# A Directed Question-Based Framework for Teaching and Learning Ethics: A Tool but also a Memorable Framework that Students Can Take Forward into their Professional Practice

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# A Directed Question based Framework for Teaching and Learning Ethics: A tool but also a Memorable Framework that Students can take Forward into their Professional Practice

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**ABSTRACT**

While interest in incorporating ethics in engineering and computer science education continues to grow, the way that ethics applies to professional practice is often too abstract for students to directly connect to their current and future work. The teaching and learning about ethics in technology and engineering programs varies from theoretical philosophy courses, to courses that examine the harms and impacts of systems and technologies. While each of these approaches is extremely valuable, Students do not necessarily leave with models of how to continue thinking about ethics in the profession or a framework that they can easily apply in the future. This paper presents a question directed approach used in the teaching of a tech ethics course. The questions are easy to understand and repeat instruction makes it natural for students to always use the questions to guide their thinking towards ethical matters throughout the course. Students are given a Why/Who/What/Where/How framework for thinking through ethical quandaries and case studies. The questions are memorable, and it is expected that students will continue applying this ethical framework in the future as they step into a profession in which they will inevitably have to grapple with ethical questions due to how closely our profession is tied to human life now and in the future. The framework also specifically addresses the how of ethical professional practice which teaches students about how to build community and social capital in the workplace and thus makes it easier to advocate for ethical behavior. This paper describes this approach in detail as well as shares experiences from the instructor who has used this methodology in a tech ethics course.

## INTRODUCTION

As undergraduate computer science (CS) and engineering education programs continue to evolve, the urgency of ethics in education is being recognized. This can be seen in the various tech ethics course offerings at educational institutions [1] and the inclusion of ethics requirements in undergraduate CS and engineering programs.

The past couple of years has also seen the coming together of CS educators around the issue of thinking about and developing guidelines for the Teaching of Responsible Computing [2]. While these are welcome developments the style of teaching ethics tends to stay at one of two extremes. A course heavily focused on the philosophy of ethics and a course that spends a great deal of time considering the impacts and harms of technology, particularly for specific application areas such as AI [1]. Both approaches are valuable in their own way, but a concern for me has been that neither of these

approaches equips students with how to actively engage in ethics throughout their future careers. Towards addressing this gap, this paper presents an approach that uses a question directed approach for carefully examining the various dimensions of tech ethics and to provide students with a memorable framework that they can continue to apply in their future professional life.

## BACKGROUND

Mabrouk [3] found that while undergraduates at Northeastern bring some prior knowledge as it relates to falsification, fabrication, and plagiarism due to other coursework, they are less likely to understand issues surrounding intellectual property, conflicts of interest, and confidentiality.

Bush et al. [4]found that providing ethics training in the right context is critical in ensuring student retention of concepts. Although their study looked at undergraduates in managerial programs, the professional nature of the discipline and the general characteristics of undergraduates supports our point of view that providing the ethics training in the context of students' summer research projects will enhance their learning and retention. The proposed project will build on this lesson in the sciences by demonstrating the value of context-based training. The tech ethics course addresses the learning of the issues and the question-directed framework. Then the question-directed framework is directly applied to the students' research project, connecting the learning to their professional practice. I believe, strongly, that this type of contextualizing will result in lifetime learning.

Olimpo et al. [5] conducted a detailed study of course-based undergraduate research ethics (CURE) training and developed a framework focused on teaching the NIH RCR concepts. The efficacy of course-based ethics training once again demonstrates the value of connecting ethical thinking with the profession and professional practice. Other studies have shown the relevance of role-playing followed by discussions in ethics instruction in various disciplines [6], [7].

Being a social justice and equity focused institution, we are interested in clearly addressing the intersection of Science and Technology and Society. The tech ethics course deliberately focuses on the impact of computing technology and the profession at the world at large. Several of the issues raised and discussed in that course apply to Science and the computing profession at large. I use a question-directed framework to teach ethical concepts and develop students' ethical thinking. I also firmly believe that ethics training must address how individuals can positively impact and shape the world beyond concerning themselves with reducing harm and assessing the negative impacts of their work. The question-directed framework utilizes questions that make it easy for students to remember. The objective is to make students fall back on thinking of the Why/Who/What/Where/How questions in each professional situation.

