ORIGINAL RESEARCH/SCHOLARSHIP

Transforming Ethics Education Through a Faculty Learning Community: "I'm Coming Around to Seeing Ethics as Being Maybe as Important as Calculus"

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Abstract

Ethics is central to scientific and engineering research and practice, but a key challenge for promoting students' ethical formation involves enhancing faculty members' ability and confidence in embedding positive ethical learning experiences into their curriculums. To this end, this paper explores changes in faculty members' approaches to and perceptions of ethics education following their participation in a multi-year interdisciplinary faculty learning community (FLC). We conducted and thematically analyzed semi-structured interviews with 11 participants following the second year of the FLC. Qualitative themes suggested that, following two years of FLC participation, faculty members (1) were better able to articulate their conceptualizations of ethics; (2) became cognizant of how personal experiences, views, and beliefs informed how they introduced ethics into their curriculum; and (3) developed and lived instructional principles that guided their ethics teaching. Results thus suggested that faculty members benefitted from exploring, discussing, and teaching ethics, which (in turn) enabled them to see new opportunities and become confident in integrating ethics into their courses in meaningful ways that aligned with their scholarly identities. Taken together, these data suggest faculty became agents of change for designing, implementing, and refining ethics-related instructional efforts in STEM. This work can guide others interested in designing faculty learning communities to promote instructional skill development, faculty members' awareness of their ethical values, and their ability and agency to design and integrate ethics learning activities alongside departmental peers in an intentional and continuous manner.

Keywords Ethics · Teaching ethics · Faculty development · Thematic analysis

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Introduction & Background

Ethical thought and practice are central to the natural and applied sciences. Accordingly, ethics must be integrated directly into STEM courses and curriculums, and (we conjecture) must respect and build on students' prior values and experiences. Yet, too often, ethics instruction in STEM is devoid of context (Resnik, 2012), requiring students to consider and configure their ethical responses to situations that are often removed from the student in terms of time, distance, and personal connection. Holsapple et al. (2011) argued that case-based approaches to ethical instruction – which is a prominent instructional strategy in engineering ethics instruction (e.g., Martin et al., 2021) – encourage students to apply a "laws and rules" approach to ethical situations (p. 11). While laws and rules, such as an engineering code of ethics (Davis, 1991), can promote coherent ethical responses, ethical formation further requires developing students' propensities to meaningfully ethically inquire into both their practice and life (Anderson, 2008; Dewey, 2008).

Many scholars have suggested embedding ethics across the curriculum to promote students' ethical learning and formation (Davis & Riley, 2008; Mitcham & Englehardt, 2019; Sia, 2008). Such across-the-curriculum approaches should be continuous and build upon each other, and thus (we surmise) they require a concerted departmental effort. Yet, little research has focused on ways to engage science and engineering faculty members in the collective design, development, and refinement of departmental ethics curricula. This study describes and explores the qualitative results – based on participants' perspectives – of such an intervention.

Within universities of higher education, faculty members are instrumental in departmental efforts, including curriculum initiatives or changes. Thus, one of Jamieson and Lohman's (2009) suggestions for "creating a culture for scholarly and systematic innovation in engineering education" was to "form learning communities to develop and share faculty development efforts" (p. 24). Thus, creating "communities of practice" (Lave, 1991; Wenger, 1999) is one way to engage faculty in the incorporation of novel pedagogies and has demonstrated success in various areas of higher education (e.g., Bringle et al., 2000; Chism et al., 2013; Furco & Moely, 2012).

Faculty development initiatives trace their initial efforts back to "situated learning" theory (Lave & Wenger, 1991) and are becoming increasingly used in STEM faculty development efforts (e.g., Gehrke & Kezar, 2017). According to Kezar and Gehrke (2015), a community of practice consists of a "group of individuals who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (p. 2). Membership in the community involves striving to achieve a shared goal, and members are expected to participate in common activities in a continuous manner. While we use the phrase "FLC" throughout this work, the FLC described in this study is like a community of practice in that it involves creating or "developing a shared repertoire of resources" (Kezar & Gehrke, 2015, p. 9) to address a common problem – here, what ethics encapsulates for faculty members and their discipline and how best to integrate these conceptions into departmental curriculums.

In alignment with Palmer (1997), we conjecture that *who one is* (i.e., one's identity) guides how and to what end one teaches. Thus, efforts at altering one's pedagogy – or a department's curriculum – must attend to all aspects of one's identity (or

the constellation of identities within a department) and assume no absolute partition between one's personal identity and one's identity as an educator and scholar. Individual faculty members bring unique identities (Palmer, 2007) and mental models (Katz, 2019), which are themselves situated alongside departmental values (Gehrke & Kezar, 2017) and institutional values (Gehrke & Kezar, 2019). Individual, departmental, and institutional values are thus critical to attend to in the design of faculty development initiatives, as such values inform one's approach to ethical inquiry and practice in their work (Weston, 2008).

In short, clarifying and reflecting on one's values and how these relate to those of others within and beyond one's department, institution, or discipline is necessary when engaging in interdisciplinary faculty development work, where colleagues can bring competing or contradictory values. The framework of ethical becoming (Fore & Hess, 2020) captures these sentiments and guided our FLC design.

Study Overview

In this study, we investigate the research question, "How did participating in a Faculty Learning Community (FLC) affect faculty members' approaches to and beliefs about teaching ethics?" To address this question, this manuscript presents the analysis of faculty interview data following 11 faculty members' participation in a multi-year FLC. The FLC and our research design were grounded in the framework of ethical becoming. As this manuscript builds on several years of work, we have brought many extensions and learnings to our analysis. Importantly, however, the nature of our research approach, the results presented, and the implications and discussion of our findings of these data are entirely novel.

Unlike our prior works, here we exclusively focus on interview data, look across the two departments involved in the FLC, and center the faculty members' own ethical growth and perspectives in our analysis (as opposed to their students' ethical growth and perspectives). Prior work associated with our project includes (1) non-peer reviewed but publicly available resources that extensively describe the FLC initiative and theory of change (Price et al., 2021; Price et al., 2023), (2) a conference paper presenting an overview of the project (Fore et al., 2018) and another presenting early findings from a subset of participants (Sanders et al., 2021), (3) the theoretical rationale for and conceptualization of the framework of ethical becoming (Fore & Hess, 2020), (4) the application of the framework of ethical becoming to understand students' learning in a single biomedical engineering course that was redesigned as part of the FLC (Hess et al., 2021), (5) analysis of biomedical engineering faculty and student artifacts (i.e., course syllabi, student reflections) coupled with confirmation of study findings using faculty interview data to understand ethical considerations recognized by both groups within the curriculums (Sanders et al., 2022), and (6) three ethnographic case studies focused on Earth Science faculty members' experiences implementing ethics into their curriculum (Fore et al., 2024).

Unlike any of these prior works, the data and themes presented in this work specifically explore the impact of the FLC intervention on faculty members' personal and instructional growth. Our focus is also cross-departmental, thus elucidating common-

alities and distinctions between Earth Science and Biomedical Engineering faculty members. Unlike any of our prior peer-reviewed works, the FLC is the central focus of this paper, and the implications suggest how similar initiatives can help improve the design of interdisciplinary communities of practice and departmental approaches to ethics instruction at other universities.

Theoretical Framework

Summary of Ethical Becoming

Following the speculative philosophy of Whitehead (1978), the conceptualization of ethical becoming begins with the idea that being is the result of a constant process of relational becoming (Fore & Hess, 2020). Being, then, is an ephemeral novelty continuously emerging through relationality. A human, for example, in any given present is a novelty that is constituted via its relationship to *all* that affects them, whether that be their own past, material others (human and more-than-human), ideologies, values, beliefs, knowledge, and more. Thus, entities are constantly becoming, although the nature of any individual entity's ethical becoming will vary based on numerous antecedent and situational considerations.

