Scholarship of Teaching and Learning (SoTL) Accelerator: A Professional Development Program for Engineering Faculty

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An Engineering Faculty Scholarly Teaching Professional Development Program: Scholarship of Teaching and Learning (SoTL) Accelerator

1. Introduction

College retention rates have historically been volatile, among both two- and four-year colleges. In 2023, retention attrition rates in four-year colleges from first to second year were, on average, 23%, although this varied greatly between different institutions. From second to third year, the attrition rates were more stable, on average at 10% [1]. However, in engineering, retention rates are much lower, with people commonly citing that 50% of students either drop out or change majors before graduation [2]. Astonishingly, around half of these students drop out during the first year [2]. Data from 2022 shows engineering bachelors have an average annual persistence and retention rate of 86.4%, transfer rate of 6.4%, and dropout rate of 7.2% [3]. However, associate's degree students had significantly lower annual retention and persistence at a rate of 62.3%, transfer rate of 8.6%, and dropout rate of 29.1% [3]. These concerningly low retention rates, especially among engineering students, prompt us to look for solutions [4].

Active learning significantly improves student performance and reduces failure rates in STEM courses [5] and can improve engineering student retention [6]. Inclusive teaching practices that can foster a sense of belonging in engineering classrooms positively affect student retention, particularly for underrepresented groups [7]. There is a growing need to train university engineering professors in effective teaching practices to ensure the quality of higher education and improve retention [5-7]. While many engineering faculty members are experts in their respective engineering/engineering technology fields, they often lack formal training in pedagogy, including active learning strategies, leading to inconsistencies in student learning outcomes. Teaching engineering at the university level requires more than just content expertise; it demands an understanding of diverse learning styles, effective communication strategies, and the ability to create engaging, inclusive learning environments.

Fortunately, a solution exists. Professional development programs focused on teaching can equip engineering professors with the tools to design curricula, assess student learning, and implement active and inclusive learning techniques that foster more profound understanding and student retention. By investing in the pedagogical development of university engineering professors, institutions can enhance the overall educational experience, improve student retention and success, and adapt to the evolving demands of higher education.

The purpose of this paper is to provide an overview and findings related to a professional development experience aimed to train engineering professors to (1) develop new curriculum, (2) assess the curriculum, and (3) disseminate findings as a conference proceeding. The participants included 30 engineering faculty from various universities throughout the United States. Perceived learning gains were measured using a retrospective post-then-pre survey. The guiding research question is: What is the perceived satisfaction associated with participating in an engineering faculty Scholarship of Teaching and Learning (SoTL) professional development experience?

Given the exploratory nature of the program assessment, we intentionally focus on satisfaction as participant satisfaction in professional development (PD) plays a significant role in promoting improved teaching practices [8, 9]. Satisfied participants are more engaged. When educators feel the PD meets their needs, they are more likely to actively participate, reflect on their learning, and apply new ideas in their teaching. High satisfaction can boost motivation to implement what they've learned, as participants perceive the PD as valuable and relevant.

2. Background

Developing effective scholarship of teaching and learning (SoTL) practices can help support the adoption of active learning practices, which continues to be a challenge in engineering education [10]. Moreover, adopting effective SoTL practices allows a gateway to improved student learning and broadening participation as engaging in SoTL requires faculty to think more critically as they adopt and disseminate research-based practices. However, the vast majority of disciplinary engineering PhD programs (e.g., non-Engineering Education programs) do not prepare graduates for teaching and/or disseminating best teaching practices through the scholarship of teaching and learning (SoTL) [11]. As a result, the limited teaching preparedness of new college and university engineering educators has the potential to turn students off from engineering [12], which directly impacts retention and completion rates [13].

