Online-Journals.org

iJEP International Journal of Engineering Pedagogy

iJEP | eISSN: 2192-4880 | Vol. 14 No. 3 (2024) | OPEN ACCESS

https://doi.org/10.3991/ijep.v14i3.43421

PAPER

Considering the Development and Evaluation of Engineers as Teachers

Cassie Wallwey[1](✉), Amanda Singer[2], Lynn Hall[2], David Delaine[2], Jennifer Herman[2]

[1]Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

[2]The Ohio State University, Columbus, OH, USA

cwallwey@vt.edu

ABSTRACT

Engineering faculty are required to teach but are rarely trained in evidence-based practices in teaching and learning. While many faculty often mirror how they were taught and slowly develop their curriculum and skills over time, the methods for their development cannot keep pace with the rapidly changing landscape of engineering classrooms. This includes changes in students' needs, pedagogical advances, and the technology accessible to students. In response to the need for training, development, and continuous improvement of engineering faculty's teaching beyond the limited feedback that student and peer evaluations provide, our department piloted a program offering 18 different options for teaching development activities. Faculty could choose from these options to enhance their teaching practices. Three focus groups were conducted with a total of 12 faculty participants to iterate and improve upon the piloted program. Qualitative analysis of these focus groups, involving multiple phases of coding and general theming of the focus group transcript data, revealed more than just the faculty's impressions of the piloted program. Our analysis revealed that two value systems exist when it comes to teaching and teaching development: what is valued personally by a faculty member and what is valued systemically by the department, college, university, or field they work within. The identification of these two distinct value systems revealed that misalignments exist between them. What faculty personally value about their teaching and teaching development might not be valued by the systems in place, and vice versa. We present examples of how faculty discuss these two value systems and explore the implications of conflicting value systems, as well as opportunities for departments to enhance alignment between these value systems to boost faculty motivation for regular engagement with teaching development practices.

KEYWORDS

engineering education, peer-review of teaching, teaching professional development

1 INTRODUCTION

Teaching and learning practices are crucial to ensuring that engineering students are effectively prepared to contribute to our continuously evolving society.

Wallwey, C., Singer, A., Hall, L., Delaine, D., Herman, J. (2024). Considering the Development and Evaluation of Engineers as Teachers. *International Journal of Engineering Pedagogy (iJEP)*, 14(3), pp. 69–91. https://doi.org/10.3991/ijep.v14i3.43421

Article submitted 2023-07-24. Revision uploaded 2024-01-31. Final acceptance 2024-01-31.

Many books (e.g., [1], [2]) and journals (e.g., *Studies in Higher Education*, *College Teaching*, etc.) have focused on communicating strategies and outcomes aimed at enhancing teaching and learning in higher education. Teaching and learning practices have also been identified as an important area of work and research focus in engineering education communities. National organizations, committees (e.g., [3], [4]), scholars (e.g., [5]), and industry stakeholders (e.g., [6], [7]) are calling for improved teaching quality in engineering. Leaders in the field set goals for teaching, learning, and pedagogy. These calls and goals have prompted ongoing efforts to enhance teaching and learning in engineering education [8], [9]. With an increasing number of research outputs (publications, workshops, etc.) concentrating on enhancing teaching and learning practices and outcomes in engineering education, a lesser explored research area pertains to how engineering faculty perceive and enhance their own teaching practices.

Many universities and research institutions have recognized the need to enhance teaching and learning practices in higher education by establishing centers for teaching, teaching development, and teaching and learning [10]. These additions to university communities provide a resource that engineering instructors and faculty can engage with to enhance teaching practices. However, evidence indicates that the implementation of 'best practices' for teaching and learning in engineering education is not as widespread as some may hope [11], and misalignments exist between the goals of faculty and the services offered by some teaching and learning centers [12], [13]. Some of the most cited reasons for the lack of implementation of evidence-based practices include a lack of resources (e.g., time, money, and space) and concerns regarding disrupting norms that could result in faculty, staff, or student resistance [11], [14].

The field of engineering education continues to encourage engineering instructors to enhance their teaching practices and improve instruction. Beyond encouragement, institutions must support educators by recognizing their participation in teaching professional development opportunities. While engagement with the growing number of university-based teaching and learning centers has the potential to alleviate some of the identified barriers to implementation, such as time and cognitive load, it may not address more deeply ingrained cultural barriers. Academic culture has a reputation for undervaluing teaching quality, as more emphasis is often placed on research inputs (e.g., awarded grants) and outputs (e.g., publications) when assessing the value of a faculty member and considering them for promotion and tenure [15]. For engineering faculty to dedicate the time, effort, and engagement with teaching and learning resources needed to address the calls for improved teaching in thoughtful and meaningful ways, their efforts should be more formally valued and recognized by the existing systems [16]. One way to achieve this is by advancing innovative and dynamic teaching and development programs in engineering departments.

2 RELEVANT LITERATURE AND CONTEXTUAL BACKGROUND

2.1 Teaching in engineering

Teaching students is an expectation of the vast majority of engineering faculty. At the same time, most faculty members are not formally trained or prepared for teaching. While the teaching load often varies across roles, departments, and institutions, teaching courses is an expectation engineering and science faculty must

balance with research and service obligations [17]. Despite this being an expectation of the job, most faculty are never formally educated in how to design curriculum or teach students. This lack of training means that most faculty learn how to teach on the job, often drawing on their past experiences as students and imitating the way they were taught [18]. While this method of self-teaching for educators provides practical classroom skills, it is inefficient and time-consuming [18]. It may also result in faculty being unaware of advancements in learning and education, their own biases and limitations in content expertise, and the problematic cultural norms within engineering.

The practice of passing down teaching strategies through generations of engineering faculty should no longer be considered the standard for educational preparation or ongoing professional development in engineering. Engineering classrooms are not what they used to be fifty, twenty, or even five years ago. Engineering teaching and training involves both practical application and theoretical knowledge [19], with the most recent calls for change pointing toward aggressive shifts in instructional design and strategies. One such shift has been precipitated by the COVID-19 global pandemic, which highlighted the need for faculty to enhance their digital literacy skills and online curriculum and course development [20–23], as well as to create new and innovative strategies to successfully establish and support online teaching and learning environments (e.g., [24–26]). Another shift in engineering education has been the push to integrate more hands-on, application-based, and complex problem-solving curricula to better adapt to the trends and changes of society and technology [4], [5]. Another recent example is the rapidly increasing use of artificial intelligence tools, such as OpenAI and ChatGPT. These rapid changes in engineering classroom landscapes establish the need for faculty to frequently and effectively evaluate and adjust their teaching practices. Increased calls for curricular change encourage practical application over theoretical knowledge and an increased emphasis on topical issues (e.g., social justice [27]), including conversations on the ways negative aspects of engineering culture and norms exist and are unintentionally perpetuated in classrooms (e.g., [28–30]). Research in these areas aims to improve engineering culture, promote diverse and inclusive learning spaces, and enhance participation in engineering. However, these calls and recommendations for curricular and classroom changes often rely on faculty for implementation.

2.2 Evaluations of teaching

When engineering faculty, who are often not formally trained in education, do engage in evaluating and refining their teaching practices, they are met with additional challenges. End-of-course surveys completed by students are a primary source of teaching-related feedback for engineering faculty. While intended to measure the effectiveness of instruction, research has shown that these student evaluations of instruction (SEIs) can reflect gender and racial biases [31–33] and may not be representative of teaching practices or teaching quality [34]. Additional ambiguity exists regarding how these forms of feedback can and should be used to inform changes to instruction. Nasser and Fresko [35] found that while over 70% of faculty surveyed agreed that SEIs can be useful, nearly 90% of faculty indicated that they had made no changes to their teaching based on the SEI feedback. Additional research into the impact of SEIs has pointed to unintended outcomes such as 'grade inflation,' where faculty members raise grades or reduce course difficulty to inappropriate levels in

an effort to improve SEI scores [36]. Research on faculty's responses to SEIs and instructional quality suggests a need for training and faculty development related to how faculty interpret and engage with student evaluations to help support positive changes in teaching [37] and foster healthy emotional responses to students' evaluations of their teaching [38]. Another way in which students evaluate faculty's teaching and instruction and communicate this evaluation is through interaction with informal methods, such as online forums such as *RateMyProfessor.com*, which have also been shown to be biased toward certain personal and professional factors of faculty [39].

