

Work in Progress: Creating a "Mechanical Engineering Teaching Community of Practice" for faculty learning and sharing pedagogical changes and innovation

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Abstract—In this work in progress we explain the development of a process or changing the teaching culture at the department of mechanical engineering of Texas A&M. The Strategy is based on addressing (a) development of reflective teachers (b) developing shared vision (c) considering policy and (d) faculty initiated curricular innovations. Teachers were trained in lean startup (incremental innovation) approaches to educational innovation. A community of practice was developed to build trust, share learning from innovations and to develop accountability. A systematic approach is being developed to evaluate the efficacy of this change strategy especially with engaging late adopters and sceptics. Preliminary results indicate that that creating and nurturing a teaching community of practice (a part of a comprehensive change strategy) is very effective in promoting a culture of innovation in teaching.

Keywords—incremental innovation, community of practice, Prochaska model, teaching innovation in mechanical engineering

I. INTRODUCTION

This Work-in-Progress paper presents the ongoing efforts of the Revolutionizing Engineering and Computer Science Departments (IUSE/PFE: RED) grant team in creating a 'Mechanical Engineering Teaching Community of Practice' (METCP). Over the past two years, the primary goal of our RED project is to transform the teaching culture of the Department of Mechanical Engineering at Texas A&M University (TAMU) from independent and isolated individuals to a collaborative and bottom-up structure, where faculty form small groups to implement pedagogical changes and innovations with reduced effort and risk. The creation of the METCP serves as an initiative to establish a learnable, sharable, and visible community that streamlines the process of faculty-driven pedagogical

improvements. The METCP has facilitated faculty learning and the sharing of pedagogical changes and innovations.

Our approach draws inspiration from the Prochaska theory of behavioral change ([1, 2]). This theory provides insights into the varying engagement levels of community of practice members within the department. We have adopted an iterative Build-Test-Learn-Share-Modify (B-T-L-S-M) model, incorporating the core concepts of the maker culture [3] and Lean Startup approach [4]. The key aspect of this model is to assist faculty in organizing themselves into communities of practice, which involve the following stages: (1) deriving inspiration from shared artifacts/ideas, (2) openly sharing and learning about the technology and processes employed to create these artifacts/ideas, (3) designing and prototyping modified versions of the shared artifacts/ideas, and (4) sharing the modified artifacts/ideas back with the community [4].

Over the course of the last two years (academic years 2021-2023), monthly 'Teaching Community of Practice' (TCP) meetings were conducted, bringing together all participants. These meetings served as platforms for teaching innovation teams to provide updates on their learning cycles, discuss challenges faced, seek advice for their projects, and commit to activities for the following month. To evaluate the changes in the departmental teaching culture, we have developed a four-quadrant change model [5] that measures the prescriptiveness and individualistic nature of the changes. Additionally, a survey questionnaire consisting of leading questions has been created and will be distributed to faculty members who participated in the TCP at the end of April. In this Work-in-Progress paper, we will delve into the B-T-L-S-M model, sustained community

engagement, and the survey results regarding the changes in the departmental teaching culture.

Ultimately, our objective is to institutionalize this community and establish an Education Development Committee (EDC) subcommittee called the "Teaching Community of Practice" (TCP). This will ensure that this collaborative model continues to foster teaching innovation even after the conclusion of the RED project. Furthermore, we aspire to expand the TCP to encompass the entire College of Engineering and potentially extend it to the university level. Our preliminary analysis indicates that creating and nurturing a teaching community of practice (a part of a comprehensive change strategy) is very effective in promoting a culture of innovation in teaching.

II. THEORETICAL FRAMEWORKS

As described by Henderson et al, the RED team considered the envisaged change to be along four axes (see fig. 1 below) with the x axis representing increasingly grass-roots efforts from left to right and the y axis being increasingly focused on individual efforts as we go from bottom to top. The key to the success of our RED project was dependent on ensuring that all aspects of the four quadrants were addressed in a balanced manner since they complement each other. In this paper, we describe our change strategy for category (B) development of reflective teachers and (C) development of shared vision and accountability.