Several factors potentially contribute to this problem. First, most disciplinary engineering Ph.D. programs focus more on technical research and development of the dissertation, with little regard for teaching [14]. Ph.D. students who are awarded a Graduate Teaching Assistantship (GTA) instead of a Graduate Research Assistantship (GRA), are typically expected to grade assignments, teach a lab, and/or offer tutoring sessions [15]. Although these tasks are related to teaching, they do not offer theoretical or holistic perspectives of teaching and student learning needs. Second, most disciplinary engineering research does not involve human subjects; thus, most disciplinary engineering Ph.D. graduates and faculty members have a limited understanding of IRBs' role in protecting human subjects [16]. Third, most promotion and tenure (P&T) policies fail to prioritize teaching efforts; for those that do, focus is placed on student satisfaction (e.g., end-of-semester course evaluations) rather than student learning [17]. These factors contribute to new college and university engineering educators' poor teacher practices and could drive student attrition.

However, a solution does exist.

SoTL was initially introduced by Boyer in 1991 to expand the definition of "scholarship." The SOTL model was based on four functions of SoTL: discovery, integration, application, and teaching. Integration is where the interdisciplinary focus of SoTL comes from. He advocated for using one's own disciplinary knowledge and integrating it into the larger body of knowledge. Boyer's model also focused on the replicability of positive education. Once teaching standards are made, the documentation and communication of these methods are necessary to grow the discipline [18]. Due to Boyer's argument, the SoTL processes moved from the process of inquiry about teaching to understanding student learning and student learning practices and how to improve them [19]. Although SoTL has been referred to as the "fastest-growing academic development movement in higher education" [20], challenges remain.

Faculty may be unfamiliar with the principles of SoTL or unsure how to conduct meaningful SoTL research. As such, this lack of knowledge may be a barrier to adoption. In addition, in some academic environments, technical research is prioritized over teaching, leading to skepticism about the value of SoTL. If SoTL is not valued, instructors may be slow to adopt it. SoTL is inherently interdisciplinary, but siloed departments may discourage cross-disciplinary learning and collaboration. Thus, the interdisciplinarity of SoTL is a challenge. Sharing teaching practices and outcomes in a scholarly format can feel risky, especially for junior faculty. This fear of criticism may be holding faculty back from obtaining helpful feedback on implementing best teaching practices in the classroom. Especially in engineering, generic workshops may not meet the specific needs of faculty from diverse disciplines or with varying experience levels. The one-size-fits-all approach needs serious reconsideration by engineering faculty. Moreover, short-term workshops may inspire interest but fail to foster long-term engagement or systemic change. Furthermore, scheduling conflicts, geographic limitations, or lack of online options can make participation difficult.

3. Methods

3.1 Participants

The participants included 30 engineering instructors from various universities throughout the United States. The gender breakdown was nine females and 21 males. Various engineering disciplines and courses were represented, and there was a mix between tenure track and non-tenure track faculty. Upon completion of the professional development intervention, all participants completed an IRB-approved assessment.

3.2 Intervention

To receive the full program stipend, $1,750, engineering faculty participants were expected to complete the following:

(1) Complete eight hours of asynchronous preparatory work using an online learning management system,
(2) Attend all required virtual meeting sessions,
(3) Design and implement their new curriculum within an engineering class with at least four students,
(4) Upload their newly developed curriculum and implementation notes as a card on EngineeringUnleashed.com,
(5) Upload a minimum of four un-identified student metacognitive reflection submissions to the learning management system,
(6) disseminate findings with a SoTL manuscript, and
(7) complete evaluations.

Requirements for the SoTL manuscript were as follows: (1) fill in the manuscript template using the headings provided, (2) write a paper that includes a minimum of 4000 words and a minimum of 20 citations, and (3) include the phrase “entrepreneurial mindset” in the title, abstract, introduction, and literature review. An example schedule is provided below.

