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Mentoring Engineering Educators with an Entrepreneurial Mindset – Focused SOTL Professional Development Experience

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1. Introduction

The *Entrepreneurship for All* movement has many universities and communities offering campus-wide initiatives in the form of new centers, degrees, minors, courses, accelerator programs, and student organizations. Many engineering faculty are becoming involved in teaching entrepreneurial thinking due to the connection between engineering design and opportunity recognition, often associated with entrepreneurship. Moreover, the Kern Entrepreneurial Engineering Network (KEEN) has made significant investments in helping engineering educators develop and assess entrepreneurially-minded curricula. However, dissemination and sharing practices have yet to be fully optimized across engineering faculty and their institutions.

The dissemination of best teaching practices can be done through a variety of formats. Yet, within the academic setting, journal manuscripts and conference proceedings are the most well-documented approaches to provide evidence of teaching and research excellence for faculty promotion and tenure (P&T) portfolio documents. For engineering faculty with formal training in engineering education research (EER), demonstrating effective teaching practices can be straightforward. However, engineering faculty with more formal technical or disciplinary training might find it more efficient to document best teaching practices through the scholarship of teaching and learning (SOTL). SOTL investigates student learning and satisfaction based on innovative teaching interventions with the purpose of sharing best practices and lessons learned from an educator perspective. In contrast, EER extends SOTL to investigate learning which happens outside the classroom, consider factors beyond student learning and satisfaction, and understand broader theoretical questions of how and why.

The overarching goal of this paper is to showcase the findings from a cohort-based engineering faculty professional development experience which has two key components. First, faculty participants completed a short virtual workshop to learn about the nuances of conducting SOTL. Second, faculty participants completed a SOTL-focused virtual writing group to develop and receive feedback on a manuscript showcasing student assessment of learning for an entrepreneurially-minded engineering curriculum. The professional development experience targeted engineering faculty who had a demonstrated understanding of how to develop and deliver the entrepreneurially-minded curriculum within the undergraduate engineering classroom, yet had not disseminated the teaching intervention thereby limiting its potential impact. The professional development experience was offered virtually, thus, increasing access to engineering faculty at colleges across the U.S., both within and outside the KEEN network.

This paper also demonstrates how KEEN's priorities of teaching entrepreneurially-minded curriculum can be aligned with the promotion and tenure (P&T) processes common at most higher education institutions. Simply put, this professional development experience offers another value proposition for engineering educators to leverage involvement in entrepreneurship education through an activity and a potential paper related to best teaching practices on their P&T portfolio documents.

2. Background

2.1 Entrepreneurial Minded Learning

Entrepreneurship education is no longer solely the domain of traditional business programs. Industry and workforce trends mean that employers now place value on engineers who have a combination of entrepreneurial and technical skills enabling them to generate innovative solutions. Increased demand for entrepreneurial abilities has led educators to develop an entrepreneurial mindset in engineering students [1, 2]. Entrepreneurial mindset (EM) is defined as an “inclination to discover, evaluate, and exploit opportunities" [3, 4], and the way to the develop EM in graduates is through education. As an example, a Moroccan university has introduced a training-based educational approach for Ph.D. students to improve their understanding of opportunity recognition and its surrounding environment by instilling an entrepreneurship mindset [5]. Many other approaches enhance engineering student abilities through forms of entrepreneurial-minded learning such as problem-based learning, and project-based learning [6, 7]. One possible way to promote these practices is through the SOTL and EER.

2.2 SOTL vs EER

The scholarship of teaching and learning (SOTL) is not new to academia. Felten, 2013 [8] defined five principles of good practices in SOTL: inquiry focused on student learning, grounded in context, methodologically sound, conducted in partnership with students, and appropriately public. The goal of SOTL is not only to identify the teaching characteristics that can enhance learning at a maximum level but also to make the teaching process available to the public. SOTL is known to operate at three different levels in academia: micro, meso, and macro. The micro is limited to an individual research and a department's effort toward teaching, meso works at the institutional level and influences faculty motivation, and macro is aimed towards national and international contexts the influence of different policies on approaches [9, 10].

In contrast, Engineering education research (EER), aims to address the challenges of students learning in an engineering education context, and then developed innovative theoretical frameworks to understand the learning outcomes. The purpose of EER is not only on the students but also explores research methodologies related to teaching approaches, teachers, and teaching institutions [11-13]. One main goal of the EER is to fill meet industry demands for engineering graduates with knowledge and professional skills (teamwork, communication, decision making, critical thinking, etc.) a acquired through educational approaches [14, 15]. In general, SOTL tends to be more practitioner-oriented while EER tends to be more theory and research-oriented. In either case, faculty professional development is one means to training engineering faculty (who are not formally trained in education research) about how to disseminate knowledge.