## WHY A QUESTION DIRECTED APPROACH?

When I began teaching tech ethics, I was daunted by the prospect of having to teach aspects of moral philosophy. I was also concerned that students who learn about philosophical models such as Utilitarianism or Golden Rule do not necessarily retain these in the long run, nor explicitly apply models they have learned when they face ethical problems outside the context of an ethics class.

Conversely, the other dominant model of teaching tech ethics relied heavily on discussions of harms and impacts, which, while valuable, does not necessarily equip students with a systematic framework for how to think about situations in the future.

After having taught tech ethics once using a standard model that began with a discussion of philosophical models and then spent time of several case studies of impacts and harms, I switched to a new course design that used questions as a means of making thinking about ethics more accessible, while capturing the complexity of considerations that are inevitably involved.

The question directed approach is presented as it is used in the next section. Here, I will briefly discuss each question group:

1. **Why?** This is of course top of mind when students are asked to take this course. In both institutions where I have taught the tech ethics course it is a required course and I think it is important to motivate the need for why thinking about ethics matters. Why should anyone care about ethics? Let's walk through that.
2. **Who?** It is important that students learn that there are various stakeholders in each situation and that they have different perspectives and concerns. This will not only make them better advocates for ethical conduct, but also enable them to practice empathy and take others views into account when thinking about solutions.
3. **What?** This is of course crucial. This part of the framework carefully addresses the spectrums of concerns and the various impacts and harms.
4. **Where?** One of the wordless messages conveyed when ethics is *pulled out* and taught in its own course is that ethics may seem like an afterthought. This question area is to get students to think about ethics in every aspect of their professional practice. (Note: the question framework is also used in a shorter version in the intro programming course, and in depth in a capstone course. Thus, the training extends beyond this course alone.)
5. **How?** A question that is in my experience universally not addressed is how to negotiate the workplace and advocate for ethical behavior. This is particularly critical for early career professionals who may not have the power in the workplace to be able to speak up for or effectuate ethical behavior. This part also explicitly brings in professional codes, ex: ACM [8].

## THE QUESTION DIRECTED TEACHING AND LEARNING MODEL: THE WHY, WHO, WHAT, WHERE, HOW, AND WHEN OF TECH ETHICS

1. **WHY** care and worry about ethics
    a. Why do ethics matter?
    b. Why do you care about ethics? **Do you?**
    c. Impact of Technology on Society: Personal, Political, Environmental, Economic
    d. Legal and policy dimensions

2. **WHO** are stakeholders in ethics?
    a. Users
    b. Tech professionals / Tech Workers
    c. Companies

    d. Institutions including governments
    e. Threat actors

3. **WHAT** are the spectrums of Ethical concerns?
    a. Privacy and security
    b. Ownership and access
    c. Surveillance and freedom AND/OR Freedom and Anti-Freedom
    d. Abuses and unintended consequences
    e. Fairness and Justice
    f. Identifying concerns by stakeholder group (connects to 2 above)

4. **WHERE** do tech ethics apply?
    a. Ethics in Design, Development, Data, Deployment, and your Day job
    b. Ethics at home, company/institution, government
    c. Ethics is important in every step of the process and in every setting

5. **HOW** can tech ethics be applied?
    a. Repeat: Ethics in Design, Development, Data, Deployment, and your Day job
    b. At the company: speaking up; advocating for ethics as an employee
    c. At the company: building social capital to help you speak up
    d. At the company: building community
    e. Ethics not as an afterthought but centered in all your processes
    f. Assessing your own impact
    g. How to connect personal ethics to professional ethics
    h. Codes of conduct
    i. Approaches in ethical tech: Design Justice, Values Sensitive Design, Privacy by Design, Consentful Tech
    j. How to use your ethical outlook: thinking beyond reducing harm to actively advancing justice and equity while addressing problems you care about

Bonus: WHEN? All the time

Students are expected to apply the questions to thinking about the case studies provided throughout the semester. Ex: when working through a particular case study they must identify who are the different stakeholders involved and what are the concerns for each group and how they may conflict with each other.

It should be noted that although this framework has been developed for and applied in a CS ethics course, the question framework is easily adaptable to other professions, particularly engineering professions. Also, the sub-bullets for each question above indicates my coverage and approach when

it comes to these questions. Others who wish to incorporate this framework may use the questions as a starting point along with the bullet points above and make changes according to the application area and as to what they see as relevant.

