (6.5)	7 (11.3)	25 (40.3)	24 (38.7)
	Follow-Up	1 (4.5)	1 (4.5)	4 (18.2)	11 (50.0)	5 (22.7)
Mechanical-based	Discovery	2 (3.3)	3 (4.9)	3 (4.9)	21 (34.4)	32 (52.5)
	Follow-Up	0 (0.0)	0 (0.0)	0 (0.0)	9 (47.4)	10 (52.6)
Industrial-based	Discovery	2 (3.2)	1 (1.6)	11 (17.7)	29 (46.8)	19 (30.6)
	Follow-Up	0 (0.0)	0 (0.0)	2 (9.5)	13 (61.9)	6 (28.6)
Manufacturing-based	Discovery	2 (3.2)	2 (3.2)	6 (9.7)	25 (40.3)	27 (43.5)
	Follow-Up	0 (0.0)	0 (0.0)	1 (5.0)	9 (45.0)	10 (50.0)
Programming-based	Discovery	4 (6.5)	11 (17.7)	12 (19.4)	20 (32.3)	15 (24.2)
	Follow-Up	2 (9.5)	5 (23.8)	5 (23.8)	7 (33.3)	2 (9.5)

Taken together, the distributions shown in Table 2 and Table 3 indicate that students' reported perceptions of ENGT 18200's preparatory efficacy differ depending on when those perceptions are measured. Rather than reflecting uniform increases or decreases in perceived preparation, the results suggest a recalibration of students' evaluations after they gain additional disciplinary context through subsequent coursework. These findings underscore the importance of considering timing when interpreting self-reported preparedness measures used to evaluate gateway engineering technology courses.

Research Question 2: Differences in Perceptions of Preparedness by Engineering Technology Major

RQ2 examined how students' perceptions of ENGT 18200's preparatory efficacy changed over time within preparedness domains aligned with their selected engineering technology major. Analyses were conducted separately for Mechanical Engineering Technology (MET) and Electrical Engineering Technology (EET) students and focused on domains for which students had direct exposure during their initial discipline-specific coursework. Results are presented as comparisons of Likert-scale response distributions between the Discovery and Follow-Up surveys within each major.

Table 4 presents MET students' perceptions of preparedness for mechanical-based coursework. In the Discovery survey, MET students' responses were predominantly positive, with 81.6% selecting *Somewhat agree* or *Strongly agree*, though a nontrivial proportion of responses were distributed across neutral and disagreement categories. In the Follow-Up survey, responses were entirely concentrated within the agreement categories, evenly split between *Somewhat agree* and *Strongly agree*, with no neutral or disagreement responses observed. This shift indicates a consolidation of positive perceptions and suggests that, after completing initial MET coursework, students more consistently endorsed the extent to which ENGT 18200 prepared them for mechanical topics encountered in their major.

Table 4. MET Students – Mechanical-Based Preparedness

Survey	**SD**	**D**	**N**	**A**	**SA**
Discovery	2 (5.3)	0 (0.0)	5 (13.2)	8 (21.1)	23 (60.5)
Follow-Up	0 (0.0)	0 (0.0)	0 (0.0)	6 (50.0)	6 (50.0)

Table 5 presents EET students' perceptions of preparedness for electrical-based coursework. Responses in both the Discovery and Follow-Up surveys were predominantly concentrated in the agreement categories, with approximately 71% of respondents selecting *Somewhat agree* or *Strongly agree* at each time point. However, the distribution of responses shifted between surveys. In the Follow-Up data, the proportion of *Strongly agree* responses decreased, accompanied by an increase in *Somewhat agree* responses, indicating a moderation in the intensity of agreement. At the same time, small increases in neutral and disagreement responses were observed in the Follow-Up survey. Collectively, these patterns suggest a modest redistribution within the agreement categories, along with a slight broadening of neutral and negative perceptions, indicating that some EET students reported more tempered views of their preparedness for electrical coursework after completing initial discipline-specific courses.

Table 5. EET Students – Electrical-Based Preparedness

Survey	**SD**	**D**	**N**	**A**	**SA**

Discovery	1 (4.2)	3 (12.5)	3 (12.5)	9 (37.5)	8 (33.3)
Follow-Up	1 (7.7)	1 (7.7)	2 (15.4)	7 (53.8)	2 (15.4)

Table 6 presents EET students' perceptions of preparedness for programming-based coursework. In the Discovery survey, responses were distributed across the full Likert scale, with fewer than half of respondents selecting *Somewhat agree* or *Strongly agree*, and a substantial proportion reporting neutral or disagreement responses. In the Follow-Up survey, agreement responses declined further, with only one-quarter of respondents indicating agreement and three-quarters selecting neutral or disagreement categories. Compared to the Discovery results, the Follow-Up distribution reflects both a reduction in agreement and an increase in disagreement responses. These patterns suggest that, after engaging with discipline-specific coursework, EET students reported lower perceived preparedness for programming-based topics relative to other technical domains, indicating that programming may represent a more challenging or less directly supported area within the ENGT 18200 experience.