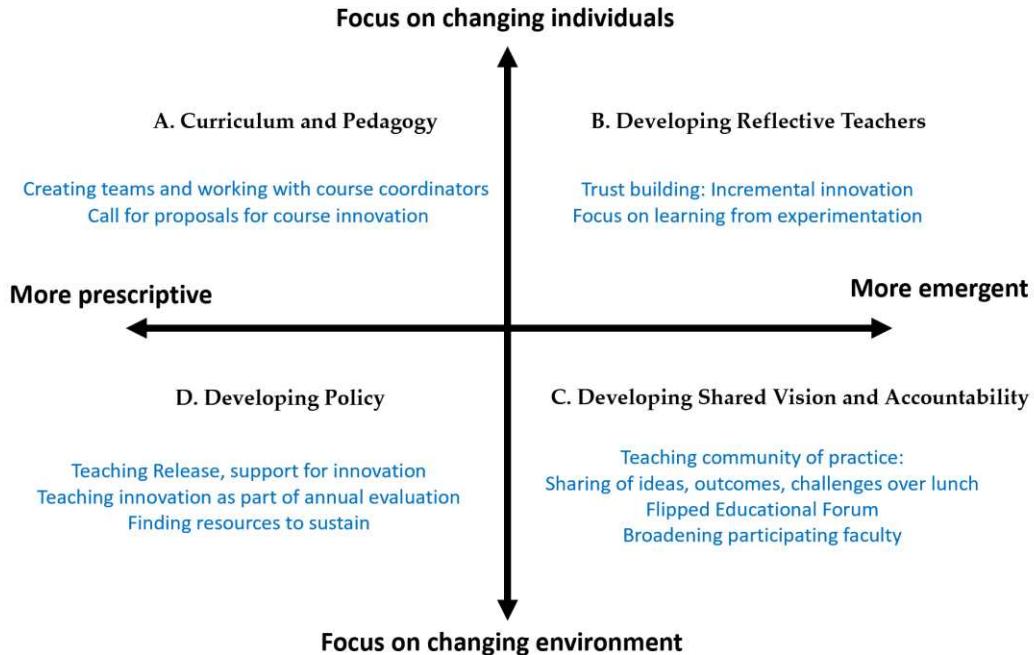


Fig. 1. Four categories of change strategies [5]

In each category (going clockwise from top left to bottom left we summarize the changes that the RED team has implemented:

A. Curriculum and Pedagogy

The team realized that curriculum and pedagogy was a matter faculty teams felt strongly about and is on the more individual aspects. The team therefore chose to provide the faculty with full control and simply requested them to propose whatever change they would like to make in the courses that they teach rather than a prescriptive route. In other words, the faculty were informed early on that the RED teams will support faculty learning, not necessarily specific outcomes. It is the faculty's prerogative to focus on student outcomes.

B. Developing reflective teachers

The RED team developed workshops for faculty to learn how to apply the Lean Startup incremental innovation approach

to educational outcomes. The aim was to focus the faculty on (a) focus on measurable student outcomes (b) identifying a minimum viable intervention or experiment to try (c) The Build-Test-Learn-Share-Modify cycle. The content of faculty development workshop and its performance can refer to our previous paper [6].

C. Developing shared vision and accountability

The RED team helped create a community of practice that meets every month. The role of the Teaching Community of Practice was to provide a low stakes space for sharing findings and challenges in a friendly and open environment and to build a sense of shared values, vision and accountability to each other rather than to the RED team. A "unconference" type Antigua Forum [5, 7] was held each year to solicit ideas and participation from the entire faculty. It also provided a means for faculty to build connections and to percolate the innovative teaching ideas in an informal way.

D. Developing Policy

The RED team worked with the administration to align policy that supports and values teaching innovation and sharing. To this end, the department now supports the faculty teaching community by hosting a monthly lunch. Also, in recognition of the time needed to carry out these innovations, the leaders of the

innovation activities are provided with some teaching release as well as some student support. The annual evaluation now explicitly includes teaching innovation activities. Finally, faculty who plan to disseminate their findings by presenting in conferences are supported by providing funds for one trip to a professional conference of their choice every year.