Legend: Part 1: Curriculum Development + Part 2: SOTL Dissemination

Week	Meeting Days	Meeting Time	Activity / Deliverable
0	Jan 3-5, 2023	2-5pm ET	Initial Workshop (daily homework ~ 30 min)
1	Jan 9-20, 2023	Book 30 min Meeting via Calendly	Curriculum Development: One-on-One Meeting to Obtain Feedback/Approval for Curriculum Intervention
2			
3	Jan 27, 2023	No Meeting - Asynchronous Individual Work Time	
4	Feb 3, 2023	3:30-5pm ET	Curriculum Development: Feedback Protocol
5	Feb 10, 2023	3:30-5pm ET	Curriculum Development: Feedback Protocol
6	Feb 17, 2023	3:30-5pm ET	Curriculum Development: Feedback Protocol
7	Feb 24, 2023	3:30-5pm ET	Curriculum Development: Feedback Protocol
8	Mar 3, 2023	3:30-5pm ET	Curriculum Development: Evaluation, Introduction to SOTL VWG
9	Mar 10, 2023	3:30-5pm ET	SOTL Dissemination: Paper Outline + Potential Problems to Solve
10	Mar 17, 2023	No Meeting - Asynchronous Individual Work Time	
11	Mar 20-24, 2023	Book 30 min Meeting via Calendly	SOTL Dissemination: One-on-One Meeting #1
12	Mar 27-31, 2023	Book 30 min Meeting via Calendly	SOTL Dissemination: One-on-One Meeting #2
13	Apr 7, 2023	No Meeting - Asynchronous Individual Work Time	
14	Apr 14, 2023	3:30-5pm ET	SOTL Dissemination Small Group Session #1
15	Apr 21, 2023	No Meeting - Asynchronous Individual Work Time	
16	Apr 28, 2023	3:30-5pm ET	SOTL Dissemination: Small Group Session #2
17	May 5, 2023	No Meeting - Asynchronous Individual Work Time	
18	May 12, 2023	3:30-5pm ET	SOTL Dissemination: Small Group Session #3
19	May 19, 2023	No Meeting - Asynchronous Individual Work Time	
20	May 26, 2023	11:59pm ET	Final Paper Submission Deadline

3.3 Data Collection and Data Analysis

The SoTL Accelerator professional development program is comprised of two main parts: (1) New Curriculum Development, Implementation, and Assessment, and (2) Reflection and Dissemination of Findings. The goal of the data collection was to better understand participant perceptions of completing the program to better assess opportunities for improvements and positive program impacts. The quantitative data was analyzed using SPSS. Descriptive statistics are provided.

1st Survey – Curriculum Development

1. **Overall Satisfaction** with the Professional Development Experience: Identify to what extent you agree with these statements (Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Strongly Agree). I found the professional development experience to…

- Be a good use of my time.
- Promote relationship development among participants
- Encourage creation of new instructional resources.
- Provide a useful protocol tool for peer feedback.

2. **Overall Satisfaction** with the Professional Development Experience: Identify to what extent you agree with this statement (Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Strongly Agree).

- I would recommend this professional development experience to my peers.

2nd Survey – Dissemination

1. **General Satisfaction with the Professional Development Experience:** Identify to what extent you agree with these statements (Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Strongly Agree). I found that participating in the Entrepreneurially-Minded (EM) Scholarship of Teaching and Learning (SOTL) Virtual Writing Group (VWG) professional development experience…

- Was a good use of my time.
- Promote relationship development among participants
- Enhanced networking opportunities.
- Provide a useful protocol tool for peer feedback.
- Offered greater reinforcement and understanding of the entrepreneurial mindset.
- Explained potential dissemination outlets.
- Highlighted the core components of writing a SOTL article.
- Improved my writing skills.
- Improved my research skills.
- Improved my curriculum development skills.

2. **Overall Satisfaction** with the Professional Development Experience: Identify to what extent you agree with this statement (Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Strongly Agree).

- I would recommend this professional development experience to my peers.

4. Results

4.1 Curriculum Development: Overall Satisfaction (Post-Survey Only)

The overall satisfaction was measured using a post-survey only. Table 1 shows the results of this survey. As can be seen in the results, all scores averaged between 4 and 5, implying the participants agreed (somewhat or strongly) for all items.