**ETHICAL REFLECTIONS**

There are 3 ethical reflections that students complete during the course. The reflections are designed to have students carefully consider their personal values and how those values are likely to play out in their future professional lives. One of the concerns that I have had for a long time is that I see a disconnect between the personal values of individuals whom I know personally that work for large tech companies and the ways that the companies that they work for act. While an individual does not have direct control over the way a company behaves and operates, their individual choices actions, and micro-decisions matter in the aggregate. Ethical reflections are designed to center individual values in their overall approach towards the profession, which along with the question-directed framework can help them to better bridge the gap between personal and professional ethics. The hope is also that future professionals consider the decisions they are making when it comes to what kind of work they choose to undertake including the types of jobs that they apply for and accept and the types of questions they would ask when interviewing.

It is of course important to acknowledge that an individual starting out in the profession is at a disadvantage in terms of power and influence and therefore the framework *explicitly* spends a great deal of time on the HOW, including how to advocate for good behavior and how to build community and social capital.

That said, individuals graduating with computer science, computer engineering, data science, information technology, and related degrees have a certain amount of privilege as far as employment opportunities are concerned and should be encouraged to carefully consider their choices right from the start.

The personal ethical reflections occur in 3 parts taken over several weeks during the semester. Following my teaching philosophy, each reflection assignment is discussed in detail at the time when the assignment is announced. The prompts for the reflections are shared below:

1. Ethical reflection 1 prompts:
    a. What are your core values?
    b. How do you think these manifest in your personal life?
    c. Share an instance where you applied one of your core values to address a dilemma or during a particular incident.

2. Ethical reflection 2 prompt:
    a. Having reflected on your personal values, how do you think they might manifest in your current or future professional life?
    b. Can you think of a scenario in which a value that you consider core might be in tension with your work in a professional setting? Discuss.

3. Ethical reflection 3 prompt:
    a. Consider the scenario in which there might be a situation in your future professional life where you find that the actions of a team, department, or company does not align with your values. (This can be the same scenario discussed in reflection 2 or another one.) How would you go about raising concerns about the situation and advocating for better behavior?

## AN EXAMPLE CASE STUDY DEMONSTRATING QUESTION-DIRECTED APPROACH

There are several case studies that students complete in the course which trains them on the use of the question-directed approach. For selected case studies, students are also asked to redesign/redo based on their takeaways from the question-directed approach. While case studies are a critical element of student learning. Following up on how to *improve things* can be invaluable training to demonstrate to students that:

1. The solution(s) presented are not the only possible solutions.
2. Ethically better solutions are possible, and, can be outlined by professionals-in-training such as themselves.
3. In some cases, the ethically poorer solutions are also technically less challenging and it is kind of fun to develop the more challenging solution.

The above are starkly apparent in the case of the case study involving voice assistant devices such as Alexa and the choice to stream data back to a central location. In fact, students reach the conclusion that not only is constantly streaming data back to a central location unnecessary to meet the application needs but also may be a worse technical solution overall and that companies can save costs by reducing data both on the network and in centralized storage locations. In terms of engineering choices, it also highlights that the choice to not put more autonomy on the voice assistant devices is a choice and a different choice could easily be made particularly if you prioritize different goals and objectives. This is supported by some of the approaches discussed in the course such as Value Sensitive Design, Design Justice, and others.

The case studies are of increasing complexity and culminated in a case study on COVID-19 tracing apps. In Fall 2022, when the course was taught the COVID-19 pandemic was still fairly front-of-mind for everyone. COVID-19 tracing was an important emergent problem in the first part of the pandemic and various technical solutions had been proposed on how to perform tracing using a variety of approaches [9]. The case study carefully reviews the problem, and students carefully work through the question-directed approach. One of the biggest concerns was privacy [10], [11], [12] and issue of whether such developers as Apple and Google ought to be trusted to handle this critical health information [13]. A major concern was also whether in the haste to produce apps many entities had not consider health privacy laws including HIPAA and HITECH in the United States, and other laws and standards around the world.

Table 1 presents a summary of the question-directed approach in this context. This table is based directly on summary notes taken after overall class discussion.