Faculty have indicated a desire for feedback on their teaching beyond what students are capable of providing [40]. This desire for additional feedback is often fulfilled through classroom observations conducted by colleagues or supervisors as a part of faculty performance evaluations for promotion and tenure review, commonly referred to as 'peer review of teaching' (PRT). Despite the desire for more feedback, faculty have mixed attitudes toward engaging in peer review of teaching programs. Participating faculty generally consider peer evaluations of teaching effective for professional development [41] and quality assurance [42]. They prefer these programs when conducted in supportive environments [43] using formative assessments [42], [43]. Participation in peer review programs structured in this manner has been associated with the advancement of teaching excellence [42], [44] and acknowledged as a mechanism to promote positive changes in faculty values concerning teaching and learning [45–47].

Despite these documented benefits, faculty have disclosed several challenges and concerns related to the PRT process and the peer evaluations they receive. For reasons such as significant time demands [48], [49], the potential strain on professional relationships related to being judged and evaluated by colleagues [50], [51], and the intrusiveness of the program on their academic freedom [52], faculty report a reluctance to participate in these programs. Faculty also question the validity and reliability of the peer review process, expressing concerns about potential bias from the reviewer in their professional evaluation. They also note the limitation that the observation provides only a 'snapshot' (i.e., a very small sample) of their teaching capabilities [48], [53]. These concerns are not unwarranted, given that peer reviews of teaching observations typically involve only one class session. Research has shown that these reviews tend to focus on less helpful aspects of the observed lesson, such as what is taught and how it is taught, rather than on the holistic contribution of the faculty member to the learning experience and environment [54]. Additional concerns include being paired with reviewers who lack proper experience or qualifications and their ability to effectively evaluate and provide feedback on one's teaching practice [47], [53], [55].

Given the urgent and timely need for engineering faculty to acquire training, experience, and confidence in developing their teaching practices to keep up with a rapidly changing engineering education landscape, there is a need for advancements in how engineering faculty engage meaningfully with teaching development practices. While research has reported progress in supporting engineering faculty teaching development (e.g., the use of instructional consultants [56], participation in teaching workshops [57], and collaboration with learning scientists [58]), most literature in this space focuses on pedagogical and educational outcomes. Literature on the values, needs, and experiences of engineering faculty related to their teaching development is scarce. One example of literature that addresses these topics is a publication by a group of researchers in 2021 that proposed a

framework for faculty teaching development. This framework integrates considerations such as contextual, relational, and individual factors into the process of teaching growth and improvement [59]. This manuscript goes one step further by reporting on the outcomes and emergent takeaways from focus groups with engineering faculty members regarding their participation in a piloted teaching development program. Based on the recommendation by Esterhazy et al. [59], the program was designed with consideration of the values, needs, and experiences of engineering faculty.

2.3 Research context

The work reported in this manuscript was conducted at The Ohio State University in the Department of Engineering Education (EED). The EED was established as a department within Ohio State's College of Engineering in 2015 with the primary goals of enhancing engineering student success and advancing the engineering profession. This is achieved through the utilization of evidence-based teaching practices and the generation of high-quality research within the department [60]. The EED houses Ohio State's first-year engineering program, multidisciplinary capstone program, engineering technical writing, and a graduate program in engineering education. With these numerous programs come various instructional positions, including graduate teaching assistants working towards their PhDs, lecturers with teaching-focused roles, and tenure-track faculty members who balance teaching and research responsibilities.

In 2018, a committee was established to develop a faculty teaching program that could cater to the requirements of all teaching positions within the department [61]. A driving goal of developing this program was to provide faculty with flexibility to enhance their teaching through evidence-based methods, including but not limited to traditional peer classroom observations. The committee reviewed existing faculty teaching development programs, systems, and literature. They also consulted with faculty teaching development experts and utilized resources from Ohio State's Drake Institute for Teaching and Learning. The committee proposed a "comprehensive faculty teaching development" program [61, p. 1] and obtained approval from the department to pilot the program starting in Fall 2020. Although the program offers 18 different teaching development activities beyond peer observation of instruction, for clarity, it is referred to as the peer review of teaching (PRT) program.

The PRT program was first implemented in the 2020–2021 academic year. This program allowed faculty members in any teaching role within the department to select from one of 18 potential teaching development activities to participate in throughout the academic year. The activity options, as well as the specific mechanics of the EED's program for teaching development, are documented in detail in a previous publication [61].

3 PURPOSE

The purpose of this manuscript is to stimulate discussions within engineering education communities regarding the importance of and participation in teaching

development opportunities by educators, as well as how education systems can enhance their recognition and support for engineering teaching development. We initiated these conversations through focus groups in our department. This manuscript will present the results of focus groups conducted with our department's faculty regarding their perceptions of and experiences with the pilot PRT program. It will also discuss the implications of emerging focus group findings related to teaching development and future discussions on how teacher development is valued and recognized. We hope these findings can influence teaching and teaching development across engineering programs to enhance and support the ongoing advancement of engineering education and those who instruct future engineers.

4 METHODS OF PILOT PRT PROGRAM EVALUATION

The focus groups reported in this manuscript were initially conducted to allow the committee to evaluate and refine the PRT program after the pilot implementation. Formal research structures were later implemented, and IRB approval was obtained in anticipation of potential publication. The analysis of these interviews resulted in findings that are valuable to share with the wider engineering education community.

4.1 Focus group development & implementation

This study of faculty experiences utilized virtual focus groups conducted through the Zoom platform as a data collection method. Focus groups were selected for their capacity to gather data from multiple participants simultaneously, foster discussions among individuals with diverse perspectives, and enable data collection for specific subsets of the groups of interest [62], [63]. Three focus groups consisting of 3–5 engineering educators from the EED were conducted. Each focus group, lasting about one hour, began with the facilitation of obtaining informed consent from the participants by a moderator independent of both the research team and the department. The purpose of using an external moderator was to minimize the risk of biases being introduced into the discussion by research team members who act as moderators [64] and to enhance the probability of fostering open and honest conversations among focus group participants.

Two of the three focus groups were purposefully assembled, taking into account two qualities of the educators: 1) self-reported years of experience teaching; and 2) position in the EED (e.g., tenure-track faculty, lecturers, and clinical faculty). The focus groups were designed to include a diverse representation of educators with varying years of experience and positions within the department. The creation of diverse focus groups was based on both previous research and expected outcomes. Instructors with varying years of teaching experience were grouped together because research on professional development in education has shown that understanding the evolving needs of instructors as they progress through their teaching experience is crucial for designing and implementing successful professional development programs [65]. We anticipated that the needs and outcomes of the PRT pilot program would vary based on both years of teaching experience and position. We hoped to gain a better understanding of the variety of needs through these focus groups.

The third focus group was conducted with members of the research team who participated in the pilot implementation of the PRT program and were also part of the departmental committee responsible for designing the pilot PRT program. This focus group was conducted in the same manner as the first two, but it was identified as a distinct data set for the purpose of data analysis, which will be further explained in the next section.

All three focus groups were audio-recorded with the permission of all research participants. The audio recordings were sent to an institution-approved online transcription service, and written transcripts of each focus group were created. Upon receiving the transcripts, a member of the research team reviewed, cleaned (revised errors in the original transcripts received from the service), and de-identified the transcripts. The de-identified and cleaned transcripts were used by the research team for data analysis.

4.2 Focus group data analysis

We performed a qualitative analysis using a hybrid inductive and deductive coding approach [66] that consisted of two phases of coding. In Phase 1 of qualitative data analysis, researchers used open coding to explore the data. This method allowed codes to emerge from salient ideas or experiences of participants in the dataset that may be related to the research context [67]. Only the first two focus groups were analyzed in Phase 1 to ensure that the biases or experiences of those who designed the new PRT program did not influence the development of inductive codes representing the experiences of those participating in the program. Two graduate students, who were not part of the PRT program development, independently reviewed the transcripts. They created memos detailing emergent participant experiences and ideas and employed a constant comparative approach [68] to refine the inductive codes. This iterative process continued until both researchers reached a consensus on the emergent codes and their definitions. After refining and finalizing these codes using the first two focus group transcripts, all three focus group transcripts were then coded with the finalized list. These inductive open codes and their definitions can be found in the Appendix (see Tables A1 and A2).

