

Supporting Engineering Ph.D. Students' Professional Development through a Career Discernment Course

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Abstract

The career landscape for engineering Ph.D. graduates is changing rapidly, creating new challenges for how students identify and prepare for career pathways. This paper evaluates the impact of a discernment course designed to support informed decision-making among engineering Ph.D. students at a medium-sized, Midwestern private institution. The course featured panels with alumni who shared experiences in industry, academia, and national laboratories, offering students concrete examples of diverse career trajectories. Additionally, the course offered career preparation activities such as resume/CV preparation, job search tools, networking, and practice interviews.

Researchers for this project analyzed pre- and post-course survey data from three cohorts of participants. Survey items captured students' career intentions (and how they have shifted throughout the course), satisfaction with academic progress, advisor and financial support, as well as open-ended reflections on career interests and concerns.

Quantitative results indicate that participation in the career panels was associated with measurable shifts in students' stated career interests, including an increase in interest in industry positions and a decline in interest in academic careers. The panels also strengthened students' confidence in evaluating the feasibility and trade-offs of different career pathways. Qualitative responses highlighted financial stability, work-life balance, and opportunities for applied impact as key drivers of interest in industry, while students who remained drawn to academia cited research freedom and mentoring as primary motivations. For international students, immigration and visa status emerged as major concerns impacting career planning. Overall, students highly valued the course components focused on career exploration and professional development, as reflected in consistently high satisfaction ratings across three cohorts.

Our findings demonstrate that structured career discernment interventions support students in identifying their career interests and provide graduate students with tools to make more intentional and informed career decisions.

Introduction

The career landscape for engineering Ph.D. graduates is changing rapidly, creating new challenges in how students identify and prepare for career pathways. Yet traditional doctoral training often provides insufficient structured guidance to help students navigate these evolving options, and evaluations of such programs have been limited. This study addresses this gap by examining a targeted intervention in the form of a credit-bearing career discernment course. The course offers a structured curricular experience designed to support intentional reflection and informed career decision-making. It integrates practical career preparation workshops, including resume and CV development, with structured exposure to diverse professional pathways through

alumni panels. This study evaluates how these components shape students' career interests, confidence, and decision-making processes.

Research has shown that choices of career pathway significantly influence a person's economic stability, emotional well-being, lifestyle, and social status [1]. Furthermore, making a career decision is a complex process that requires students to evaluate multiple potential paths and consider how well these align with their interests, as well as their respective advantages and disadvantages. Many studies have focused on engineering undergraduate students' career paths [2], [3]. Results by Schadl et al. suggest that, among other factors, more frequent conversations about professional futures with peers and faculty members helped career certainty [4]. Ro analyzed survey data from over 5,000 engineering undergraduates across 31 U.S. institutions to examine factors influencing their post-graduation plans [5]. Their findings revealed that engineering students' career intentions are complex and fluid, shaped by curricular experiences, co-curricular engagement, self-assessed skills, and gender. The study argued that engineering programs should provide diverse and integrated academic and professional experiences to help students make more informed and sustained career decisions.

Compared with the extensive literature on undergraduate engineering students' career pathways, less research has examined graduate students' career exploration and professional development needs. The existing graduate-level literature, however, provides important evidence that engineering graduate students' career interests are complex, evolving, and shaped by their doctoral experiences. Choe and Borrego surveyed 249 engineering graduate students and found that they are considering multiple career options, which led to the argument that they need broader professional preparation [6]. Shanachilubwa et al. conducted qualitative interviews with 42 engineering graduate students to explore how they construct schemas of academia [7]. They found that unmet expectations about their graduate experience, limited agency, and inadequate support often led to disenchantment and reduced interest in academic careers. The authors recommend that engineering programs better prepare students for diverse career paths, including industry and government roles. Similarly, Sallai and Berdanier's longitudinal qualitative study of first-year engineering doctoral students found that students' goals changed over the course of the first year, often becoming more short-term as students encountered the pressures of graduate school [8]. They argued that graduate programs should create more opportunities for reflection on students' goals, the value of the doctoral degree, and the alignment between doctoral training and future careers. Some researchers have looked into support programs. For example, Ortega-Alvarez et al. analyzed professional development plans written by engineering Ph.D. students in a course called "Succeeding as an Engineering Professor" [9]. They found that guided reflection and mentorship helped students identify imbalances between their skills and career expectations, emphasizing the need for explicit training in balancing teaching, research, and personal goals.

