ASEE 2022 ANNUAL CONFERENCE
Excellence Through Diversity
MINNEAPOLIS, MINNESOTA, JUNE 26TH-29TH, 2022 ASEE
Paper ID #36851

A Model for Student-led Development and Implementation of a Required Graduate-level Course on History, Ethics, and Identity in Aerospace Engineering

Emily Palmer

Emily H. Palmer is a Ph.D. candidate at the Graduate Aerospace Laboratories of the California Institute of Technology (GALCIT). Her current research focuses on the neural mechanisms underlying steady state flight control in Drosophila melanogaster. She has been involved in numerous educational outreach programs throughout her undergraduate and graduate career, and holds a leadership position in the GALCIT graduate student council. She earned her M.S. from Caltech in Aeronautics in 2019, and her B.S. in Mechanical Engineering from Johns Hopkins University in 2018.

Jacqueline Rose Tawney

Jacqueline (Jacque) Tawney is a Ph.D. candidate in GALCIT (Graduate Aerospace Laboratories of the California Institute of Technology). Jacque is a National Science Foundation Graduate Research Fellow, member of the GALCIT Graduate Student Council, and founder of Women in GALCIT. At Caltech, Jacque researchers polymer drag reduction in turbulent pipe flow with experiments and mathematical modeling. She is passionate about creating positive change within her communities and being a compassionate and inclusive scientist and leader.

Jenn Weaver

Dr. Jenn Weaver is currently the Director of Curriculum at UC Berkeley Executive Education, a division within the Haas Business School at UC Berkeley. Until the fall of 2020, she was the Associate Director for University Teaching and a Lecturer at Caltech.

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Abstract

Engineering is often treated as apolitical fact, removing historical context, ethical responsibility, and human subjectivity from the field. As such, engineering programs, especially at the graduate level, often do not require that students engage with these aspects of their discipline in a meaningful way. But the failure of engineering to attract, retain, and provide a supportive environment for underrepresented students underscores a pressing need to address the historical, political, and social dimensions of the field in academic environments at all learning stages. Further, the particular history and function of aerospace engineering poses unique questions and challenges which higher education should work to address. We posit that for educational institutions to create capable engineers who are also the future leaders in the field of aerospace engineering, it is critical that students are well-equipped to ask and answer questions which properly contextualize their work.

Upon recognizing this need for contextualizing aerospace engineering within our graduate curriculum, we, a team of doctoral students, proposed, developed, and implemented a required graduate-level course on history, ethics, and identity in engineering. The curriculum was designed in collaboration with on-campus pedagogy and DEI experts who were familiar with the issues facing the aerospace engineering department. With the intention of building an inclusive environment of trust and mutual learning, the course's subject matter progressed from historical case studies, to current ethical issues, and finally to the intersection of identity and STEM. The course aimed to illuminate various dimensions of academic and industry-based engineering to graduate students with disparate exposure to these subjects. In practice, external speakers with relevant expertise were invited to give 30-minute lectures, followed by discussions in groups facilitated by trained senior graduate students. Rather than teaching a prescribed moral code or political position, students were urged to think critically, share their perspectives, and be aware of how their work affects society on a larger scale. The successes were two-fold in that new graduate students attained the aforementioned learning outcomes, while senior graduate students gained practical professional development in both communication and facilitation skills.

We propose this framework as a model for the development and implementation of graduate-level history, ethics, and identity curricula in other aerospace engineering programs. Structurally, our seminar was implemented to complement an existing, required lecture series; there were therefore few administrative barriers given that no new course was created, there was no added workload for faculty or teaching assistants, and there were no additional curricular requirements for students. While we present the framework within an aerospace engineering curriculum, we believe that the same questions are applicable more broadly to engineering and

science curriculums, and will discuss our current work to develop shared or parallel programs in other fields. Results of our student feedback surveys and focus group sessions providing lessons learned will be shared. In summary, this accessible framework of invited speaker seminars followed by student-facilitated discussions offers an inexpensive yet highly impactful method to enable engineering graduate students to develop as more aware, responsible, and inclusive leaders within our field.

Introduction

In the summer of 2020, academic communities across the United States grappled with their roles in perpetuating power structures that exclude underrepresented groups from science, technology, engineering, and mathematics (STEM), resulting in the #ShutDownSTEM and #ShutDownAcademia movements [1], [2]. A salient feature of academia as a power structure is its role in gatekeeping the professional positions typically afforded the ability to shape society through the acclaim and security associated with the positions. Indeed, while new engineering bachelor's degree graduates enjoy relatively high salaries and relatively low unemployment rates [3], degrees in mechanical and aerospace engineering are awarded disproportionately to male students and white students [4], [5].

