

Lessons Learned from Developing an Online, Asynchronous, Non-Credit RECR Course for Engineering Graduate Students

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Abstract

During the pandemic, the College of Engineering at Michigan State University (MSU) developed an online, asynchronous, non-credit course to provide required training in RECR (Responsible and Ethical Conduct of Research) for graduate students. Each week, students completed one online training module from the Collaborative Institutional Training Initiative (CITI); topics included: Introduction to the Responsible Conduct of Research; Authorship; Plagiarism; and Research Misconduct. After completing the CITI module, students used MSU's online learning system to engage in asynchronous discussions about reflection questions and/or case studies related to the weekly CITI topic.

Students' experiences with this online course during the pandemic were unexpectedly positive: what had been intended as a stop-gap measure until in-person training resumed turned out to be an excellent method for fostering ongoing conversations between graduate students about ethical issues. While this course serves hundreds of students each year, participants are organized into smaller discussion cohorts that provide opportunities to build community within and across majors. Offering this RECR training in a virtual, asynchronous format also allowed students from fully-online graduate programs to connect with students enrolled in traditional, in-person MS and PhD programs.

This RECR course has been offered 11 times over five years (2020-2025), serving more than 1,600 students across eight engineering disciplines. This paper discusses lessons learned by developing and refining this program, including insights about the cadence, structure, and content of the training that may be valuable to other institutions seeking to adapt this approach.

Introduction

Training in the Responsible and Ethical Conduct of Research (RECR) is a requirement for students engaged in most federally-funded research, and increasingly is a graduation requirement for engineering graduate programs in the United States. The details of how and when to provide RECR training are often left up to individual institutions, which sometimes further delegate the responsibility to individual colleges, departments, or even graduate programs. Regardless of these external mandates, training in the ethical conduct of engineering research and practice is an important focus for graduate programs.

This paper describes one approach to RECR training for graduate students, developed over five years by the College of Engineering at Michigan State University (MSU). We created an online, fully asynchronous, discussion-based training program to meet our university's RECR requirements during the pandemic. While online training has its challenges, there were also unexpected benefits to this approach that led us to continue refining the RECR program, which is now required for all of our first-year graduate students.

This paper describes the structure, content, and evolution of our RECR training program and offers practical advice for other institutions seeking to adapt this approach. While online RECR training is not new, our approach offers a scalable, fully asynchronous, discussion-based model that (1) supports both discipline-based and interdisciplinary student cohorts; (2) fosters interactions between students in different programs (e.g., fully online MS program, traditional in-person MS and PhD programs); (3) leverages time-constrained assignments to encourage student engagement and thoughtful discussion; and (4) introduces a “zero post drop” policy that reduces administrative burden and discourages students from rushing through last-minute assignments.

Background and Related Work

In the United States, training in the responsible and ethical conduct of research (RECR) is mandated as part of many federally-funded research projects. For example, in 2010 the National Science Foundation (NSF) began requiring RECR education for undergraduates, graduate students, and postdoctoral scholars involved in NSF-sponsored projects [1]. In 2023, the NSF expanded this mandate for RECR training to include faculty and other senior personnel, and to require that the training include mentoring [2]. The NSF has delegated to individual institutions responsibility for developing appropriate RECR training plans and ensuring that their trainees and researchers are in compliance with current guidelines [3].

For the National Institutes of Health (NIH), RECR training has been a requirement since 1989, with multiple expansions over time to include both more trainees (undergraduates, graduate students, postdoctoral scholars, other researchers supported with NIH funding, etc.) and topics (authorship, data management, misconduct, mentoring, working with human and animal subjects, etc.) [4], [5], [6]. Current funding proposals to the NIH must include a detailed description of how RECR training will be provided, with a specific focus on addressing ethical issues in the areas of proposed research [7]. The NIH also outlines requirements for the format, frequency, and timing of RECR instruction – notably indicating that substantial, real-time, face-to-face discussions are required, and training plans that rely solely on asynchronous or even synchronous online engagements is not sufficient for NIH-funded researchers [6].

Beyond funded research, ethical conduct is central to the engineering profession, as noted in the National Society of Professional Engineers code of ethics for practicing engineers [8]. ABET requires that accredited engineering degree programs train students to “recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts” [9]. Engineering research and practice directly impact human health and well-being, and thus engineers are expected to meet the highest standards of integrity.

RECR training has been part of graduate engineering programs for decades, and in recent years has expanded to include online, in-person, and hybrid offerings. Each modality has its benefits and challenges, as documented in previous research. For example, a large meta-analysis found that in-person training was most effective for learning about ethical decision making and other process-based content, while online trainings could be effective when the content was more instructional or factual in nature. Ultimately, these authors suggested that a hybrid approach, combining in-person and online training, may be the most effective structure [10]. However, a

smaller study [11] compared the experiences of in-person and online participants in an RECR training program for graduate students. Both groups were trained simultaneously, in a hybrid format (e.g., some students in small in-person groups, and other students in small breakout groups online). While the remote option made participation more accessible for some students, the pre- and post-test results indicated that the training was less effective for online participants.