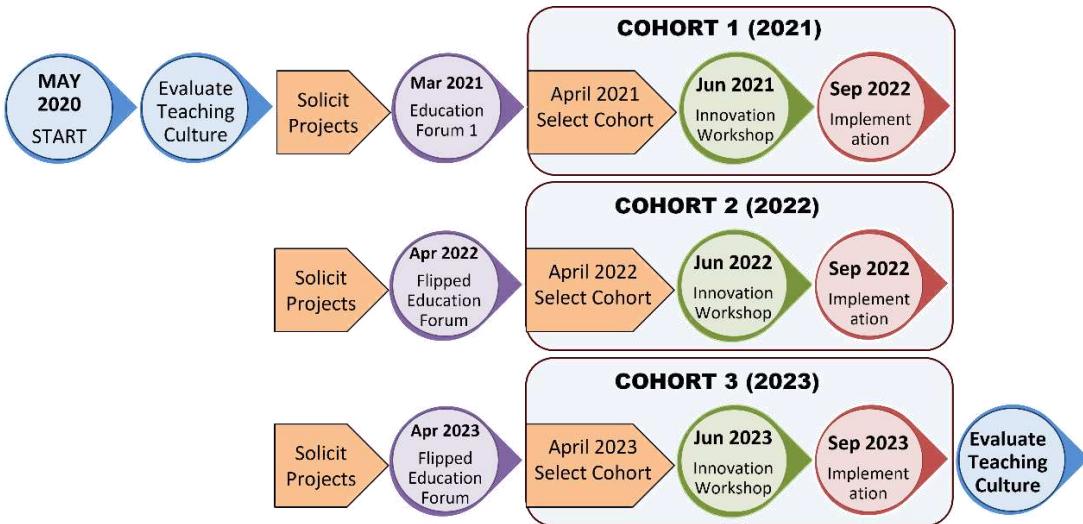


Fig. 2. Global scheme of the implementation process of RED project

III. IMPLEMENTATION

Based on the above strategy, the RED team requested cohorts of faculty to propose curricular changes in the spring semeste of each year (see fig. 2 above).

Based on the Prochaska model of behavioral change ([1, 2]) which is based on 6 categories of change: precontemplation, contemplation, preparation, action, maintenance, and relapse (see figure 3), the Red team realized that different groups of faculty are in different stages of this cycle. Thus, In the first year of the project (AY 2021-2022), the faculty who were already in the contemplation and preparation stages were selected and formed 4 teaching innovation teams for the Year 1 cohort. They formed the core group that created the Teaching Community of Practice. By inviting faculty who were in the precontemplation stage to the community of practice meetings and showcasing the approach, in the second year, as expected, many department members were moved from precontemplation to contemplation. Thus in Year 2 cohort, 5 teaching innovation teams were formed, and 30 of the 98 Mechanical Engineering (MEEN) faculty engaged in process. In the third cohort, currently underway, new faculty (many of whom have limited teaching experience) are being encouraged to learn from the others and try low-stakes teaching innovations with help and support from previous cohort members.



Fig. 3. Prochaska model's stages

During the **monthly meetings**, faculty are encouraged to present their teaching innovation implementation updates. All the faculty and TAs from relevant courses are invited to attend this meeting and lunch. A presentation template based on the process of the B-T-L-S-M model (see fig. 4) is provided by the RED committee including the following aspects:



Fig. 4. The iterative innovation and sharing culture that we seek to develop in the faculty and students [3]

- A. *What is the Absolute Greatest Goal (it should be in the form of measurable outcomes (from X to Y by when) and leading indicators of progress towards goal;*
- B. *Initial scoreboard (lag measure and leading measures);*
- C. *Learning cycle update:*
 - 1) *What are you trying to learn?*
 - 2) *What is your Minimum Viable Product?*
 - 3) *Experiment Status.*
 - 4) *Learning from No. # experiment.*
- D. *Additional information to share.*

Faculty are encouraged to evaluate their learning and modify the goal of their project, if necessary, based on what they learn. The encouragement to experiment, and the willingness to change their goal are two key elements that lower the stakes in making these changes. It is also a recognition that the faculty need to innovate continuously in their teaching (just as they do in their research). Thus, monthly meetings and discussions of the Teaching Community of Practice also served as a means not only for exchange of ideas but also moving faculty along the change cycle.

IV. EVALUATION AND FUTURE WORK

We are tracking the following measures of success for this effort are (1) how many faculty are taking part in the innovation process (2) evaluation of their innovation process on a 6 point scale (3) how engaged are they (how often do they share their innovations) in the teaching community (4) How many from the earlier cohorts are continuing to innovate beyond their initial efforts in the project (5) are they showing leadership in encouraging new faculty to join the group and sustain the effort.

Preliminary results:

- A. *Currently there are about 26 faculty who have undergone the process. A total of 8 projects are currently underway*
- B. *The faculty proposals were scored on six items (1) was the goal student outcome oriented or is it something that they wanted to do? How aligned was their proposed activity to their stated goals?*
- C. *Whether they have leading indicators (i.e., progress indicators indicating how well they were implementing their proposed activities) and lag measures (ways to evaluate whether they have met their goals)?*
- D. *Whether they have articulated any plan for tracking their lead and lag measures and making plans for modifications?*
- E. *How do they address inclusivity in their plan?*
- F. *Did they articulate the state change in the form of "From X to Y by When" so that the start and the end were clearly and measurably articulated?*
- G. *Are they taking an incremented/iterative approach or is it a big upheaval). On average, the faculty scores improved by 1-2 points on a five-point scale after the innovation process.*

We are currently tracking Items 3, 4 and 5 and will report on it when completed.

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