Becoming as a relational process is, hence, a natural occurrence, happening (often) with little conscious intention. While one who is becoming may lack conscious awareness, ethical becoming draws attention to individuals being cognizant (and, ideally, purposeful) in their ethical becoming process. Ethical becoming, then, is becoming in an ethical way, or with a degree of intentionality which manifests through critical reflection where one seizes on the potentialities presented through actualizing (including but not limited to self-actualizing) affective forces.

Since one is concretely *constituted through relationality*, the entities to which one relates possess value; given this relationality, one is *indebted* to others who themselves play an instrumental role in one's own becoming (Nyamnjoh, 2017). In the operationalization of ethical becoming, Whitehead's (1978) notion of beauty—comprising harmony and intensity (or potency)—inspires obligations to refuse foreclosure on as much difference as possible, thereby contributing to the creation of novel actualities that harmonize difference and possess maximum capacity to affect everything that encounters these actualities in ways that lead to additional beautiful creations (Harthshorne, 1970; Henning, 2008). One must seek to ensure beauty with care, reflective thought, and devotion to ethical inquiry. One's actualization thus becomes ethical through reflective thought in service to a creative process of ethical inquiry toward beauty and with care. Ethical becoming is, therefore, what we would call an ethico-aesthetic framework (Guattari, 1995). This framework guided our FLC design and research inquiry in this work.

Connecting Ethical Becoming to the FLC Through Care and Moral Inquiry

We merged ethical inquiry and an ethic of care and established four conjunctions that laid the foundation of a "caring ethical inquiry": "attentive awareness, respon-

sible judgment, competent experimentation, and responsive iteration" (Fore & Hess, 2020). These four foundational conjunctions can (and should) co-manifest within concrete ethical practice. In the context of this study, we sought to cultivate these foundational conjunctions and the actual praxis of them through an interdisciplinary multi-year FLC (Price et al., 2023).

Drawing on the work of Tronto (1993), care is comprised of four elements: attentiveness, responsibility, competence, and responsiveness. Tronto (1993) paints these elements as both practices and dispositions through which one comes to know about a problem, take responsibility for the problem, competently address the problem, and heed the responsiveness of care recipients to the appropriateness of the care given to solve the problem. Here, it is the dispositional aspect of these elements as parts of the moral excellency of care that is most relevant. In the FLC, we encouraged participants to take responsibility for their curriculums, competently address curricular problems, and be responsive to feedback based on ongoing assessment (including self-assessment and course assessment) throughout their multi-year engagement in the FLC.

Care as a moral excellency provides the means to connect an ethic of care to Dewey's (2008) conceptualization of ethical or moral inquiry. The process of ethical inquiry must be animated by moral excellencies (Dewey, 2008), which are embodied throughout concrete enactions of inquiry. **In ethical becoming**, **care is that moral excellency**. Therefore, the steps implicit in Dewey's notion of ethical inquiry—awareness, judgment, experimentation, and iteration—are animated by care and the elements which care comprises. Iteration is another central facet of ethical becoming and refers to the process by which one's interventions into the world are tested, assessed, and tweaked. Just as one might iterate on a design, one then can iterate by caringly inquiring into personal and collective problems; in that spirit, participants in this study caringly ethically inquired into their selves, their disciplines, and their departments through this manner and as guided by our FLC curriculum.

Faculty Learning Community (FLC)

The FLC was intended to cultivate caring ethical inquiry among faculty (and, in turn, their students) in two STEM departments. To this end, the FLC fostered interdisciplinary dialogue and collaboration among two departments (Earth Sciences and Biomedical Engineering), FLC designers and researchers (social scientists, a philosopher, and STEM educators), multiple institutional centers, campus administrators, and community partners.

Throughout the FLC, faculty members embraced their professional perspectives whilst they engaged with epistemological, axiological, and ontological questions regarding ethical science and engineering. Overall, faculty members in the FLC engaged in five overarching activities: (1) examining personal criteria for good teaching and their relation to scholarly values and disciplinary understandings regarding what constitutes good science, (2) considering the public purposes of their professional work and how it relates to research and teaching, (3) identifying moral situations suitable for use in experiential learning in STEM courses, (4) assessing

colleagues' work on implementing course design principles, and (5) integrating ethical frameworks, critical reflection, and experiential learning in STEM curriculum. Price et al. (2023) details the FLC in full, which we summarize in brief in the following sub-sections.

Year 1 of the FLC

During the first year of the FLC, participants (1) identified how ethics already manifests within their degree programs, (2) explored paradigm shifts related to educational innovations from the ethics literature, (3) discussed mechanisms for incorporating philosophical ethics into STEM curriculums, (4) designed practices for actively and effectively building relationships with communities, and (5) created or modified curriculums and approaches to integrate ethics and civic-rich learning experiences. The first year of the FLC consisted of monthly meetings, which introduced participants to ideas or practices related to civic-rich learning, philosophical ethics, experiential pedagogy, ethical inquiry, and community partnership development. Table 1 summarizes the learning progression in the first year of the FLC with additional details regarding activities and our rationale for learning objectives and activities.

During the first year of the FLC, we prioritized foci on ethics and critical reflection, which were two of three components of the ICELER framework (Integrating Community-Engaged Pedagogy and Ethical Reflection) that we encouraged participants to embrace. While we did not emphasize community-engaged pedagogy throughout Year 1, we began orienting faculty to community-engagement by discussing scholarly identity and ethos. We viewed such initial work to be integral faculty members later embracing community-engage pedagogy, particularly given that such pedagogy is grounded in a particular ethos, ways of knowing and being that are counter normative in STEM.

Sessions 1–4 (refer to Table 1) occurred monthly and included a progressive emphasis on exploring individual values that participants knowingly or unknowingly enacted in their roles of teacher, professional, and citizen. Participants then considered the significance of these articulated values for integrating ethics into a STEM curriculum. For example, in the second and third sessions, faculty members identified agreements and disagreements among themselves regarding values related to moral situations. Discussion of these (dis)agreements then challenged a static conception of their own articulations and encouraged ongoing reflection.

Sessions 5–8 again occurred monthly but during the second half of the first year. In these sessions, we introduced the FLC participants to a variety of resources for instruction—including reflection strategies, assignment design, and assessment practices—as a means for teaching ethical inquiry in STEM courses. Sessions had participants engage in course design and curriculum planning. Participants had opportunities (within and outside of FLC sessions) to receive feedback on their instructional designs.