In addition to delivery modality, past research has explored factors such as the length and content of RECR training. Effective ethics instruction has been demonstrated in a variety of timeframes, including two day [12], one day [13], and one hour [14] programs. Other studies have examined factors like instructors' experience, participants' demographics, and various types of learning activities [15], finding that in general RECR training has improved over time and there are numerous effective instructional approaches. One tool that has proven to be beneficial in RECR training is the use of case studies or discussion scenarios, which typically present an ethical challenge in a specific context and invite participants to consider and discuss different approaches and outcomes. Case studies can be developed within a specific disciplinary context, can focus on specific ethical issues, and are easily adjusted to different audiences and learning environments [16], [17]. Engaging with a case study can encourage participants to develop and apply problem-solving skills to real-life situations in a low-risk environment, and allows participants to build on previous experiences to address novel situations [18], [19].

RECR Training Requirements at Michigan State University

At MSU, the responsibility for determining minimum RECR training requirements and monitoring compliance is handled centrally. RECR training records are maintained as part of the university's system for tracking other non-credit courses, such as safety training for laboratory work. All graduate and professional students (including students in fully-online programs) are required to complete RECR training as a condition of graduation, with specific requirements varying depending on the degree program [20]. All graduate students must complete four online, asynchronous training modules through the CITI Program (Collaborative Institutional Training Initiative), including an introduction to RECR, authorship, plagiarism, and research misconduct [21]. In addition to this foundational training, all graduate students must complete a minimum of six hours of discussion-based RECR; this is commonly completed by participating in real-time, online workshops hosted by the MSU Graduate School. These workshops cover a range of topics, from research skills and policies (data management; rigor and reproducibility; human and animal subjects; intellectual property and export controls) to interpersonal communications and conflict management. Many colleges and departments provide additional courses, workshops, and seminars that can also count towards RECR discussion-based training requirements; these tend to focus on specific ethical issues related to students' discipline or research focus.

In addition to the four CITI modules and six hours of discussion-based training, students completing a master's or doctoral thesis must complete an additional three training modules through CITI. Students select from six options, covering: collaborative research, conflicts of interest, data management, mentoring, peer review, and financial responsibility. All of these requirements must be met within the first two years of thesis-based degree programs, and then PhD students have an additional requirement of 3 hours per year of "refresher training" through the end of their doctoral program. There are numerous ways for PhD to fulfill these annual

requirements, including additional CITI modules, RECR conversations with their research group and advisor, and various for-credit and non-credit courses and seminars. These additional requirements for students pursuing research-based graduate programs help to ensure that they have a breadth of RECR training that is sufficient to meet not only the University’s expectations but the external requirements for those students working on federally-funded research.

Approaches to Program Development and Revision

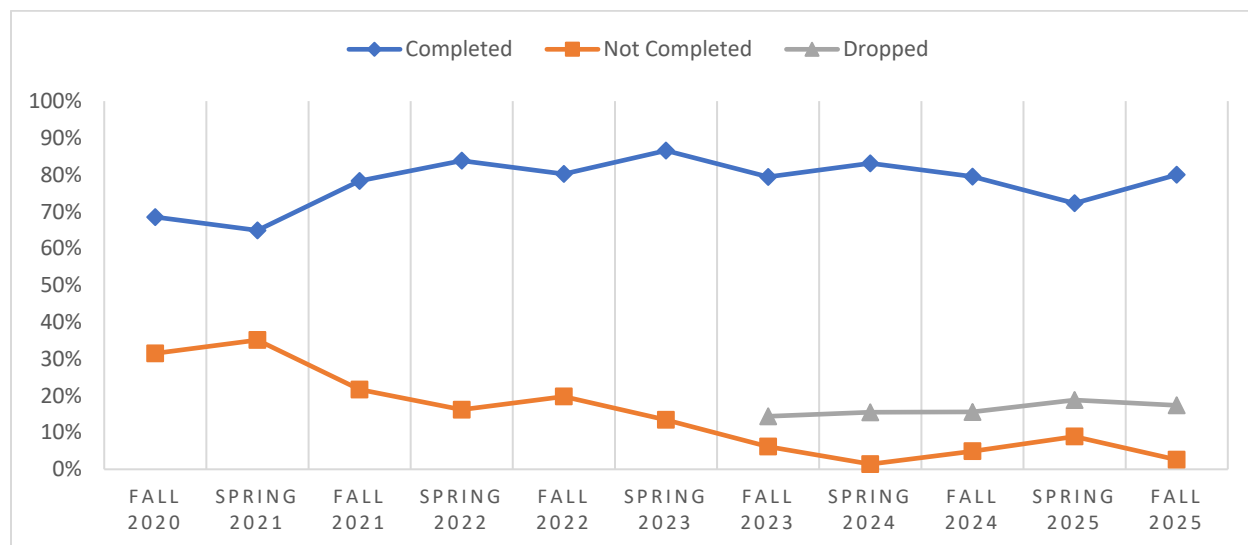
This RECR training was originally developed during the pandemic and was first offered in Fall 2020. This paper summarizes program logistics, participation, and lessons learned across 11 course offerings, from Fall 2020 through Fall 2025. The course evolved in response to student feedback and to address practical course management issues, and this paper shares those logistical lessons and anecdotal insights with the goal of assisting other institutions in adapting similar approaches. This effort is an internal program evaluation in an educational context, rather than a research study requiring IRB (institutional review board) approval; thus, this paper reports only aggregate participation data and uses paraphrased, anonymized examples for illustration.