Phase 2 of qualitative data analysis is best described as structural coding [67]. This coding method explored the data through the lens of structural codes that reflected the goals of the PRT program. The codes reflecting the program's goals were developed from documentation of the program's development and then reviewed for alignment by the committee member who spearheaded the design and implementation of the new PRT program. After refining and finalizing these codes, all three focus group transcripts were coded. These deductive structural codes and their definitions can also be found in the Appendix (see Tables A1 and A2). One additional analysis step that was completed to compare the three focus groups was quantifying the data [69]. The codes in each transcript were counted by participant to determine if the first two focus group data sets differed noticeably from the third, considering that the participants in the third focus group were also involved in designing and implementing the piloted PRT program. If they showed large or significant differences, we would have considered the data from the third focus group to be biased and not used it for further analysis.

Finally, after all codes were developed and applied to the focus group transcripts, a comprehensive thematic analysis of the complete codebook [66], [70] was conducted. This zoomed-out thematic analysis of both code sets allows for broader

themes related to the program's goals and individuals' experiences with teaching professional development in engineering to emerge. This thematic analysis was conducted by considering all codes and definitions and grouping the codes based on similarities (e.g., sentiments, values, challenges, etc.). Once a few general themes emerged, the graduate students conducting the analysis noticed a pattern and confirmed that pattern using the text to which the codes were applied. They further refined the broader themes and takeaways of the research by utilizing the data highlighted through the hybrid coding process. After identifying and describing these patterns, they were presented to the faculty overseeing the research. The faculty developed the PRT program to be further validated and refined by faculty with experience and knowledge in experts' development.

By employing focus groups for data collection and utilizing a hybrid inductive and deductive approach to qualitative data analysis in two phases, we were able to not only better understand how EED educators navigated the pilot PRT program, but also gain insights into how teaching professional development experiences and opportunities are valued and experienced broadly. These insights will be further shared in the section that follows.

4.3 Limitations

While this data was collected with research outputs in mind, rigorous engineering education research was not the primary purpose of the focus groups at the time they were conducted. Therefore, there are limitations to the work presented in this manuscript. The data was specifically collected and analyzed initially through the lens of continuous improvement within a department of engineering education at a large, public, research-intensive university in the United States. The structure of our piloted PRT program, as well as our methods of internal data collection for continuous improvement, may not be feasible for all engineering department needs, but we do hope they are scalable to the needs of individual departments. Due to the limited availability of our facilitators, we were only able to conduct three focus groups. Due to this limitation, we likely did not achieve full saturation and capture all faculty members' unique experiences with the newly implemented program through our data. Additionally, we recognize that participation in these focus groups, where data was collected on participants' experiences with the piloted PRT program, was voluntary. Therefore, it may have been affected by self-selection bias. Finally, although we intentionally had these focus groups facilitated by educational specialists external to the department, it is possible that some faculty didn't feel comfortable participating in discussions with their colleagues in the department regarding their teaching development and peer reviews of teaching, given the implications these reviews and metrics have on promotion and tenure packages.

5 RESULTS: FACULTY DEVELOPMENT OUTCOMES

In total, 12 faculty members from Ohio State University's Department of Engineering Education participated in focus groups to discuss the pilot PRT program. Figure 1 visually represents participants' teaching positions and self-reported years of teaching experience in higher education.

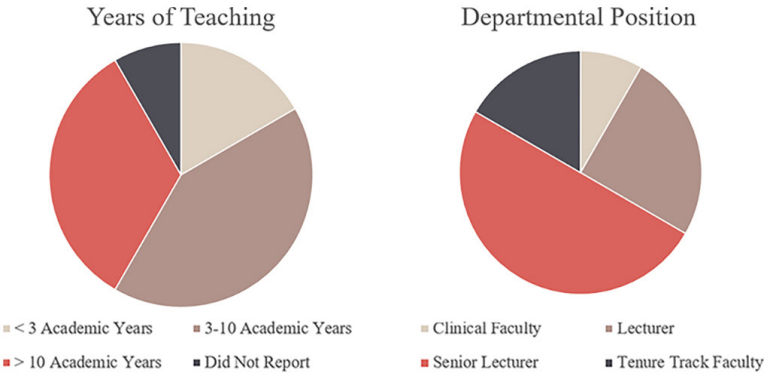

Fig. 1. Representation of participant's years of self-reported teaching experiences and departmental position

We purposefully created three separate focus groups to ensure a diverse representation of both positions and titles in the department and self-reported years of experience. The composition of each focus group based on these metrics, as well as all participants' pseudonyms, is detailed in Table 1.

Table 1. Table of the participant make-up of each focus group

Focus Group	Participant Pseudonym	Years of Teaching	Departmental Position
1	Jane	3–10 Academic Years	Tenure Track Faculty
	Ron	<3 Academic Years	Lecturer
	Tim	3–10 Academic Years	Senior Lecturer
2	Ashley	3–10 Academic Years	Senior Lecturer
	Wendy	>10 Academic Years	Senior Lecturer
	Kevin	>10 Academic Years	Senior Lecturer
	Gretta	>10 Academic Years	Clinical Faculty
	Katie	<3 Academic Years	Lecturer
3	Avery	>10 Academic Years	Tenure Track Faculty
	Betty	3–10 Academic Years	Senior Lecturer
	Denise	3–10 Academic Years	Senior Lecturer
	Carl	3–10 Academic Years	Lecturer

Through the analysis process described in the previous section, these focus groups yielded valuable insights related to how participants experienced the pilot PRT program and how these experiences aligned with their teaching development values and needs. These results are further detailed in the following sections.

5.1 Hybrid analysis outcomes

Phase 1's inductive open coding approach yielded 11 codes that were identified as significant in participants' experiences with the newly implemented PRT program. Figure 2 presents the 11 inductive codes that emerged from open coding. Phase 2's structural codes were developed based on artifacts from the PRT program's development and implementation (e.g., [61]). Figure 2 also lists the five deductive structural codes. The full list of codes, along with their definitions and example passages, can be found in the Appendix (see Tables A1 and A2).

Codes Developed Through Open Coding
Agency & Autonomy in PRT Tasks and Timing
Collaboration and Cross-Communication
Departmental Structure, Support, and Space for Teaching & Development
Empathy
Future PRT Considerations & Recommendations
Lacking & Receiving Education Training & PRT Training
Personal Value of Teaching & Teaching Development
Personal Stories
PRT Cognitive Load & Time Investment
Slipstreamed
Systemic Value of Teaching & Teaching Development

Codes Developed for Structural Coding
Development of Teaching Practices, Considerations, or Artifacts
Robust Feedback
PRT Process Serving Diverse Needs
Need-Based Approach to PRT Participation
Instances of Reflection

Fig. 2. List of inductive codes developed through constant comparative open coding and list of deductive codes informed by PRT program goals and used for structural coding

When the three focus groups' codes were compared by quantifying the data [69], we found that the differences were minimal and not a cause for concern or a reason to exclude focus group 3's data from the overall thematic qualitative analysis. Table 2 summarizes the code counts. Table 2 indicates that the third focus group did have a slightly higher ratio of deductive to inductive codes, as expected, given the focus group members' familiarity with the piloted PRT program's goals.

Table 2. Table of code counts from focus groups

	Focus Group 1 Transcript		Focus Group 2 Transcript		Focus Group 3 Transcript	
	Code Instances (Count)	Code Instances (%)	Code Instances (Count)	Code Instances (%)	Code Instances (Count)	Code Instances (%)
Inductive Codes	117	79%	105	79%	91	72%
Deductive Codes	31	21%	28	21%	36	28%
Total Codes	148	100%	133	100%	127	100%

5.2 Emergent themes: teaching values systems

After the research team finalized both the inductive and deductive codes through iterations to ensure quality and trustworthiness [68], they further examined these codes using a thematic analysis approach [70]. This analysis aimed to establish connections among the codes and identify themes that emerged when faculty discussed their experiences in the pilot PRT program.