**Table 1: Question-directed approach applied to COVID-19 tracing.**

| | | |
|---|---|---|
| WHO | • users / citizens<br>  ○ other users / citizens<br>• government – city/state/country<br>• World Health Organization (WHO)<br>• companies – app creators<br>• medical profession<br>• public health professionals | |
| WHAT | *Concerns:*<br>• privacy and security<br>• data integrity<br>• validity<br>• functionality & usability<br>• runtime<br>• effectiveness | *Interests:*<br>• health<br>• being COVID free<br>• reducing spread<br>• widespread usage<br>• effectiveness |
| WHY | Public health, reducing deaths | |
| WHERE | • When designing<br>• In deployment<br>• Centralized vs decentralized | |
| HOW | *Approaches:*<br>• Centralized – government or tech company<br>• Bluetooth<br>  ○ Beacons: how many phones even support this tech in 2020? What about the others?<br>• Location tracking<br>  ○ GPS<br>  ○ QR codes | *Fixes*:*<br>• decentralized for notifications<br>• double anonymized data (for tracking) – only positive cases reported and with user opt-in<br>• peer2peer data exchange<br>• rotating cryptography |

* Some approach ideas to deal with issues perceived with known approaches were quite brilliant and hold the potential to have a standalone solution with key ideas that address most of the ethical concerns. Students have unfortunately not followed up on developing the approach, possibly due to waning interest as they saw tracing to no longer be the most urgent need. **This author is open to working with any student to help develop such an approach.** References [9-12] are used during the case study, not all readings are shared prior to students having had a chance to consider the issues on their own.

The final project in the course is to evaluate a current or emerging tech scenario using the tools refined during the course. The final project provides a chance for deeper look at a specific situation and helps the class get exposed to a whole range of current and emerging tech scenarios.

**STUDENT REFLECTIONS**

The following reflections were collected in early 2024 (about 13 months after conclusion of the course). Student names are used with their permission. Students were asked to reflect on how they are using the questions learned in the course in their daily professional life.

**Jayson Matsuura, BS CS, BS Physics, BS Math 2023, Employed at the FBI**

> *My overall experience in Tech Ethics during the Fall 2022 Semester at Saint Mary's College of California was very enlightening. The course challenged me to think in new ways, and the exercises helped me to expand beyond the typical computer scientist mindset (coming up with a solution that works and not considering the impacts of my solution). The readings and assignments were relevant topics going on during the time which further emphasized the importance of considering the ethical impacts of these technical decisions. The tech ethics debates helped me to think through multiple perspectives for a given topic, and it encouraged me to develop and justify my own views. The point of all these assignments was to get me to think about the ethical impacts of my technical decisions; a skill that is lost in the computer science field.*
>
> *Through the assignments and readings, the course provided me with a more formalized approach to consider how everyone would be impacted by the technological decisions made. Each assignment, whether it was a reading, discussion, or debate, the material got me in the habit of considering all parties involved and where those parties' interests lied. These assignments had me think about who was impacted, what they were interested in, why they cared, where these views applied, and how these views applied for each individual. This was a process we went through for each assignment. This gave me a consistent approach for me to apply to every situation I encounter where I must consider the ethical impacts of these technical decisions.*
>
> *The approach to evaluating the ethical impacts of technical decisions then extended beyond the classroom and to aspects of my own life. From using Google's services to the Amazon Alexa in my house, I can consider the ethical impacts of these companies and their products. Even just hearing the latest developments in technology in the news, I find myself evaluating how those products could be misused, or the ethical implications of such technology. The class provided me an extra tool to evaluate the technology I see on a daily basis. I now evaluate them on their technological choices and their ethical impacts. Furthermore, when applying for jobs at different entities, I can also consider the ethical ramifications of their practices and projects. I look to see if the entity I am affiliated with is a good ethical fit in*

*addition to other technical aspects, and I do this by applying the same approach as I did in class.*

**Laura Trapero Sanz, BS CS 2023, Data Science, Banco Santander, Spain**

*In this course, I had the opportunity to dig into the ethical aspects of the tech realm, exploring the implications that come with it. Through lively discussions and enlightening readings, we investigated the effects in society of different elements such as algorithms, products, and developments, enabling us to form our own conclusions and internalize insightful perspectives. The course encouraged me to look beneath the surface, prompting me to consider questions that had never crossed my mind before. While our attention often gravitates towards the positive impacts of certain technologies, we rarely take a moment to contemplate the potential downsides.*