Findings from prior studies support the need for career discernment interventions like the course examined in the present study. Existing research has established that engineering graduate students need opportunities for career reflection, professional development, and exposure to diverse career pathways. However, fewer studies have examined the efficacy of such interventions using pre- and post-course evidence. Similar initiatives have aimed to help engineering graduate students gain clarity about professional pathways through mentoring,

reflection, and experiential learning. McComb and Blevins's [10] graduate seminar series at Purdue University aimed at demystifying academic careers by covering topics such as the academic job search, interview process, and development of a teaching philosophy. Purdy's evaluation of the Preparing Future Faculty program at the University of Cincinnati found that structured mentoring and seminars on teaching, job searches, and career planning helped participants make more realistic and informed academic and nonacademic career decisions [11].

These studies suggest that effective career discernment interventions integrate mentoring, reflective practice, and exposure to real-world professional experiences. They help students not only explore multiple career trajectories but also develop the self-awareness, confidence, and contextual understanding necessary to make intentional career decisions. The present study extends this line of work by evaluating a structured career discernment course, which is focused on understanding professional pathways open to engineering Ph.D. students and supports engineering Ph.D. students' career preparations, including resume, CV, LinkedIn, job-search, and practice-interview support.

Project Approach

The current study was conducted at a private institution in the Midwest with a Carnegie classification of R1, a doctoral university with high research activity [12]. The current study focused on the assessment of a 1-credit hour Engineering Graduate Discernment Course which has two primary components: (1) personal career preparations, which consisted of interactive workshops that included resume and CV preparation, practice interviews, job search tools, and networking/LinkedIn; and (2) exploring future professional options for Ph.D. students, where a series of panels were scheduled relating to academic pathways, industry pathways, government/national labs, postdoctoral studies, and entrepreneurship. Panelists offered differing perspectives among those pathways; for example, the academic panel included faculty who held different types of appointments: research, teaching, teaching & research (i.e., tenure track), and tenured with administration. The class has been offered three times from 2023 to 2025 and has around 40 students enrolled each time. Students are asked to complete a pre-course and post-course survey to indicate their career interests and feedback for the course, among other background information. Table 1 shows a subset of survey questions and Table 2 lists the sample sizes. The full survey is attached in Appendix 1 and the results of those surveys are analyzed in the next section.

Table 1. Example of Survey Questions.

Topic	Question	Scale
Likelihood of career field	How likely are you to pursue a career in academia (college professor/instructor/researcher) after graduation?	- Definitely yes
	How likely are you to pursue a career in industry (profit sector) after graduation?	- Probably yes
	How likely are you to pursue a career in government (e.g. at a national lab) after graduation?	- Neutral
		- Probably no
		- Definitely no

	After completing my graduate studies, I plan to work in a field related to the degree I am pursuing.	
	Explain your interest in an industry career.	
	Explain your interest in an academic career.	
	Explain your interest in a government career.	
	Are there other career fields that interest you? Please describe.	

Table 2. Number of Responses.

	2023	2024	2025	Total
Pre-course Survey	41	36	46	123
Post-course Survey	39	32	36	107

Results and Discussion

Students’ evaluation of the course and its components

Figure 1 summarizes student evaluations of the course and its major components across three academic years (2023-2025). The results reveal a consistent upward trend in student satisfaction, both for the course overall and for both components.