Thematic analysis of the codes and passages tagged with those codes revealed two distinct value systems related to teaching and teaching development: ***personal values*** of teaching and teaching development and ***systemic values*** of teaching and teaching development. It was important to consider both the codes and their associated definitions, as well as the transcript passages tagged with those codes, when identifying and developing emergent value systems. This is because codes and

transcript passages tagged with those codes do not directly correspond to a single value system. In some instances, transcript portions are tagged with specific codes related to personal and systemic teaching values or interactions between the two value systems. Figure 3 illustrates how most codes applied to the transcripts generally map to the two emergent value systems.

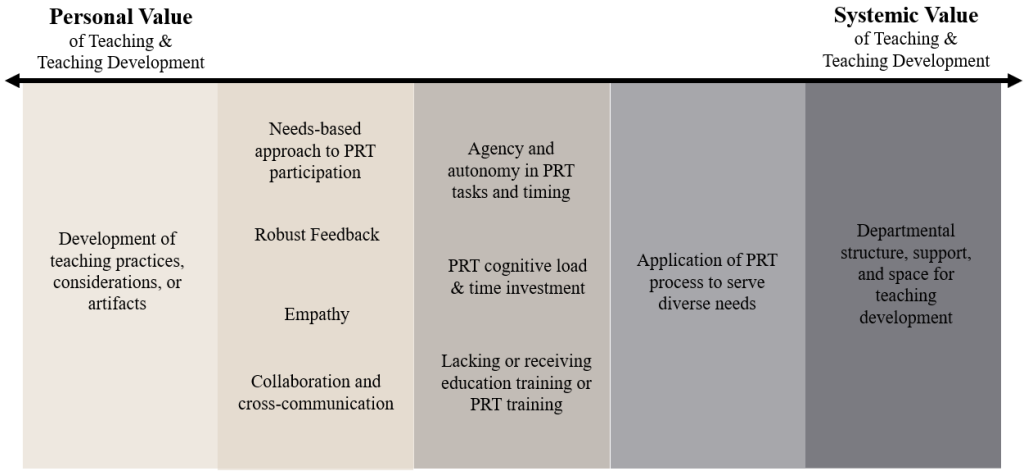

Fig. 3. Mapped codes that were applied to text in transcripts that related to one or both of the two emergent value systems of teaching and teaching development

Personal values of teaching and teaching development emerged when educators discussed their own needs, goals, or activities for professional growth. Often, their personal values were teaching informed and motivated these needs, goals, or activities. This is illustrated in the quotes from the focus group participants below:

> *"I was forced into doing a lot of workshops. Well, I didn't have to. I wasn't forced, and I didn't have to. I wanted to because I care about my teaching. And I had never taught a class online before, and so I wanted to know what were the best practices? What should I be doing? How do I convert everything over and so on? So, I did a lot of training"—Gretta*

> *"I think the emotional part, for me, because I was having very intentionally, the person I observed and who observed me, we chose days that we were nervous and worried about leading with our students because of the fraught-ness of the topic, given the political and social climate. It was really helpful just to have the pre-observation meeting and discuss those concerns, the emotional concerns of teaching, as well as just the actual instructional methods that were going to be used. It made me feel more confident in my approach, even if it didn't totally diffuse the anxiety."—Denise*

Gretta described her experience transitioning to online learning and realizing that it was an area of teaching in which she lacked experience. Gretta values effective teaching and is motivated to enhance her skills by attending workshops and training sessions to improve her online course instruction. Denise described her experience with another faculty member during peer teaching observations. Denise values being emotionally comfortable with the subject matter she is teaching. Denise and the peer she partnered with for observations were intentional in choosing days for observation and discussion. They selected days when they were teaching challenging topics that evoked feelings of nervousness and anxiety. This way, they had someone to express and discuss those concerns with.

Systemic values of teaching and teaching development frequently surfaced when faculty discussed departmental expectations, institutional values, or broader institutional expectations regarding teaching and teaching development. These instances are illustrated in the quotes from focus group participants provided below.

> *"How is this going to be used in things like performance reviews? I mean, so the fact that we fill it out shows us the department values it, but what does that value mean to them? How is this going to be used ...?"—Ashley*

> *"In the meetings, they're like, 'Jane, you get good SEIs, stop working on your teaching, write papers.' ... Like this is the advice you sort of get in terms of if you want to be successful here because we're at an R1 institution"—Jane*

Ashley speculates on the value and utilization of faculty participation in the pilot PRT program within the department. She notes that by having faculty participate in the program, the department must value the outcomes in some way. However, she lacks clarity on how the department values their participation and in what ways the outcomes might be used. Jane, on the other hand, clearly defines how the system she works within values her teaching, and it is through good SEIs. She notes that the advice she receives regarding being successful in her role is more research-oriented than focused on teaching, considering her SEI feedback is already satisfactory.

5.3 Values systems interactions

While these two value systems emerged as different from one another in thematic analysis, focus group participants often spoke about interactions between the two value systems. In some instances, internal conflict was described when participants' personal teaching values were misaligned or conflicted with systemic teaching values. This misalignment can be observed in the following quotes:

> *"Moving up the tenure track, [I'm] having to check those boxes of having peer review, an appropriate number of peer-reviewed teaching [observations]"—Avery*

> *"So, in my role ... scholarship of teaching and learning, any publications, research, that sort of thing, is not compensated. Going to extra workshops and things are really great and it was really wonderful to do, but that was a voluntary thing on top of the work that we're compensated for. ... It's challenging to feel like we're both being told that this thing is very valuable and important, but it's just not quite important enough that it can be paid for."—Ashley*

> *"We know that we want to provide our students the best experience that they can have. Teaching is like a very important aspect of our goals in our department. And you hear Jane say it like how it's not a super important part of her promotion and tenure process that she is in right now, but she is ... I could hear that little bit of a conflict as well like I still kind of want to do these things, but it's just not valued by the system in place."—Tim*

In each of the three quotes above, it can be observed that there are value tensions that exist as these faculty members navigate teaching development within their roles. Avery discusses the process of "checking boxes" as she seeks peer review of her teaching experiences while progressing through her tenure track role. The term

"checking boxes" is typically used synonymously with doing things for the sake of doing them and not for genuine value. This indicates that Avery did not personally value those experiences but was merely "checking boxes" because the system she was working within placed value on them. Ashley illustrates these value tensions using compensation. She notes that while she finds value in engaging in teaching development opportunities that are aligned with what the field defines as the scholarship of teaching and learning (SOTL) [71], in her role, she is not compensated for SOTL work. Therefore, she does not feel that the system she works within values her engagement with SOTL, given that she is not formally compensated for it. Tim points out that while he values teaching and perceives it as an important departmental goal, he also recognizes that institutionally, some faculty must prioritize other aspects of their job over teaching to be promoted by the systems in place because teaching is not valued equally across the institutional system.

While these focus groups revealed not only the existence of these two value systems, they also shed light on the ways in which they interact. It was clear from the quotes above that value tensions exist, and there are times when these two value systems appear to be misaligned. When discussing their involvement in the piloted PRT program within the department, participants in the focus group overwhelmingly described experiencing reduced tensions and improved alignment between their personal values and the department's systemic values, which were facilitated by the piloted program.

> *"I think what this experience did for me is it kind of gets me back in touch with how much I really do think about teaching and how much I have thought about it and how hard I am trying, but that's just usually all in my head. And so, it's almost like I just lose track of it. And it's not the thing I'm talking about, even though I'm doing it. ... But I think, for me, it's very valuable that the department is making that space and making that accountability to get back in touch with that thing that you're also doing. And so, for me, it's more of like a reminder perhaps than the other things that are so more obvious or spoken. I like the fact that we're speaking to the teaching."—Jane*

> *"Knowing that our department and our supervisors value these things because especially for lecturers, I think, since our role is more in teaching, it's nice to know that. I also think I have a slightly different perspective because my background in education is much stronger than my background in engineering. And so, for me, this is like one of those nice reminders to have every once in a while, because sometimes you can just get in a grind so much that you forget what the focus is and [that teaching is] important."—Kevin*

Both Jane and Kevin note in these quotes, that in the roles they serve, it is possible to lose sight of the personal value of teaching. They note that the new PRT program implemented by the system they work within served two main purposes: 1) as a reminder to critically evaluate and refine their teaching practices while embracing their personal values related to teaching, and 2) as a means to clearly communicate the systemic value of quality teaching practices and teaching development within the department.

