Improving Major Selection and Academic Trajectories: The Impact of a Common First-Year Engineering Orientation Course

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Improving Major Selection and Academic Trajectories: The Impact of a Common First-Year Engineering Orientation Course

Abstract

This Complete Evidence-Based Practice paper studies the impact of Kennesaw State University's new, 1 credit hour engineering orientation course, ENGR 1000, in increasing first-semester students' confidence in their major choice. This course is part of the Southern Polytechnic College of Engineering and Engineering Technology's new first-year common core curriculum, aimed at addressing the challenges faced by students who enter the university unsure of their major and precluding the challenges faced by students who later decide to change majors. ENGR 1000 introduces students to the various programs offered by the college and the resources available to support their academic journey. This is followed by a second semester, major-specific 1 credit hour laboratory course. ENGR 1000 is a 15-week course that is structured to provide both an introduction to the ten different engineering and engineering technology disciplines offered at the college and a roadmap for succeeding as a student in the college.

Each section of ENGR 1000 is taught by an instructor-of-record, who is responsible for guiding the students through the course material, managing grades via the university's learning management system, shepherding student progress and communication, and addressing student issues. Note that students are not grouped together by their intended major, nor specifically placed with ENGR 1000 instructors in their intended major. During the first and last weeks of the semester, the instructor-of-record meets directly with the students, setting the tone for the course and helping them reflect on what they have learned. During week six, academic advisors join the class and the instructor-of-record to help students understand their degree plans, select appropriate courses for the following semester, and plan their academic trajectory. The active involvement of academic advisors ensures that students receive timely and relevant guidance, which is particularly important for those still uncertain about their major.

One of the course's unique features is its integration of faculty presentations from across the six departments within the Southern Polytechnic College of Engineering and Engineering Technology without an increase in the effective workload of any faculty member. During the remaining twelve weeks of the course, students see presentations about the programs offered within the college's six departments, with instructors rotating between the various sections. Each department is allocated two weeks to introduce students to key concepts, career paths, and challenges specific to their discipline. These presentations aim not only to inform students about the various options available but also to inspire them through the faculty member's passion for their field. This exposure helps students make more informed decisions about their academic and career paths, reducing the chances of major changes later that could delay graduation and increase costs due to untransferable credits. Students are assessed via attendance and the following six assignments: a virtual scavenger hunt, time management, resume building, professional licensing, engineering ethics, and an engagement assignment where they attend a college club meeting or seek college tutoring.

To evaluate the impact of the ENGR 1000 course, more than 1,500 students were administered brief surveys three times during the semester. The surveys focus on students' self-reported

confidence and satisfaction with their chosen major, and their reflections on the course content and structure. Topics included demographics (age, race/ethnicity, gender, first-generation college student status, current math course, etc.), major choice, confidence in major choice (beginning and end of course), and impact of the orientation course on major choice and confidence at the end of the semester. Survey responses were de-identified prior to analysis. Methods of analysis include descriptive statistics and hypothesis testing to identify differences between student perceptions at different times in the semester.

Results yield insights into students' confidence in selecting their major, and their expectations of what they hope to gain from the course. Additionally, potential obstacles are identified that may affect students' progression toward graduation. The findings from this study will provide valuable insights into the effectiveness of a common first-year engineering orientation course in supporting student success. By evaluating both student perceptions and academic outcomes, the Southern Polytechnic College of Engineering and Engineering Technology at Kennesaw State University aims to continuously refine its curriculum to better serve its diverse student body and achieve its long-term goals of improving retention and graduation rates.

Introduction

First-year introductory courses have long existed in attempts to support student success. Introductory courses may focus on specific majors [1] or may be designed to address mixed-major or interdisciplinary students. Regardless of the introduction class structure or focus, the intent of introductory courses is to provide students with information, content, and tools that foster academic success and wise career decisions - maximizing the probability of both academic success and confirmation of major choice.

In literature, studies investigated the likelihood that students change majors based on how well they perform in their first-year college courses. It was found that students tend to stick with their major if their grades are high in first-year introductory courses [2]. A statistical report from the National Center for Education Statistics in 2013 [3] shows that nearly one-third of STEM students change their majors and based on cultural belonging [4], [5]. A study on the cognition of the human mind and specifically the conation; or the students' willingness, drive, and determination; reports that an introductory engineering course has the potential to activate students' conation, but that there is no significant evidence that such a course impacts students' conation [6].

The orientation course discussed here was designed to achieve several goals: 1) inform students of available engineering majors, 2) prompt students to switch their major sooner rather than later, 3) point students toward campus resources such as tutoring and advising, and 4) expand students' knowledge of professional organizations and engineering events. The purpose of this study is to discover if the course design significantly affects the confidence of students' selecting their engineering or engineering technology major.