The most prominently rated scores related to the professional development experience were perceived to be a good use of participant time, encouraged the creation of new instructional resources, and the participants would recommend the professional development experience to their peers, closely followed by providing a useful protocol for peer feedback and promoting relationship development among participants.

Table 1. Results for Overall Satisfaction: Post-Survey Only

1. Overall Satisfaction with the Professional Development Experience: Identify to what extent you agree with these statements. I found the professional development experience to…	
Statement	**AFTER (average)**
Be a good use of my time.	4.93
Promote relationship development among participants.	4.72
Encourage creation of new instructional resources.	4.93
Provide a useful protocol tool for peer feedback.	4.86
2. Overall Satisfaction with the Professional Development Experience: Identify to what extent you agree with this statement.	
Statement	**AFTER (average)**
I would recommend this professional development experience to my peers.	4.86

4.2 Dissemination: General and Overall Satisfaction (Post-Survey Only)

The general satisfaction was measured using a post-survey only. Table 2 shows the results of this survey. As can be seen in the results, all scores had an average between 4 and 5, implying the participants agreed (somewhat or strongly) for all items.

The most prominently rated scores related to the professional development experience were perceived to be a good use of participant time, promoted relationship development among participants, highlighted the core components of writing a SOTL article, enhanced networking opportunities and offered greater reinforcement and understanding of the entrepreneurial mindset.

The overall satisfaction was also measured in the same manner and the highest rated score to the professional development experience was for the recommendation of the professional development experience to their peers.

Table 2. Results for Overall Satisfaction: Post-Survey Only

1. General Satisfaction with the Professional Development experience: Identify to what extent you agree with these statements. I found that participating in the Entrepreneurially-Minded (EM) Scholarship of Teaching and Learning (SOTL) Virtual Writing Group (VWG) professional development experience...	
Statement	**AFTER (average)**
Was a good use of my time.	4.89
Promote relationship development among participants.	4.82
Enhanced networking opportunities.	4.79

Provide a useful protocol tool for peer feedback.	4.75
Offered greater reinforcement and understanding of the entrepreneurial mindset.	4.79
Explained potential dissemination outlets.	4.71
Highlighted the core components of writing a SOTL article.	4.82
Improved my writing skills.	4.68
Improved my research skills.	4.50
Improve my curriculum development skills.	4.39
2. Overall Satisfaction with the Professional Development Experience: Identify to what extent you agree with this statement.	
Statement	**AFTER (average)**
I would recommend this professional development experience to my peers.	4.96

5. Discussion and Lessons Learned

The guiding research question is as follows: What is the perceived satisfaction associated with participating in an engineering faculty Scholarship of Teaching and Learning (SoTL) professional development experience?

The quantitative findings of this study primarily addressed the “learning gains” aspect of the research question. The retrospective post-then-pre surveys clearly show that the SoTL professional development experience has had a statistically significant effect on the engineering faculties confidence and abilities, being that all the p-vales were less than 0.01. Regarding the overall satisfaction post-survey, all means lay in between 4 to 5 (somewhat or strongly agree), suggesting that engineering faculty had generally had a positive experience with the SoTL professional development. The qualitative results also support the quantitative findings, through responses related to sub-themes such as structure and tools, pedagogical skill development, and research skill development which all describe the tangible learning gains reported by faculty.

The qualitative results also explored the engineering faculty’s “perceived motivations” obtained from the research question. Sub-themes such as learning from others, quality student feedback and quality peer feedback responses best show how the engineering faculty obtained motivations. Faculty noted after experiencing that part of the SoTL experience, they got encouragement from their students and could learn from others. From both the qualitative and quantitative results, the evidence shows the overall positive impact that the SoTL professional development experience had on the engineering faculty participating.

There are three key lessons learned from a facilitator’s perspective. First, the SoTL Accelerator program may not be suitable for everyone. Due to the rigorous schedule and the need to meet strict deadlines, not all participants who began the program were able to complete it. Future iterations of the program will explore alternative formats, such as a two-semester cohort (with the teaching intervention implemented in the first semester and the SoTL-focused paper drafted in the second), a self-paced option, a team-based approach, and an accelerated summer format.