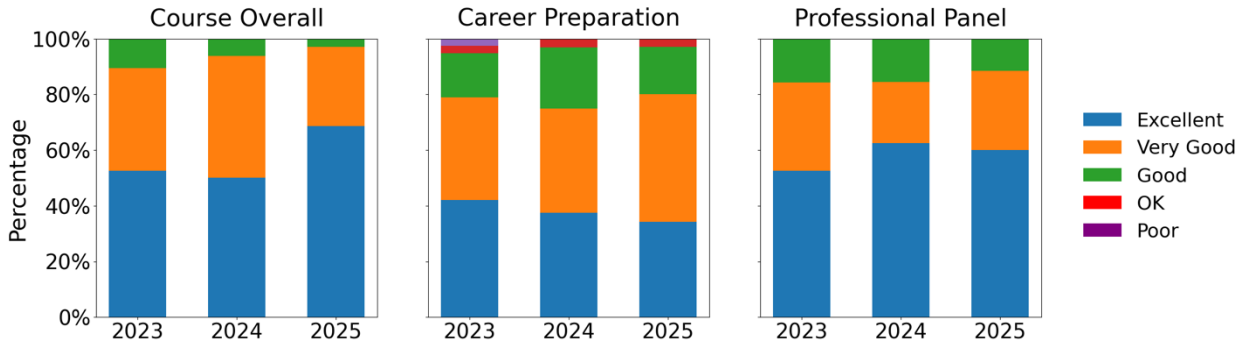


Figure 1. Student ratings of (a) the course overall, (b) the career preparation component, and (c) the professional panels.

The first panel shows students’ overall evaluation of the course. The overall satisfaction rates (combining “Excellent” and “Very Good”) were 89.2% in 2023, 93.6% in 2024, and 97.2% in 2025. This upward trend suggests sustained improvement in course quality over time, likely reflecting iterative refinements in course design and alignment with student needs.

The second panel shows that the combined “Excellent” and “Very Good” ratings for the career preparation component were 78.3% in 2023, 74.2% in 2024, and 80.0% in 2025. Although these ratings are lower than those for the course overall, the notable increase in 2025 suggests that recent revisions to this component have positively impacted student perceptions. At the same time, the comparatively lower ratings indicate continued room for improvement, particularly in tailoring career preparation content to diverse student goals and career trajectories.

The final set of ratings evaluated the professional panel component, which exposes students to career pathways and lived experiences across multiple sectors. The combined “Excellent” and “Very Good” ratings for this component were 83.8% in 2023, 83.9% in 2024, and 88.6% in 2025. The marked increase in the most recent year suggests that enhancements to panel structure, speaker selection, or integration with course objectives have strengthened student engagement and perceived value. Overall, students consistently rated the professional panels more favorably than the career preparation component, indicating that first-hand perspectives from professionals may resonate particularly strongly with students.

A qualitative analysis of students’ open-ended feedback to the course reinforced the strong perceived value of both the career preparation component and the professional panels, while also highlighting their distinct and complementary roles in supporting career discernment. Students consistently described the career preparation component as practical, necessary, and action-oriented, emphasizing its focus on resumes and CVs, job searching, and awareness of campus resources, which are areas that many felt were insufficiently addressed elsewhere in graduate training. Several students noted that this component was “the whole reason I took this class” and praised the structured accountability for prompting timely engagement with career materials that they “would otherwise hold off on until applications were due.” At the same time, some students expressed a desire for more differentiation by career stage and status, particularly for international students and those seeking more advanced or tailored guidance.

The professional panels were widely characterized as the most engaging and influential aspect of the course, valued for providing firsthand perspectives on real career trajectories and day-to-day work realities. Students frequently emphasized the importance of hearing from professionals who were “5-10 years ahead” and appreciated the honesty with which panelists discussed trade-offs related to work-life balance, career mobility, and uncertainty. As one student reflected, “The only shortcuts we have through life are someone else’s experience,” a sentiment echoed by many who described the panels as eye-opening and central to clarifying their own career thinking.

Taken together, the feedback suggests that the career preparation sessions primarily supported students’ development of concrete skills and readiness, while the professional panels played a critical role in shaping perspective, confidence, and long-term career discernment. Many students highlighted how the combination of skills-based preparation and experience-based exposure created a more holistic and meaningful framework for navigating complex career pathways.