Course Description

ENGR 1000 is a first-year, first-semester, 1 credit hour course required for all students enrolled in the Southern Polytechnic College of Engineering and Engineering Technology (SPCEET) at Kennesaw State University (KSU). SPCEET currently consists of six teaching departments: Civil and Environmental Engineering, Electrical and Computer Engineering, Engineering Technology, Industrial and Systems Engineering, Mechanical Engineering, and Robotics and Mechatronics Engineering. In the semester under study, the enrollment size total was 1,641 students in fifteen sections. Of those fifteen sections, eleven had a face-to-face teaching modality, three were online, and one was an honors section that met face-to-face.

Course Structure

ENGR 1000 is designed to inform students about careers in engineering and engineering technology, aiming to boost their confidence in their chosen major. Each entering engineering and engineering technology student is encouraged to choose their major upon admission into the university, yet some choose "undecided" at that time. The structure of this course is to introduce these new engineering-inspired students to the various programs/degrees offered and the resources available to support their academic journey. It is important to note that these students are not grouped with their intended major, nor are they grouped with a like major instructor. The sections are all composed of mixed disciplines.

Since KSU offers ten different engineering and engineering technology programs, all fifteen weeks are carefully scheduled to efficiently disseminate this information to the students. This highly structured curriculum also covers campus resources, curriculum advising, student organizations, competition teams, professional societies, professional licensure, and engineering ethics. Additionally, personal skills essential for long-term career success are reviewed, including time management and professional resume preparation.

During this study period, there were fifteen sections of this introductory course offered, each with an instructor assigned called the instructor-of-record. This instructor manages the content and grades in the learning management system, shepherding student progress and communications, and addressing student concerns and issues. During the first and last weeks of the semester, the instructor-of-record meets directly with the students of their assigned section, setting the tone for the course and helping them reflect on what they have learned. During week six, academic advisors join the class and the instructor-of-record to help students understand their degree plans, select appropriate courses for the following semester, and plan their academic trajectory. The active involvement of academic advisors ensures that students receive timely and relevant guidance, which is particularly important for those still uncertain about their major.

One of the course's unique features is its integration of faculty presentations from across the six departments within SPCEET without an increase in the effective workload of any faculty member. During the remaining twelve weeks of the course, students see presentations about the programs offered within the college's six departments, with instructors-of-record rotating between the various sections. Each department is allocated two weeks to introduce students to key concepts, career paths, and challenges specific to their discipline. These presentations aim

not only to inform students about the various options available but also to inspire them through the faculty member's passion for their field. This exposure helps students make more informed decisions about their academic and career paths, reducing the chances of major changes later that could delay graduation and increase costs due to untransferable credits.

Student are assessed via homework assignments and attendance, with their final course grade calculated as 50% assignments and 50% attendance. The six assignments were completed outside of class time and typically involve either the student watching a video on a topic and taking a quiz or completing a homework assignment. The topics of the assignments include time management, professional licensure, professional communication and resume preparation, engineering design, engineering ethics, and a scavenger hunt highlighting university history and resources. There is also an engagement assignment where students attend a college club meeting or seek college tutoring. The students are allowed to drop their lowest attendance and assignment grades.

Experimental Methods/Materials/Project Approach

Kennesaw State University (KSU) is a large, public, Carnegie-designated doctoral research institution (R2). This study was reviewed and approved as exempt by the University Institutional Review Board (IRB Number: FY25-269).

Participants and Data Collection

To evaluate the impact of the ENGR 1000 course on students' confidence in their major choice, awareness of academic programs, decision-making processes, consideration of minors, and whether their plans regarding majors or minors changed during the semester, more than 1,600 students were administered brief surveys three times during the fall 2024 semester. The surveys were administered online through the D2L (Desire2Learn) learning management system during class sessions in the second, sixth, and fifteenth weeks of the semester across all fifteen sections. Participants were provided with information about the study's purpose, voluntary participation, and confidentiality measures.

Students completed the surveys during weeks 2, 6, and 15, identified as the "pre-survey", "demographics", and "post-survey", respectively. Most of these students were freshmen majoring in Civil Engineering, Computer Engineering, Electrical Engineering, Electrical Engineering Technology, Environmental Engineering, Industrial and Systems Engineering, Industrial Engineering Technology, Mechanical Engineering, Mechanical Engineering Technology, or Mechatronics Engineering. The surveys included the multiple choice or multiple select questions shown in Table 1.

Table 1. Questions posed in the three surveys.

WEEK 2 (Pre-Survey)	WEEK 6 (Demographics)	WEEK 15 (Post-Survey)
I am planning to major in the following:	What is your gender?	As of today, what major are you planning to pursue?
How confident are you of your current choice of major?	Choose a race/ethnicity that you consider yourself to be:	Is this a different major than you planned to pursue at the beginning of the semester?
How informed do you feel about all the programs that KSU offers in both engineering and engineering technology?	What is your age group?	How confident are you today of your current choice of major?
How do you feel about the decision-making process you used in selecting your major?	Did you complete high school in the U.S. or another country?	How informed do you feel today about all the programs that KSU offers in both engineering and engineering technology?
What are you hoping to learn from this course?	What was (or is) your high school GPA?	How do you feel today about the decision-making process you used in selecting your major?
I am strongly considering pursuing the following minor(s) to go along with my major of choice.	What is your current academic level?	How has ENGR 1000 impacted your choice of major?
	Are you currently a full-time student?	What do you think that you learned from ENGR 1000?
	What is the first math class that you took, are taking, or will take at KSU?	As of today, what minor(s) are you strongly considering to go along with your major of choice?
	Are you currently enrolled in a paid position?	Has your opinion on pursuing a minor changed over the course of this semester?
	Have you ever served in the military?	
	Are you the parent or legal guardian of a minor?	
	Do you consider yourself a first-generation college student?	
	Please indicate if you have experienced any of the following barriers due to a disability when selecting your engineering major (check all that apply):	
	What was your educational background immediately before joining KSU's Southern Polytechnic College of Engineering & Engineering Technology (SPCEET)?	