Table 1 summarizes enrollment by semester for the last five years, along with outcomes (completed, not completed, dropped) by program type (PhD, MS, MS Online). The “dropped” option was added in Fall 2023 to ease program administration by proactively removing students who had zero engagements at the end of the third week (out of six). As shown in Figure 1, this change did not significantly impact completion rates; however, the drop policy reduces administrative burden and helps ensure that students are engaging in discussions across time, rather than completing all of the course requirements at the last minute. The remainder of this section describes these data in more detail, explains the current course structure, and shares key decision points and alternative approaches tried during the program’s evolution.

Table 1: Enrollment and Outcomes by Semester and Program Type (PhD, MS, MS Online). “Total” is the number of students across all degree programs; the percentages are the distribution of PhD, MS and MS-O (online) students for each total.

Semester	Enrollment				Completed				Not Completed				Dropped			
	Total	PhD	MS	MS-O	Total	PhD	MS	MS-O	Total	PhD	MS	MS-O	Total	PhD	MS	MS-O
Fall 2020	181	51%	30%	18%	124	56%	32%	12%	57	42%	26%	32%				
Spring 2021	94	44%	36%	20%	61	46%	46%	8%	33	39%	18%	42%				
Fall 2021	180	50%	37%	13%	141	50%	38%	12%	39	51%	33%	15%				
Spring 2022	68	63%	21%	16%	57	63%	19%	18%	11	64%	27%	9%				
Fall 2022	182	57%	31%	13%	146	55%	31%	14%	36	61%	31%	8%				
Spring 2023	67	52%	36%	12%	58	50%	38%	12%	9	67%	22%	11%				
Fall 2023	243	55%	31%	14%	193	58%	30%	12%	15	80%	13%	7%	35	29%	46%	26%
Spring 2024	71	54%	37%	10%	59	51%	39%	10%	1	100%	0%	0%	11	64%	27%	9%
Fall 2024	244	51%	32%	18%	194	53%	32%	14%	12	58%	42%	0%	38	37%	24%	39%
Spring 2025	101	51%	28%	21%	73	55%	26%	19%	9	44%	44%	11%	19	42%	26%	32%
Fall 2025	230	43%	34%	23%	184	45%	35%	21%	6	67%	0%	33%	40	33%	35%	33%
Total	1661	51%	32%	16%	1290	53%	33%	14%	228	53%	27%	21%	143	36%	33%	31%

Figure 1: Completion Outcomes for All Students, By Semester



Course Structure. This four-week course is actually offered over six weeks, with a “Week 0” introductory period and a “catch up” week at the end. We use the D2L Brightspace online learning platform [22], which is the primary learning management system used at MSU to support both online and in-person coursework. Since this RECR course is usually completed in students’ first semester at MSU, not all participants have experience using D2L. Thus, the “Week 0” onboarding structure gives students time to learn how to navigate D2L without the pressure of a graded assignment. Those come in Weeks 1 through 4, when students are required to submit a minimum number of posts on one or two discussion boards each week. The RECR course wraps up with a final “catch up” week, where students can submit missing posts. The appendix includes key communications from the RECR course, including detailed instructions provided to students in Weeks 0-4.

Course Timing. The RECR course is offered twice a year, in the fall (September-December) and spring (January-April) semesters. Students can only complete this RECR course one time, and while most do so in their first semester at MSU some opt to not participate until later. Fall enrollment averages 210 students and we initially started the RECR course about two weeks after the semester began. However, as shown in Figure 1, we saw completion rates improve when we shifted the fall start back to the first week of October. This delayed timing allows students to settle into their new academic routines and still ensures that the whole course is wrapped up before midterms, finals, and holiday breaks.

The spring semester training tends to be smaller (averaging 66 students), and for many years we started the spring course approximately February 1. This timing worked well for new students but often missed current students who realized too late in the semester that they had not met their RECR training requirements. In 2025 we shifted to a post-spring-break start (early to mid-March), which better accommodates students who need to complete the training in order to graduate, and both students and staff have indicated that delayed timing is preferable.