Students’ reported likelihood of pursuing different career fields

Figure 2 illustrates graduate students’ self-reported likelihood of pursuing four broad career pathways after graduation across three cohorts (2023-2025): industry, national laboratories, academia, and entrepreneurial/start-up roles. Across all years, industry careers consistently attract the highest level of interest, with combined “definitely/probably yes” responses remaining high (85% in 2023, 75% in 2024, and 89% in 2025). This pattern suggests that industry is widely perceived as the most accessible and practical pathway, likely reflecting clearer hiring pipelines, competitive compensation, and more predictable career trajectories.

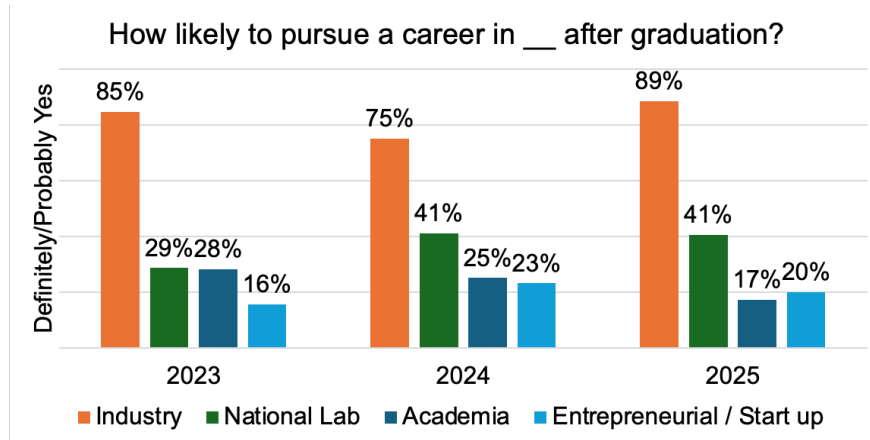


Figure 2. Graduate students' interests in four types of jobs.

Interest in national laboratories increased substantially from 29% in 2023 to 41% in both 2024 and 2025, suggesting growing awareness or appreciation of this sector among students. In contrast, interest in academia remains comparatively lower and shows a gradual decline over time (28% in 2023, 25% in 2024, and 17% in 2025), consistent with broader concerns about job availability, extended training periods, and job security in faculty careers. Entrepreneurial and start-up interest remains modest but stable, ranging from 16% to 23%. This suggests that while entrepreneurship appeals strongly to a subset of students, it is not perceived as a primary pathway for the majority, possibly due to perceived risk, lack of institutional support, or limited prior exposure.

Open-ended responses in the survey help explain these trends. Students interested in industry most often emphasized practical considerations, including compensation, job availability, visa sponsorship, and work-life balance. Several described industry as offering “better pay and clearer career paths” or a chance to “see my work make a real-world impact,” though some also noted concerns about limited autonomy or narrowly defined roles. Meanwhile, national laboratory careers were frequently described as a “middle ground” between academia and industry. Students valued the opportunity to work on mission-driven, large-scale research with greater stability and fewer publication pressures, with one noting the appeal of “cutting-edge research without the constant pressure to publish.” At the same time, many international students cited citizenship and security-clearance requirements as significant barriers, which reduced feasibility despite strong interest.

Responses about academia were more ambivalent. Even among students reporting low likelihood of pursuing academic careers, many expressed appreciation for teaching, mentoring, and intellectual freedom, while highlighting concerns about job uncertainty, prolonged training, and work-life balance. As one student summarized, “I enjoy teaching and research, but the job market and tenure process are intimidating.” Entrepreneurial pathways appeared primarily as long-term or secondary options, often framed as exploratory rather than immediate career plans. Overall, the qualitative responses suggest that students' stated career interests reflect careful consideration of both opportunities and constraints, shaped by increased exposure to professional pathways and realistic assessments of feasibility.