Researchers have long endeavored to untangle the factors affecting women and underrepresented minorities (URMs) in STEM, in the hopes of developing guidelines for academic administrators to implement to improve retention [6]–[8]. Studies suggest that retention of excluded groups in engineering is positively affected by an improved sense of belonging (that is, students who feel as though they "belong" in the academic community are more likely to stay in engineering), which can be encouraged by both hearing from diverse identities and finding social relevance within STEM [5], [9]. Presenting engineering within a societal context can also aid in retention, as women in particular often choose engineering as a path to help people [9], [10]. Curricular and institutional changes, innovated with these factors in mind, can assist in making engineering more appealing, welcoming, and inclusive for women and URMs.

Despite the urgency that disparate representation in STEM presents, history, ethics, and identity (HEI) are almost never included in graduate programs, as shown in the *Appendix*. Graduate students generally constitute the next generation of leaders in academia, industry, and policy. As seen in Figure 1, roughly a quarter of PhD recipients in aerospace engineering at our institution become faculty members within ten years, while a third hold senior roles in industry. Given their positions as leaders in engineering, it is critically important that they are well-versed in the social, political, and historical dimensions of their work [11]. Furthermore, within academia, courses covering HEI topics are typically taught by women and URMs [12], [13]. As both the development of a sense of belonging (through being taught by diverse identities) and the presentation of STEM within a societal context aid in retention, teaching HEI topics at the graduate level can help attract and retain women and URMs for the current and future

generations of leaders. Addressing the role of history, ethics, and identity (HEI) in STEM curricula, especially at a graduate level where it is almost never included, would therefore not only help mitigate the field's disparate representation, but also provide crucial context to the next generation of leaders regardless of their background or identity.

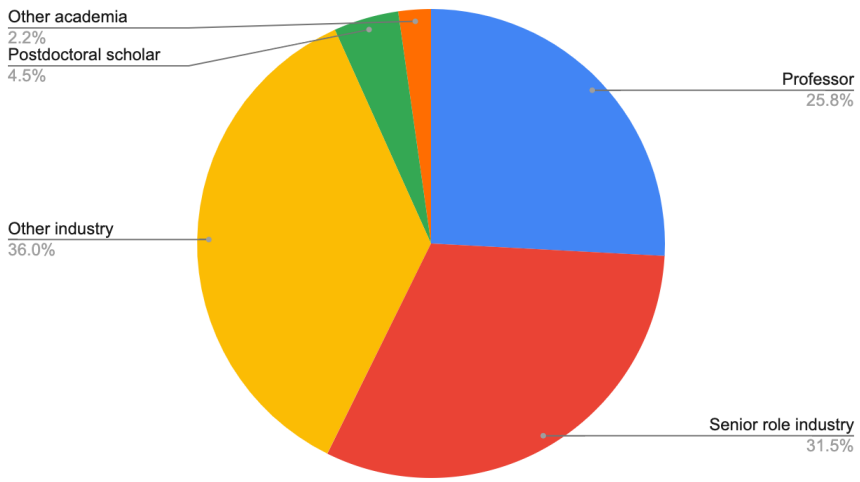

Figure 1. Current positions held by doctoral alums graduating between 2011 and 2020 from The Graduate Aerospace Laboratories at The California Institute of Technology.

We, a team of doctoral candidates in aerospace engineering, developed a required, first-year, graduate-level course in aerospace engineering to fill the gap of HEI in graduate engineering education. The course was intended to illuminate the various dimensions of engineering via lectures from external speakers with relevant expertise followed by in depth discussions facilitated by senior graduate students. In this paper, we present the theoretical framework guiding the course structure and curriculum, the practical development and implementation, and the results of the course through student feedback and current efforts in the department. In brief, rather than imposing a moral code or political stance onto the students, the course was designed to equip students with the tools necessary to properly contextualize their work. Students were urged to think critically and communicate their positions with their peers in a positive, collaborative, and professional way. Our course was implemented as an update to an existing, required course, eliminating the majority of administrative barriers usually associated with the inclusion of new material. The course is therefore an accessible yet highly impactful framework for HEI coursework at the graduate level, contributing to the development of future leaders who are more aware, responsible, and inclusive.