Data Analysis

Survey responses were de-identified prior to analysis. Descriptive statistics were used to summarize and examine overall trends in students' responses. Measures including frequency

distribution and means provided an overview of patterns as well as shifts in student perceptions before and after completing the ENGR 1000 course. To assess whether these changes were statistically significant, tests for equivalence of proportions were conducted to compare responses at the beginning and end of the semester.

Results and Discussion

The study surveyed over 1,600 participants enrolled in the ENGR 1000 course to gather comprehensive insights into their demographic, academic, and employment-related characteristics. The diverse student population reflects a wide range of experiences, backgrounds, and aspirations, offering valuable context for evaluating the impact of ENGR 1000 on students' academic trajectories, decision-making processes, and confidence in their chosen paths.

Demographic Profile

The demographic data reveals the diverse composition of students enrolled in ENGR 1000, highlighting trends in gender, race/ethnicity, age, and high school backgrounds. Below, Figures 1-3 provide a visual summary of some of the key demographic findings, followed by an in-depth discussion of the results.

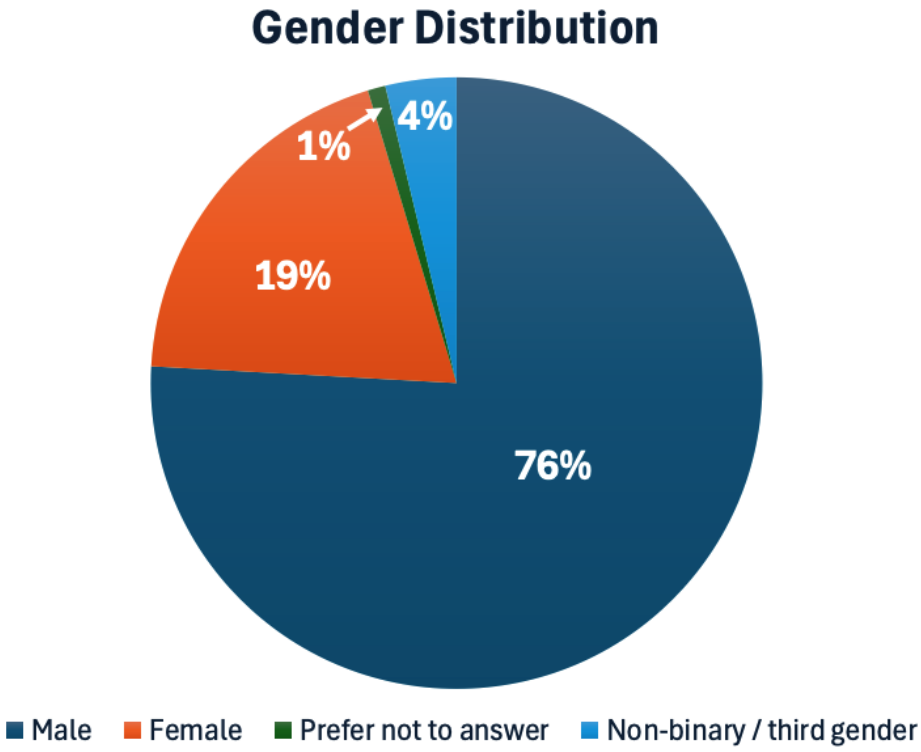

Figure 1. Student Demographics: Gender.