Enrollment. We have experimented with self-enrollment, as well as automatic enrollment with an opt-out. RECR training is a graduation requirement at our institution, and students are supposed to meet that requirement well in advance of commencement. We have found that automatically enrolling new students is the most effective way to encourage compliance with the university's expected timeline for RECR training. The RECR requirements are explained in detail at new student orientations, and students receive regular email reminders about unmet requirements. Students can opt out and are allowed to complete the RECR training course in a later semester if they wish; however, at that point they are responsible for remembering to request enrollment. Students can also choose to complete their RECR training in other ways, but over time both students and staff have recognized that this online training is the easiest way to fulfill the requirements, and very few students opt out entirely.

Discussion Boards and Sections. This RECR course organizes students into D2L course "sections" to facilitate robust conversations and to allow students to get to know their peers. In the fall semester, when enrollments are typically large, students are grouped into sections by major/department. For example, all Mechanical Engineering students work together as one section of the fall RECR course, regardless of whether they are enrolled in the fully-online MS program, the traditional in-person MS program, or the PhD program. Sometimes we cluster small cohorts together, combining 2-3 majors in one discussion board, in order to allow for more robust discussions and engagement. Fall sections can vary in size from 10 to 60 students, depending on the number and distribution of new graduate students in our programs. In the spring semester, enrollment in the RECR course is typically too small to allow for active participation within majors/departments. Instead, we typically organize students alphabetically and divide them into roughly equal sections; as an example, in spring 2025 about 70 students completed the course, divided across two sections.

Within these sections, students communicate with each other through weekly discussion boards, which allow for asynchronous conversations in multiple threads. Threads are created when one student makes an initial post and other students reply within the same conversation thread. During Week 0, students are encouraged to log into D2L and introduce themselves; this ungraded "assignment" allows students time to resolve login and other technical issues. In Weeks 1-4, students are expected to complete one CITI training module and participate in 1-2 discussion boards in D2L. Each week starts at 12:01am on Monday and posts are due by 11:59pm on Sunday. This pacing allows students to have sufficient time to complete the CITI module and then reflect on and asynchronously discuss that content with their peers. Discussion prompts are provided for students who are not sure where to start, but students may post about anything that is related to that week's CITI module. Weeks 2 and 3 also include case studies that ask students to consider ethical decision making and research practices in the context of specific scenarios, which are drawn from evidence-based training on RECR for undergraduate and graduate students [23]. Overall, students are required to participate in six discussion boards over four weeks (not including the Week 0 introductions).

Over the years, we have refined the timing and pacing of the online RECR course to address challenges and incorporate student feedback. For example, the discussion boards become visible on the Friday before the week that they are assigned. That provides a few extra days at the beginning for students who want to get started or need more flexibility in completing the work.

However, releasing the assignments incrementally prevents students from rushing through the whole course at once – which would circumvent the goal of having students discuss each week’s materials with their peers. Students receive weekly email reminders on Thursdays to complete the current week’s work before the midnight Sunday due date.

Course Grading and Management. This course is offered as a pass/fail experience, with students needing to meet 100% of the expectations (CITI modules and minimum number of posts in each required discussion board) in order to pass. There is no partial credit, as students are reminded weekly of the requirements and have a one-week grace period after the four-week course in which they can complete any missing assignments. Early on, we had a few students who would ignore the course reminders until the very last minute and then complete all of the training at once. That approach does not align with the goal of having students engage in back-and-forth conversations with their peers, so in Fall 2023 we implemented a “zero post drop” policy. This means that students who do not post anything in the first two weeks are dropped from the course and are not able to complete it until a future semester. Students receive multiple warning emails prior to being dropped, and this approach has largely resolved concerns about students procrastinating until the end of the course. As shown in Figure 1, the drop policy did not significantly impact completion rates – but it does reduce the administrative burden of sending repeated emails to students who are not engaged in the course.

Late posts are accepted without penalty up until one week after the “Week 4” work is due, and students who complete all requirements by the end of this sixth week will pass the course. We originally allowed two weeks after the course ended but found that encouraged procrastination without increasing completion rates. A one-week grace period has proven to be effective at accommodating students who need a little extra time, without wasting time waiting for students who do not intend to complete the work.

Students’ discussion posts are not anonymous and are not actively moderated. The course administrator monitors participation and updates grades each week but does not systematically read or participate in students’ conversations. Students are graded based on effort, rather than specific content, and both new posts and reply posts are of equal value (1 point). A minimum number of posts (3) are required for each discussion board. Students must post at least 3 times on each of the six required discussion boards in order to pass the course. This grading structure was developed to encourage students to invest equally in each CITI module and discussion board, rather than earning all of their points in an early (or late) discussion. This structure also keeps the grading process simple for students and the course instructor, which reduces miscommunications about expectations or missing requirements.