Change in students' career interests after the course

Figure 3 provides a comparison of how students' career interests change over time as a function of two distinct influences: their broader Ph.D. program experience and their participation in this specific course. These two influences do not operate uniformly across career pathways, nor do they exert effects of the same direction or magnitude. For academic careers, interest changes associated with the Ph.D. program are consistently negative across all three cohorts, with especially pronounced declines in 2024 and 2025. This pattern aligns with a well-documented phenomenon in doctoral education: as students gain more direct exposure to academic labor conditions, expectations, and career uncertainty, enthusiasm for an academic trajectory often decreases. In contrast, the course itself exerts a small but consistently positive influence on academic interest in all three years, most notably in 2024. This divergence suggests that the course may play a buffering or reframing role, helping students reinterpret academic careers in more concrete, skill-based, or realistic terms rather than idealized ones.

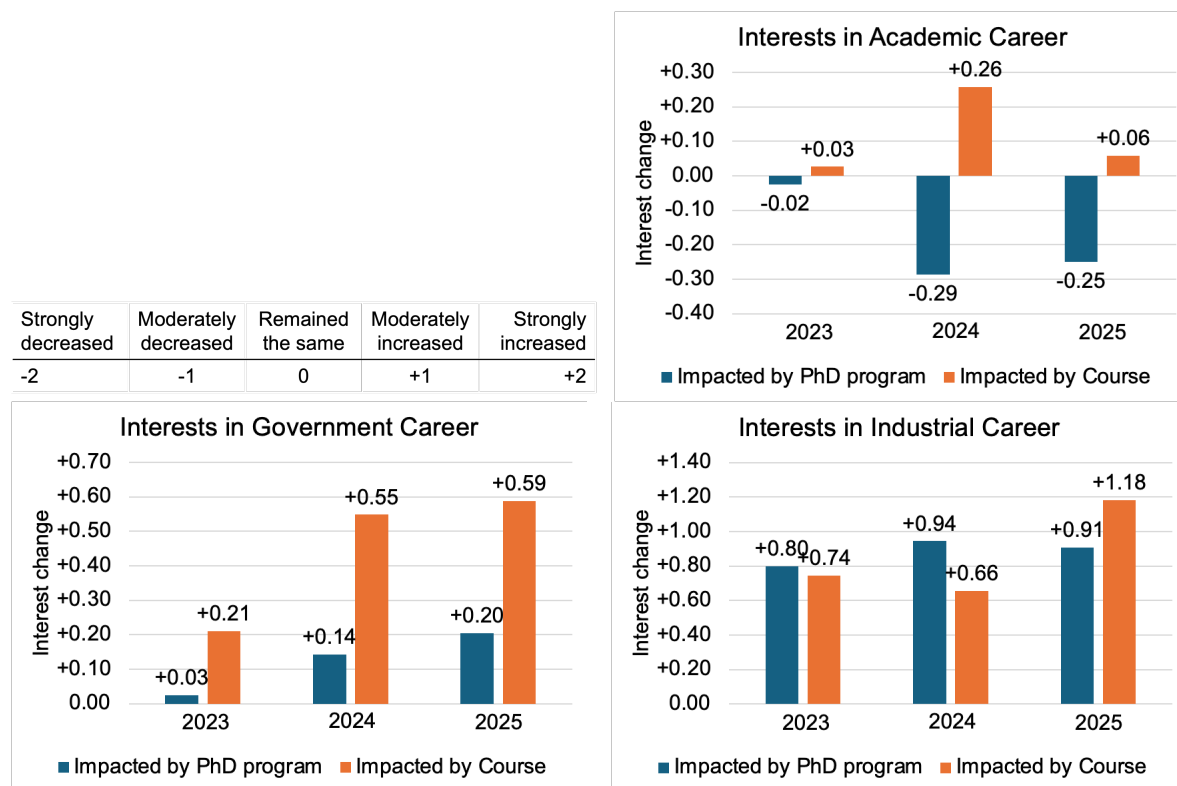


Figure 3. Changes of students' interests in different types of careers after the course.