Theoretical framework

Too often, STEM is viewed as objective, apolitical fact, despite its undeniably sociopolitical nature [14]. Our course structure was therefore inspired by critical pedagogy, the philosophy that social justice, democracy, teaching, and learning are all indistinguishable, as presented by Paulo

Freire in *Pedagogy of the Oppressed* [15], [16]. Critical pedagogy embraces the student's ability to participate as active subjects within their own learning process and within the development of the world at large, in part by rejecting the "banking system" of education–the one-way deposit of knowledge from teacher to student [17]. Presenting HEI topics through the lens of critical pedagogy invites students to reflect on their position within this seemingly objective field and to act in a way that will uplift themselves and their work towards a more engaged and conscientious state [18]. Within this framework, students are urged to contribute their unique perspective while welcoming that of their peers, learning to hold multiple truths at once, and accepting new ways of thinking. While the administration in our department generally preferred that the material was presented by speakers with relevant expertise (interpreted by us to mean professors of the relevant topics), we sought to create a space where it was possible for students to reject exclusively learning via the banking system, and instead engage more deeply with the material through discussion. Our pedagogical structure therefore relied heavily upon in-depth discussions following short lectures so that students were afforded the opportunity to think critically and independently about the material, embracing the principles derived from critical pedagogy.

We further noted the pedagogical possibility of a transdisciplinary course in graduate STEM education. Whereas an interdisciplinary approach synthesizes multiple fields for the generation of new knowledge or methodology, transdisciplinarity unites intellectual frameworks for the generation of a new perspective in a human context [19], [20]. While there are many objective technical principles one must learn as a scientist, engineer, or mathematician, the principles are developed, interpreted, and applied by necessarily subjective humans, requiring a transdisciplinary, contextualizing treatment [21]. In unpacking the intersection of HEI with STEM, the sociopolitical and human nature of the field quickly becomes undeniable to the student. Given that graduates from top STEM institutions often land in unique positions of power to make significant changes, a transdisciplinary treatment of STEM can serve to acknowledge student potential after graduation and to prepare students to take advantage of that opportunity by practicing meaningful, transformative dialogue [22].

Finally, while it may be difficult to conceive how a STEM curriculum could be taught without some extent of "banking" knowledge transfer from teacher to student, we hope that our course can inspire future educators to consider student-driven approaches to teaching and learning STEM. So ingrained in our educational system is the banking system, especially at the collegiate and graduate levels, that the thought of teaching mechanics or thermodynamics through discussion may feel impossible. But educational systems through the secondary level have demonstrated that STEM can be effectively taught with some rejection of the banking system–the Harkness method, for example, seats a small group of students around an oval table with their teacher and allows the students to learn the material through independent discussion with only minimal intervention from the teacher [23]. While typically implemented for humanities courses [24], [25], certain schools also teach STEM via the Harkness method [26].

We hope that this first small foray into discussion, transdisciplinarity, and critical interpretation of engineering may enable future reimagining of how STEM itself can be taught.

Development and implementation

We, a team of PhD students, submitted a formal proposal to update the course to the faculty member tasked with supervising the academic programming in our department. The proposal argued that history, ethics, and identity were critical subjects absent in our curriculum, laying out the goal of encouraging students to become aware of the historical, political, and social dimensions of engineering and science and to recognize how they are capable of shaping the future. The course was proposed, designed, and implemented as an update to an existing, required seminar series for first-year master's and PhD students in aerospace engineering. Nominally, the course's explicit purpose, as laid out in the course description, is to "discuss current problems and advances in aerospace engineering" [27]. Originally, this definition supported lectures given by current faculty members on active research so as to introduce students to the research occurring in the department and facilitate PhD students' advisor search, as well as lectures from professional engineers in industry on opportunities for aerospace engineers outside of academia. But the context within which we perform our work as researchers and engineers also presents current problems and room for advances in aerospace, and therefore seemed to the students proposing the update to be a natural addition to the course. Furthermore, the vernacular of the department frequently refers to the first-year curriculum as a mechanism to ensure all students have received commensurate training in the field. While this training was traditionally treated as proficiency in fluids, solids, and math, students also come to the department with disparate training in history, ethics, and diversity. The proposed update would therefore serve to discuss the social aspects of aerospace engineering, contextualize our work as practicing engineers and researchers, and ensure all students are well-equipped to think about how history, ethics, and identity intersect with engineering.