In spring of 2022 we introduced the use of individualized reminder emails about missing posts. While this does require more time from the course administrator, it has helped to ensure more timely posts (rather than catching up on all of the missing work at the end) and serves as a safety net for those students who may have inadvertently missed a post. Students also receive a reminder email after Week 4 that highlights specific discussion boards where they have not met minimum posting requirements and reminding them of the one-week grace period for catching up on missing work. Weekly grading has proven most successful when done on the Monday immediately following the midnight Sunday due date. This allows the administrator to remind

students promptly if they have missed work from the previous week and tends to encourage students to catch up more quickly than when these grade emails were sent later in the week.

Observations and Discussion

Over the last five years, there have been thousands of individual posts in this RECR training course. For this paper, we manually reviewed a sample of conversations across 7 semesters, which included 5 falls (when students worked primarily in disciplinary cohorts) and 2 springs (when students were organized into interdisciplinary cohorts). We noticed repeated themes, including examples of students:

- Building on past knowledge or experience in research
- Building on past knowledge or experience in the workplace
- Interacting across programs (traditional vs. online MS, MS vs. PhD)
- Applying lessons learned from this course to their own academic or work experiences

The remainder of this section offers anecdotes and examples of these types of conversations, which have been paraphrased and avoid or remove potentially identifying details. These examples are not offered as an exhaustive study but instead illustrate interesting conversations and topics that might inspire future areas of research.

Building on Past Knowledge or Experience in Research Environments. The first CITI module, discussed in Week 1, introduces RECR and overviews the types of topics that will be covered as part of the CITI training. Students are encouraged to discuss the importance of RECR training, share what they hope to learn by participating in this training, and consider how RECR topics relate to their own research. One student prompted a robust discussion by sharing an undergraduate research experience when they hoped to build on work described in an existing research paper. In trying to replicate and scale this research, the student and their lab mates realized that paper's model did not work as described and that the authors had not fully discussed or disclosed the limitations of their approach. In sharing this experience, this student commented on the importance of honesty and transparency in research, which was a key theme of the introductory CITI module. In response, other students shared their own experiences with similar issues when trying to reproduce or reuse prior work, and the impact of choosing to include – or exclude – data sets and detailed methodologies when publishing research. Students also discussed the temptation to manipulate or exclude data when results are not as expected, and the potential ethical and practical impacts of these choices.

In another conversation thread, responding to the Week 2 content on authorship, a student shared their expectation that they would be a co-author on a previous research project where they had developed a key piece of equipment, even though the experiments were not complete by the time they left the lab. Other students shared their own experiences contributing to group research and navigating authorship issues. In a different conversation from the same week, several students discussed their experiences with authorship and how the ordering and crediting of authors varied between disciplines and across advisors or research groups. Students compared some of the approaches they had experienced (e.g., alphabetical ordering of authors, taking turns in first- and second-author roles when one project has multiple publications, having the advisor decide who is

listed in what order), and discussed the importance of transparency and communication when determining authorship and other forms of acknowledgement – particularly when research crosses disciplines, research groups, or institutions.

Building on Past Knowledge or Experience in Work Environments. Many students shared their work experiences and real-world perspectives as part of conversations about responsible, ethical and transparent behavior. One student who worked in the aerospace industry talked about FAA (Federal Aviation Administration) and military standards for safety and reliability. Another student noted that in the workplace there is a very real cost to ensuring ethical and responsible engineering; for instance, companies invest in hiring, training and retaining experts who can ensure the safety and security of their products. These posts generated numerous replies about the responsibilities of companies, and their employees, in making ethical and responsible choices – and the potential impacts on people when companies do not embrace these best practices.

Several students shared their experiences gathering, analyzing and applying data from various industrial sources. They discussed the challenges of sharing and using data within and across companies, and the importance of transparency and ensuring data are presented honestly and accurately. Students talked about how small variations or irregularities in test results at a supplier can multiply unexpectedly, causing manufacturing delays at best – or endangering consumers in the worst case. These conversations emphasized the importance of building and maintaining trust between collaborators, particularly those at different stages of a supply chain or manufacturing process, and the consequences of losing that trust relationship.

Interactions Between Students from Different Programs. Some of the most interesting conversations in this RECR course have taken place between students who have very different experiences and backgrounds. For example, an online MS student and a PhD student from the same discipline had an interesting exchange about the friction between the RECR emphasis on transparency and the need for companies to protect their intellectual property. The online MS student worked full-time in industry and shared an opinion that if something could be patented then it should be kept secret – assuming secrecy would not harm the public. The PhD student responded that the expectations of their academic discipline were completely different, and the results of their research would be made freely available in the hope that it would provide a broad public benefit. While neither student swayed the other to their side of the academy-vs-industry debate, the conversation was respectful, insightful, and a learning experience for these two students and for the many others who read and commented on the conversation.