These focus groups facilitated conversations about faculty teaching development, enabling us to identify ways in which teaching development programs and initiatives align or do not align with personal and professional value systems related to teaching and teaching development. The pilot PRT program offered a wide range of teaching and development opportunities, enabling participants to select the

development activity that best suited their needs. The program served as a system to professionally recognize teaching development and provided autonomy to each faculty member in the department to choose the teaching development activity they would undertake. This autonomy led to participants experiencing improved alignment between their own values and the systemic values of teaching quality and teaching development.

6 DISCUSSION AND IMPLICATIONS

The evaluation and professional development of engineers as teachers in higher education needs reform to align with the changes and evolution of engineering education. Despite lacking formal education training [18], engineering faculty are expected to teach students and are evaluated on their teaching. Additionally, the most widely used methods for teaching evaluation—SEIs and classroom observations—have alarming limitations and concerns regarding reliability and validity [31–34], [47–51], [53]. Yet, they continue to be utilized to assess the teaching proficiency of faculty in promotion and tenure decisions. Many researchers are starting to emphasize the necessity for a change in how we assess teaching performance [72], [73].

In our data, engineering faculty express mixed feelings and describe value tensions regarding the evaluation and development of their teaching. This process involves balancing their personal needs and teaching goals with systemic expectations and outcomes. The results of the focus groups conducted with EED faculty align with research that has also found that faculty want feedback on their teaching [40] and find feedback useful [35]. Faculty in our focus groups described ways in which they engaged in their teaching professional development for this pilot PRT program, as well as in various other ways to enhance their skills as educators. Despite their desire to continue growing as teachers, our focus groups also revealed that engaging in teaching evaluation and development is not always easy. Participants mentioned that teaching professional development activities are time-consuming, and it is unclear how the hours spent on these tasks align with their job responsibilities. Many participants were uncertain about how evaluative teaching development activities could be used to make adjustments to their teaching and how administration might utilize them for discussions related to promotion. Our focus group participants addressed these concerns, which have also been expressed in literature related to faculty teaching evaluation and professional development activities for teaching. Researchers have noted that faculty are often reluctant to participate in evaluative teaching professional development activities, such as peer review of teaching, due to the time it consumes [48], [49], the lack of actionable feedback [74], and the potential impact on relationships with colleagues [50], [51], or on the reviewee's professional growth [48], [53].

Our emerging findings, 1) that there exist two value systems (personal and systemic) associated with teaching and teaching development and 2) that these value systems may or may not align with specific teaching evaluation or development activities, have significant implications for teaching evaluation and professional development in higher education. Any program that aims to evaluate or enhance the teaching of engineering faculty should recognize the presence of these two value systems. More specifically, they need to recognize the current tensions that exist as well as opportunities for improved alignment between the two value systems. While we understand that programs need to consider systemic policy and

meet the procedural needs of the institution within which they are implemented, they also exist to serve the faculty with continuing growth. Therefore, they should be driven by the values and needs of the faculty participating in the program. These recommendations, based on our research findings, are well aligned with the work of Esterhazy et al. [59], who make similar recommendations in their proposed approach to a more holistic framework for collegial faculty development [59]. The pilot PRT program discussed in this manuscript was designed for a department at an R1 institution that accommodates various teaching roles with differences in the expectations for teaching evaluation and development across these roles. The program was designed to address the departmental need for a common tool that could be utilized for teaching evaluation and development purposes across all faculty and teaching roles.

By creating a program with 18 teaching development options to meet the potential needs of all departmental faculty, we also established a program that readily enabled faculty to navigate the existing tensions between what they personally value about their teaching and teaching development and what the department values about their teaching and teaching development. Many participants found that activities they were already engaging in to improve their teaching, driven by their personal values related to teaching, now 'counted' and were systematically valued as well. This parallels faculty motivation research, in which Lechuga and Lechuga [75] argue that in an academic system with faculty reward structures more focused on research (i.e., tenure), faculty often rely on intrinsic motivators when it comes to teaching. The personal values of many faculty members, including the participants in our focus groups, intrinsically motivate them to engage in teaching evaluation and development activities beyond SEIs and classroom observations. Future teaching development programs would benefit from formally recognizing and valuing this engagement.

Having 18 options not only served to cast a wider net in terms of teaching development, which is now recognized and valued as significant by the department, but also offered increased levels of autonomy to faculty. In fact, providing faculty with multiple options to choose how they engage with their teaching development, along with a structure that values their engagement within the existing systems, led to high satisfaction with the piloted program. The design of autonomy was intentional, considering that autonomy is crucial for faculty motivation and satisfaction [76]. The autonomy built into this piloted PRT program provided faculty with a means to not only navigate but also align the two value systems, resulting in high levels of satisfaction and appreciation for the piloted PRT program. These emergent findings mirror what Pollicino [77] reported when surveying faculty about job satisfaction. One of her most important findings was the faculty's need for congruence between the individual goals of faculty members and the goals and mission of the institution. The benefits of autonomy and clear alignment between personal values and goals with departmental values and goals on faculty satisfaction and motivation also serve as reasons to consider advancing teaching development program structures in similar ways to what we have piloted [61]. While we recognize that the program developed and implemented was designed for an engineering education department at a large R1 public institution and therefore might not be implementable across all engineering departments or contexts, what we do find to be transferable from our context to nearly all other contexts is faculty's desire for and satisfaction with having the autonomy to develop their teaching in ways that are both valuable to them personally and valued by the systems within which they work.

7 CONCLUSIONS AND RECOMMENDATIONS

As the calls and recommendations for faculty to make changes to their curricula and classroom learning environments to keep pace with the world's evolving engineering education landscape continue to grow, the support available to assist them in doing so should also evolve. Engineering faculty require support in assessing and enhancing their teaching performance due to the absence of formal education training. However, this is not a call to create or reinvent faculty teaching evaluation tools or to establish entirely new programs to facilitate teaching professional development. These resources already exist in the form of SEIs and observations for evaluation, as well as workshops, publications, seminars, teaching and learning centers, etc., to support teaching development. This is a call to reimagine and enhance how we utilize, leverage, and collaborate with these current tools and resources to promote the assessment and growth of engineering educators as instructors in a manner that aligns institutional needs with faculty objectives. This is crucial given the diverse teaching roles and positions within departments across universities.

The piloted PRT program in Ohio State's EED is at the forefront of this advancement by establishing a program that recognizes a wide range of activities that faculty have long valued for their teaching development as meaningful contributions to the advancement of teaching within the department. Focus groups with the faculty discussing this piloted program revealed that two value systems exist: one related to what the departmental system values about teaching, and the other related to what they personally value about their teaching. Faculty focus group participants were overwhelmingly satisfied with the piloted program. They noted that the autonomy to choose one of the 18 teaching development activities for the academic year allowed them to "count" teaching development activities they normally engage with on their own. This alignment of their personal values regarding teaching development with those of the department was highly appreciated.

The engineering education community has an opportunity to reimagine what engineering teaching evaluation and teaching development look like for engineering faculty in higher education. Evidence-based pedagogy tells us that reflection [78] and good feedback, coupled with many opportunities for practice [79], significantly improve learning and performance for our students. Therefore, why not design the continuing education of educators using those same principles? Departments have the opportunity to reconsider how teaching performance is measured. This can be achieved not solely through the evaluations of students or observations of colleagues, but also by including the developmental activities and reflections of those engaged in teaching. This approach offers a more holistic perspective that places value on the needs, goals, and growth of the individual whose performance is being reviewed.

8 ACKNOWLEDGEMENTS

The authors thank the department of engineering education at Ohio State University for providing the funding necessary to conduct the research. They express their thanks to the PRT committee members for their assistance in developing and implementing the peer review of teaching program. The authors thank Ohio State University's Drake Institute for Teaching and Learning for providing consultation throughout the development of the peer review of teaching program as well as for

serving as focus group facilitators for research data collection. The authors thank Rob Pancoast for providing additional support for the data analysis. The authors thank the participants in the research for sharing their experiences with the peer review of the teaching program.