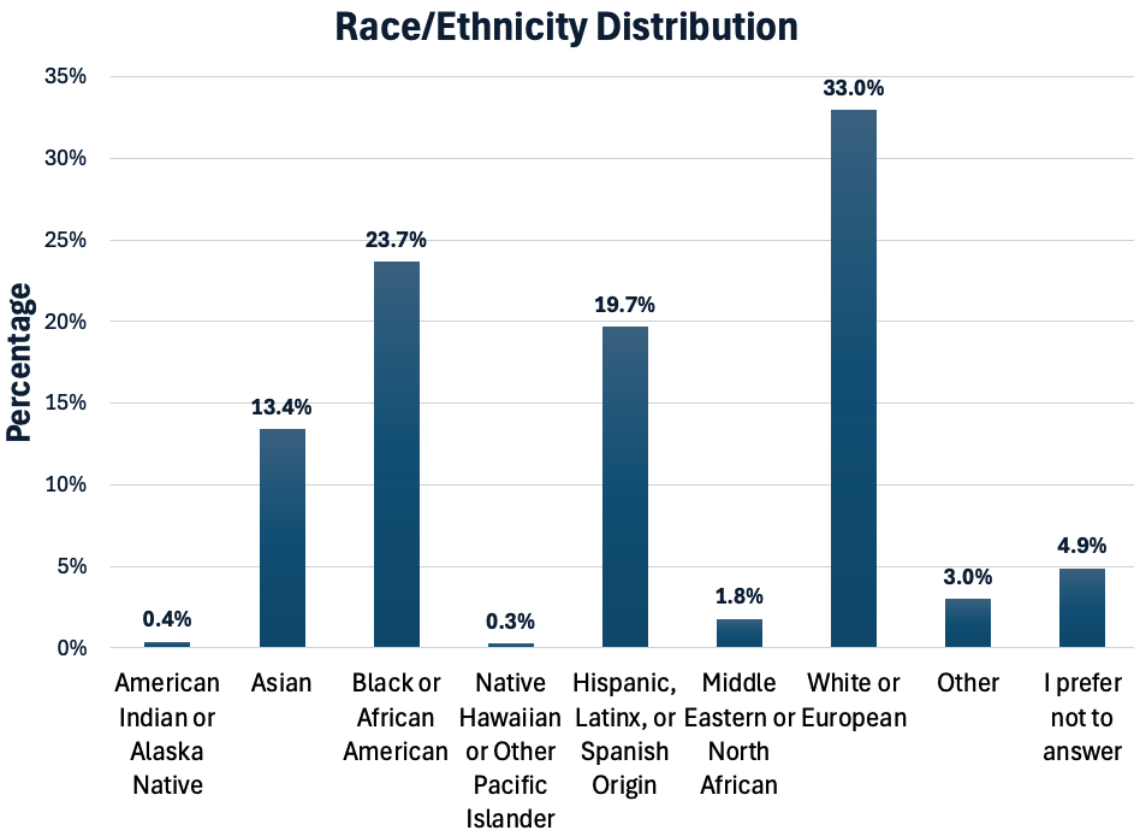

Figure 2. Student Demographics: Race/Ethnicity.

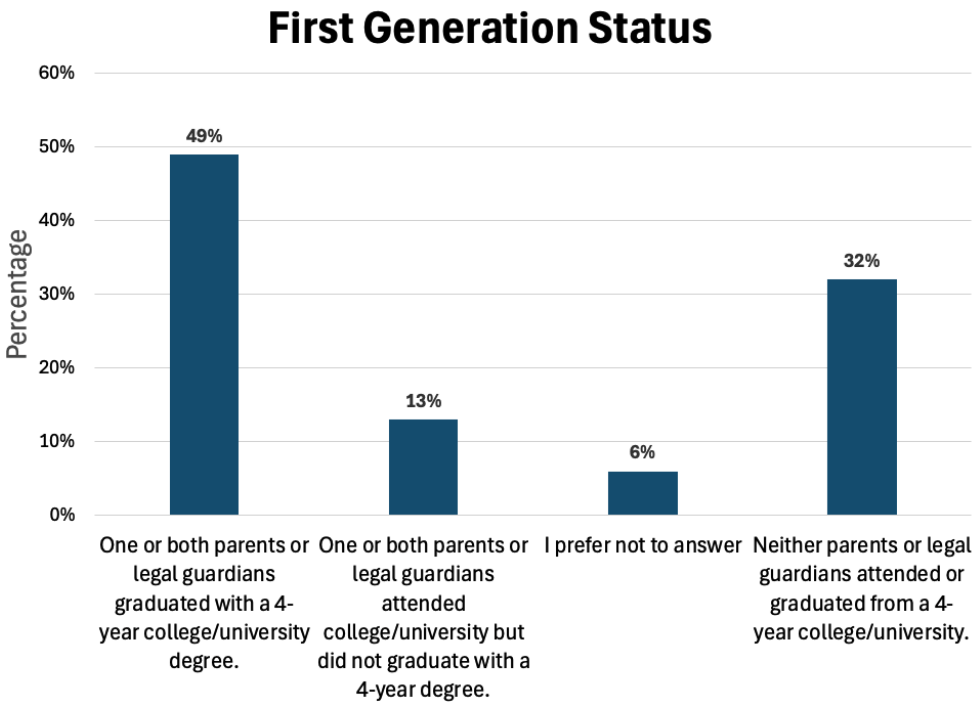

Figure 3. Demographics: First Generation College Student Status.