*Caring about ethics defines who we are as individuals, and at the same time it defines the society we live in. The class pushed me to reflect on who might be reaping the benefits of a particular technology and, conversely, who might be experiencing discrimination. What are the repercussions for these marginalized groups, often without the resources for protection and unable to change their circumstances? It became clear that those in privileged positions, despite personal gains from certain technologies, bear the responsibility to advocate for marginalized groups. This understanding, in particular, stands out to me as a significant personal takeaway from the course. – that individuals in privileged positions should actively support the underprivileged, contributing to the collective effort to build a more equitable society.*

*Since completing the course, the questions raised about ethics in technology have continued to resonate with me. The class served as a motivation for ongoing introspection, pushing me to consider the ethical implications of technology beyond the academic setting. I find myself consistently considering who the beneficiaries and potential victims of certain technologies might be, and how these advancements could impact society at large.*

*Looking forward, these questions will continue to shape my future approach to the tech profession. With this class, I gained a profound sense of responsibility, emphasizing the need for tech practitioners to actively advocate for ethical considerations. I am now more committed to aligning myself with companies and projects that prioritize the well-being of all stakeholders, particularly those who are often marginalized or disadvantaged. This heightened awareness of the ethical dimensions of technology will guide my decision-making processes, encouraging me to integrate ethical considerations into every aspect of my work. I see technology not just as a tool for personal advancement but as a means to contribute to a more equitable and fair society, and I feel the need to help improve technology so that it helps us more than it harms us.*

**Luiza Nazarkulova, BS Math and Data Science 2023, Project Control Analyst @ Jacobs and applying to graduate school**

*I wanted to share my thoughts on the Tech Ethics course with Professor Das during the Fall Term of 2022. This class, which was part of my Math/CS coursework, stood out from the rest in terms of its unique approach and engaging content.*

*The course primarily focused on discussing relevant and timely topics related to advancing technologies, specifically AI and its huge impact on our society. What I liked the most was how the class revolved around open discussions, debates, research presentations, and intensive case studies. The questions raised during these sessions guided our exploration of each topic which made every class very dynamic and thought-provoking.*

*Given the increasing ubiquity of AI, a significant portion of the course was dedicated to understanding privacy and security issues. We delved into identifying stakeholders in security ethics and discussed how, as future participants in the tech workforce, we could advocate for justice, harmreduction, and equality within AI deployment frameworks.*

*One particularly memorable aspect of the course was our final projects, where we had to present an ethical tech problem. My team partner and I chose to research the topic of TikTok's Algorithm and its harmful effects on politics. This project not only deepened our understanding of the governmental involvement of the CCP and censorship but also allowed us to explore the future of TikTok users' data ownership and privacy in the US.*

*Overall, the Tech Ethics course built a valuable platform for critical discussions and insights into the ethical dimensions of technology. It was an enriching experience that expanded my outlook on the responsibilities we carry as future tech professionals.*

**INSTRUCTOR REFLECTION AND DISCUSSION**

As someone who doesn't have a background in philosophy, I have always found the task of teaching formal ethical theories extremely daunting. I personally think that an applied disciplinary ethics course is best taught when the course is cotaught by a disciplinary expert as well as a philosopher or ethicist. Even when coteaching there is still a challenge for students to remember and think about applying ethical theories in a practical context without getting lost in the abstract. The value of disciplinary ethics training is in making connections between what students learn in philosophy and humanities courses to their professional practice. Towards achieving this connection, I developed the question directed framework when thinking about both how to structure a CS/tech ethics course as well as to develop learning tools that students can keep in mind and actively apply in the future. Using common questions means that students can better retain at least the basic questions themselves. The

questions then can function as a mnemonic and enables individuals to then probe deeper into their learning and consider the issues involved and to answer the questions in a particular scenario. Ultimately ethical training that leads to ethical practice must depend upon values and how individuals choose to apply values towards actual action. One of the deepest challenges in the CS/tech industry is that seemingly ethical people contribute to unethical practices and results [14]. Training individuals to carefully think through each situation is critical. While traditional ethics training is a critical element of developing this outlook and strengthening values, one of the biggest challenges in the CS/tech industry (and perhaps the corporate world at large) is that one must go far and beyond simply thinking carefully about ethical issues but also have tools and approaches to deal with ethical quandaries when they arise. Speaking up is often the first step towards change, but even speaking out requires a certain amount of advocacy training. To address power dynamics, particularly for early career professionals, it is also important that college graduates have the tools to develop social capital and advocate beyond the level of speaking up as an individual but to develop consensus among groups of people from teams, to departments, to organizations. Embedded explicitly within the question directed framework is the how that carefully addresses these issues. (Pedagogically, roleplays [6], [15] and debates are a critical element of this training.)