9 REFERENCES

[1] H. Fry, S. Ketteridge, and S. Marshall, Eds., *A handbook for teaching and learning in higher education: Enhancing academic practice, 3rd Edition*. Routledge, 2008. https://doi.org/10.4324/9780203891414

[2] G. Nicholls, *Developing teaching and learning in higher education*. Routledge, 2002. https://doi.org/10.4324/9780203469231

[3] Committee on Science Engineering and Public Policy, "Rising above the gathering storm executive summary," National Academies Press, 2007. [Online]. Available: http://www.utsystem.edu/competitive/files/RAGS-fullreport.pdf

[4] National Academy of Engineering, "The engineer of 2020: Visions of engineering in the new century," The National Academies Press, Washington D. C., 2004.

[5] S. Sorby, N. L. Fortenberry, and G. Bertoline, "Stuck in 1955, engineering education needs a revolution," *Issues in Science and Technology*, 2021.

[6] K. Ramakrishnan and N. M. Yasin, "Higher learning institution-industry collaboration: A necessity to improve teaching and learning process," in *2011 6th International Conference on Computer Science & Education (ICCSE)*, Singapore, Singapore: IEEE, A2011, pp. 1445–1449. https://doi.org/10.1109/ICCSE.2011.6028902

[7] J. Uhlemann, R. Costa, and J.-C. Charpentier, "Product design and engineering – past, present, future trends in teaching, research and practices: Academic and industry points of view," *Current Opinion in Chemical Engineering*, vol. 27, pp. 10–21, 2020. https://doi.org/10.1016/j.coche.2019.10.003

[8] Steering Committee, "The research agenda for the new discipline of engineering education," *Journal of Engineering Education*, vol. 95, no. 4, pp. 259–261, 2006. https://doi.org/10.1002/j.2168-9830.2006.tb00900.x

[9] K. A. Smith, S. D. Sheppard, D. W. Johnson, and R. T. Johnson, "Pedagogies of engagement: Classroom-based practices," *Journal of Engineering Education*, vol. 94, no. 1, pp. 87–101, 2005. https://doi.org/10.1002/j.2168-9830.2005.tb00831.x

[10] D. W. Schumann, J. Peters, and T. Olsen, "Cocreating value in teaching and learning centers," *New Directions for Teaching and Learning*, vol. 2013, pp. 21–32, 2013. https://doi.org/10.1002/tl.20043

[11] M. Borrego, J. E. Froyd, and T. S. Hall, "Diffusion of engineering education innovations: A survey of awareness and adoption rates in U.S. engineering departments," *Journal of Engineering Education*, vol. 99, no. 3, pp. 185–207, 2010. https://doi.org/10.1002/j.2168-9830.2010.tb01056.x

[12] A. C. Frantz, S. A. Beebe, V. S. Horvath, J. Canales, and D. E. Swee, "5: The roles of teaching and learning centers," *To Improve the Academy*, vol. 23, no. 1, pp. 72–90, 2004. https://doi.org/10.1002/j.2334-4822.2004.tb00427.x

[13] M. D. Sorcinelli, A. E. Austin, P. L. Eddy, and A. L. Beach, *Creating the Future of Faculty Development: Learning From the Past, Understanding the Present*, 1st ed. Jossey-Bass, 2005.

[14] C. Henderson and M. Dancy, "Increasing the impact and diffusion of STEM education innovations," in *Commissioned paper for National Academy of Engineering Forum – The Impact and Diffusion of Transformative Engineering Education Innovations*, New Orleans, LA, 2011.

[15] J. C. Shin, A. Arimoto, W. K. Cummings, and U. Teichler, Eds., *Teaching and Research in Contemporary Higher Education*. Springer Dordrecht, 2014. https://doi.org/10.1007/978-94-007-6830-7

[16] H. van der Sluis, P. Burden, and I. Huet, "Retrospection and reflection: The emerging influence of an institutional professional recognition scheme on professional development and academic practice in a UK university," *Innovations in Education and Teaching International*, vol. 54, no. 2, pp. 126–134, 2017. https://doi.org/10.1080/14703297.2016.1273790

[17] H.-C. Han, H. Wan, and X. Wang, "Quantifying engineering faculty performance based on expectations on key activities and integration using flexible weighting factors," *Journal of Biomechanical Engineering*, vol. 142, no. 11, p. 114701, 2020. https://doi.org/10.1115/1.4047478

[18] P. C. Wankat and F. S. Oreovicz, "Teaching prospective engineering faculty how to teach," *International Journal of Engineering Education*, vol. 21, no. 5, pp. 925–930, 2005.

[19] B. E. Seely, "The other re-engineering of engineering education, 1900–1965," *Journal of Engineering Education*, vol. 88, no. 3, pp. 285–294, 2013. https://doi.org/10.1002/j.2168-9830.1999.tb00449.x

[20] I. Holik, T. Kersánszki, G. Molnár, and I. D. Sanda, "Teachers' digital skills and methodological characteristics of online education," *International Journal of Engineering Pedagogy*, vol. 13, no. 4, pp. 50–65, 2023. https://doi.org/10.3991/ijep.v13i4.37077

[21] A. R. Pinto-Santos, C. E. George Reyes, and O. F. Cortés-Peña, "Training and educational innovation: An evaluative perspective of the digital teaching competence," *International Journal of Emerging Technologies in Learning*, vol. 17, no. 7, pp. 38–53, 2022. https://doi.org/10.3991/ijet.v17i07.28867

[22] M. Perifanou, A. A. Economides, and K. Tzafilkou, "Teachers' digital skills readiness during COVID-19 pandemic," *International Journal of Emerging Technologies in Learning*, vol. 16, no. 8, pp. 238–251, 2021. https://doi.org/10.3991/ijet.v16i08.21011

[23] D. Gormaz-Lobos, C. Galarce-Miranda, and H. Hortsch, "Online engineering pedagogy: A proposal for specialization of the teacher training in engineering," *International Journal of Engineering Pedagogy*, vol. 11, no. 5, pp. 105–121, 2021. https://doi.org/10.3991/ijep.v11i5.22427

[24] Y. Wang and Q. Wang, "A student grouping method for massive online collaborative learning," *International Journal of Emerging Technologies in Learning*, vol. 17, no. 3, pp. 18–33, 2022. https://doi.org/10.3991/ijet.v17i03.29429

[25] B. Standl, T. Kühn, and N. Schlomske-Bodenstein, "Student-collaboration in online computer science courses – An explorative case study," *International Journal of Engineering Pedagogy*, vol. 11, no. 5, pp. 87–104, 2021. https://doi.org/10.3991/ijep.v11i5.22413

[26] P. Chatwattana, "Massive open online courses model with self-directed learning to enhance digital literacy skills," *International Journal of Engineering Pedagogy*, vol. 11, no. 5, pp. 122–137, 2021. https://doi.org/10.3991/ijep.v11i5.22461

[27] D. Nieusma and D. Riley, "Designs on development: Engineering, globalization, and social justice," *Engineering Studies*, vol. 2, no. 1, pp. 29–59, 2010. https://doi.org/10.1080/19378621003604748

[28] R. Tuchscherer, R. Gray, and C. Gray, "Reshaping engineering classroom norms to expand the profession," in *2017 ASEE Annual Conference & Exposition Proceedings*, Columbus, Ohio: ASEE Conferences, 2017, p. 27763. https://doi.org/10.18260/1-2--27763

[29] B. Benedict, D. Verdín, R. Baker, A. Godwin, and T. Milton, "Uncovering latent diversity: Steps towards understanding 'What Counts' and 'Who Belongs' in engineering culture," in *2018 ASEE Annual Conference & Exposition Proceedings*, Salt Lake City, Utah: ASEE Conferences, 2018, p. 31164. https://doi.org/10.18260/1-2--31164

[30] L. L. Long III, "Toward an anti-racist engineering classroom for 2020 and beyond: A starter kit," *Advances in Engineering Education*, 2021. Accessed: May 27, 2022. [Online]. Available: https://onlinelibrary.wiley.com/doi/10.1002/jee.20363.