The faculty and department administration were quite amenable to the update, though they had several hesitations which were accounted for through an iterative development process. Initially, the proposal included lectures from experts not affiliated with the department as well as presentations by more experienced graduate students and other forms of media (e.g., episodes of a docuseries or podcast), but through development with the faculty we instead chose to only have lectures from experts. The faculty emphasized their desire to provide programming via individuals or organizations with the relevant expertise in performing research in and teaching the material they would present to the students. As this would involve inviting faculty members at our institution or others, this lessened the burden on the graduate students developing an extensive curriculum update. While the department was initially hesitant to devote an entire semester to this new format, they eventually approved a proposed syllabus of seven speakers for the semester. Finally, given the heavy course-load associated with the first-year graduate student curriculum in our department, it was decided that there would not be additional work (e.g.,

required readings or tasks) outside of the preset hour-long timeslot. This did not seem to negatively affect the students' ability to benefit from the course.

In practice, we implemented these changes during the Winter quarter of the existing course in a new seminar format consisting of 30 minutes of formal lecture followed by 30 minutes of discussion facilitated by trained senior graduate students. We were fortunate in that the course we wished to augment had a number of key characteristics: (1) The course already existed; there were therefore no administrative hurdles involved in the creation of a new course. (2) The course was already required for first-year students in the department; there was no need to add to the workload of first-year students or to convince the administration that requiring a new course was warranted. (3) Historically, a large number of the seminars in the course were unfilled and therefore canceled; we were therefore able to take a full semester for the update with little to no loss of learning outcomes for the students. These features allowed us to quickly transition through proposal and development to implementation; we submitted our proposal to the faculty in June 2020 and the updated semester of the course began in January 2021.

Upon approval from the faculty, we entered the preparation stage of the course development, consisting of two major efforts: speaker selection and outreach; and, discussion facilitator search and training. We leaned upon the expertise of on-campus resources including the Center for Inclusion and Diversity (CCID) [28] and the Center for Teaching, Learning, and Outreach (CTLO) [29] to develop best practices for both the speaker and facilitator sides of the project. Our facilitator search consisted of independent research that we conducted to find speakers at our institution and other schools with relevant expertise, as well as a survey sent to the department soliciting speaker suggestions. The latter effort did not yield many recommendations and most of the speakers came from our research. We primarily found speakers based on their published work or lectures we found online, but other approaches included making use of our school's alumni network and looking specifically at professional organizations (e.g., Society of Women Engineers). A subset of the speakers who participated in the 2021 series are presented in Table 1, along with the module (history, ethics, or identity) and topic of which their lecture was a part.

Given the emphasis on the discussions, it was critical that we found senior graduate students to facilitate who were excited about the update to the course and eager to participate, and that the facilitating students were well-equipped to moderate the discussions. The facilitator search process was very similar to the speaker selection; a facilitation interest survey sent to the students in the department yielded few responses, but we realized that a successful strategy in recruiting facilitators was to directly approach and invite fellow students. The facilitator training was hosted by representatives from the CCID and CTLO, and major themes included:

- Best practices for creating an inclusive classroom
- Engaging and including students over Zoom
- Facilitating difficult conversations

- Effective debrief questions

Also in collaboration with the CCID and CTLO, we developed a list of discussion ground rules to help foster an environment where students felt safe, supported, and comfortable participating:

- Give everyone the space to speak and share.
- Listen to understand, not to react/respond.
- Avoid generalizations. Speak from personal experience.
- Take the stories, leave the names.
- Allow yourself and others to make mistakes and learn and grow from them.
- Allow others to learn what you already know.
- Expect and accept non-closure and discomfort.

The discussion ground rules were also a useful tool for the facilitating students, as they could use them to guide their thinking as to what a productive conversation looked like, as well as how and when guiding the discussion was necessary. Though there was some apprehension on the part of the facilitating students as to whether they would be able to moderate the discussions, the enrolled students were intensely conscientious and engaged, making the job of the facilitator much easier than expected.

Table 1. Subset of speakers from 2021 series and course progression through History, Ethics, and Identity.