2.3 Faculty Professional Development

The continued growth of teaching pedagogies and educational standard requires that faculty members keep up with the new trends [16, 17]. Yet, the vast majority have never been exposed to effective practices for teaching and learning. As such, they are more likely to use the same

approaches taken by professors before them regardless of outcomes [18]. Traditional teaching practices were upended by the COVID-19 pandemic which resulted in a surge of courses delivered online that required attention to online teaching techniques and abilities [19, 20]. The acceptance of online learning has spread to faculty development, where many formerly in-person conferences and workshops are now held online. The purpose of this paper is to describe preliminary findings from a grant-funded project that delivers professional development to engineering faculty through an entrepreneurially-minded SOTL virtual writing group.

3. Methods

3.1 Study Design

This paper summarizes preliminary results from a semester-long, cohort-based engineering faculty professional development experience that required participants to complete these major tasks:

1. Asynchronous Pre-Workshop Assignments
2. Virtual 3-hour Workshop on SOTL and Virtual Writing Group (VWG) protocol
3. Asynchronous Post-Workshop Assignments
4. Virtual Writing Group = 10 weekly meetings during the semester
5. Asynchronous Final Deliverables (e.g., SOTL paper) and Evaluation

In return for completing all tasks, participants earned a stipend payment of $750. Additional program details can be found here: www.PurduePD.com.

Since the PD experience was completed in a virtual format, it was expected that all participants had the following technology capabilities:

- Computer access
- Dependable internet access
- Reliable computer camera (turned on during virtual meetings)
- Reliable computer audio (microphone or phone to call in)

3.2 Participation Information

Participants include six engineering educators from throughout the United States including three females and three males. The participants were split into two cohorts of three and assigned to work with a facilitator. Participants were required to attend 80% of the VWG sessions. Participants applied to the program and were accepted based upon many criteria including tenure status, previous data collection and IRB approval.

3.3 Primary Interventions

3.3.1 SOTL Outline Template

See appendix.

3.3.2 Virtual Writing Group Directions

Each participant received feedback three times throughout the session from peers and the facilitator. Following the workshop participants agreed to dates for ten virtual writing group sessions, the first of which the facilitator shared a paper to model the VWG process. The following nine sessions permitted each of the three participants to receive feedback three times. Before each VWG the designated participant for that week shared a manuscript draft days before the VWG in order to allow other participants time to review. During the meeting, the facilitator led the group through the following rounds of constructive feedback:

- Clarification Round: Participants ask questions to clarify (not critique) points of confusion. These should typically be yes/no questions or one-answer questions.
- Positive Feedback Round: There are many good parts to the paper that should be kept. Be prepared to state at least one positive thing about the writing.
- Round to Respond to Author's Request: <Insert: Author should highlight specific areas where feedback is requested…ideally 3-5 focus areas.>
- Final Round: Participants should share any remaining comments or suggestions.

3.4 Data Collection

Upon completion of the original workshop, participants were asked to respond to these open-ended survey questions.

1. Please summarize at least one thing you learned (e.g., a key takeaway) during this 3 hourSOTL workshop.
2. Please share at least one thing that was confusing or that we could have spent more time on.
3. What additional support might you need to apply what you learned?

4. Preliminary Results & Discussion

4.1 Question #1: Please summarize at least one thing you learned (e.g., a key takeaway) during this 3 hr SOTL workshop.

Example Participant Quotes: Question #1
"I learned quite a few things! I appreciated the differences between educational research and SOTL. I also found the outline for papers to be extremely useful."
"A template for SOTL papers."
"Prior to this workshop I had no knowledge of SOTL; after attending the workshop, I know what SOTL means, how to leverage the benefits of EM, SOTL and VWG to reform our instructional practices, framework of a typical manuscript with examples and the various dissemination outlets for publishing research work."
"I learned that what I was doing before was SOTL, not engineering education research, and that there are several resources and publications that share and accept articles on what I'm doing."

4.2 Question #2: Please share at least one thing that was confusing or that we could have spent more time on.

Example Participant Quotes: Question #2
"I felt kind of in the dark working on the outline at this point, I was not prepared to do that. I do think the work time was extremely valuable but for me, coming back together a few minutes early for some feedback at this point would have been helpful. I would feel better about moving forward even at this point to prepare something more useful for the first meeting next week, if I had one quick round of feedback on my sketchy draft."
"It would have been valuable to have another 1-3 examples of outlines and works-in-progress based on the templates."
"Nothing was confusing to me, the presentation was pretty straightforward and well laid out. Most of the information was self explanatory as well."
"Confused about the expectations for the manuscript especially if you don't have sufficient or any data. I think writing a manuscript up to Methodology and Result with prelim data is more practical (thus maybe at a conference level), but to have a manuscript with 20 citations and 4000 words can be asking a lot if certain information is missing. I think the process of accepting applicants was confusing since some of us stated that we had limited to no data and were trying to learn about SOTL approach of publication."

4.3 Question #3: What additional support might you need to apply what you learned?

Example Participant Quotes: Question #2
"At this point I'm feeling OK, the meeting next week will be very helpful. Thanks."
"Right now, I have everything I need. Thank you."
"Regular feedback on my writing and content."
"At this time, no additional support is needed. I think guidance during 1-on-1 sessions hopefully will be of great support."