While this presentation of the first year of the FLC may seem static, our design of the FLC curriculum was iterative and responsive to participants' views and experiences. As one example, during session 7, we presented the following series of claims near the beginning of the two-hour FLC session:

Table 1 Summary of FLC sessions, session learning objectives, and rationale

Session	Learning Objectives	Activities	Rationale
#1 - Teaching Who We Are (*08/23/2018*)	To examine implicit and explicit assumptions that each faculty member holds about the standards and practices of good teaching.	Participants reflected on the connection between individual character and teaching; articulated their understanding of good teaching by considering the claim that "teaching is more than technique;" and established guidelines for FLC norms and dialogue. Pre-session, participants read Palmer (1997) entitled, "The Heart of a Teacher."	This session communicated values and principles relevant to the overall project, including our team's prioritization of faculty praxis in relation to their own ethical becoming. The session activities fostered an intensive internal reflection on one's values and how these inform their instructional choices in their curriculums.
#2 - Making Values Explicit in Our Work (*09/18/2018*)	To describe the values significant in one's work as faculty members and, in particular, their personal scholarly values across teaching, research, and service; to compare scholarly values with standards of good teaching.	Faculty analyzed professional values in light of their roles across teaching, research, and service using the Scholarly Identity Mapping activity (Price, 2018). We used an active learning technique called "Stand and Declare" to engage faculty in embodying their assumptions about science and teaching and discussed the concepts of "good science" and "good teaching." Pre-session, participants read Bird (2014) on social responsibility and good science.	We built on the values faculty members began engaging with in session 1 to identify how values undergird assumptions about good teaching in STEM, including one's self-conception as academic professionals. This was used to examine the relation of values to one's understanding of "good science." The conversation enabled us to better understand faculty connections and tensions.
#3 - Scholarly Identity and Public Purposes (*10/16/2018*)	To attend to a broader realm of values and describe the public purposes and values of faculty members' professional work, including how these influence teaching and research.	Faculty members revised their Scholarly Identity Maps (Price, 2018) to show the intersection of scholarly identities, professional values and roles, and the "public purposes" of academic work. Prior to the session, participants reviewed the second chapter from Peters' (2020)s book, "Democracy and Higher Education," which prompted participants to consider the civic dimensions of their work.	The focus on public purposes provided a conceptual foundation for how participants (1) could ground community engagement and civic learning as dimensions of their ethics-related teaching practice, (2) could (re)define what constitutes of "good science," and (3) to interrogate individual scholarly values and standards of good teaching.
#4 - Making Values Explicit in the Curriculum (*11/15/2018*)	To understand the source and nature of ethical inquiry in concrete human experiences of doubt, confusion, and conflict.	Faculty engaged with tools for ethical inquiry and distinguished between values and moral values guided by a framework comprised of four families of moral values and read Chap. 1 and 6 from Weston (2008). Ethical inquiry was offered as a process for discerning opportunities for ethical inquiry and reflection in any curriculum.	This session guided participants in the identification of moral values embedded (intentionally or unintentionally) in their courses, including how these values relate to disciplinary, departmental, and personal standards.

Table 1 (continued)

Session	Learning Objectives	Activities	Rationale
5. Connecting Values to ICELER (Integrating Community-Engaged Learning & Ethical Reflection) (*01/18/2019*)	To identify learning objectives for faculty members' programs and courses.	This session drew explicitly on a backwards design model (Wiggins & McTighe, 2005). Participants developed concept maps of what constitutes ethical STEM practice both as a department and as individuals. Concept maps were used to generate programmatic and course learning objectives and goals. Participants reviewed Hess & Fore (2018), which was intended to motivate pedagogical ideas.	Recognizing the distinction between learning goals and learning objectives are prerequisite to understanding the traits of effective learning objectives and the sorts of helpful learning goals for integrating ethics into STEM courses. Concept maps became touchstones for further refinement over the remaining sessions.
6. Critical Reflection and Experiential Learning (*02/22/2019*)	To recognize the role of critical reflection in learning and consider evidence of how it might improve ethical reasoning and its translation into action	This session prompted participants to outline learning plans and strategies for critical reflection grounded in experiential learning, and to do so in a way that yielded evidence of learning. Participants were provided multiple examples, including Ash and Clayton (2009) on critical reflection, Sternberg's (2010) ethical reasoning heuristic, and AAC&U's (n.d.) rubric for assessing ethical reasoning.	The draft learning plans developed in this session became touchstones for further refinement over the remaining sessions, particularly in relation to aligning and scaffolding programmatic objectives, identifying critical constructs that might serve as threshold concepts, and elucidating ways for faculty to convey to students the character of an ethical STEM practitioner.
7. Evidence of Ethical Reasoning and Ethical Reflection Strategies for Assignments (*03/22/2019*)	To experience a reflection exercise and to reflect on the experience and articulate its significance for learning.	Types of assignments and potential evidence for assessment for student learning were introduced in this session, namely, the DEAL model of Critical Reflection (Ash & Clayton, 2009). The session guided design of reflection using the Four C's (Continuous, Connected, Challenging, and Contextualized). During the session, we connected learning to experience (Marton & Booth, 1997).	This session offered critical reflection as one way to realize ethics learning goals and objectives. By experiencing reflection in ways that are potentially similar to their students, faculty members were better prepared to generate an assignment incorporating ethical reflection.
8. Backward Design, Experiential Learning, and Reflection Strategies (*04/19/2019*)	To receive feedback and consultation on revised draft course plans based on instructional design frameworks.	We directed attention to Phase 3 of the Backwards Design model (Wiggins & McTighe, 2005), with an added focus on Experiential Learning. We focused on course planning activities and instruction and participants received feedback on course plans. Participants reviewed an adaptation from McTighe and Wiggins (2004) focused on design critical reflection in alignment with students' learning experiences.	A concerted focus on instructional design and experiential learning theory was intended to help participants connect experiential learning with ethical inquiry and critical reflection. This focus was based on participants' state of curriculum development and resistance/uncertainty regarding experiential learning (including but not limited to community engagement) that we observed in session 7.

Table 1 (continued)

Session	Learning Objectives	Activities	Rationale
9. Participant Curriculum Presentations (05/13/2019)	To share refined curriculums and receive feedback from external audiences.	FLC members presented to FLC peers, colleagues outside the FLC, and experts in ethics, community-engagement, or institutional change.	This session provided an opportunity for campus colleagues and project advisory board members to learn about the FLC and the accomplishments of the past year and for the participants to receive feedback and suggestions on their work.

1. People live in a world which they experience.
2. Experiences include physical, social, cultural (and other) dimensions. In teaching, we need to take the experiences of people seriously.
3. To take experiences of people seriously, we need to account for the physical, the social, and the cultural world that individuals experience.
4. "The world we deal with is the world as experienced by people, by learners — neither individual constructors nor independent realities; the people, the learners we deal with are people experiencing aspects of that world — neither bearers of mental structures nor behaviorist actors [only]." (Marton & Booth, 1997).

We intended for these claims to set the stage for other activities focused on critical reflection that accounted for students' experiences. Alas, we were surprised by reactions to these claims among participants, where we observed resistance or uncertainty regarding whether incorporating experiential learning into one's STEM course was always appropriate. One concern seemed to be that building on students' experiences may lead to high-stress course discussions and potentially high levels of emotional distress among students. We felt it was critical for us to discuss these concerns in-depth and as a community before advancing to a focus on critical reflection during this session. Thus, we devoted half of our two-hour session to this series of claims and participants' associated concerns. Moreover, we realized that we needed to continue discussing experiential learning in more detail in session 8. This is but one example of the iterative nature of the FLC design and how we aspired to ground the FLC curriculum in our participants' lived experiences and understandings.

As a result of the Year 1 FLC, all participants incorporated ethical inquiry and critical reflection into existing courses. At the end of Year 1, a subset of participants included community-engaged learning, especially earth science participants, many of whom had experiences with community-engaged teaching prior to the FLC. Nearly all biomedical engineering participants had not implemented community-engaged pedagogy before beginning the FLC. As a result, FLC participants' courses featured variable levels of community-engaged pedagogy, although we note that several participants engaged in creative expressions of community-engagement. For example, during an introductory biomechanics course, participants had students consider the rodents who participated in their study as a form of community, thus expanding the definition of community by drawing attention to human and more-than-human relationships (Hess et al., 2021).