Another fascinating exchange resulted from a reflection prompt asking why RECR training was important for all graduate students, regardless of their role or research area. One MS student responded that integrity, competence, transparency, and collegiality were all RECR-related values that would impact their work, especially when they were collaborating with teams or working on larger research projects. Another MS student responded that they had more than two decades of experience in industry and had never conducted research, but that these same values were essential in any workplace – noting in particular the importance of not taking credit for another's work. A PhD student commented that while not all aspects of RECR applied to all students or employees directly, there was value in understanding the full range of topics and potential challenges. For instance, this PhD student did not conduct research with animal

subjects, so that part of the RECR training was not directly relevant to their degree. However, knowing that there are ethical practices to consider when working with animals is important general knowledge for any researcher – or practicing engineer.

Applying Lessons Learned from the RECR Course. Throughout the five years of discussions in this RECR course, we have seen recurring – and reassuring – signs that students are able to apply the lessons from this training to their own academic and work experiences. For example, many MS students (both online and traditional in-person students) have commented over the years that even though they are not engaged in research, they recognize that the values and best practices shared as part of the RECR training are broadly applicable. As we explain to our students, our university requires RECR training of all graduate students precisely because advanced degree recipients are expected to be able to understand and apply research results, even if they are not directly involved in research activities. Thus, it is heartening to see the many comments from students sharing their experiences applying or building on research in their industry jobs or recognizing that conducting research with the highest standards of integrity is critical to ensuring that the academic knowledge that filters out to practicing engineers is accurate and applicable.

Other students note that while they are not officially engaged in research, in many engineering workplaces the problem-solving process often mirrors research approaches. In these cases, understanding the basics of how to conduct research in an accurate, transparent, and reproducible manner can help students solve challenging problems in industry with the same high standards. Students also discussed the important social responsibility of professional engineers, and the challenges of behaving ethically in the workplace, especially when the consequences of unethical behaviors can have dramatic consequences for humans and their environments. Students often noted the challenges of balancing engineering priorities (like accuracy, reproducibility, and transparency) with business priorities (like staying on-time and under budget) and discussed the benefits of RECR training for understanding what needs to be considered in these situations.

Research-focused students also frequently talk about how the RECR training directly impacts them. Perhaps not surprisingly, given that most of our students enroll in this course at the beginning of their graduate program, authorship is one of the most common topics of conversation. Few students have substantial publication records at the time they complete this training, and many are just starting to engage in the types of collaborative research projects that may lead to conflicts around authorship and other types of credit. Navigating relationships with advisors, research collaborators, and other students engaged in complex projects is a frequent topic of conversation in these RECR trainings, particularly for students in our PhD programs.

Concluding Discussion and Future Work

Our online RECR training program has many practical benefits, not the least of which is the ability to scale to accommodate several hundred students a year in interactive, engaging conversations about ethics in engineering research and practice. Although our original intention was to meet the university's training requirements during the pandemic, we were pleasantly surprised at the quality of student conversations. Anecdotal evidence suggests that this online, asynchronous training can foster engagement and reflection and provide a good introduction to responsible and ethical conduct in engineering research and practice.

This paper offers a retrospective program evaluation, rather than a comprehensive study, and is intended to assist other institutions in implementing their own introductory RECR training programs. In the appendices, we have provided samples of key correspondence with students about this online training, which others are free to adapt or re-use as appropriate.

Moving forward, we intend to continue revising and refreshing this training, starting with updates to the case studies included in Weeks 2 (authorship) and 3 (research misconduct). The current case studies were adapted from evidence-based sources [23], [24] but do not reflect more current challenges to RECR, like generative AI. We also are interested in exploring whether varying the case studies by discipline or research type (e.g., adjusting for experimental- vs. theoretical-research approaches) impacts how students engage with the scenarios.

At our university, there is also a substantial need for additional RECR training options for students in thesis-based MS and in PhD programs. Demand for RECR training on our campus far outstrips the capacity of the RECR training workshops offered by our Graduate School, and while we do offer some in-person and virtual training options within our College of Engineering they cannot scale to meet the need. Thus, we are interested in exploring whether we can develop additional online, asynchronous training to provide more advanced or in-depth training in RECR for students who need more than the foundational training provided by our existing program.

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Appendix 1: Welcome Announcement and Course Overview

The following post is pinned to the home page of the D2L course, visible when students log in.

Welcome! We are happy to have you participate in the College of Engineering virtual RECR (Responsible and Ethical Conduct of Research) Discussion Hours. Click on "Content" in the menu at the top of the page to get started.

This is an online, asynchronous, 4 week course which helps students complete two major components of the required RECR training: the "first year" requirements (CITI Programs Basic Course) and the 6 hours of "discussion-based" training. This course is organized into 1 week modules, each focused on a lesson from the CITI Program.

Students who are pursuing coursework-only MS degrees can fulfill all of their RECR requirements by completing this online course (CITI Basic Course Modules and Discussion Board Assignments). Thesis-based MS and PhD students have additional RECR training requirements to complete prior to graduation. Please review the RECR Requirements for College of Engineering Graduate Students for more detailed information.