[31] V. Ray, "Is gender bias an intended feature of teaching evaluations?" Inside higher Ed. Accessed: May 27, 2022. [Online]. Available: https://www.insidehighered.com/advice/2018/02/09/teaching-evaluations-are-often-used-confirm-worst-stereotypes-about-women-faculty

[32] C. Flaherty, "Teaching evals: Bias and Tenure," Inside higher Ed. Accessed: May 27, 2022. [Online]. Available: https://www.insidehighered.com/news/2019/05/20/fighting-gender-bias-student-evaluations-teaching-and-tenures-effect-instruction

[33] Y. Fan *et al.*, "Gender and cultural bias in student evaluations: Why representation matters," *PLoS ONE*, vol. 14, no. 2, p. e0209749, 2019. https://doi.org/10.1371/journal.pone.0209749

[34] B. Uttl, C. A. White, and D. W. Gonzalez, "Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related," *Studies in Educational Evaluation*, vol. 54, pp. 22–42, 2017. https://doi.org/10.1016/j.stueduc.2016.08.007

[35] F. Nasser and B. Fresko, "Faculty views of student evaluation of college teaching," *Assessment & Evaluation in Higher Education*, vol. 27, no. 2, pp. 187–198, 2002. https://doi.org/10.1080/02602930220128751

[36] W. Stroebe, "Why good teaching evaluations may reward bad teaching: On grade inflation and other unintended consequences of student evaluations," *Perspect Psychol. Sci.*, vol. 11, no. 6, pp. 800–816, 2016. https://doi.org/10.1177/1745691616650284

[37] J. W. B. Lang and M. Kersting, "Regular feedback from student ratings of instruction: Do college teachers improve their ratings in the long run?" *Instr. Sci.*, vol. 35, no. 3, pp. 187–205, 2007. https://doi.org/10.1007/s11251-006-9006-1

[38] L. R. Kogan, R. Schoenfeld-Tacher, and P. W. Hellyer, "Student evaluations of teaching: Perceptions of faculty based on gender, position, and rank," *Teaching in Higher Education*, vol. 15, no. 6, pp. 623–636, 2010. https://doi.org/10.1080/13562517.2010.491911

[39] D. Murray *et al.*, "Exploring the personal and professional factors associated with student evaluations of tenure-track faculty," *PLoS ONE*, vol. 15, no. 6, 2020. https://doi.org/10.1371/journal.pone.0233515

[40] S. A. Safavi, K. A. Bakar, R. A. Tarmizi, and N. H. Alwi, "Faculty perception of improvements to instructional practices in response to student ratings," *Educational Assessment, Evaluation and Accountability*, vol. 25, no. 2, pp. 143–153, 2013. https://doi.org/10.1007/s11092-013-9160-3

[41] L. Lomas and G. Nicholls, "Enhancing teaching quality through peer review of teaching," *Quality in Higher Education*, vol. 11, no. 2, pp. 137–149, 2005. https://doi.org/10.1080/13538320500175118

[42] A. R. A. Salih, "Peer evaluation of teaching or 'Fear' evaluation: In search of compatibility," *HES*, vol. 3, no. 2, pp. 102–114, 2013. https://doi.org/10.5539/hes.v3n2p102

[43] A. Barnard, W. Croft, R. Irons, N. Cuffe, W. Bandara, and P. Rowntree, "Peer partnership to enhance scholarship of teaching: A case study," *Higher Education Research & Development*, vol. 30, no. 4, pp. 435–448, 2011. https://doi.org/10.1080/07294360.2010.518953

[44] J. W. Stigler and K. F. Miller, "Expertise and expert performance in teaching," in *The Cambridge Handbook of Expertise and Expert Performance*, *2nd ed.*, K. A. Ericsson, R. R. Hoffman, A. Kozbelt, and A. M. Williams, Eds., Cambridge University Press, pp. 431–452, 2018. https://doi.org/10.1017/9781316480748.024

[45] R. J. Woodman and M. B. Parappilly, "The effectiveness of peer review of teaching when performed between early-career academics," *JUTLP*, vol. 12, no. 1, pp. 4–18, 2015. https://doi.org/10.53761/1.12.1.2

[46] S. Weller, "What does 'Peer' mean in teaching observation for the professional development of higher education lecturers?" *International Journal of Teaching and Learning in Higher Education*, vol. 21, no. 1, pp. 25–35, 2009.

[47] A. Bell and R. Mladenovic, "Situated learning, reflective practice and conceptual expansion: Effective peer observation for tutor development," *Teaching in Higher Education*, vol. 20, no. 1, pp. 24–36, 2015. https://doi.org/10.1080/13562517.2014.945163

[48] C. Kell and S. Annetts, "Peer review of teaching embedded practice or policy-holding complacency?" *Innovations in Education and Teaching International*, vol. 46, no. 1, pp. 61–70, 2009. https://doi.org/10.1080/14703290802646156

[49] D. R. Mager *et al.*, "Development, implementation and evaluation of a Peer Review of Teaching (PRoT) initiative in nursing education," *International Journal of Nursing Education Scholarship*, vol. 11, no. 1, pp. 113–120, 2014. https://doi.org/10.1515/ijnes-2013-0019

[50] L. Hammersley-Fletcher and P. Orsmond, "Reflecting on reflective practices within peer observation," *Studies in Higher Education*, vol. 30, no. 2, pp. 213–224, 2005. https://doi.org/10.1080/03075070500043358

[51] L. Lomas and I. Kinchin, "Developing a peer observation program with university teachers," *International Journal of Teaching and Learning in Higher Education*, vol. 18, no. 3, pp. 204–214, 2006.

[52] L. Keig and M. Waggoner, *Collaborative peer review: The role of faculty in improving college teaching*, in ASHE-ERIC Higher Education Report, no. 2, 1994. Washington, DC: Graduate School of Education and Human Development, George Washington University, 1994.

[53] S. Shortland, "Feedback within peer observation: Continuing professional development and unexpected consequences," *Innovations in Education and Teaching International*, vol. 47, no. 3, pp. 295–304, 2010. https://doi.org/10.1080/14703297.2010.498181

[54] L. A. Braskamp, "Toward a more holistic approach to assessing faculty as teachers," *New Directions for Teaching and Learning*, vol. 2000, no. 83, pp. 19–33, 2000. https://doi.org/10.1002/tl.8303

[55] G. F. Kohut, C. Burnap, and M. G. Yon, "Peer observation of teaching: Perceptions of the observer and the observed," *College Teaching*, vol. 55, no. 1, pp. 19–25, 2007. https://doi.org/10.3200/CTCH.55.1.19-25

[56] C. J. Finelli, M. Ott, A. C. Gottfried, C. Hershock, C. O'Neal, and M. Kaplan, "Utilizing instructional consultations to enhance the teaching performance of engineering faculty," *Journal of Engineering Education*, vol. 97, no. 4, pp. 397–411, 2008. https://doi.org/10.1002/j.2168-9830.2008.tb00989.x

[57] R. M. Felder and R. Brent, "Learning objectives: A foundation of effective teaching," in *Teaching and Learning STEM: A Practical Guide*, John Wiley & Sons, pp. 17–40, 2016.

[58] A. F. McKenna, B. Yalvac, and G. J. Light, "The role of collaborative reflection on shaping engineering faculty teaching approaches," *Journal of Engineering Education*, vol. 98, no. 1, pp. 17–26, 2009. https://doi.org/10.1002/j.2168-9830.2009.tb01002.x

[59] R. Esterhazy, T. de Lange, S. Bastiansen, and A. L. Wittek, "Moving beyond peer review of teaching: A conceptual framework for collegial faculty development," *Review of Educational Research*, vol. 91, no. 2, pp. 237–271, 2021. https://doi.org/10.3102/0034654321990721

[60] Ohio State University College of Engineering, "Proposal to establish the department of engineering education," 2015.