While not all participants featured community-engaged pedagogy in their revised courses, all participants engaged in some form of experiential pedagogy. Authentic education environments and reflective assessments on relational experiences within those environments are key elements of experiential learning, of which community engagement is one expression. We theorized that a community-engaged approach provides a rich modality for achieving the ethical growth prescribed by the ethical becoming framework, in that it prioritizes relational care for self and others, ethical inquiry, and a commitment to safeguarding difference as we scientifically intervene in the world.

Year 2 of the FLC

In Year 2, participants began implementing their refined courses. Year 2 FLC sessions concertedly focused on exploring the possibilities of incorporating or revising community engagement learning approaches in participants' courses and curriculums. Thus, participants either bolstered their community-engaged pedagogical efforts or considered how to incorporate community-engagement or – in instances where community-engaged pedagogy was deemed infeasible – civic-rich experiences.

During the first Year 2 session (September 2019), we prompted participants to consider their ethics teaching and learning in the context of community. Participants read about the affordances of civic-rich education (Musil, 2015), completed a self-reflection rubric on their level of preparation for integrating community-engaged learning in courses, and identified where they would individually and collectively like their courses and curriculums to continue improving in light of these considerations. The second session (November 2019) had participants visit one of two local community partners (NGOs) and consider learning opportunities afforded by engaging community partners in STEM curriculums. In the third session (December 2019), participants revised their critical reflection activities, and participants who had implemented their revised courses reflected on the course experience and shared lessons learned with others in the FLC.

Due to the rise of COVID, we only met one more time in Year 2. Given ethical tensions and turmoil associated with COVID-19 and the state of the US, our final session (April 2020) had participants reflect on ethical tensions that they were experiencing in their lives (both personal and professional) and share these tensions with their peers. The session concluded with participants considering how such tensions might translate to their teaching efforts and revisions to the ethical aspects of the courses that they had implemented over the past year.

Years 3–5 of the FLC

In Years 3–5, all participants implemented their refined courses. In addition, participants met twice per semester to receive formative guidance on their interventions. During these FLC sessions, participants continued inquiring into and iterating upon their teaching approaches, with many becoming more involved in disseminating findings to external audiences. Sessions in Years 4 and 5 concertedly focused on sustaining momentum, reflecting on departmental culture, and identifying ongoing areas for

growth. Each year concluded with a celebration-like presentation, where we invited individuals who were external to the FLC to learn about the instructional efforts and departmental outcomes resultant from the FLC.

Research Design

Data Collection

We conducted interviews during May or June of 2020 with 11 faculty members. All interviewees had thus participated in the FLC for one or two years at the time of the interview (refer to Table 2). As part of the Year 1 efforts, each faculty member revised an existing disciplinary course. As part of Year 2 efforts, each participant implemented their refined course. Moreover, as part of Year 2 efforts, eight of 11 participants continued engaging in the FLC, wherein they reflected on and shared their experiences delivering the course.

During interviews, participants discussed their: (1) "motivation for participating in the FLC," (2) "perceptions of ethics," (3) "perceptions of community engagement," (4) "perceptions of critical reflection," (5) "impact of the FLC" on their own learning or their departmental changes, and (6) "a summative/closing section." (Sanders et al., 2021).

Due to the goal of conducting interviews soon after participants' end-of-year 2 FLC presentations, multiple researchers conducted interviews. To ensure consistency across interviews, our team designed the protocol together, wherein we identified must-ask questions (which opened each interview section) and a series of potential follow-up questions for interviewers to use at their discretion. Following interviews, each interviewee generated a memo representing key takeaways. The team of inter-

Table 2 Participant overview

#	Pseudonym	School	All Four Years of FLC?	Interviewer
P1	Bastion	Biomedical Engineering	Yes	Hess
P2	Beckon	Biomedical Engineering	Yes	Coleman
P5	Blair	Biomedical Engineering	No	Fore
P6	Brantley	Biomedical Engineering	No	Coleman
P7	Briar	Biomedical Engineering	No	Hahn
P3	Eagle	Earth Sciences	Yes	Price
P4	Eden	Earth Sciences	Yes	Hahn
P8	Ellis	Earth Sciences	Yes	Fore
P9	Emerson	Earth Sciences	Yes	Hess
P10	Esker	Earth Sciences	Yes	Price
P11	Eve	Earth Sciences	Yes	Hahn

viewees then reviewed peer reflections, met to discuss these reflections, and generated a list of common memo reflections.

Participant Overview

All FLC participants who participated in this project informed our qualitative analysis. We chose gender-neutral pseudonyms for all participants. We provided biomedical engineering participants with "B"-starting pseudonyms and earth sciences participants with "E"-starting pseudonyms (refer to Table 2).

Data Analysis

We performed a thematic analysis (Braun & Clarke, 2006). Our iterative analysis approach involved (1) immersion in the dataset, (2) reviewing data for emergent codes and patterns, (3) sharing emergent codes and patterns and discussing them as a whole team, (4) generating themes, (5) sharing themes with project participants as a form of member checking, and (6) narrating and iteratively improving themes with external feedback.

First, Author 2 (Sanders), who did *not* interview participants, initiated analysis by immersing themselves in data collected from four participants who were FLC leaders or developed what we viewed as notable innovations in their curriculum: Bastion and Beckon from biomedical engineering; Eagle and Eden from earth sciences. Author 2 engaged in iterative rounds of coding development and received synchronous feedback from Author 1 on a weekly basis. Initial codes described specific activities that participants delivered to their students (e.g., case studies, integration within design curriculums, delivery of reflection), faculty members personal and professional development (e.g., beliefs of students' capacity, observations of students' engagements), as well as factors that seemed to affect faculty-decision-making and instructional approaches (e.g., relationship to the environment, the pandemic, individual obligations).

Authors 1 (Hess) and 2 (Sanders) then shared emergent codes with members of the research team to clarify the language and ensure core ideas reflected in research memos were not lost. Team members provided peer critique, discerned the alignment of the codes with their interview reflections and FLC experiences, and offered formative suggestions. Following these discussions, Authors 1 and 2 revisited the remaining 7 interviews to determine the relevance of codes across other interviews.

Next, Author 2 generated initial themes that described interview data. They then presented these to the team, who collectively provided suggestions to reframe codes in ways that represented or aligned with FLC goals and facets undergirding the theory of ethical becoming. Through these actions, we generated two key categories focused on (1) ethics as a concept and as viewed by participants and (2) how participants sought to or actively taught ethics in their curriculums.

Member checking occurred during a Year 3 FLC session, where we shared the current state of the themes with the seven present FLC participants, including three in biomedical engineering and four in earth sciences. During this meeting, participants had the opportunity to critique or reject emergent codes. Participants primarily shared

questions and offered formative points of clarity to ensure that the themes accurately reflected their experiences.

Narration of themes occurred throughout the prior activities, with slight iterations and evolutions at each stage. In addition to member checking, multiple external presentations (i.e., outside of the FLC) afforded opportunities to revisit and refine emergent themes. External presentations included a seminar presentation with a department, a written annual report to an external agency, and a presentation to the institutional assessment group at the university associated with the FLC. These opportunities enabled us to share findings in verbal and written modalities and discern the understandability of themes with multiple external groups.

Results

We generated eight themes, which we grouped into two categories: (1) Perceptions of Ethics and (2) Principles for Teaching Ethics. We present the themes associated with each category in separate sections, each of which includes a thick description, including excerpts from participants' interview transcripts.

Category 1—Perceptions of Ethics

We generated four themes associated with Category 1: (1) Connections to Self, (2) Connections to Others, (3) Entanglements, and (4) Limitations of Compliance. These themes are depicted in Table 3, which also include exemplary quotes.