- **Gender**: Most respondents identified as male (76%), while female students constituted 19% of the sample. A smaller percentage of students identified as non-binary or third gender (4%) or preferred not to disclose their gender identity (1%).
- **Race/Ethnicity**: The survey captured a broad range of racial and ethnic representation. White or European students made up the largest group (33%), followed by Black or African American students (24%) and Hispanic, Latinx, or Spanish Origin students (20%). Asian students accounted for 13% of respondents, while smaller percentages identified as Middle Eastern or North African (2%) and American Indian/Alaska Native (0.4%). Approximately 5% preferred not to disclose their race or ethnicity.
- **Age**: The survey population was predominantly composed of traditional college-aged students, with 91% aged between 18 and 24 years. Smaller subsets included students aged 17 or younger (3%) and those aged 25 or older (3%). An additional 3% chose not to disclose their age.
- **First-Generation College Students**: The US Department of Education defines first-generation college students as those where neither parent has completed a bachelor's degree [7]. 45% of respondents in this study are identified as being first-generation college students, reflecting an important demographic group larger than those found in other studies [8], and who may require targeted support. 49% of the respondents indicated that at least one parent had completed a four-year degree. The remaining respondents (6%) preferred not to answer.

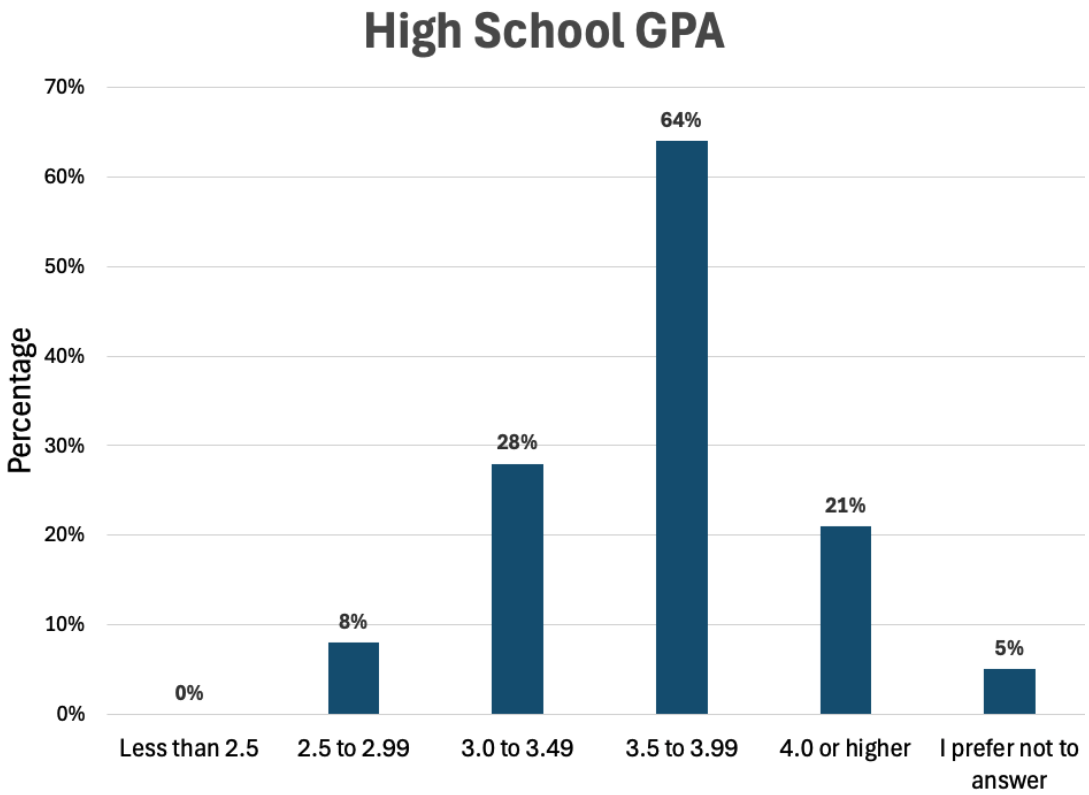

Figure 4. Students' Academic Background: High School GPA.