5. Discussion & Conclusion

Survey results indicated that participants gained insight on SOTL, the difference between SOTL and EER, and how to use the SOTL writing framework. Participants indicated very few needs for additional support with the main need being continued feedback on their work. One participant indicated confusion about prerequisite data needed to participate in the program. To write a manuscript, and to participate fully in the VWG experience, participants needed to have data collected and IRB approval. For participants who had limited data or incomplete data, simple methodologies were shared to begin collecting formative data immediately instead of waiting to the end of the semester. Going forward, the facilitators will make additional efforts to ensure participants have an adequate dataset to position them for the greatest success in the program.

Currently, there are many approaches to enhance faculty motivation and professional development. First, there are many internally funded traditional mentoring programs to support the faculty's learning and teaching activities. They also help newly appointed faculty to engage with senior faculty for better direction and personal growth [21, 22]. However, despite the

advantages related to the program, there are many limitations associated with it. Most of these programs face challenges related to the requirement of training, time, funding, and high involvement of the trainee and mentor. It becomes more challenging when it comes to institutions with limited resources.

Secondly, engineering faculty have access to fees-based external mentoring programs such as the National Center for Faculty Development & Diversity (NCFDD) for carrier and research skills advancement. These programs further provide an opportunity to enhance professional development and learn the work and life balance to increase work productivity[23, 24], but it fails to address many problems within the institutional ground level. Moreover, these programs have high costs ($4,750), are centered especially on general research, and do not cover the broader concepts of EM and educational research.

Thirdly, some educational institutions offer faculty-led writing groups as another opportunity for faculty members to accomplish personal and career goals. In these cases, it's common for the faculty members in these groups to be randomly assigned and receive the benefits of peer feedback on their research [25, 26]. However, there is the possibility to get paired with people of different disciplinary interests and motivational levels. Despite a seemingly successful beginning, the lack of motivation, monetary benefits, and similar education or research background still possess challenges.

This professional development experience, an entrepreneurially-minded SOTL virtual writing group, overcomes these barriers through increasing access to like-minded peers through a structured cohort-based community of practice. Participating in this program allows engineering faculty to add value to the promotion and tenure portfolio that goes beyond curriculum development to disseminating best teaching practices. Given that today engineering faculty members are even more accountable for the effectiveness of their teaching and learning activities, this is an ideal program to incentivize engineering faculty in a way that enhances their promotion and publishing opportunities.

To learn more, visit www.PurduePD.com.

6. Appendix

1. Introduction *[Introduction section should include at least 4-6 citations]*

1.1 Problem Identification
<Insert problem identification: (1) This section should summarize the problem. (2) At a minimum, this section should include a sentence that directly states the problem (e.g., "The problem is…" or "The challenge is…"). (3) This section should state what will happen if the problem doesn't get solved, and document the size of the problem. Statistics are helpful here.>

1.2 Current Approaches to the Problem
<Insert current approaches to the problem (ideally, a minimum of three current approaches to the problem).>

1.3 Gaps in Current Approaches
<Insert gaps in current approaches: For each current approach mentioned in Section 1.2, this section should provide a gap (e.g., reason why the approach doesn't completely solve the problem identified in Section 1.1).>

1.4 Proposed Solution
<Insert proposed solution: (1) This section should provide a summary of the solution proposed in response to the problem identified in Section 1.1, explain how it is different from the current approaches mentioned in Section 1.2, and how is overcomes the gaps stated in Section 1.3. (2) This section should include a research question and/or research objectives.>

2. Background *[Each sub-section should include at least 4-6 citations. Consider this approach to each sub-section: (1) define topic area, (2) explain benefits of topic area, (3) explain challenges of topic area, (4) include transition sentence to next sub-section.]*

2.1 Topic Area #1
2.2 Topic Area #2
2.n Topic Area #n

3. Methods

3.1 Study Design
<Insert high level overview of context, intervention, and data collection.>

3.2 Participation Information
<Insert overview of participants, course name/number, and participant demographics.>

3.3 Data Collection
<Insert actual data collection instruments (e.g., assessment/evaluation/rubric).>

3.4 Data Analysis
<Insert overview of software and/or protocols used to analyze data. Potential reference the literature here.>

4. Results *[Potentially share findings by research question, instrument, or data analysis method]*
4.1 Findings #1
4.2 Findings #2
4.n Findings #n

5. Discussion *[Be sure to weave in instructor lesson's learned]*

5.1 Summary
<Insert summary of results to connect findings to research question(s) / research objectives.>

5.2 Compare and Contrast
<Insert compare and contrast of findings to existing literature; at least 4-6 citations>

5.3 Limitations
<Insert limitations with respect to generalizability, choice of data collection/analysis (e.g., qualitative vs. quantitative>

6. Conclusions

6.1 Practical Summary
<Insert explanation of why this research matters and implications for practitioners>

6.2 Future Research
<Insert explanation of future research and next steps>

7. References

7. References

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