[61] A. Christy *et al.*, "Creating a peer review of teaching process to enhance instructor feedback in engineering education," in *2021 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual Conference: ASEE Conferences, 2021, p. 36869. https://doi.org/10.18260/1-2--36869

[62] D. L. Morgan, *Focus groups as qualitative research*, *2nd ed.* Thousand Oaks, CA: Sage, 1997. https://doi.org/10.4135/9781412984287
[63] J. W. Creswell and C. N. Poth, *Qualitative Inquiry & Research Design: Choosing Among Five Approaches*. SAGE Publications, 2017.
[64] J. L. Drayton, G. A. Fahad, and A. C. Tynan, "The focus group: A controversial research technique," *Graduate Management Research*, vol. 4, no. 3, pp. 34–51, 1989.
[65] E. Villegas-Reimers, "Teacher professional development: An international review of the literature," in *Quality Education for All. Paris: International Institute for Educational Planning*, 2003.
[66] J. Fereday and E. Muir-Cochrane, "Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development," *International Journal of Qualitative Methods*, vol. 5, no. 1, pp. 80–92, 2006. https://doi.org/10.1177/160940690600500107
[67] J. Saldaña, *The Coding Manual for Qualitative Researchers*, *3rd ed.*, Thousand Oaks, CA: SAGE Publications, 2016.
[68] S. R. Jones, V. Torres, and J. Arminio, *Negotiating the Complexities of Qualitative Research in Higher Education*, *2nd ed.*, New York: Routledge, 2014.
[69] A. J. Onwuegbuzie and R. B. Johnson, "The validity issue in mixed research," *Research in the Schools*, vol. 13, no. 1, pp. 48–63, 2006.
[70] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, 2006. https://doi.org/10.1191/1478088706qp063oa
[71] R. A. Streveler, M. Borrego, and K. A. Smith, "Moving from the scholarship of teaching and learning to educational research: An example from engineering," *To Improve the Academy*, vol. 25, no. 1, pp. 139–149, 2007. https://doi.org/10.1002/j.2334-4822.2007.tb00479.x
[72] C. Cook, J. Jones, and A. Al-Twal, "Validity and fairness of utilising student evaluation of teaching (SET) as a primary performance measure," *Journal of Further and Higher Education*, vol. 46, no. 2, pp. 172–184, 2022. https://doi.org/10.1080/0309877X.2021.1895093
[73] H. A. Hornstein, "Student evaluations of teaching are an inadequate assessment tool for evaluating faculty performance," *Cogent Education*, vol. 4, no. 1, p. 1304016, 2017. https://doi.org/10.1080/2331186X.2017.1304016
[74] I. A. Iqbal, "Don't tell it like it is: Preserving collegiality in the summative peer review of teaching," *CJHE*, vol. 44, no. 1, pp. 108–124, 2014. https://doi.org/10.47678/cjhe.v44i1.183625
[75] V. M. Lechuga and D. C. Lechuga, "Faculty motivation and scholarly work: Self-determination and self-regulation perspectives," *Journal of the Professoriate*, vol. 6, no. 2, pp. 59–97, 2012.
[76] A. J. S. Reed, V. E. Bergemann, and M. W. Olson, *In the Classroom: An Introduction to Education*. New York: McGraw-Hill, 1998.
[77] E. B. Pollicino, "Faculty satisfaction with institutional support as a complex concept: Collegiality, workload, autonomy," in *Annual Meeting of the American Educational Research Association*, 1996, p. 19.
[78] P. C. Brown, H. L. Roediger, and M. A. McDaniel, *Make it stick*. Harvard University Press, 2014. https://doi.org/10.2307/j.ctt6wprs3
[79] S. A. Ambrose, M. W. Bridges, M. DiPietro, M. C. Lovett, and M. K. Norman, *How Learning Works: Seven Research-Based Principles for Smart Teaching*. John Wiley & Sons, 2010.

10 APPENDIX

Table A1. Table of inductive codes and corresponding definitions

Inductive Code	Definition
Agency & Autonomy in PRT Tasks and Timing	Passages related to participants having (or not having) the freedom and flexibility to make their own choices regarding PRT activities and interactions with others.
Collaboration and Cross-Communication	Passages related to the existence (or lack of) collaboration and communication between colleagues and between the pillars of the department or other departments.
Departmental Structure, Support, and Space for Teaching & Development	Passages that relate to the acknowledgement of the Department's organizational behavior (structure, resources, support, etc.) that impact the PRT process.
Future PRT Considerations & Recommendations	Passages referring to forward thinking related to PRT beyond what was experienced in the past academic year.
Lacking & Receiving Education Training & PRT Training	Passages related to existence (or lack of) training in education, or training in how to review teaching/ teaching materials.
Personal Value of Teaching & Teaching Development	Passages related to personal, or Departmental (or larger university or funding systems') values related to the importance of teaching and teaching development.
Systemic Value of Teaching & Teaching Development	Passages related to Departmental (or larger university or funding systems') values related to the importance of teaching and teaching development.
Personal Stories	Creating a shared vision and unification via adversity encountered during teaching experiences in the department—talking about adversity then using the plural 'we' when describing dealing with that challenge
PRT Cognitive Load & Time Investment	Passages related to the cognitive load (both initial understanding and activity) and time load or investment involved in understanding, participating in, and reflecting on the PRT goals and activities.
Slipstreamed	Passages that highlight the benefits of getting 'double time' for participating in the Program. This is when participants explicitly state the synergy of the peer review of teaching program.—when they were already doing something and now, they are getting 'credit' for in PRT system.
Empathy	Mention of taking the role of another person or putting themselves in another's shoes. Perspective taking and consideration.

Table A2. Table of deductive codes and corresponding definitions

Deductive Code	Definition
Development of Teaching Practices, Considerations, or Artifacts	Passages related to participation in the PRT process leading to outcomes of further development of teaching methods, artifacts, or considerations by participants.
Robust Feedback	Passages related to the transfer of knowledge from feedback as a result of the PRT processes being 'robust'—strong, meaningful, or genuinely helpful in various/multiple ways—E.g., not just 'good job' but instances of deeper meaning or multiple suggestions/outcomes from feedback
PRT Process Serving Diverse Needs	Passages that discuss the utility of the PRT process across all teaching members of the department despite their rank. Applicability ranging from GTAs to documentation for promotion and tenure packages
Need-Based Approach to PRT Participation	Passages in which participants identify that the PRT activity of their choice addressed a topic/need/ shortcoming/concern of theirs that they had regarding their knowledge, skills, ability, or artifacts/processes used in teaching.
Instances of Reflection	Passages in which the participants describe the act of reflecting on their PRT activity/activities and/or the impacts of these reflections.

11 AUTHORS

Cassie Wallwey, Ph.D., is a Collegiate Assistant Professor in the Engineering Education Department at Virgnia Tech in Blacksburg, VA where she teaches the first-year General Engineering program. She holds a B.S. and M.S. in Biomedical Engineering (Wright State University ’17 and ’18, respectively) and a PhD in Engineering Education (The Ohio State University ’22). Her research specialties include classroom feedback, engineering student success, student learning and learning experiences, and student motivation and engagement.

Amanda Singer is a graduate student of the Engineering Education PhD program at Ohio State University. Before attending OSU, she earned her B.S. and M.S. in Environmental Engineering from Michigan Technological University. She currently serves as a graduate teaching assistant for OSU’s first-year engineering program. Her research interests include the regional campus student experience, first-year engineering student support systems, engineering identity formation, and mixed methods research.

Lynn Hall, Ph.D., is a Senior Lecturer at the Department of Engineering Education at The Ohio State University where she teaches technical and professional communications topics in a range of courses.

David Delaine, Ph.D., is an Associate Professor in the Department of Engineering Education at The Ohio State University’s College of Engineering. He leads the Inclusive Community-based Learning (iCBL) Lab that advances knowledge on the ways in which community-based learning (service-learning, outreach, and volunteerism) in engineering can impact local communities, students, and other participating stakeholders through reciprocal partnership. The iCBL develops evidence-based approaches within CBL contexts that can support the formation of reflexive engineering professionals while promoting social justice and broadening participation outcomes in engineering. Dr. Delaine has obtained a bachelor’s in electrical engineering from Northeastern University, a Ph.D. in electrical engineering from Drexel University, and served as a Postdoctoral Fulbright Scholar at the Escola Politécnica da Universidade de São Paulo.

Jennifer Herman, Ph.D., is a Senior Lecturer in the Department of Engineering Education at the Ohio State University, where she also serves as Interim Director for Engineering Technical Communications. Dr. Herman’s expertise is in writing and communication pedagogy, and current her scholarly interests include developing writing-related communities of practice for graduate students and junior faculty in STEM. Currently, Dr. Herman teaches courses on the intersections of citizenship, accountability, and engineering practice.