A different pattern emerges for government careers, where both the Ph.D. program and the course contribute positively to interest growth, but the course effect is substantially larger and increases steadily from 2023 to 2025. This finding suggests that structured curricular exposure can make government careers more visible and attainable than they might otherwise appear within a traditional Ph.D. environment. Finally, industrial careers show the strongest overall interest gains, driven by both influences. However, the relative balance between program and course shifts over time: while the Ph.D. program consistently increases interest in industry

(reflecting internships, collaborations, or peer norms), the course impact surpasses the program effect in 2025, reaching its highest value across all panels. Overall, Figure 3 suggests that career interest formation is not a passive byproduct of doctoral training; rather, it is highly sensitive to targeted curricular design.

Limitations and Future Directions

Several limitations to this study should be considered. First, the analysis relies on self-reported survey data collected immediately before and after the course. While these comparisons capture short-term changes in perceptions and stated career interests, they do not reflect long-term behavioral outcomes such as internship participation, first-position placement, or sustained career trajectories. Changes in reported interest may not translate into actual employment outcomes. Accordingly, the findings should be interpreted as evidence of short-term shifts in self-reported career intentions rather than definitive indicators of long-term impact. However, these self-reported pre- and post-course measures provide a useful starting point for assessing whether intentional career discernment programming can influence students' thinking. Future research should examine whether post-course intentions align with subsequent career outcomes through longitudinal tracking of employment data. Linking survey responses with alumni follow-up surveys or institutional placement records would allow assessment of whether shifts in stated intentions correspond to realized career pathways and durable career decision-making.

Second, the course was embedded within the institution's specific resources, alumni networks, and career services infrastructure. Because access to professional development support varies across universities, the structure and outcomes of this intervention may not be directly replicable in all settings. Transferability is therefore strongest in institutions with comparable professional development resources. At the same time, the core model, which integrates structured career preparation workshops with structured exposure to professional pathways, can be adapted across institutional contexts. Institutions with fewer resources could scale the model by leveraging virtual panels, cross-institutional collaborations, or embedding career preparation modules within existing graduate seminars rather than offering a standalone credit-bearing course. Future work could examine how institutional differences influence implementation and effectiveness.

Finally, qualitative responses indicated that immigration and visa considerations influenced career decision-making for international students. These concerns were addressed during panel discussions and Q&A sessions, where speakers discussed employment constraints across sectors. However, future iterations of the course could provide more targeted guidance, including structured discussion of visa sponsorship trends, employment eligibility limitations, and alternative pathways. Recognizing that career feasibility differs across student populations is essential for ensuring equitable access to professional development support.

Summary

Taken together, these findings indicate that the career discernment course plays a meaningful role in supporting engineering Ph.D. students' professional decision-making beyond what occurs through doctoral training alone. High satisfaction ratings demonstrate strong student appreciation

for both the practical skill development and experiential exposure embedded in the course design. At the same time, shifts in career interest patterns suggest that structured interventions can influence how students interpret, evaluate, and prioritize available career pathways.

Importantly, the course supported students' exploration of a wide range of career pathways without privileging or narrowing outcomes, combining skills-based preparation with direct exposure to professionals' lived experiences. For many students, particularly those navigating uncertainty related to academic careers or structural constraints such as visa status, this approach enhances confidence, clarity, and intentionality in career planning. These results highlight the potential for intentionally designed, credit-bearing career discernment courses to complement doctoral programs and better prepare engineering Ph.D. students for diverse and evolving professional futures.