All students are encouraged to participate in ongoing RECR training as a way to build their professional skills and prepare for successful careers. There are many more opportunities to learn more about RECR and ask questions, including:

- The MSU Graduate School offers a variety of workshops and seminars on the Responsible Conduct of Research, Scholarship and Creative Activity. [Link to event list.]
- The College of Engineering Graduate Lunch and Learn seminar series includes several RECR related seminars each year. These seminars are held during the academic year (September - April). Look for announcements in your MSU email.
- Research group discussions can also help you learn more about RECR. Ask questions and be an active participant in these conversations.

Discussions with your research advisor are an important part of your RECR training. Don't hesitate to ask questions and engage in discussions. Informal/indirect RECR related conversations happen more often than you might think!

The following overview explanation is the first "topic" listed in the course content. It provides an explanation of how the RECR training is structured, what students are expected to do each week, and how the course is graded. Information that is highlighted in colored text and/or bold font is emphasized because students frequently overlook these details, which are essential to successfully completing the course requirements.

ENGINEERING RECR DISCUSSION HOURS COURSE INFORMATION

Course Overview

This D2L course is designed to satisfy the Responsible and Ethical Conduct of Research requirement for 6 hours of Discussion Based Training. The discussions are organized around the required CITI Basic Course.

This course in combination with the CITI Basic Course will satisfy the Responsible and Ethical Conduct of Research requirements for first year graduate students. For students

beyond the first year, completion of this course will be equivalent to 6 hours of Discussion Based Training provided that the course has not been previously completed.

YOU MUST COMPLETE ALL OF THE D2L COURSE MODULES/DISCUSSIONS TO RECEIVE CREDIT FOR ANY DISCUSSION BASED HOURS.

Course Dates

The table below shows the course assignments for each week of the course and includes the dates each week's modules will open and close. Please note that this course requires participation each week. **Students with zero posts after the close of Week 2 will be dropped from the course.**

Week	D2L Course Assignment	Open	Close
Week 1	1. Introductions (not graded) 2. CITI Basic Course Topic 1 Discussion	Sept. 26	Oct. 5
Week 2	1. CITI Basic Course Topic 2 Discussion 2. Credit Where Credit is Due Case Study Discussion	Oct. 3	Oct. 12
Week 3	1. CITI Basic Course Topic 3 Discussion 2. Selection of Data Case Study Discussion	Oct. 10	Oct. 26
Week 4	1. CITI Basic Course Topic 4 Discussion	Oct. 24	Nov. 2

Course Grading

Students are required to make a **minimum of 3 posts per DISCUSSION (except the Introductions)**. This means that **WEEK 2 AND WEEK 3 will require 6 posts in total**. Each post is worth 1 point and each discussion board has a maximum of 3 points. A minimum of 18 points (minimum of 3 posts for each discussion board) are needed to receive credit for the course. A post can be either an original thread or a reply to another participant's post.

The assignments for each week will be graded the week the module closes. Posts completed after the first grading will be graded again when the course closes.

Questions?

If you have any questions or concerns, please email [course instructor name and email].

Appendix 2: Week 0: Introduction

The following message is posted in the introductory Week 0 section of the course in D2L and provides more detailed information about the RECR requirements and course structure, and includes practical suggestions from previous students, like setting reminders to post each week and paying attention to emails from the course administrator.

Welcome!

All graduate students at MSU are required to complete annual RECR (Responsible and Ethical Conduct of Research) training. The College of Engineering has developed this asynchronous, online course in D2L to help first-year graduate students complete two essential components of these requirements:

1. The “First Year” training, which includes four required modules completed online through CITIprogram.org
2. The six hours of “Discussion Based” training, which must be completed prior to graduation

We have set up this course in D2L to take place over four consecutive weeks. Each week, students will complete one of the required CITI Basic Course topics and participate in one or two online, asynchronous discussions related to that topic. By the end of the four weeks, students who complete all of the course elements will have met the requirements for both the “first year” and the “discussion based” RECR training (by participating in each of the 6 discussion boards related to RECR during this online course, you will meet the requirement for 6 hours of discussion based training).

The course weeks will run Monday through Sunday, with one CITI Basic Course topic and one or two discussion boards due each week. We expect that students will need 4-6 hours total to complete this course, with that time divided up across 2-3 short logins per week. Since a key element of this training is that students have the opportunity to engage in back-and-forth discussion about RCR topics and have time to reflect on what they are learning, we have purposely set up the course so that there is work due each week, and it is not possible to “work ahead” into future weeks.

Given the minimal additional workload of this course each week, we expect that you will be able to complete all assignments by their due dates. However, if there are extenuating circumstances that make participating in this online training an undue burden, please email [the administrator] and we can discuss alternatives.