Theme 1.1: Connections to Self

Across interviews, faculty members reflected on their positionalities (both personal and professional) and framed ethics as self-directed. As Beckon shared, "I do know that it's [ethics] driven by your moral compass inside." Blair described how a "gut feeling" can inform one's action and that "being ethical" involves "being able to listen to that inner voice," including when specifying principles (e.g., beneficence). Likewise, Emerson described ethics as "having that [ethical] framework that is pretty deep in your DNA." Participants called attention to the role that life experiences play in shaping one's perceptions of ethics. For example, Eagle shared that dedicating time to groups like the FLC was looked upon favorably in his university position:

I feel like I lived with a lot of privilege. I lived with the privilege of being able to do this. Not only as part of my job and my department, and my chair, my university looks favorably on my involvement in something like the Faculty Learning Community, but then, also just where I am socially and economically. I have that opportunity, and I'm not saying that people who don't have opportunities like me are not ethical. - Eagle.

Table 3 Themes associated with category 1 – perceptions of Ethics

Theme	Description—Participants feel or believe that…	Exemplary Quote
Connections to Self	…ethical personal and professional decisions and actions are informed by one's personal values, morals, and life experiences.	"I do know that [ethics is] **driven by your moral compass** inside in making decision that are, without using ethics language, for the greater good. Whatever you define as your greater good." – *Beckon* "[For an individual to act ethically], internally I guess it's more, you just need to think about yourself, and the integrity you should have." - *Ellis*
Connections to Others	…ethics constitutes relationships with "others" (e.g., community members, students, stakeholders), and thus, ethical courses of action are informed by who or what might be affected and how.	"[Being ethical] is broadly thinking of others or society or whomever just besides one's self when taking actions or making choices or whatever it may be." - *Briar*
Entanglements	…ethics is connected to one's disciplinary/course topics and is critical to one's disciplinary and professional practice.	"You have to integrate the data and make sure it's consistent. And they [the students] never really seemed to recognize the value of how you gather consistent information to make it a long-term process. So just understanding the value of each number they write down and why they do it and what happens if you have bad values." - *Ellis*
Limitations of Compliance	…rules of one's discipline (e.g., standards, codes) and one's societal affiliations (e.g., laws) can guide practice but are insufficient by themselves for helping one become an ethical scientist or practitioner.	"To get to the understanding ethics, for me, the point I was trying to make is that **it's multilayered**, so broader societal norms and ethics, right? I mean, **we've got our laws**. If you break laws, if you don't follow societal norms that are codified in policy, that that can be deemed unethical, assuming that they're good laws, right? Assuming that you're not breaking it for a reason. [….] being ethical is recognizing all those layers, but all of those layers working together, I mean, just sort of crossing seamlessly. - *Blair*

Theme 1.2: Connections to Others

The FLC also supported faculty members' understanding of ethics as it relates to others. Thus, it was not surprising that faculty members framed ethics as contextual and influenced by relationships with others, including students, animals, communities, society, and extant social systems (e.g., the law). As Eden shared:

If you're studying the ocean and you're talking about sea level rise and beach erosion, when you raise the question, should we develop the coasts? Should that be allowed? I've used a lot of examples like that in the classroom in the past, but [now, after the FLC] having the students interact with the community members got them to say things like, "Oh, this isn't just for a class, this isn't just a lab. I'm actually doing something real." So, in that sense, making those connections to the community between science and the implications of what they do just certainly made it more real. — Eden.

Eden draws attention to the connection between community and science, which was a key aspiration from the FLC and a key aspect of the framework of ethical becoming, where becoming aware of others is essential to capitalizing on relational processes that are essential to caring inquiry. For example, ethical inquiry involves negotiating ethical possibilities across stakeholder groups. Like Eden, other participants discussed the impacts of science and engineering on both living and non-living entities and shared successes in helping students see such connections to others. Thus, participants sought to help students evaluate (1) who might be affected by STEM decisions and (2) how they might be affected.

Theme 1.3: Entanglements

While participants felt that, generally, STEM curriculum tends to treat engineering, science, and ethics as separable entities, they came to view ethics as entangled with disciplinary viewpoints, course topics, and pedagogies. Ellis shared, "Originally, I would think the ethics component and community engagement are more like separate things. Right now, we use them more, like, integrated." Like Ellis, others came to view ethics as inseparable from course topics and as core to their discipline. Blair reflected on their prior academic training and shared:

> *My engineering undergraduate [training], even in my high school, ethics was always compartmentalized into a course or a series of lectures, or it was just something separate. When I went through it in college and then even in graduate school, it seemed like it was an appendage. It was something that was supposed to be so important and fundamental to our profession, but it was this separate thing. […] It wasn't essential to my education. It was just something that they had to check off and I had to check off, but it was never really integrated in the curriculum. - Blair.*

Despite these experiences, Blair shared that ethics was integral to their discipline, stating, "I think I'm coming around to seeing ethics as being maybe as important as calculus."

Participants often discussed the societal impacts of STEM and how that necessitates STEM practitioners' attentiveness to such impacts. Thus, they saw such community engagement as a meaningful way to integrate ethics into their teaching, although participants held varying conceptualizations of what constituted community and engagement. Ellis shared their changed perspective regarding the import of connecting ethics and community in their teaching, "I guess [I now have] really just a deep appreciation of ethics, self, and also the integration between ethics, and community engagement." Eagle came to view ethics as omnipresent in life, writ broadly. As they stated, "I guess what's really changed is that, now, you see ethics everywhere."

Theme 1.4: Limitations of Compliance

Nearly all faculty members discussed ethics in the context of standards set by a governing body in their discipline, scholarly community, or the government (i.e., "laws").

Such standards serve as rules to outline ethical science and engineering work. Some participants valued the clarity that standards bring but noted that morals make ethics "messy." As Brantley shared:

Anything that becomes a moral question, anything that cannot be addressed or answered completely in terms of scientific facts or engineering solutions, anything that goes beyond that, that becomes very personal because everyone's going to have different moral standards, and this is I think where things get really messy. That's what I think of when the word ethics come up, and I always find it challenging how to make that... [pause] Because everywhere you go, whether in your life, or in the classroom, or work, you're interacting with people that are completely different. Everyone has a completely different story. Again, I know we talked about this in training. How do you make everyone agree or come to the same conclusion, agree to do something together? I kind of file all that under ethics or ethical issues, and this is where I would say default to someone that has more experience dealing with these issues.

Brantley expressed challenges with the uncertainty and subjective aspects of ethics, which is in part due to their embracing both their own and other individuals' prior experiences and histories. Yet, they expressed a desire to "default" to others with expertise when "dealing with these issues" where disagreement and uncertainty manifest, including but not limited to sources of expertise offered through standards of compliance. Despite this, Brantley expressed that their role as a teacher is to help students work through such ethical tensions. They stated, "As a teacher, I wouldn't solve these issues for a student, instead I would try to help them work through the problem. Especially something that's related to their career, their personal lives, the final decision is theirs." Brantley thus indicates that the context of an ethical issue also informs what their role is in the situation.

They later elaborated on this consideration in light of the heavily regulated nature of the pharmaceutical industry and the goals of their course. Here, they drew attention to the myriad connections between stakeholder groups in this industry (i.e., entanglements), the ethical challenges resultant from decision-making given these connections, and how they view their students to have internalized a broadened awareness of ethics (including the limitations of abiding by standards set forth by FDA alone).

...this was a class on pharmaceutical drug manufacturing, so we had a lot of examples where I challenged them to think… and this is so easy to make an ethical correlation about… let's say that the cost of healthcare in this country, drug manufacturing. I think I made them think even though we always hear complaints about why drugs are so expensive, we talk about some of these cancer drugs, it's like 10 or 20,000 dollars a year for… and that's cheap for a good cancer drug. So, on one hand, that's terrible. Most people can't afford that. On the other hand, I think they see in some cases why that's so costly, because we go through the manufacturing steps, and the fact that it takes years. Drugs in America at least take 10, 20 years to go from discovery all the way to market. [...] They're [the students are] starting to see there's many layers to an issue.