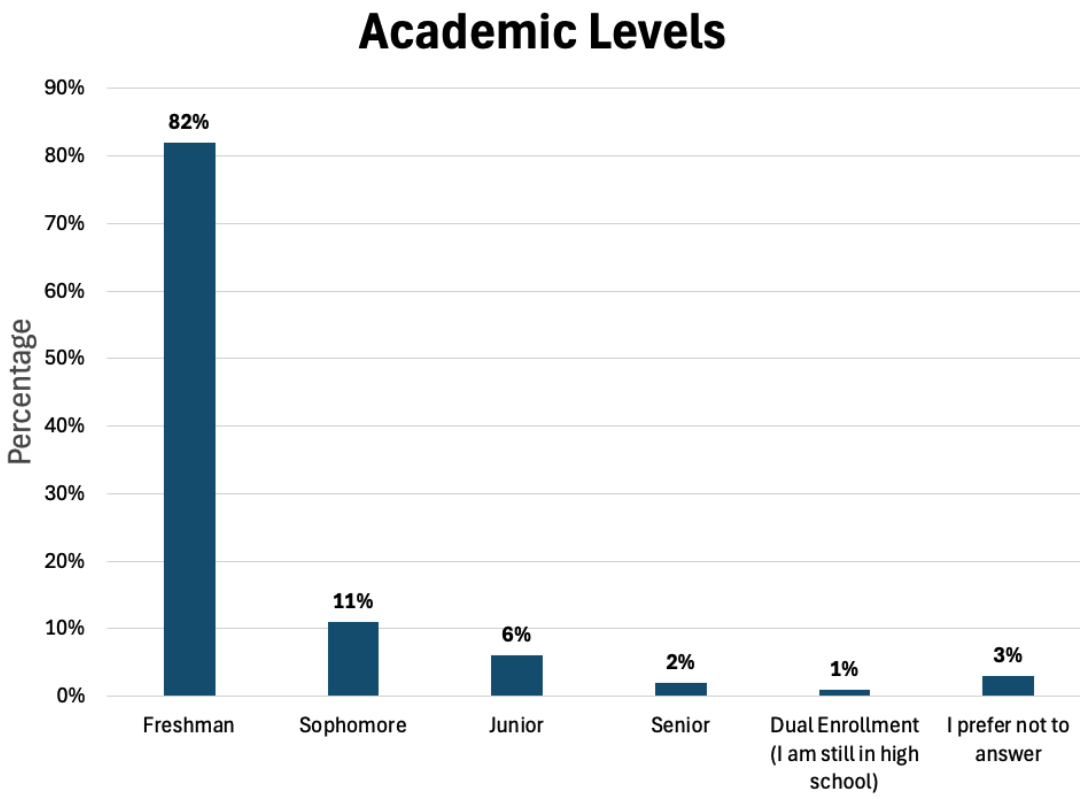

Figure 5. Students' Academic Background: Current Academic Level.

Academic Background

Understanding students' academic preparation and enrollment patterns provides context for the course's impact. Below, Figures 4-5 provide a visual summary of some of the students' academic backgrounds, followed by an in-depth discussion of the results.

- **High School Background**: Many respondents (94%) graduated from high schools in our state of Georgia, underscoring the local impact of Kennesaw State University (KSU) on engineering education. A smaller subset of students completed high school either in other U.S. states (2%) or internationally (1%), with 3% choosing not to answer.
- **High School GPA**: Academic performance among respondents was strong, with 64% reporting high school GPAs between 3.5 and 3.99. A smaller but significant portion (28%) had GPAs between 3.0 and 3.49, while 21% achieved a perfect GPA of 4.0 or higher. These findings highlight a cohort with strong academic preparation entering ENGR 1000.
- **Current Academic Level**: The survey primarily included first-year students, with 82% identifying as freshmen (defined as fewer than 30 earned credit hours). Sophomores constituted 11% of the sample, while juniors accounted for 6%. This distribution aligns with the course's focus on first-year engineering students.
- **Math Preparedness**: Math placement varied among respondents. A plurality (37%) began their coursework at KSU with Math 1111 (College Algebra), while 19% started with Math 1113 (Pre-Calculus) and 24% with Math 1190 (Calculus 1). Notably, 15% of

participants had completed Calculus 1 prior to enrolling at KSU, suggesting a subset of students entered with advanced math preparation.

- **Enrollment Status**: Many respondents (87%) were full-time students, consistent with typical enrollment patterns for first-year engineering programs. A smaller portion (9%) were enrolled part-time.

Employment and Life Circumstances

The survey also explored students' employment status, family responsibilities, and military service, offering insights into their broader life circumstances. The students' current employment status is shown in Figure 6, followed by an in-depth discussion of the results.

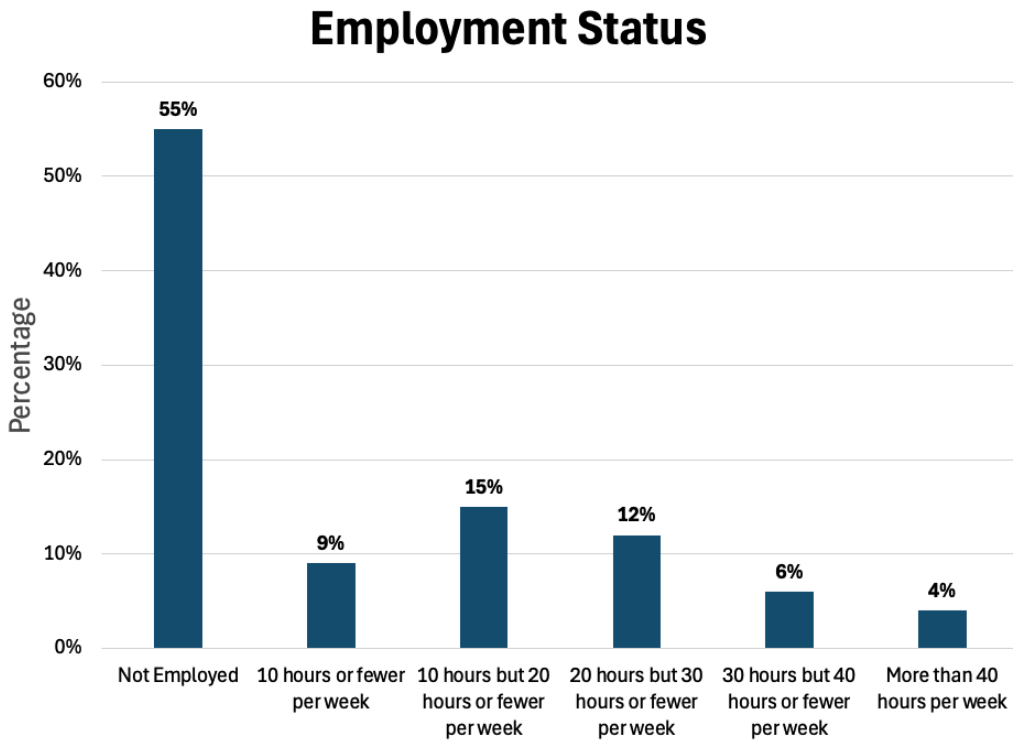

Figure 6. Employment and Life Circumstances: Employment Status.