Appendix

Pre-Course Survey Questions (Grouped by Topic)

Topic	Sub-category	Question	Scale
Graduate Experience	Research fit	I am interested in my research topic.	- Strongly agree - Somewhat agree - Neither agree nor disagree - Somewhat disagree - Strongly disagree
		My current research topic aligns with my professional goals.	
		I am generally satisfied with my research.	
		I enjoy conducting my current research.	
	Academic progress	I am generally satisfied with my academic progress.	
		I am generally satisfied with the progress I am making on my goals.	
		I am generally satisfied with my choice in discipline.	
		I plan to complete my graduate degree program.	
	Support and resources	I feel supported by my advisor.	
		I have a peer group of graduate students that have similarly focused goals.	
		I am generally satisfied with my financial support.	
Career	Likelihood of career field	How likely are you to pursue a career in academia (college professor/instructor/researcher) after graduation?	- Definitely yes - Probably yes - Neutral - Probably no - Definitely no
		How likely are you to pursue a career in industry (profit sector) after graduation?	
		How likely are you to pursue a career in government (e.g. at a national lab) after graduation?	
		After completing my graduate studies, I plan to work in a field related to the degree I am pursuing.	
		Explain your interest in an industry career.	
		Explain your interest in an academic career.	
		Explain your interest in a government career.	
		Are there other career fields that interest you?	
	Change of career interest	My interest in an academic career has ___ since deciding on my graduate degree program.	- Strongly increased - Moderately increased - Remained the same - Moderately decreased - Strongly decreased
		My interest in an industry career has ___ since deciding on my graduate degree program.	
		My interest in a government career has ___ since deciding on my graduate degree program.	
Background	Academic background	Which Engineering Department are you working in at the University of Notre Dame (currently)?	
		What year did you begin your graduate studies at the University of Notre Dame?	
		Was your bachelor's degree in Engineering?	
		Which discipline most closely describes your bachelor's degree?	
	Personal background	What was your first language?	
		Do you have any concerns about your future career plans related to immigration or Visa status?	

Post-Course Survey Questions (Grouped by Topic)

Topic	Sub-category	Question	Scale
Research		My current research topic aligns with my professional goals.	- Strongly agree - Somewhat agree - Neither agree nor disagree - Somewhat disagree - Strongly disagree
Career	Likelihood of career field	How likely are you to pursue a career in academia (college professor/instructor/researcher) after graduation?	- Definitely yes - Probably yes - Neutral - Probably no - Definitely no
		How likely are you to pursue a career in industry (profit sector) after graduation?	
		How likely are you to pursue a career in government (e.g. at a national lab) after graduation?	
		After completing my graduate studies, I plan to work in a field related to the degree I am pursuing.	- Strongly agree - Somewhat agree - Neither agree nor disagree - Somewhat disagree - Strongly disagree
		Explain your interest in an industry career.	
		Explain your interest in an academic career.	
		Explain your interest in a government career.	
		Are there other career fields that interest you? Please describe.	
	Change of career interest	My interest in an academic career has ___ since taking this discernment course.	- Strongly increased - Moderately increased - Remained the same - Moderately decreased - Strongly decreased
		My interest in an industry career has ___ since taking this discernment course.	
		My interest in a government career has ___ since taking this discernment course.	
Evaluation and Feedback	The career preparation component	How would you rate the career preparation component of the course? (resume/CV, interviewing, networking, job search)	- Excellent - Very good - Good - Fair/OK - Poor
		What is your recommendation for future course offerings regarding the Resume/CV Preparation Session?	- Definitely keep - Maybe keep - Skip
		What is your recommendation for future course offerings regarding the Resume Review Session (1:1 with Career Center)?	
		What is your recommendation for future course offerings regarding the LinkedIn Segment?	
		What is your recommendation for future course offerings regarding attending the career fair?	
		What is your recommendation for future course offerings regarding the Job Search Session?	
		Comments on the career preparation component of the course?	
	The professional panels	How would you rate the professional panels? (industry - tech & sustainability, faculty, national labs)	- Excellent - Very good - Good

			- Fair/OK - Poor
		What is your recommendation for future course offerings regarding the Industry Panel?	- Definitely keep - Maybe keep - Skip
		What is your recommendation for future course offerings regarding Faculty Types?	
		What is your recommendation for future course offerings regarding National Labs?	
		Comments on the professional panels?	
	The course	How would you rate the course overall?	- Excellent - Very good - Good - Fair/OK - Poor
		What could be done to improve the course? (content, topics, speakers, food, etc.)	

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