Although formal ethics training is invaluable and I would strongly argue a  for the general education requirements for a college education, the training can sometimes be abstract and can stay in the thought realm alone. This was certainly my experience with ethics coursework, a great of deal of thought and writing but not a clear picture of how to then take that and apply it to the profession. My conversations with students, as well as studies [16] has indicated that most students do not make a connection between what they learned in the ethics course and how they would apply that learning to the profession. This is of course a challenge with all general non-major education requirements where different students disengage with different aspects of the curriculum. Even those who strongly engage with and enjoy non-major coursework may not necessarily make the connection with their profession. While writing and mathematical reasoning are skills that nevertheless become part of the students repertoire of applied skills, it is less clear that the intellectual learning of ethics training is easily brought back into the profession. Critical thinking is clearly a benefit from ethics training, and students no doubt strengthen their understanding of values and ethical conduct. But does such training prepare them to think about ethical issues all the time in their work? The objective of a disciplinary ethics course is to ensure that that connection is made. However, CS/tech ethics courses often spend a lot of time discussing ethical problems in the current profession [1] without explicitly addressing the how portion of practice that is part of this framework.

The best programs will contain both a humanities/philosophy ethics course as well as a disciplinary ethics course. To ensure that the disciplinary course meets the needs of the profession, I think it is important as with many other CS and CS-adjacent courses that there is a strong application component. To ensure retention, I also think that is important to go beyond formal ethical theories which students may not remember in the long term and instead give them tools that they can easily apply and hopefully over time becomes part of their nature of how they approach things in the profession. The section above with student reflections shows that students who took the course with this framework found it useful and they have been thinking about the questions actively in their professional life.

I had not collected data when this course was taught with the formalized framework but intend to do so in the future and report on the results. As it stands, this paper is an experience report and an introduction to the framework that other instructors can utilize.

Because of the simple underpinning of the baseline questions, this framework can also be used in individual modules in coursework throughout the curriculum. At Saint Mary's ethics module start at the very first course in the CS sequence, and culminates in applying the question-directed framework in the capstone course, reiterating the importance of applying the framework to professional practice.

## FUTURE WORK

Apart from repeating this methodology in future courses, the intention is to continue to reach out to individuals who have taken the course and following up with them periodically to see how well they recall the question-directed framework and how they see it playing out in their daily profession, including the individuals who shared reflections in this paper.

I am seeking to formalize the process when I teach a tech ethics course next so that there is student data to demonstrate their perception and recall of the question-directed approach.

We are also looking to apply a modified and generalized question-directed approach towards embedding ethics training in the Saint Mary's College of California School of Science Undergraduate Summer Research Program. This will provide us valuable information on the efficacy of this approach across a variety of STEM disciplines since the Summer Research Program has students from the spectrum of majors offered in the School of Science, from Physics to Psychology. Our plan also explicitly tests a subset of participants a year later to see how well they retain their ethics training and how well they recall the question-directed approach.

## CONCLUSIONS

This paper presents an approach that uses a question directed approach towards the teaching and learning of tech ethics. The questions are memorable, and the expectation is that students through repeated instruction in the framework will continue to have this front of mind and therefore consider ethics in all aspects of their future life and profession. In building a better profession it is necessary that we train a community that treats ethics not as an afterthought, but as something central to their professional practice.

The selected reflections demonstrate the perception of students who have taken the course and show that they have continued to think about and reflect on ethical questions and issues in their professional life. I intend to follow-up with these students again in 5 years to see the extent to which they have retained the framework and how they are still actively applying ethical thinking. Future sections of this course will also include pre- post- questionnaires to collect data that I hope to present at a future time. We are also planning to apply the framework to ethics training for Summer Research students in the School of Science which will provide data on how effective this approach is to a broader set of STEM disciplines.

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