Fostering Innovation: Insights from Faculty Participation in Teaching-Focused Communities of Practice

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Abstract

This work-in-progress paper describes a study to examine faculty participation in communities of practice for teaching innovation at a large midwestern research intensive university. This study is making progress from collecting data from a faculty survey to interviews and focus group for the practitioners from all engineering majors. Extensive research reported a variety of barriers and motivators for individual engineering faculty's adoption of instructional change. However, there is little research focused on engineering faculty participation in communities of practice for instructional change, particularly teaching innovation. This study has two objectives: (1) to better understand how engineering faculty members perceive their participate in communities of practice for teaching innovation supported by an annual funding program and (2) to make the program better to enhance the communities of practice. In this study, our participants included faculty from various engineering departments with various backgrounds, interests, and teaching experience. Using a community of practice as a theoretical framework, we conduct a qualitative case study, collecting data from multiple sources, such as an online survey, individual interviews, focus group, and a mini case study, to ensure the validity of our study. The survey results show that 92% of the faculty members are highly engaged in the faculty communities of practice and 76% of them answer this funding program helps their teaching practices be more innovative. However, only 45% of the respondents say that faculty members interact with each other within engineering departments. The survey results may not show individual engineering faculty members' various lived experience in the communities of practice but need to explore their lived experience through other data, such as interviews and focus groups. The survey results enable the funding program conveners to recognize engineering faculty's experiences to interdisciplinary interactions with diverse faculty for teaching innovation. In late Fall 2023, we will interview engineering faculty members who participated and are currently participating in the funded communities of practice. Conducting individual interviews, we will analyze the respondents' answers to open-ended survey questions about their experiences and perceptions related to the communities of practice and the teaching innovation funding program based on thematic analysis. From individual interviews, we anticipate some unexpected or hidden findings based on individual participants' diverse backgrounds, motivations, and their experiences on the faculty communities of practice for teaching innovation in the specific institutional contexts. This work-in-progress paper will discuss the details about the survey questions and the responses, and the findings of open-ended responses. We hope it will be able to contribute to reducing existing barriers and

expanding motivators from engineering faculty members to consider their participation in the communities of practice as a means to advance teaching innovation.

Introduction

In a large university with high research activities, our team has conducted an evaluation study from 2023 to assess how engineering faculty members view their participation in our internal grant program. We refer to this program as Education Innovation Program (EIP), which is a pseudonym for a confidential purpose. The goal of this funding for teaching innovation is to promote faculty to build communities of practice that have shared interests and goals to advance teaching and learning in engineering education. The grant program has provided annual funding for between 7 to 17 groups of faculty members, mostly related to engineering disciplines. This study aims to examine how faculty members view their participation in this program and their research activities and find the ways to improve this program based on their feedback. This study has two objectives:

1. Better understand how engineering faculty members perceives their participate in communities of practice for teaching innovation supported by an annual funding program and
2. Make the program better to enhance the communities of practice. Collect diverse ideas to improve the program to enable faculty communities of practice thrive based on their lived experiences.

Background

Engineering communities have integrated Evidence-Based Instruction Practices (EBIPs) in STEM (Science, Technology, Engineering, and Mathematics) courses (Biswas et al, 2020; Borrego, M., & Henderson, 2014). The objective of the study is to advance the integration of evidence-based teaching practices in introductory STEM courses and enhance student learning outcomes. The EIP program aims to create and nurture communities of practice (CoPs) within the participating teams, fostering collaboration, knowledge dissemination, and the adoption of progressive pedagogies across the college and beyond.

To understand the basis for our study, we reviewed several key studies. First, Tomkin et al. (2019) have examined the impact of the EBIP through faculty communities of practice on student learning outcomes. The authors report that faculty communities of practice played a critical role in implementing EBIPs and positively affecting student learning in STEM courses. Tomkin et al. also reveal that a faculty community of practice promotes its members to collaborate with peers, develop complementary skill sets, and build social networks of professional practice. They highlight the benefits of engaging faculty in collaborative efforts to improve pedagogical practices and deepen their understanding of the science of teaching and learning.

Additionally, the role of faculty mentoring is important in promoting institutional change. It propagates educational innovations that emerge from faculty-driven teaching innovation projects (Ma et al., 2019). This research sheds light on the impact of faculty mentoring in driving the depth and degree of change in educational practices based on how engineering faculty members related to their peers with shared interests and practices within the institution.