Table 6. EET Students – Programming-Based Preparedness

Survey	**SD**	**D**	**N**	**A**	**SA**
Discovery	2 (8.3)	5 (20.8)	6 (25.0)	8 (33.3)	3 (12.5)
Follow-Up	2 (16.7)	4 (33.3)	3 (25.0)	2 (16.7)	1 (8.3)

Across the discipline-aligned domains examined in RQ2, changes in perceived preparedness were neither uniform nor consistently positive. MET students' perceptions of mechanical preparedness strengthened after discipline-specific exposure, with Follow-Up responses concentrated entirely in the agreement categories. For EET students, perceptions of electrical preparedness remained largely positive across both time points but exhibited a redistribution from *Strongly agree* toward *Somewhat agree*, accompanied by small increases in neutral and disagreement responses. In contrast, EET students' perceptions of preparedness for programming-based coursework declined more noticeably, with agreement responses decreasing and neutral or negative responses becoming predominant in the Follow-Up survey. Collectively, these findings highlight how exposure to discipline-specific academic demands can prompt students to recalibrate their evaluations of a shared gateway course, reinforcing perceptions of preparedness in some domains while moderating or challenging them in others.

Qualitative Insights from Open Ended Responses

In addition to the Likert-scale items, students were invited to provide open-ended comments regarding how well ENGT 18200 prepared them for subsequent coursework. While these responses were not analyzed using formal qualitative methods, they provide contextual insight that helps explain patterns observed in the quantitative results.

Several Electrical Engineering Technology (EET) students described entering discipline-specific coursework with initial confidence that was later tempered by direct exposure to electrical and programming content. One student noted, “I feel that it hasn’t prepared me enough for my EET major,” while another commented that the lack of depth became evident after progressing into the curriculum: “I also feel it did not focus enough on coding, which became very apparent once I took my programming course.” These reflections align with the observed decline in perceived preparedness for both electrical- and programming-based coursework among EET students in the Follow-Up survey.

Multiple comments emphasized that ENGT 18200 provided broad exposure across technical domains but limited depth within any single area. For example, one student stated, “ENGT18200 exposed me to a lot of different topics, but it did not go far enough into any one area,” while another remarked, “I believe the class gave me a clear understanding of each subject, but not enough depth to feel confident moving forward.” Such responses suggest that students’ early perceptions of preparedness may reflect familiarity rather than readiness for the rigor of discipline-specific coursework.

In contrast, Mechanical Engineering Technology (MET) students more frequently described stronger alignment between the gateway course and subsequent mechanical coursework. One student observed, “I felt more prepared for my mechanical classes after realizing how much of ENGT18200 related back to them,” highlighting how disciplinary context influenced retrospective evaluations of the course. These comments are consistent with the increased endorsement of mechanical preparedness observed among MET students in the Follow-Up survey.

Taken together, the open-ended responses reinforce the quantitative findings by illustrating how students reassess the preparatory value of a gateway course after encountering the academic demands of their major. Rather than uniformly increasing confidence, discipline-specific exposure appears to recalibrate students’ perceptions of preparedness in domain-dependent ways, particularly where differences in depth and emphasis become more apparent.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, all measures of preparedness were based on students’ self-reported perceptions rather than direct assessments of knowledge, skills, or academic performance. While self-perception is an important construct related to student confidence and self-efficacy, it may not fully reflect actual preparedness for discipline-specific coursework.

Second, the Discovery and Follow-Up surveys were administered anonymously, which precluded matching individual student responses across time points. As a result, analyses were conducted at the group level using repeated cross-sectional comparisons rather than true longitudinal tracking of individual students. Differences in sample size between the Discovery and Follow-Up surveys further limit the strength of inferences regarding changes over time.

Third, although the same instructor served as instructor of record for all cohorts and efforts were made to maintain consistency in course structure and instructional materials across offerings, minor variations in instructional delivery are possible. As is typical in multi-cohort instructional studies, incremental refinements in pacing, emphasis, or explanation may have occurred over time, potentially influencing students' experiences and perceptions independently of curricular structure.

Finally, follow-up data were available only for students enrolled in Electrical Engineering Technology (EET) and Mechanical Engineering Technology (MET) programs at a single statewide campus, reflecting the majors represented among respondents at the time of follow-up data collection. Findings may not generalize to other engineering technology programs, institutional contexts, or curricular structures, particularly those with different gateway course designs or sequencing of discipline-specific coursework.

Conclusion

This study examined how students' perceptions of preparedness for engineering technology coursework evolved from the end of a first-semester gateway course to after completion of initial discipline-specific coursework. By comparing Discovery and Follow-Up survey responses across multiple cohorts, the study provides insight into how timing and disciplinary context shape students' evaluations of a shared gateway experience.

Across all preparedness domains, results from RQ1 indicate that students' initial perceptions of preparedness are not static. Exposure to discipline-specific coursework appears to prompt recalibration, with shifts in response distributions observed across academic, technical, and professional domains. These findings suggest that end-of-semester evaluations conducted immediately after a gateway course may capture provisional judgments that change once students encounter the academic demands of their major.

Results from RQ2 further demonstrate that this recalibration is discipline-dependent. Mechanical Engineering Technology students reported stronger endorsement of mechanical preparedness after completing initial mechanical coursework, whereas Electrical Engineering Technology students reported modest declines in perceived electrical preparedness and more pronounced declines in perceived programming preparedness following corresponding coursework.

Qualitative responses reinforce these patterns, indicating that students' retrospective evaluations of preparedness are influenced by perceived depth, alignment, and relevance of gateway content to subsequent courses.

Together, these findings highlight the importance of considering both timing and disciplinary context when using student self-reports to evaluate gateway courses in engineering technology. Rather than interpreting end-of-course perceptions as definitive indicators of preparedness, educators and program evaluators may benefit from incorporating delayed or follow-up assessments that allow students to situate early experiences within their broader curricular trajectory. Future work could extend this approach by linking perceived preparedness to direct measures of learning or by examining how specific gateway design choices influence longer-term student outcomes.

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