- **Employment Status**: A little over half of respondents (55%) were not employed while attending school. Meanwhile, 15% worked 10–20 hours per week, 12% worked 20–30 hours, 6% worked 30–40 hours, and 4% worked more than 40 hours. These data suggest that a significant portion of students balance employment with their academic commitments, which could influence their engagement with the course.
- **Parenting and Military Service**: Only 2% of respondents identified as parents or legal guardians of a minor. Similarly, 1% identified as veterans, and another 1% were actively serving in the military. Most students (95%) reported no such responsibilities.
- **Future Academic Plans**: Most respondents (72%) planned to continue their studies at KSU as full-time students, while smaller subsets considered part-time enrollment (3%), transferring to another institution (8–10%), or discontinuing their studies (less than 1%).

Learning Objectives and Outcomes

The course successfully addressed students' pre-course learning objectives. Respondents entered the course with clear goals, including gaining knowledge about careers in engineering (1,185 responses), KSU majors (908 responses), and average starting salaries (845 responses). Post-course data indicated significant increases in learning across these areas, including a 142-response gain in understanding KSU majors and a 221-response gain in awareness of KSU's student support services. However, undergraduate research opportunities showed no notable change (463 responses pre- and post-course), indicating a potential area for improvement.

Table 2. Answers to the pre-semester survey question "What are you hoping to learn from this course? (Select all that apply)"

Summary	
Types of careers in engineering and/or engineering technology.	1185
The different majors offered at KSU in engineering and/or engineering technology.	908
The average starting salaries different majors earn in engineering and/or engineering technology.	845
Information about graduate school.	463
Undergraduate research opportunities at KSU.	463
KSU student support services: free tutoring, mental health support, etc.	345
I prefer not to answer	41

Table 3: Answers to the post-semester survey question "What do you think that you learned from ENGR 1000? (Select all that apply)"

Summary	
The different majors offered at KSU in engineering and/or engineering technology.	1050
Types of careers in engineering and/or engineering technology.	1000
The average starting salaries different majors earn in engineering and/or engineering technology.	728
KSU student support services: free tutoring, mental health support, etc.	566
Undergraduate research opportunities at KSU.	514
Information about graduate school.	514
I prefer not to answer	47

Impact on Major Selection

ENGR 1000 demonstrated a meaningful influence on students' major decisions, as demonstrated by their answer to the question 'How has ENGR 1000 impacted your choice of major?'**:**

- 50% confirmed their prior major choice, reflecting the course's ability to reinforce students' initial decisions.
- 14% changed their major, highlighting the course's role in guiding students toward more suitable academic paths.
- 27% indicated that while the course had no impact on their major choice, the students still found the course useful.
- Only 7% reported no impact or utility from the course, and 2% preferred not to give a response.

These findings suggest that ENGR 1000 serves as both a validation tool for students with clear preferences and a corrective tool for those exploring their options.

Confidence in Major Selection

Students were asked 'How confident are you today of your current choice of major?' at both the beginning and end of the semester, and results are displayed in Table 4. The data reveal that the course significantly enhanced students' confidence in their major selection:

At the end of the semester, a combined 73.3% of respondents rated their confidence as "Very Confident" or "Extremely Confident," indicating a high level of conviction in their academic choices, compared with 56.0% at the beginning of the semester. (Statistically significant difference at p-value 0.0000.) Only 5.3% reported low confidence levels ("Not Confident at All" or "Slightly Confident"), compared with 9.0% at the beginning of the semester, suggesting the course is generally effective at addressing uncertainty.

Table 4: Comparison of student confidence in their major choice in the pre- and post-semester surveys.

Summary	Pre	Post
1 - Not Confident at All I lack conviction in my choice of major or have not yet chosen a major.	1.7%	0.9%
2 - Slightly Confident I am leaning towards my choice of major but have some uncertainty.	7.8%	4.3%
3 - Moderately Confident I am reasonably confident that my choice of major is the best possible major for me, but still have some lingering doubts.	33.3%	20.1%
4 - Very Confident I am pretty confident that my choice of major is the best possible major for me.	36.9%	42.1%
5 - Extremely Confident I am completely confident that my choice of major is the best possible major for me.	19.1%	31.3%
I prefer not to answer	1.1%	1.4%

Confidence in the decision-making process used to select a major mirrored these findings. Students were asked 'How do you feel about the decision-making process you used in selecting your major?' at the beginning and end of the semester, with results displayed in Table 5. The percent of students who were very confident or extremely confident increased over the semester (p-value 0.0000), with 69.9% at the beginning and 78.9% at the end. This indicates that ENGR 1000 not only supports students in selecting a major but also helps them feel assured in the methods they use to arrive at their decisions.