Please set appropriate calendar reminders for yourself so that you remember to log into the course 2-3 times per week as needed to complete the assignments. We plan to send reminder emails each Thursday, which should give you plenty of time to complete the week’s assignments by the midnight Sunday deadline if you happen to have forgotten.

Appendix 3: Discussion Prompts and Case Studies

Each week of the RECR course includes one or two asynchronous discussions, which are related to the CITI module for that week. In Week 0, students are invited to participate in an optional introductory discussion to get to know the other students in their section/major. While this discussion board is not graded, the grading expectations for the other weeks (one point per post, three post minimum per week) are included in Week 0 for consistency. The discussion questions each week are identical across sections, but having separate conversations by section/major allows students to discuss RECR in the context of their own discipline and allows students from different programs in the same major or department (online MS, traditional MS, PhD) to interact with each other.

Introductions

It's time to introduce yourself and meet your fellow students! While this is not a "graded" item, it is important to help build community!

Post a thread introducing yourself to the other participants. Feel free to share a picture or video if you wish. The goal is to get to know each other a bit before you spend the next 4 weeks learning about and discussing RCR topics together.

You only need to post what you are comfortable sharing with other students. Some ideas include:

- What are you studying?
- Where are you from?
- Something that interests you
- Your favorite (food, book, snack,...)

Once your thread is posted, reply to at least 3 other threads over the course of the week to earn full points for this discussion!

The first week introduces the structure that is used for the remainder of the RECR course: a brief explanation of exactly what students are expected to do each week, with one or two discussion boards. The discussion boards have reflection questions and/or case studies, all related to the content of that week's CITI module.

Week 1: CITI Program – Introduction to RCR

To complete Week 1, you must do the following:

1. Complete CITI Program Basic Course - Introduction to RCR module (including the quiz).
2. Participate in the CITI Program - Introduction to RCR discussion board. Complete 3 posts. A post is defined as an original post (thread) or a reply to a peer's post.

Let's Discuss CITI Module 1 - Introduction to RCR

Participation in this discussion board will be worth 3 points. Each post will be worth 1 point. A post is either an original thread or a reply to another student's post.

Complete CITI Module 1 before you join the conversation!

Post your thoughts about Module 1. Valid posts are original threads or replies to the posts of other students. The discussion prompts are listed below. Reflect on what you have learned and complete 3 posts.

Students are reminded of this structure within each week's discussion forum and then provided with specific discussion prompts related to the topic/focus, as listed below.

Discussion Prompts (Week 1) – Introduction to RCR

You don't need to answer all the questions below and/or limit your response to this list. The questions are here to help you start formulating your thoughts.

- Why is RECR important for all researchers?
- What do you hope to learn from the RECR modules?
- Select a RECR topic and discuss how it fits your role / your research.
- What did you learn from this RECR module? What questions do you still have?

Discussion Prompts (Week 2) - Authorship

You don't need to answer all the questions below and/or limit your response to this list. The questions are here to help you start formulating your thoughts.

- What are some of the criteria that should be used for determining who should be listed an author or who should be credited with an acknowledgement?
- How do you think the criteria apply to your work as a graduate student?
- What are some of the challenges you might face as a graduate student in seeking appropriate credit for your work?
- How do you think you might approach your research advisor to discuss authorship issues before one arises and/or if there is a concern?
- Were there any aspects of the authorship information that were surprising and/or did you realize that you have a voice/responsibility in the area of authorship?

Discussion Prompts (Week 3) – Research Misconduct

You don't need to answer all the questions below and/or limit your response to this list. The questions are here to help you start formulating your thoughts.

- What is the difference between fabrication, falsification and plagiarism in the context of research misconduct?
- What strategies can be used to prevent or mitigate research misconduct?
- As a first-year graduate student, what do you think you can do to learn more about preventing research misconduct?
- How can you help to ensure that research is conducted ethically, and that research misconduct is avoided?

Discussion Prompts (Week 4) – Plagiarism

You don't need to answer all the questions below and/or limit your response to this list. The questions are here to help you start formulating your thoughts.

- What are some conditions that might lead someone to plagiarize?
- What is your responsibility as a graduate student researcher in regard to plagiarism?

- What skills can you develop and/or strategies can you use to avoid plagiarism in your own work?
- What is the difference between summarizing and paraphrasing?

Week 2 includes a case study entitled “Credit Where Credit is Due” and Week 3 includes a case study entitled “The Selection of Data.” Both of these scenarios were adapted from Branchaw, Pfund and Rediske (2010) Entering Research: A Facilitator's Manual. W.H. Freeman and Company, New York. pp. 199. Their original source is "On Being a Scientist: Responsible Conduct in Research," 2nd ed., National Academy Press, 1995. The case studies used in our RECR course were customized for our audience and are not reprinted here, but interested readers are invited to explore these source materials, which include numerous case studies that can be adapted for various audiences.