Many engineering faculty members express the need to integrate teaching innovation into their existing responsibilities due to the traditional university system that more explicitly rewards research outputs over teaching. Research outputs can be quantified by the number of publications, the amount of research grants, and other traditional indicators of research productivity and impact. However, engineering faculty members face challenges in justifying the productivity and impact of their teaching innovations. These systems recognize engineering faculty's research achievements more clearly than teaching innovations. Extensive literature on engineering education reform has documented this emphasis on research over teaching (Borrego & Henderson, 2014; Felder et al., 2011; Finelli et al., 2014; Mallouk et al., 2022).

Overall, the literature review provides our fundamental understanding of the research area and the basis for our study's objectives: (1) to better understand how engineering faculty members perceive their participate in communities of practice for teaching innovation supported by an annual funding program and (2) to make the program better to enhance the communities of practice. The findings from previous studies provide a foundation for understanding the potential impact of the EIP program on student learning outcomes, faculty development, and institutional change**.**

Methods

In Fall 2023, we conducted a faculty survey to examine how engineering faculty perceived their experience in the education innovation program.

We aim to investigate how faculty members evaluated their experience on the EIP projects from their program engagement to the sustainability of the EIP projects in the future. We developed a survey questionnaire consisting of 28 questions, including 20 Likert scale and 8 open-ended items (see Appendix A). We asked engineering faculty to rate the items from "1 = Not at all" and "2 = Somewhat to "3 = Mostly" and "4 = Extremely Well or Extremely Highly." According to the records of the EIP, 150 current faculty members currently working at our institution have participated in the program. We sent invitation emails with an online survey to faculty members. The survey was open from October 2023 through January 2024.

Participants included current tenure-track faculty members and non-tenure-track across all engineering departments employed at a large Midwestern public university with high research activity. Individuals not included in the survey invitation were emerita faculty and those who left our university. Response rate was high with 62 faculty completing the survey (see Table 1).

The survey included seven main topics related to (1) program engagement. (2) application process. (3) program support, (4) collaboration and interdisciplinary interactions, (5) project outcomes and impact, (6) program improvement, (7) program sustainability.

This work-in-progress paper presents some preliminary findings related to the identified themes, offering a nuanced understanding of how participants evaluate their experiences in the EIP.

For data analysis, we used descriptive statistics for 20 Likert scale survey responses and thematic analysis (Braun & Clarke, 2006; Braun & Clarke, 2019) for the written responses for eight open-ended questions. Particularly, doing thematic analysis with open-ended responses, we conducted iterative reading of the initial responses, finding codes, and categorizing the codes. Finally, we found five themes: (1) involvement of new faculty, (2) integration with existing responsibilities, (3) recognition and promotion, (4) emphasis on funding sustainability, and (5) cultural shift towards teaching. In this work-in-progress paper, we report the preliminary findings related to these themes (see Table 2)

Sixty-two participants in EIP projects took the survey. As Table 1 indicates, men highly outnumber women; 61% identify themselves as men, 31% identify themselves as women. Faculty participation varied across departments. For instance, the Civil and Environmental Engineering department had the highest participation (21%). Participation was moderate in Bioengineering (7%). Participation was less in Physics (3%). There is no participant from Chemical Engineering. It is important to note that the demographics of survey participants do not reflect the overall demographics of program participation by gender, departments, and other categories.

Findings and Discussion

Most engineering faculty members are highly engaged in their teams' education-innovation projects.

Based on the faculty survey, the application process is considered highly accessible, and the faculty believe the proposal review process is mostly transparent and supported by a reasonable budget. According to the survey results, our tentative conclusion is based on the engineering faculty are aware of the goals of and objective of the EIP program, "accelerate the spread of best practices for teaching, develop new best practices, and reimagine what it means to educate our students." Table 1 shows that almost all the engineering faculty (91%) acknowledge those goals and objectives. The data show that approximately 85% of participants are actively engaged in EIP projects. However, it is important to note that the survey was sent to faculty members who had participated in EIP teams. Thus, this high level of engagement might reflect our sampling strategy, which purposefully selected previous EIP participants.