On one hand, you can talk about the cost to the end user, to the consumer; on the other hand, you can think of… these are companies, especially smaller pharmaceutical companies, that still have to pay their bills. They have to pay for infrastructure, for the sterilization, for the approval. They have to pay for lawyers to get… help the drugs go through FDA. So they can start to see the cost of everything, and also why some things are as expensive as they are. Of course, you can go do this in a third world country and things might be cheaper, but then they don't have something like FDA to safeguard their people from bad drugs. And this is when you hear in the news every once in a while how everyone gets poisoned by something that they're taking that they thought was going to help them. So I can see how they're starting to see everything, things are not always as straightforward as they have come to know.

Brantley next connected the idea regarding the limitations of compliance (here, FDA regulations) while considering the ongoing pandemic. Specifically, Brantley drew attention to public pressure in juxtaposition with FDA approval processes:

Students, they don't always pay attention to everything. They may just read one headline and just hold onto that instead of, if you dig a little bit deeper, you'll see there's often many sides to one story. There's reasons why things are the way they are. I also push them to think about, if you were to go into this industry, how would you deal with some of these issues? We actually had a really interesting… this is happening at a very interesting time because of this whole Coronavirus situation. We're sort of watching [it] happening right before our eyes, this whole process of regulation and FDA approval for vaccines, for drugs. Then there's the mounting pressure right now to have something out there, and I always bring out the example of the AIDS epidemic in the 80s. It was the same deal. People were dying, but we had nothing to treat them, just like kind of what we're doing right now. So everything is fast tracked, just like we're doing right now, but now they can see why things are the way they are normally, and how when we are under certain pressure from the community, from the society like we are right now, exceptions are made. But again, the cost of these things, how to pay for these things, we just had… what is it? A two trillion dollar recovery package passed, and then hopefully when they get older and they go out there and they start to have jobs and pay taxes, they'll see how all these things are linked, and how they are part of this whole big picture.

While standards can provide clarity and guidance, participants shared that professional practice was an interpretive act. Thus, participants discussed multiple situations where standards or regulations may not suffice and thus require ethical considerations beyond compliance. Blair discussed the need to "appreciate" possible uses of technology ("nefarious" or otherwise), including "the potential downsides" and "negative aspects." Blair indicated that standards are often backward-looking and hearkened to the need to develop "forward thinkers" who are prepared to consider such unforeseen potentialities whilst designing engineering solutions. Such thinkers ought to consider but not limit their thinking to compliance-based standards of practice.

Category 2—Lived Principles for Teaching Ethics

In addition to identifying shifts in participants' perceptions of ethics, we also gathered guiding principles for teaching ethics shared by the participants. We generated four themes associated with Category 2: (1) Intentionality, (2) Personalization, (3) Integration, and (4) Continuity. Each of the themes are defined in Table 4, which also includes one exemplary quote for each theme. Importantly, each of these principles were *lived principles*. In short, participants not only viewed these principles to be important, but they framed the principles as manifesting in their teaching.

Theme 2.1: Intentionality

Many faculty members across departments shared that they incorporated community-engaged activities before their involvement in the FLC, but they did so in ways that were largely incidental or unintentional. Due to the FLC, all participants intentionally integrated activities related to ethics and critical reflection into their courses, ensuring alignment of course content with ethics learning goals or objectives; a subset also employed community-engaged pedagogy.

Beckon discussed making prior implicit instruction more explicit and refined one of their existing class activities. Beckon updated their course to include multiple ethics-related touch points. In their revised syllabus, they updated the course's learning outcomes to include "an awareness of ethical responsibilities" that students would

Table 4 Themes associated with category 1 – lived principles for teaching ethics

Theme	Description—Participants feel or believe that…	Exemplary Quote
Intentionality	…it is critical to intentionally (rather than unintentionally) and, often, explicitly (rather than implicitly) teach ethics.	"I think a lot of people in the department already operated at that level [before the FLC], but I think now that there are few of us who can see it a little clearer, it helps us get closer to what our intentions are, and maybe faster." – *Eagle*
Personalization	…it is important to connect personal experiences and values to instructional goals, practices, and aspirations in ethics education.	"…I guess just being a bit more in place and in the moment and mindful about what it is I'm doing. Now, every single thing I see… it's really creeping into everything I do, which is a great thing." – *Eagle*
Integration	…it is important to integrate ethics and experiential learning through critical reflection and associated activities.	"We had some good pieces here in terms of how can we communicate that [i.e., ethical issues regarding lead contamination] to the public. This was one of the things that I did through this year, studying, was really having them [students] think about, "Okay, how can you, as a scientist, engage the community?" […] so this integration with the community piece, I think, has been very tied-in that way. - *Esker*
Continuity	…it is important for ethics learning to build on prior experiences, including current and prior courses in one's discipline or program.	"This [continuity in the biomedical engineering curriculum] gives it the cohesiveness of making it more meaningful. And, when you do that, like I said earlier, the students notice." - *Beckon*

cultivate by participating in learning modules related to (1) introductory and research ethics, (2) business and professional ethics, and (3) the outside-of-class activity and in-class discussion. For example, prior to the FLC, Beckon asked students to watch a documentary addressing ethical professional practice related to course material, but after the FLC, Beckon added an in-class ethics discussion about the documentary coupled with critical reflections.

Bastion described a shift in the intentionality of their facilitation style to promote students' critical reflection. When asked to comment on their students' ethical development throughout their course, Bastion cited a fruitful in-class ethics discussion where they were surprised by the length of the discussion and students' high levels of engagement. This experience motivated Bastion to refine the way supported and implemented students' critical reflection. For example, Bastion leveraged the ideas that students articulated in their reflections to help students deepen their reflections. Of note, Bastion shared that the success of this in-class discussion motivated them to double the allotted time for this discussion in future semesters.

Eagle reflected on the earth sciences department's curriculum before the beginning of the FLC and shared that many earth sciences faculty members implicitly engaged their students in ethics instruction through their course content—however, Eagle (and their students) did not explicitly realize the connections of course content to ethics. Thus, the FLC provided language for bolstering the way they presented ethics in existing practices. Moreover, Eagle felt that the FLC enhanced their department's understanding of "what our intentions are." Thus, intentionality manifested on both a course and departmental-level in participants' interview responses.

Theme 2.2: Personalization

In addition to making ethics instruction more intentional in their curriculums, participants sought to bring professional and personal life experiences into their classroom and prompted students to draw connections between class learning and their lives. During class sessions, Beckon now expressed the human impact of biomedical engineering based on their direct interactions with patients in operating rooms and by sharing such experiences with their students. Bastion discussed animal ethics and their struggles with euthanasia as an early career biomedical researcher. Bastion chose to discuss these personal struggles openly with their class and connected these struggles to ethical considerations. For example, they sought to help "the students in my lab understand the sacrifice that these animals are making." Bastion found that such ethical discussions, especially around animal euthanasia practices, were engaging for students. Moreover, the department found course retention rates to increase following the implementation of the new curriculum.

While these biomedical engineering faculty members personalized their instruction by bringing their career experiences into the classroom, other participants discussed experiences outside of their discipline. For example, Eagle reflected on their role in society, writ broadly. Following the FLC, Eagle shared, "Now, every single thing I see, I'm using a bamboo toothbrush now. So, it's [being ethical] really creeping into everything I do." This infusion of critical reflection on ethical practices into Eagle's life directly informed their approach to teaching ethics in the classroom.