Module	**Topic**	**2021 Speaker**
History	History of field	Dr. David Kaiser, Massachusetts Institute of Technology: "The Military-Astronomical Complex: Testing Einstein's Relativity during the Cold War"
	History of department	Dr. Erik Conway, NASA Jet Propulsion Laboratory: "Founding JPL: The GALCIT Rocket Research Project"
Ethics	Ethics in industry	Dr. Martin Peterson, Texas A&M University: "The Ethical Failures Behind the Boeing 737 MAX Disasters"
	Ethics in research	Dr. Diana Kormos-Buchwald, The California Institute of Technology: "What Price For Victory? The Ethics of Scientific Research During Wartime"
Identity	Inclusive approaches to teaching STEM	Dr. Rochelle Gutiérrez, University of Illinois at Urbana–Champaign: "Restor(y)ing Engineering for Our Future"
	Personal stories and experiences of pioneers in STEM	Dr. Ron Buckmire, Occidental College: "The Intersection of Mathematics and LGBT Identity Is Not Empty (LGBT Mathematics $\neq \{\}$)"

In order to ensure engagement from the enrolled students, we had a kick-off meeting at the start of the semester, during which we explained the change to the curriculum and the reasoning behind it. We covered, in brief, the same concepts that had been included in the original proposal to the faculty; namely, the relevance of history, ethics, and identity to graduate students in aerospace engineering, as well as logistical information on how the seminars would be structured and what would be expected from the students. Not only did the kick-off meeting prime the students for the coming lectures and discussions, but it also gave us an opportunity to make an appeal that they give their full attention and effort to the program. The series came at an unusually political moment on campus, in academia, and culturally, following the #ShutDownSTEM and #ShutDownAcademia movements in the summer of 2020; the students therefore came to the program with heightened awareness of the importance of contextualization. We were forthright with the students that this was a pilot program and its continued existence in the department depended in part on their involvement.

Throughout the semester, the seminars were presented as expected, with the teaching assistant introducing the speaker, 30-45 minutes of lecture depending on what the speaker had prepared, and the remainder of the hour devoted to discussion. Depending on the amount of time alloted for discussion, we either split the group into two or three break-out rooms over Zoom or remained as one larger group. The speaker moved between break-out rooms so that all students were able to have equal time speaking with them in a more intimate setting. Student responses to the series are presented in the Results section.

Results

Advantages and disadvantages

In updating the established course, we were able to institute a required curriculum for first-year graduate students in aerospace engineering on history, ethics, and identity with no loss of previous learning outcomes and no additional workload for enrolled students. Our update involved a single quarter of the existing course, which typically had a large number of canceled lectures throughout the academic year; by eliminating those cancellations and collapsing the typical lectures into the fall and spring quarters, we were free to implement our update in the winter. Further, as in the existing course, we did not ask the students to complete any work outside of the allotted hour devoted to the course weekly. Thus, despite the inclusion of a full quarter of new lectures, the students still retained all the benefits of the existing course without a heavier workload. Moreover, augmenting an existing course rather than developing an entirely new course eliminated the vast majority of the administrative barriers usually associated with the creation of a new required course, since there was no additional teaching load for faculty or teaching assistants and there were no additional curricular requirements for students. Our update was even relevant enough to the original course that we did not need to update the description in the course catalog. Updating an established course therefore facilitated the inclusion of the new material into the required first-year curriculum with limited hurdles.

Our course structure offered significant learning outcomes both to the enrolled students and the senior students involved in the creation and organization of the course and the facilitation of discussions. The primary benefit to enrolled students was exposure to seminars on the intersection of engineering with history, ethics, and identity. But since we could hardly teach students all the relevant material in a semester of weekly, hour-long lectures, our goal was explicitly not to have the students finish the course as experts in, for example, the ethical theory applicable to engineering research. Rather, our course offered students the opportunity to develop the language necessary to discuss nontechnical but critically important issues. Both the enrolled and facilitating students may have come from academic traditions where they had never had the chance to interact with the material presented on a personal level; through the discussions in particular, the students developed the ability to think critically about and communicate effectively their thoughts on current social issues in aerospace engineering. The course also presented a chance for students to internalize the importance of contextualizing research and engineering, a crucial characteristic for leaders in engineering. Requiring the course emphasized to the students that our departmental culture prioritized contextualization, as did featuring the update in emails to the department and during departmental events, including new student orientation and visit days for applying students. Thus, enrolled students gained the language necessary to think critically and communicate on history, ethics, and identity in engineering, along with the inclination to do so through the emphasis on appreciating contextualization.