Engineering faculty members believe that EIP teams have limited interaction with other teams, with less-engaged faculty within departments, and outside the College of Engineering

Faculty members report the lack of peer support among EIP teams. Only 33 % of respondents indicate that teams assist other teams in addressing project challenges. The survey results show that 45% of respondents believe the EIP encourages interactions among faculty within engineering departments. Furthermore, although the EIP highly promotes interdisciplinary education research, only 23% state that the program encourages interdisciplinary interaction among faculty outside the college of engineering.

Table 1

Engineering Faculty Perceptions of Participation in the Education Innovation Program (N=62)

	Very Highly	Mostly	Somewhat	None
How familiar are you with the goals and objectives of the EIP program? **(91%)**	**40**	**51**	9	0
In general, when you participate in an EIP project, what is your level of engagement in the EIP project? **(85%)**	**54**	**31**	14	0
How clear and transparent is the proposal review process? **(84%)**	**29**	**55**	12	5
To what extent did the EIP budget support your projects? **(64%)**	**38**	**28**	31	3
To what extent did the other EIP teams help address any challenges encountered during your project **(33%)**	**8**	**25**	52	15
How valuable were the networking opportunities provided by the program for exchanging ideas and best practices? **(67%)**	**10**	**57**	29	5
To what extent did the program encourage interactions between different faculty members within your department? **(45%)**	**11**	**34**	42	13
To what extent did the program encourage interdisciplinary interactions between different faculty members across departments OUTSIDE The College of Engineering? **(23%)**	**8**	**15**	62	15
How satisfied are you with the overall impact of your EIP project on improving engineering education? **(84%)**	**36**	**48**	15	2
To what extent did the EIP program help you to improve your teaching? **(55%)**	**13**	**42**	44	2
To what extent did the EIP program encourage you to be more innovative in your teaching practices? **(79%)**	**21**	**58**	19	2
How would you rate the influence of the EIP program in enhancing teaching and learning experiences in your department? **(63%)**	**24**	**39**	34	3

Engineering faculty members want the EIP participation to better enhance teaching and learning in their departments as they believe it does in their own teaching.

Most respondents believe the EIP program and their EIP participation encourages being innovative in their teaching and improving engineering education in general. For instance, 84% of the engineering faculty believe that their EIP project contributed to improving engineering education. However, although 63% of the participants believe the EIP contributes to improving teaching and learning in their engineering departments, 37% of them say its effect on departments is insufficient.

The survey results reveal a critical challenge in the EIP program. Although engineering faculty members are highly engaged in their teams' education innovation projects, they report there are limited interactions between teams and limited influence beyond the boundaries of their own teaching and projects. This issue raises an important question about the impact of the EIP on engineering departments in our institution: "How can we change the EIP to extend its benefits more broadly across engineering departments?"

EIP participants' suggestions to improve the engineering faculty members' participation in the communities of practice

1. Involvement of New Faculty

Many faculty members emphasized the involvement of new engineering faculty to expand the communities of practice for teaching innovation. The members of the EIP team vary. Some teams have new faculty members. Nevertheless, the number of new faculty members is relatively low in EIP teams. For instance, one faculty said, "I think there is a very talented group of people currently involved in EIP, but moving forward, the community needs to recruit new people and ideas to make sure innovation continues." This is also a valuable opportunity for new faculty members who begin their careers in a new institution because joining an EIP team enables them to meet with a group of senior faculty members and receive mentoring from them. Another faculty member wrote, "Include new faculty participation, submit papers to conferences to disseminate what we do here, become a reference as internal grants for engineering education."

2. Integration with Existing Responsibilities

Some faculty members express the need to integrate teaching innovation into their existing responsibilities and workloads. They highlighted a practical approach to balancing various academic duties. Particularly, many tenure-track engineering faculty members hesitate to participate in EIP communities of practice because they prioritize research. This mainly results from the university's emphasis on rewarding research outputs over teaching in institutions with high research activity. However, one tenured engineering faculty member argued against this perception. He wrote, "I think it needs to integrate into our existing responsibilities and teaching loads. I think it requires multiple people who care about it and are invested in it." This

response shifts the existing perspective from their participations in a teaching-focused community of practice to the systemic investment of time to address the challenge of teaching for tenure-track faculty members, particularly new faculty who can receive shared resources, teaching approaches, and mentoring to teach engineering courses. On the other hand, other faculty members addressed the role of engineering departments on complex issues for teaching large class size undergraduate engineering classes. A faculty member pointed out that "Requirements of teaching personnel, space, and equipment for specific classes should be clearly spelled out and agreed on by the department(s)." Although teaching has been more valued in this college of engineering in recent years, compared to research, college of engineering and individual engineering departments will need to value teaching as explicit policies and procedures. The more engineering administration values teaching, the more engineering faculty will recognize the value of the faculty communities of practice that aim to advance teaching engineering.

