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Engineering Education Guilds: Understanding Their Vision for Innovation

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Introduction

The major aim of this project is to understand how, and the extent to which, engineering education guilds (e.g., the Consortium to Promote Reflection in Engineering Education (CPREE) and the Kern Entrepreneurial Engineering Network (KEEN)) foster propagation and adoption of their respective pedagogical innovations. Engineering education guilds like CPREE and KEEN seek to work at the forefront of educational innovation by creating networks of instructor change agents who design and implement a particular innovation in their own context to further the professional formation of engineers.

Background

Research indicates that many faculty at U.S. Colleges and Universities have not adopted evidence-based approaches to teaching engineering students [1], [2]. And yet, the professional formation of engineers is largely reliant on faculty to enhance course-specific and broader developmental outcomes. We know that "high-quality teaching is essential to retain qualified engineering students" [3] and decades of effort have resulted in many evidence-based approaches for achieving these technical and broader developmental outcomes; still, these approaches often remain unused. Recently, research has been conducted to try to understand characteristics of pedagogical innovations and dissemination plans that lead to adoption of new practices among faculty (Table 1).

Table 1. Strategies for sustained adoption.

Strategies for Sustained Adoption	
What Works	**What Does Not Work** [4]
Allowing for grassroots initiatives led by faculty [5]	Prescribing top-down change
Providing ongoing support during development [3]	Developing new materials and simply making them available to others
Considering the complexity of the academy in the development of the innovation [4]	Designing innovative pedagogies for a single case

Dissemination-Propagation Spectrum

To conceptualize how developers of innovative/research-based pedagogies should view their goal of encouraging systemic adoption of their work, Froyd et al. described the "dissemination paradigm" in contrast to the "propagation paradigm" [6]. The dissemination paradigm is the idea that "if we build it, they will come," meaning that developers acting in this paradigm believe that

designing evidence-supported pedagogical innovations and presenting the results at conferences and in journal articles will result in adoption. However, the data suggest that this is not the case [7], [8]. On the other hand, the propagation paradigm involves developers working *with* potential adopters throughout the development process to create innovations that meet the needs of a wide range of engineering educators, thus providing motivation and opportunity for sustained adoption. Using Froyd et al.'s [6] paradigms as two ends of a spectrum, we can capture a wide variety of models that are used to propagate engineering education pedagogies.

Designing for Sustained Adoption Instrument (DSAAI)

One instrument that aims to assess propagation plans along the Dissemination-Propagation spectrum is the Designing for Sustained Adoption Instrument (DSAAI) [8]. Described in 2016 by Stanford et al., the DSAAI is an instrument designed to provide education developers, grant writing consultants, and funding agencies with a tool for assessing the propagation plans of researchers developing educational change strategies [8]. The DSAAI incorporates the findings of the research on dissemination and propagation discussed earlier by including items such as engaging potential adopters as the innovation is being developed and considering the instructional and institutional context of potential adopters, among others [8].

Engineering Education Guilds of Interest: CPREE and KEEN

There are several well-known examples of these guild-like organizations. The two that are the focus of this work, CPREE and KEEN, are described in Table 2. Each of these organizations seeks to propagate their work by bringing together engineering educators who work within their own context to integrate the pedagogical change into their teaching. While CPREE and KEEN are well-established initiatives, they have not been understood in the context of the dissemination-propagation spectrum, nor have they been assessed using the DSAAI. Understanding the structure and efficacy of these guilds can inform future attempts to facilitate the sustained adoption of research-supported pedagogical innovations.

CPREE and KEEN, the guilds of interest, were chosen for several reasons: (1) both represent large networks of faculty, (2) both provide funding to faculty and institutions as part of their dissemination/propagation model, which appears to support propagation based on Henderson's assertion that long-term projects and those that recognize the complexity of the academy are more likely to succeed [4], and (3) one (CPREE) was established by engineering education researchers with experience studying pedagogical innovations, while the other (KEEN) was established by philanthropists with industrial, but not educational, experience, which provides an interesting dichotomy to explore.

Table 2 Engineering Education Guilds of Interest

Guild Name	**Guild Leader**	**Pedagogical Innovation**
Consortium to Promote Reflection in Engineering Education (CPREE)	Cindy Atman & Jennifer Turns (University of Washington)	Reflection in Engineering Education

Kern Entrepreneurial Engineering Network (KEEN)	Douglas Melton & Thor Misko (Kern Family Foundation)	Entrepreneurial Mindset

Project Overview

The specific aims of this overall project are to (1) characterize two engineering education guilds with respect to their dissemination/propagation plans, (2) understand the extent of their pedagogical innovations' adoption and (3) identify and describe the resource networks used by educators who have adopted the innovations. This paper will focus on the first of these aims.

The research questions related to the first project aim are:

- What are the planned dissemination/propagation approaches of well-established engineering education guilds?
- To what extent do these approaches change based on the context and nuances of professional formation (e.g., Reflection, Entrepreneurial Mindset)?
- To what extent do their characteristics align with the Designing for Sustained Adoption Assessment Instrument?

Interviews with guild leaders were conducted to collect data to answer these questions, and the data is being analyzed using deductive, provisional coding, as described below.

Study Design

The purpose of the interviews is to understand the intention of the leaders in the creation and execution of their organization. Semi-structured interviews were conducted with the leaders of each guild. The interviews included four phases. The opening questions asked guild leaders to describe the pedagogical innovation that is at the core of their guild and the history of the development of that innovation and the guild itself. These questions sought to better understand the innovation from the guild leaders' perspectives. The second and third phases of the interviews were aligned with the DSAAI [9] and focused on the ideal implementation of the innovation and what mechanisms were used to propagate the innovation, respectively. Follow-up questions for both the second and third phase were about resources used by the adopting faculty/instructors, approaches for supporting widespread adoption, and barriers to implementation. The final phase included a question the future role of the guild in engineering education.

Interview Data Analysis

Upon completion, the interviews were transcribed by a third party. These transcribed interviews are being qualitatively coded using deductive provisional coding [9] with the DSAAI informing the codes [8]. Thematic analysis will also be used to capture emerging themes that arise from the interviews [9].

Project Status and Future Work

Interviews with guild leaders were conducted in Fall 2020 over Zoom. Qualitative analysis of these interviews is ongoing. Early results suggest that providing potential adopters with funding to tailor the pedagogical innovation to their context could be an important tool in propagating the innovation, however this is a feature that is not captured in the DSAAI.

Other aspects of this work aim to understand the extent of the pedagogical innovations' adoption and the resource networks that faculty use when they make changes to their pedagogical approach. This understanding will come from surveys that first targeted individuals who have had primary exposure to the pedagogies and educational innovations championed by each guild of interest. As part of the survey to primary participants, we asked for the contact information of connections with whom they had shared or discussed the innovation of interest and the survey was then sent to those individuals, who were also asked to share contact information of those they may have shared the innovation with. With this data, we will be able to estimate how far from the primary participants the innovation propagated. We will also use the information about which resources adopters used to support their implementation to construct resource networks, which will serve to inform guild leaders about the resources that best support adoption.

Human Subjects Approval

This work was conducted under Rowan University IRB approval, study number PRO-2020-61.

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