Senior students who acted as facilitators also benefited through their exposure to the material, and further gained significant professional development skills through their involvement. The facilitators developed both the technical ability and confidence to moderate difficult conversations, a skill critical for future leaders in engineering. They were particularly exposed to the pedagogical framework of hosting discussions, a noteworthy benefit to those facilitating students who intended to stay in academia as professors. Facilitating students were also offered the chance to develop their professional communication skills, via opportunities to network with the invited speakers (as students emailed speakers directly to invite them to participate in the series) and to interact directly with faculty and staff in our department.

A final benefit to incorporating discussions throughout the course was the opportunity for community building between academic cohorts in the department. Traditionally, students within a cohort become close through the academically rigorous first-year curriculum, and students within a lab group become close through their research efforts. However, relying on only these two structures for community building leaves a number of deficits; in particular, first-year students have limited opportunities to engage with more senior graduate students before they join a lab group (typically in the spring quarter of their first year). There are therefore few chances for mentorship during the first year, a stressful time for first-year students attempting to navigate residence at a new institution, the search for an advisor, and the expectations of graduate

curricula. Our course offered weekly interactions between first-year students and more senior graduate students, resulting in a less insular first-year experience and a more connected graduate student body as a whole.

One of our primary concerns in the development phase was the lack of funding for the program and our resulting inability to compensate the speakers for their contributions. We were aware of the issues surrounding the lack of compensation for underrepresented minorities [30]–[32] and did not want to contribute to systemic inequities by asking the speakers to contribute without appropriate compensation. Ultimately, we were advised by the CCID that it was critical that whatever compensation we offer, we offer it to all the speakers identically. They suggested a number of non-monetary forms of compensation, including the opportunity for outreach, press (e.g., pictures of the lecture, positive quotes from enrolled students, posting about the lecture on our department's website or Twitter), and tokens of appreciation (e.g., mugs, stickers, t-shirts). We found that the speakers were largely extremely enthusiastic about participating without any form of compensation, monetary or otherwise, consistent with the idea that they saw the lectures as an opportunity for outreach, though we did make a point of sending warm thank-you notes to the speakers following their seminars.

A final concern for the future is that the newly developed course has been largely student-driven and developed, which, while an amazing opportunity for our growth as graduate students, results in the possibility of a lack of continuity going forward. We proposed the course as third-year PhD students and through the first year of the program were completely responsible for its trajectory and success. We certainly benefited from that autonomy, as we were afforded the liberty to steer the program as we wished. However, the course's future success relies in part upon the involvement of the faculty to ensure continuity between cohorts of facilitating students. One area of improvement is therefore in involving faculty or departmental administration more heavily in the maintenance of the course.

Survey results and student response

Following each weekly seminar, a survey was sent to the enrolled students, soliciting feedback on the lecture and discussion. The surveys were intended to be used as a tool to improve the course throughout the semester and from year to year, as well as evidence in support of or against the continuation of the program in future years. The questions on the survey were:

- How familiar were you with the material before the seminar? (Rated response 1-5)
- How familiar do you feel now with the material after the speaker's lecture? (Rated response 1-5)
- How helpful was the small group discussion for deepening your understanding of the material? (Rated response 1-5)
- How comfortable were you participating in the small group discussion? (Rated response 1-5)

- Do you have any thoughts on the topic and/or speaker? (Short response)
- Is there something that really stuck out to you that you learned during this seminar? What's something that you will take away from this? (Short response)
- Do you have any comments on the discussion portion of the seminar? (Short response)
- Any remaining questions, comments, or concerns? (Short response)

The survey defined a response of "1" for the rated response questions as "Not at all" and a response of "5" as "Very." The number of responses to each survey diminished rapidly throughout the semester, suggesting that we over-surveyed the students; eight out of 12 enrolled first-year students responded to the first survey, as opposed to only three for the final survey. Regardless, across the semester, the students reported increased familiarity with the material following the lectures, comfort participating in the discussion, and that the discussions were helpful for deepening their understanding of the material.

Following the course, we hosted a feedback session with the students and the faculty member responsible for the course. In both this session and the open response survey questions, the students reported many of the same thoughts. Given the limited sample size, we will summarize the discussion and survey results rather than present student responses verbatim, so as to ensure respondent anonymity.