Second, it was found that success relied heavily on preparation, structure, and accountability. Participants noted that elements such as the consistent schedule, regular weekly and bi-weekly meetings (held on the same day and time), milestones, and learning activities were instrumental in ensuring a paper was drafted by the conclusion of the cohort session. Third, of the six tools used in the SoTL Accelerator program (https://www.sotlaccelerator.com/), faculty participants found three tools particularly helpful.

- Peer Feedback Tuning Protocol (https://www.sotlaccelerator.com/s/Tool-2-Peer-Feedback-Tuning-Protocol.pdf)
- Assessment of Student Learning (https://www.sotlaccelerator.com/s/Tool-3-Assessment-of-Student-Learning.pdf)
- SoTL Template (https://www.sotlaccelerator.com/s/Tool-6-SoTL-Template.pdf)

6. Conclusion

6.1 Summary

The Scholarship of Teaching and Learning (SoTL) Accelerator program (a new engineering faculty professional development program) was created, implemented, and assessed with funding provided by the Kern Entrepreneurial Engineering Network and Arizona State University Mentorship 360 Program. The SoTL Accelerator program had two core parts: (1) New Curriculum Development, Implementation, and Assessment, and (2) Reflection and Dissemination of Findings. The SoTL Accelerator program was delivered in a virtual, structured, cohort manner to promote accessibility, accountability, and a sense of belonging.

The SoTL Accelerator has preliminary quantitative supporting data [21-25] concerning learning gains, and the program has acquired third-party validation in that the first 12 papers submitted to the American Society of Engineering Education (ASEE) conference were all accepted. Additional details can be found here: https://www.sotlaccelerator.com/.

The following stakeholder recommendations should be considered.

1. First, engineering professors should consider integrating diverse perspectives (e.g., STEAM, bio-inspired design, entrepreneurial mindset).
2. Second, engineering PhD programs should consider including educator training, such as IRB preparation and developing assessments, as a requirement to better equip graduates for academic careers.
3. Third, on-campus centers for teaching and learning should consider incorporating innovative pedagogical methods into training and promote the use of tools and strategies available on the SoTL Accelerator project website.
4. Finally, Provost's Offices should consider updating promotion and tenure guidelines to encourage faculty participation in professional development for teaching.

6.2 Limitations and Future Research

While this faculty professional development program successfully integrated quantitative assessments to evaluate its effectiveness, several limitations should be acknowledged. First, the

study primarily relied on self-reported data, which may be subject to biases such as social desirability and personal interpretation of growth. Future research could incorporate more objective performance measures, such as classroom observations or student learning outcomes, to validate the self-reported improvements.

Second, the program was conducted within a single university, limiting the generalizability of findings to other institutions with different faculty compositions, resources, and institutional cultures. Expanding the study across multiple university facilitators, including those with varying levels of research intensity and teaching focus, would provide a broader perspective on the program's effectiveness. Moreover, assessing differences between tenure-track and non-tenure-track perceived experiences could offer additional insights.

Additionally, while the quantitative assessments provided valuable insights into faculty development, they may not have fully captured the depth of participants' experiences and challenges. Future research should incorporate qualitative methods, such as interviews or focus groups, to gain a richer understanding of faculty perspectives and the long-term impact of the program on teaching practices. Also, the qualitative methods should be complimented with positionality statements, which are important in qualitative research because they help acknowledge and reflect on the researcher's identity, background, biases, and perspectives, which can influence the research process.

Lastly, the long-term sustainability and retention of faculty development outcomes remain uncertain. Future studies should explore longitudinal data to determine how faculty members apply and sustain the skills gained over time. Investigating the integration of ongoing support mechanisms, such as peer mentoring or follow-up workshops, could further enhance the program's impact and ensure continued professional growth.

By addressing these limitations, future research can refine faculty development initiatives, leading to more effective training models that support engineering educators in enhancing their teaching effectiveness and student learning outcomes.

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