Eagle shared, "One of the big problems that I try to focus on is plastics pollution. For the longest time I've just been lecturing on it, which is a bit stale. There's a crap ton of plastic in the ocean. We're all responsible." Given these personal connections, Eagle, in turn, sought to help make ethics personal for their students by calling upon students to participate in a "plastics pledge" wherein they prompted students to "pledge to yourself that you're going to cut a certain number of disposable plastic items out of your everyday life for two weeks." Eagle even participated in the pledge alongside students, thus adding an additional layer of personalization to their course.

Theme 2.3: Integration

All faculty members refined their existing courses by designing new course activities to integrate ethics, critical reflection, and experiential pedagogy. These integrations manifested in-class discussions, written reflections, case studies, design project components, and field trips.

In biomedical engineering, Bastion developed a multifaceted experience for students that incorporated outside-of-class activities, in-class discussions, and individual reflections about the value of life and ethical decision-making in science, particularly as it relates to animal ethics. Encouraged by student engagement during an in-class discussion, which was further facilitated by Bastion's newly acquired ethics "vocabulary", they nurtured discussions about ethics during other lessons and activities as well. Beckon similarly integrated a case study experience for their students that consisted of an outside-of-class activity, in-class discussion, and individual reflection assignments about one's responsibilities and connections to society. Both faculty members observed willingness and enthusiasm among students to engage in discussions about ethics, which (in turn) motivated their continued iteration on courses and curriculums.

In earth sciences, participants similarly integrated ethics across individual courses by incorporating critical reflection assignments. For example, Eden prompted students to consider the ethical implications of bias that may be introduced during fieldwork data collection and, whilst considering such bias, each data point's value. They adapted a community-engagement field trip to make science "more real" for students. They found that "students really have a hunger for a discussion about ethics, and anytime I brought it up, most students seem really to have opinions and [are] willing to talk about it more-so than some of the science content." Separately, Eagle incorporated assignments throughout the course that required students to critically reflect on their personal responsibility for environmental issues, alongside an extra credit reflection assignment that prompted students to journal about the environmental implications of their lifestyle.

Theme 2.4: Continuity

Faculty from both departments articulated the value of students' repeated engagement with ethics-focused content and discussed the benefits on students' overall learning. However, the conceptualization of ethics curriculum continuity differed between departments: (1) earth sciences participants strove for continuity within sin-

gle courses, and (2) biomedical engineering participants strove for continuity across their program.

Biomedical faculty members discussed students' repeated engagement in ethics content throughout their program. Beckon described how their department developed a curriculum-wide portfolio project to document students' critical reflection, ethical development, and experiential learning (including community engagement). Thus, students would develop their portfolios throughout the required biomedical engineering course sequence. The biomedical engineering department also created two tools to aid faculty across the department as they sought to integrate ethics content in discrete courses. These tools included an ethical reasoning heuristic model, which demonstrated the departments' synthesis of ethical decision-making considerations from multiple decision-making models and a rubric designed to evaluate students' ethical inquiry skills. Beckon felt that their departmental approach led to student learning experiences that were "more meaningful."

Earth sciences faculty members became more aware of peers' teaching approaches, but they generally discussed continuity in the context of one class. Accordingly, they sought opportunities to use ethics as a thread throughout each course. For example, Eagle prompted students to consider the question, "Does earth have rights?" quite literally throughout their course. To address this question, they sought to "start small" with tangential but related questions and "carry that thread to the end of the semester." While continuity largely manifested in individual courses for the earth sciences department, participants expressed a desire for more department engagement, with a goal of fostering such continuity. As Emerson shared:

> I think it [the FLC] would've been improved a little bit if we would've had at least, if not one or two additional opportunities, whether it be one hour or two hours to huddle back as a department, we did that a number of times throughout this, but huddle back as an entire department. Bring some of the shifts back to earth sciences and discuss, basically have more of an opportunity to share with the rest of the faculty. And hear what they had to say about this and to discuss how we might want to implement this as a department-wide program. – Emerson.

Importantly, the interviews took place during the conclusion of the second year of the FLC. Since the interviews, we have observed departmental-wide engagement in this department regarding ethics, critical reflection, and community-engaged learning. These discussions have included non-FLC departmnetal faculty members and students. Such distal outcomes were beyond the scope of our analysis in this paper, but they speak to the importance of the continuity of the FLC program itself in prompting departmental changes.

Discussion

This study explored the impact of a multi-year FLC on STEM faculty members' understanding of and approaches to teaching ethics. We theorized that ethical becoming would be animated through the FLC. This discussion extends our theory and discusses the role of identity and agency in teaching STEM ethics, coupled with implications for cultivating FLCs.

A key goal of an FLC is to promote faculty learning within a community. An essential aspect of an FLC, then, is the community itself. The FLC was comprised of interdisciplinary scholar-practitioners, including participants from earth sciences and biomedical engineering and investigators from anthropology, STEM education, and philosophy. We observed challenges, many of which we felt were due to distinct guiding paradigms for knowledge creation – anthropologists and engineers, for example, usually approach research in different ways and use vastly distinct language. Yet, the interdisciplinary nature of the community was conducive to growth, both for the participants and our team, and seemingly fostered interdisciplinarity itself. For example, throughout the project, we observed meaningful community building at not only the interpersonal and departmental levels but also with other departments across the university, with local non-governmental organizations, and for many participants, in the domain of educational research.

Given challenges associated with interdisciplinarity, we conjecture that, foremostly, the early development of a safe and trusting learning community made possible all other successes (Patton & Parker, 2017; Whitcomb et al., 2009). Whitcomb et al. (2009) argued that "respect and trust" were "essential features of a productive learning community" (p. 210). Similarly, we surmise that when a FLC brings together individuals with different ways of seeing the world, such trust is tantamount to the success of the intervention.

Our data suggested that faculty members became more attentive to their individual and teaching identities and, in turn, became agentic forces in the cultivation of their individual and departmental curriculums. Palmer (1997) argued, "good teaching cannot be reduced to technique." Rather, "good teaching comes from the identity and integrity of the teacher" (p. 16). In short, "we teach who we are." We initiated the FLC by discussing this reading and claim. The claim was, at the time, met with resistance and cognitive dissonance by some participants but also positivity and receptiveness by others. We built on this initial reading throughout the FLC by exploring the role of scholarly values in one's teaching praxis (Price, 2018). In short, we surmised that ethics and identity (including one's scholarly identity) were inseparable.

Like Weston (2008), we argued that self-knowledge and mindful awareness are foundational to ethical inquiry. We found that participants grounded their perceptions of ethics in identity considerations by explicitly naming how the self itself informs one's views on ethics (theme 1.1). Many participants personalized their instruction and brought their whole self into their courses (theme 2.2). Nonetheless, participants did not view ethics as a solitary endeavor. Rather, participants viewed ethics as connected with others (theme 1.2), they viewed ethics and one's disciplinary practices as entangled (theme 1.3), and they viewed ethics as informed by (but not limited to) existing standards (theme 1.4). They also sought to integrate novel perceptions

in their curricular instruction (theme 2.3) in an intentional (theme 2.1) and continuous (theme 2.3) manner. Connecting these findings to ethical becoming, participants brought a concern for improving their own or departmental curriculums, which motivated their inquiry process. Through inquiry, participants became *aware* of the ethical salience of their own values and those of others; after *judging* the salience of such values, disciplinary norms, and societal values, then designing pedagogy based on such entanglements, participants then actively *experimented* and *iterated* on their instructional designs in light of peer perspectives, investigator feedback, and (during Year 2 and thereafter) observations of student learning and engagement. Thus, whilst becoming increasingly attentive and aware of their own values, faculty increasingly became responsive agents of change for imbuing ethics into their departmental curriculums.