Table 5: Comparison of student confidence in their decision-making process in the pre- and post-semester surveys.

Summary	Pre	Post
1 - Not Confident at All I have no confidence in the decision-making process that I used to select my major, or I haven't yet chosen a major.	1.9%	0.6%
2 - Slightly Confident The decision-making process that I used to select my major was probably not very good.	5.1%	2.9%
3 - Moderately Confident I am not sure if the decision-making process that I used to select my major was good.	21.8%	16.0%
4 - Very Confident I think that my decision-making process in selecting my major was pretty good.	50.2%	46.8%
5 - Extremely Confident I have no doubts or reservations about my decision-making process in selecting my major.	19.7%	32.1%
I prefer not to answer	1.3%	1.7%

Distribution of Planned Majors

At both the beginning and end of the semester, Mechanical Engineering emerged as the most popular major, accounting for 41% of students planned choices at the beginning and 39% at the end. As shown in Table 6, other majors above 10% of the students were Civil Engineering, Computer Engineering, and Electrical Engineering.

Table 6: Comparison of students' major choices in the pre- and post-semester surveys.

Summary	Pre	Post
Mechanical Engineering	40.7%	38.7%
Civil Engineering	12.5%	13.5%
Computer Engineering	12.6%	11.5%
Electrical Engineering	10.4%	11.9%
Mechatronics Engineering	6.5%	4.9%
Mechanical Engineering Technology	3.4%	5.5%
Industrial and Systems Engineering	2.8%	3.8%

Environmental Engineering	2.6%	1.8%
Industrial Engineering Technology	1.9%	1.6%
Electrical Engineering Technology	1.6%	*
Other	0.8%	2.6%
I want to study engineering or engineering technology, but I am not yet sure which major	2.1%	1.5%
I'm not yet sure if I want to major in engineering or engineering technology	0.9%	1.4%
I prefer not to answer	1.0%	1.2%

Notably, 1.5% of respondents at the end of the semester indicated they were still unsure about their specific major within engineering, and 1.4% remained uncertain about pursuing engineering altogether. This highlights the importance of continued support for undecided students. Unfortunately, there was an error in our data collection in which the post-survey had electrical engineering listed twice for a major rather than electrical engineering technology (EET) as one of the options. 1.6% of students had selected EET as their major choice in the pre-survey and we do not have the data for the post-survey, as noted by an asterisk (*) in the table.

Majors Changed and Trends

As noted above, a significant subset of students (14%) reported that ENGR 1000 helped them realize that their initial choice of major was not the best fit. This outcome underscores the course's ability to function as a transformative experience for students in evaluating their academic and career goals.

Overall, 24.0% of students reported that they changed their major to another major within engineering and engineering technology over the course of the semester and 1.6% determined they no longer wanted to major in engineering or engineering technology. Seventy-one percent of students stayed in the same major and 3.3% selected “other” or preferred not to answer.

Conclusion

The study highlights the significant role of the ENGR 1000 course in shaping students’ academic decisions, confidence levels, and future trajectories. The surveyed population included over 1,600 participants, predominantly composed of male students (76%), with diverse racial and ethnic representation and strong academic backgrounds. Most students were freshmen (82%) with a high school GPA of 3.5 or above (85%) and enrolled full-time (87%). These demographics provide valuable context for understanding the course's broader impact.

The ENGR 1000 course successfully addressed students' pre-course learning objectives, with notable increases in knowledge about engineering careers, KSU majors, and student support services. A significant portion of students (50%) reported that the course confirmed their initial choice of major, while 14% reported it impacted them changing their major, underscoring the

course's role as both a validation and corrective tool. Additionally, the course effectively enhanced confidence in major selection, with 75% of respondents expressing "Very Confident" or "Extremely Confident" ratings in their choice at the end of the semester, an increase of 19% compared to the beginning of the semester, and 79% reporting similar confidence in their decision-making process at the end of the semester, an increase of 9% compared to the beginning of the semester.

Mechanical Engineering emerged as the most popular planned major (43%), with Civil and Computer Engineering each accounting for 13% of respondents. Smaller percentages of students showed interest in disciplines such as Environmental and Mechatronics Engineering, while 2% remained undecided about their specific major, highlighting a need for ongoing support for undecided students. The course also demonstrated its transformative potential, guiding students to majors better aligned with their goals and helping a small subset (2%) make the informed decision to leave the field of engineering altogether.

These findings emphasize the importance of ENGR 1000 in facilitating informed academic choices, enhancing confidence, and supporting students in aligning their career aspirations with their skills and interests. However, areas such as undergraduate research opportunities and targeted advising for students with lingering doubts remain opportunities for improvement to further enhance the course's impact.

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