Table 2

Preliminary Themes to redesign faculty communities of practice for teaching innovation

Theme	Faculty Responses
1. Involvement of New Faculty	"Include new faculty participation, submit papers to conferences to disseminate what we do here, become a reference as internal grants for engineering education."
	"I think there is a very talented group of people currently involved in EIP, but moving forward, the community needs to recruit new people and ideas to make sure innovation continues."
2. Integration with Existing Responsibilities	"I think it needs to integrate into our existing responsibilities and teaching loads. I think it requires multiple people who care about it and are invested in it."
	"Requirements of teaching personnel, space, and equipment for specific classes should be clearly spelled out and agreed on by the department(s)."
3. Recognition and Promotion	"The work of the EIP teams and the long-term impacts need to be better recognized in promotion and as part of the expected (not additional workload)"
	"EIP as a 'grant' is clear how it fits into an annual review or your Biodata for promotion."
4. Emphasis on Funding Sustainability	"Funding and more events and space for multidisciplinary collaborations to take place."
	"Continued funding. This is really hard to do while being a TT (Tenure track) faculty member."
5. Cultural Shift towards Teaching	"Teaching culture must be taught to new assistant professors so that as they mature, they infuse departments."
	"There must also be a cultural sense of value for innovative teaching."

2. Integration with Existing Responsibilities

Some faculty members express the need to integrate teaching innovation into their existing responsibilities and workloads. They highlighted a practical approach to balancing various academic duties. Particularly, many tenure-track engineering faculty members hesitate to participate in EIP communities of practice because they prioritize research. This mainly results from the university's emphasis on rewarding research outputs over teaching in institutions with high research activity. However, one tenured engineering faculty member argued against this perception. He wrote, "I think it needs to integrate into our existing responsibilities and teaching loads. I think it requires multiple people who care about it and are invested in it." This response shifts the existing perspective from their participations in a teaching-focused community of practice to the systemic investment of time to address the challenge of teaching for tenure-track faculty members, particularly new faculty who can receive shared resources, teaching approaches, and mentoring to teach engineering courses. On the other hand, other faculty members addressed the role of engineering departments on complex issues for teaching large class size undergraduate engineering classes. A faculty member pointed out that "Requirements of teaching personnel, space, and equipment for specific classes should be clearly spelled out and agreed on by the department(s)." Although teaching has been more valued in this college of engineering in recent years, compared to research, college of engineering and individual engineering departments will need to value teaching as explicit policies and procedures. The more engineering administration values teaching, the more engineering faculty will recognize the value of the faculty communities of practice that aim to advance teaching engineering.

3. Recognition and Promotion

Many faculty members emphasize the importance of recognition and rewards for faculty who participate in EIP projects at our institution. They addressed the needs for institutional acknowledgment of these efforts to advance teaching innovation. A faculty member wrote, "the work of the EIP teams and the long-term impacts need to be better recognized and as part of the expected (not additional workload)." This suggests there is a disconnection between the faculty's efforts and time invested in EIP projects for teaching innovation to improve student learning and how they valued at our institution.

Regarding compensation, the EIP teams should use project budgets for hiring students as research assistants and purchasing resources to conduct studies, yet the faculty members' work typically remains uncompensated. Another faculty member explicitly wrote, ""the EIP as a 'grant' is clear how it fits into an annual review or your Biodata for promotion." This response emphasizes the need for a formal recognition system, similar to research grants.

Currently, it is evident that engineering faculty members' contribution to enhancing student learning are not adequately recognized at the college and university levels. However, as more faculty express their desire for improved recognition and promotion based on their involvement

in the EIP projects, university administrators may become more aware of the importance of teaching innovation, which can drive potential changes in institutional recognition and rewards in the near future.