- An hour felt too short for both the lectures and the discussions, and despite the heavy first-year course load, students would have been happy to devote another hour to the program.
- It may have been helpful to temporally separate the lectures and discussions so students had more time to digest the lecture before discussing.
- Students reported further discussions with other enrolled students, with students not enrolled in the course, and with family members.
- Students tended to prefer smaller discussion groups (3-5 students) as opposed to discussion with the entire group.
- Some students preferred the lectures and others preferred discussions; in general, it seemed like the lectures were more impactful in the history module, whereas the discussion was more impactful in the ethics and identity modules.
- The curriculum likely has appeal to other departments and is generalizable (e.g., in a conversation about the Boeing 737 MAX disasters [33], what is an equivalent event in chemical engineering?)
- The course was a nice opportunity to take a break from technical work and shift their thinking.

Overall, students responded very favorably to the inclusion of the course in the required first-year curriculum.

Current and future work

Following the positivity of the enrolled students' responses to the course, the department has made the history, ethics, and identity series a permanent part of the first-year graduate student curriculum. Per the student feedback, we have changed the format slightly to lengthen both the lectures and discussions to an hour each, with the discussions occurring the following day, such that students have more time to digest the material presented in the lecture. We are working to grow the program by advertising to the entire university community and hosting discussion groups for students across the Engineering and Applied Science (EAS) division. The EAS Diversity, Equity, and Inclusion (DEI) committee has provided funding to cater the discussion groups. We hope to continue to grow the program in our community and ensure there are structures in place that guarantee it will be maintained upon our graduation.

Conclusion

In this paper, we have presented the process through which we conceived of, developed, and implemented a graduate-level course on history, ethics, and identity in aerospace engineering. HEI topics should be considered crucial to the training of future leaders in engineering and are therefore a critical gap in traditional graduate curricula where they are absent. By updating an existing course to include HEI material, we were able to remedy this omission with few administrative barriers. Our course's framework was designed as a rejection of the banking system of education, embracing the sociopolitical nature of engineering and equipping students with the ability to think critically about how they engage with their work within a greater context. Including HEI into the required coursework also represents a significant step in promoting recruitment and retention of underrepresented minorities and women in engineering as lectures were given by speakers of diverse identities (encouraging a sense of belonging in students), engineering was presented in a societal context (enabling students to see how their work can benefit their communities), and the course essentially served to broadcast the importance of these topics to the department (helping to reset the departmental culture to one which prioritizes inclusivity and diversity). Following the success of the course in its pilot year, the course was made a permanent component of the first-year curriculum, and we are now working to grow the program by advertising the lectures to the entire university and hosting discussion groups for members of our community from the undergraduate to postdoctoral level. It is our hope that this paper can serve as a model for any STEM department which does not currently include HEI topics in their core curricula. As members of a community which has critically failed underrepresented groups, a semester of lectures and discussions on history, ethics, and identity enables us to take great strides, with minimal effort, towards equity, inclusivity, and professional responsibility.

Acknowledgements

We would like to thank Dr. Dan Meiron, Fletcher Jones Professor of Aeronautics and Applied and Computational Mathematics and former Options Representative in the Graduate Aerospace Laboratories at the California Institute of Technology, for supporting our efforts in bringing this series to fruition in our department, Dr. Hanna Song, the former Senior Director for Inclusion & Diversity at Caltech, for her invaluable guidance in developing the program and for providing facilitator training, Miles Chan, Narravula (Harsha) Reddy, & Peter Renn, graduate students in Aerospace Engineering, for facilitating discussions, and all our wonderful speakers for contributing their time, energy, and wisdom to the course.

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Appendix: Graduate aerospace engineering course requirements for history, ethics, and identity.

We surveyed the 15 top aerospace engineering graduate programs, as ranked by U.S. News in 2021, to determine the prevalence of requirements that students engage with history, ethics, and identity material. The requirements were taken from the school's aerospace engineering department website. A school is listed as having no graduate requirement if there was no clear requirement listed on the website.

School	**Graduate Requirement**
Virginia Tech	None
University of California, Los Angeles	None
The University of Maryland, College Park	None
Cornell University	None
Princeton University	All PhD and MSE candidates are required to take a course in the responsible conduct of research.
The University of Colorado Boulder	None
Texas A&M University	None
The University of Texas at Austin	None
Purdue University	None
The University of Illinois Urbana-Champaign	None
The University of Michigan	None
Georgia Institute of Technology	None
Stanford University	It is recommended that Masters students enroll in a humanities or social sciences course.
Massachusetts Institute of Technology	None
The California Institute of Technology	The course described in this paper is required for first year graduate students.