Agency draws attention to one's ability to manifest their values. As shared in Blalock (2019), Campbell and O'Meara (2014) defined agency as "taking strategic or intentional actions or perspectives towards goals that matter to oneself" (p. 52). They theorized that individual, organizational (i.e., departmental and institutional), disciplinary, and societal factors influence faculty agency. In our work, the FLC served as a mechanism to help participants develop individual and departmental clarity around their perceptions of ethics and to co-develop strategic actions for refining departmental curriculums. We observed differences in how identity and agency manifested in departmental teaching practices. Coupling this finding with Campbell and O'Meara (2014), we argue that departmental contexts (including faculty relationships, historical departmental teaching approaches, and disciplinary norms) played a particularly strong influence on participants' approaches to teaching ethics. We elaborate on these considerations for each of the two departments below.

Biomedical engineering faculty members began the FLC with a higher level of cohesion among participants, as evidenced by their knowledge of each other's courses and course goals. This prior knowledge stemmed from having a shared set of standards driven by a professional accreditation agency (ABET, n.d.) and ongoing departmental self-assessment efforts. Biomedical engineering participants thus used FLC meetings to refine and revise ongoing work, aligning their curriculums with these ongoing events. While ABET standards appeared to aid the faculty with programmatic scaffolding of ethics learning goals and outcomes, the same standards also appeared to be a barrier to thinking about ethics in novel ways. Specifically, the experiential-oriented dimensions of ethical inquiry were new – and, we observed, challenging – for some participants. Leveraging existing standards is a common approach to ethics education, but it can serve to reify extant practices (Resnik, 2012; Zhu & Clancy, 2023). The FLC encouraged faculty members to act as agentic instructors; thus, we encouraged them to align their ethics teaching choices with their individual and their departmental identities (i.e., rather than disciplinary norms alone). While participants valued extant norms and standards, as a result of the FLC, participants did not limit their teaching of ethics to such standards (theme 1.4) but rather embraced their identities and their agency.

The earth sciences faculty members appeared to come to the FLC with less understanding of the role of ethics in the earth sciences, each other's teaching practices, and how ethics manifested within departmental peers' courses. However, several partici-

pants from the earth sciences had previously integrated community-engaged learning into their courses; thus, this type of experiential learning was evident in almost every earth science member's refined course. Earth science FLC members did not appear to have another common task or working group that could stimulate deliberation on departmental teaching and learning. Moreover, the earth sciences department did not have specific disciplinary accreditation standards that set or informed programmatic learning outcomes. Thus, earth sciences faculty were wading into a novel domain of inquiry both for themselves and, to a large extent, their discipline. These factors influenced how the earth sciences faculty inquired together during FLC meetings and how they navigated shared assignments. This may help explain why continuity (Theme 2.4) manifested largely within earth sciences courses rather than across the department as a whole, at least at the time of the FLC (in recent years, we have found earth sciences faculty actively realizing continuity across their program).

Both departments actively and enthusiastically engaged in deliberation during active learning sessions. While earth sciences faculty tended not to progress as far or as quickly on FLC assignments during the first two years of the FLC, the absence of existing common tasks, working groups, and disciplinary standards did not detract from their progress. Indeed, and perhaps counter-intuitively, such differences may have strengthened their work. Whereas biomedical engineering deliberations extended and refined ongoing efforts, earth sciences deliberations involved the exploration of largely novel concepts and ideas to their discipline.

Future efforts striving to replicate study findings will find a series of FLC documents available online (Price et al., 2023), as well as the theory of change that guided our work (Price et al., 2021). In addition to these materials, we felt that the following items were critical to the success of this FLC. First, this project included FLC leaders who were committed and responsible (quite literally as part of their employment) for the FLC efforts. We surmise that this was essential to ensure continued support to and engagement among FLC members. Second, through external funding, we incentivized faculty engagement through monetary support. Such support can be a critical affordance to involving otherwise busy faculty members, especially when initiating such a project. Finally, we constantly strove to respect faculty agency and engaged the FLC members as co-inquirers who, as we explicitly shared with them, were the experts in understanding how to integrate ethics in their courses. Recognizing participants as the experts in their courses seemed paramount, given that the FLC implementers were *not* biomedical engineering or earth science experts. To the extent that others can replicate such aspects, we posit that others who implement this FLC design will find similar positive outcomes among their participants.

Limitations & Future Work

First, this study explored patterns in faculty members' growth and learning through qualitative data collection and analysis. Separately, we have collected and compiled quantitative data (e.g., self-report surveys), where our analysis has thus far suggested growth in key areas, such as faculty members' confidence in teaching ethics and valuation of ethics teaching. Future work will focus on these data, seeking to juxtapose, extend, and confirm quantitative data with qualitative findings generated herein.

Second, our sample size is small ($n=11$), thus leading to concerns regarding generalizability. Future work aspiring to replicate findings with other groups can further substantiate the findings generated herein. Despite this limitation, we also recognize that small-sample studies recognize individual experiences that large-sample research may otherwise neglect or fail to capture (Pawley & Slaton, 2018). Thus, there is a heightened valuation of small sample studies amidst calls to rethink what constitutes "rigorous" research within the domain of engineering education (Riley, 2017).

Third, a focus on students' ethical formation was beyond the scope of this work, but research focused on student outcomes is the ultimate goal of such FLC curriculums. We have begun exploring student changes in other students (e.g., Hess et al., 2021; Fore et al., 2024). Moreover, as student engagement motivated several participants, future work should explore the instructor-student dyad, including how student engagement can inform teachers' values and perceptions regarding ethics teaching.

Finally, in this work, promoting the integration of community-engaged learning with ethical reflection was our starting goal, but not all members embraced community-engaged pedagogy in their refined courses. Importantly, this project spanned the COVID-19 pandemic, which led to novel challenges with engaging community partners (especially novel partners). We emphasize that exploring affordances and barriers for encouraging faculty members to connect ethics and community engagement ought to be a concerted focus of future research.

Conclusion

The design and implementation of an FLC fostered faculty participants' ethical becoming through the cultivation of an awareness of their scholarly identities, including but not limited to their personal ethical values, disciplinary values, and institutional norms. The outcomes identified through our analysis suggested that the FLC led to learning outcomes associated with ethical awareness (e.g., self, other, entanglements) and teaching praxis. Through the FLC, we sought to foster participants' purposeful engagement with ethics instruction that accounts for and integrates others, including but not limited to external communities. As a result of FLC experiences, our findings suggest that faculty members were better positioned to design and integrate ethical inquiry and critical reflection activities in purposeful and integrative ways. Moreover, our data revealed that faculty members felt a greater sense of connection amongst themselves and others, as well as empowered to personalize their curriculums with intentionality in light of such connections. Faculty members thus became attentive, responsive, and responsible agentic drivers of their own classroom practices as well as departmental efforts in ethics education. This study, including our empirical research approach and the FLC design itself, can guide the design and evaluation of similar faculty development initiatives in STEM education, particularly those that seek to foster ethical becoming among faculty members, cultivate departmental communities committed to ethics, and diffuse pedagogical approaches across departmental curriculums.

Declarations

Study Description This manuscript presents the analysis of faculty interview data following 11 faculty members' participation in a multi-year faculty learning community. Our learning community and research design was grounded in the framework of ethical becoming.

Conflict of Interset The authors report no conflicts of interest related to this work.

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