4. Emphasis on Funding Sustainability

Several responses address the concern for funding sustainability and the challenges of maintaining projects without sufficient financial support in the future. For instance, a faculty member was concerned about funding sustainability. He wrote, "Continued funding. This is really hard to do while being a tenure track faculty member." This tenure track engineering faculty member describes the importance of funding for their teaching projects. As tenure-track engineering faculty members, funding for research could play a critical role in becoming a tenured faculty. However, they make more priority to secure funding for research in their research area than for engineering education research. Therefore, funding sustainability for the EIP enables the engineering faculty members to continue to design teaching innovation projects with their community of practice through the institutional funding program. Furthermore, a faculty member responding to a survey, highlights the challenges of multidisciplinary teams, specifically the need for “funding, and more events and space for multidisciplinary collaborations to take place."

5. Cultural Shift towards Teaching

Since this internal funding program began, engineering faculty have built project teams and have maintained their collaboration for over a decade. Many responses emphasize the importance of building a supportive community of practice that values innovative teaching. One engineering faculty member underscored the importance of faculty’s cultural awareness by stating, "There must also be a cultural sense of value for innovative teaching.” Faculty members involved in the EIP community of practice have established a culture that focuses on improving engineering instruction and sharing it with other faculty members. For instance, a EIP team developed a platform with technology to integrate computation into engineering courses, which improved student engagement and collaboration. This community of practice have not only changed teaching and learning in engineering classroom but also have established the faculty culture that value teaching among faculty. A senior tenure track faculty member stressed the importance of fostering this culture among new faculty by responding, “Teaching culture must be taught to new assistant professors so that as they mature, they infuse departments with collaborative practice."

Future Direction

Our team continues to conduct this evaluation study by collecting additional data sources, including faculty demographic information, faculty interviews, and artifacts from project teams. For example, the demographic information includes gender, teaching experiences, role of faculty (tenure-track or non-tenure track), engineering departments, and other variables. Moreover, we have conducted interviews with engineering faculty members who have

participated in the faculty community of practice to examine how they view their participation in these communities of practice for teaching innovation. Triangulating these multiple data sources will enable us to improve the trustworthiness of our data analysis and to examine the current issue of our internal funding program and constructive recommendation to thrive the faculty community of practice for teaching innovation within our institution and in undergraduate engineering education.

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Appendix. A.

Survey Questionnaire for faculty members' experience on an Internal Funding Program for Teaching Innovation

Q	Main Objectives	Questions
1	Program engagement	How familiar are you with the goals and objectives of the EIP program?
2		In general, when you participate in a EIP project, what is your level of engagement and involvement in the EIP project?
3	Application Process	How well did the Request for Proposal guidelines and instructions explain the requirements and expectations of the EIP program?
4		How clear and transparent is the proposal review process?
5		What much effort were you required to submit your proposal for the EIP program?
6		What challenges did you experience when preparing a EIP proposal?
7		What additional support might have been helpful in the proposal process?
8	Program support	To what extent did the EIP budget support your projects?
9		What was the level of support you received from EIP supporting staff during your project implementation phase?
10		What was the level of support you received from Education Innovation Program Fellows during the project implementation phase?
11		To what extent did the other EIP teams (other faculty, department staff, etc.) help address any challenges encountered during your project implementation?
12		What additional support might you have needed to better implement your project?
13	Collaboration and Interdisciplinary Interactions	How valuable were the networking opportunities provided by the program for exchanging ideas and best practices?
14		To what extent did EIP promote collaboration among project team members?
15		To what extent did the program encourage interactions between different faculty members within your department?
16		Please share specific ways in which the program encouraged interdisciplinary interactions WITHIN the College of Engineering?
17		To what extent did the program encourage interdisciplinary interactions between different faculty members across departments OUTSIDE The College of Engineering?

18		Please share specific ways in which the program encouraged interdisciplinary interactions OUTSIDE The College of Engineering?
19	Project Outcomes and Impact	How satisfied are you with the overall impact of your EIP project on improving engineering education?
20		To what extent did the EIP program help you to improve your teaching?
21		To what extent did the EIP program encourage you to be more innovative in your teaching practices?
22		In general, to what extent did your project achieve the expected outcomes as outlined in the proposal?
23		How likely are you to (continue to) incorporate the innovations developed through the EIP in future courses?
24		How would you rate the influence of the EIP program in enhancing teaching and learning experiences in your department?
25	Program improvement	Based on your experience, what suggestions do you have for improving the EIP program in the future?
26	Program sustainability	To what extent will your EIP project be sustainable in terms of its long-term impact on faculty members in the College of Engineering?
27		Based on your experience, what is necessary for the EIP program to be sustainable in the future?
28	Other feedback/comments	What is the best aspect of the EIP program?