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# Faculty Autonomy in Teaching Development Groups

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# Faculty Autonomy in Teaching Development Groups: Analyzing Decision-making Using a Diffusion of Innovations Framework

A gap, or "valley of death," has been identified between research findings in engineering education and their implementation by instructors[1,2]. A variety of efforts have been made to bridge this valley and broaden the use of evidence-based practices in engineering classrooms. In the majority of cases, these efforts are focused on particular interventions, e.g. encouraging instructors to incorporate in-class group problem solving or to use a particular technology tool[3]. While the particular intervention may prove useful for some instructors and some courses, it is not always chosen with the needs or challenges of the instructor in mind. We argue that efforts to broaden use of innovative instructional techniques can be more successful when faculty have ownership of how change is implemented in their classes (rather than having strategies mandated). Higher education faculty members do have significant autonomy in their teaching, and we focus here on the factors that influence the pedagogical choices faculty make. In particular, there is value in structuring an instructional innovation such that instructors identify the need in their own classrooms and potential mechanisms to address that need. Within this structure, instructors retain autonomy in deciding which evidence-based practice(s) will address a need in their courses without requiring infeasible levels of change. In this paper, we consider a study in which instructors participated in ongoing faculty development through which they selected and implemented an evidence-based teaching innovation in their classrooms. We focus on the factors that influence the pedagogical choices faculty make when they are given an array of teaching strategies from which to choose. Our research question is: How can a diffusion of innovations framework be used to understand how instructors select, refine, and use evidence-based instructional practices?

## Background and Related Work

To study the characteristics common to innovations adopted by engineering instructors, we examine how Rogers' Diffusion of Innovations framework[4] can be used to characterize faculty autonomy in decision-making about their teaching, in particular, how faculty make choices from among a menu of options in adopting evidence-based pedagogical innovations. We selected Rogers' framework because of its focus on understanding why individuals make the decision of whether or not to adopt a particular innovation. The factors Rogers identified provide a method for understanding how individuals in a system may adopt innovations.

This study takes place in the context of a set of long-term faculty development groups. The groups follow the SIMPLE model for faculty development: **S**ustainable, focus on **I**ncremental change, include **M**entoring, be **P**eople-driven, and emphasize interactive **L**earning **E**nvironments[5–7]. Through these groups, engineering faculty meet regularly over the course of an academic year to learn about evidence-based instructional practices, identify innovations that serve a need in their classes, implement these innovations, and reflect on their effects. The innovations selected by the participating faculty and their reflections on choosing and using these innovations form the basis of this paper.

Rogers (p. 15-16)[4] stated that five factors influence the adoption of an innovation:

- Relative advantage refers to whether the innovation is an improvement over what is currently in use. In the context of pedagogical innovations, relative advantage characterizes the extent to which the innovation addresses the need identified by the instructor, assuming the need is not sufficiently met by the technique(s) currently in use. When instructors use challenges in their classroom as motivation to innovate, opportunity for improvement is clear to them.
- Compatibility with the pre-existing system includes the needs of the users and the ease of integration. To what extent can the instructor implement the pedagogical innovation within the existing structure of the course, program, and institution? When instructors identify their own problems, they select or adapt interventions that fit well within their course and minimize additional overhead.
- Complexity refers to the difficulty in learning or using the innovation. In education settings, what level of time and effort must the instructor invest to become sufficiently competent in implementing the proposed innovation?
- Trialability refers to the user's ability to apply (or test) the innovation in their own setting. Can the instructor conduct a "test run" of the innovation with a reasonable amount of time/effort and without a complete course overhaul?
- Observability refers to how visible or observable the results are to other people. How easily (and quickly) can the instructor, students, other faculty see the effects of the newly implemented innovation? Is there peer discussion of the new teaching strategy?

We will describe various innovations adopted by faculty participating in long-term faculty development groups and frame these innovations within the characteristics defined by Rogers' Diffusion of Innovations.

Factors affecting the dissemination and adoption of innovations in STEM pedagogy have been studied in a variety of contexts, often guided by Rogers' Diffusion of Innovations framework[4]. Other authors have researched how engineering education innovations propagate via a survey administered to nearly 100 engineering department chairs[8]. Using Rogers' framework, they focused on the *rate* of adoption of seven specific innovations, and their results point to department-level reasons for adopting or not adopting particular innovations. Henderson, Darcy, and Niewiadomska-Bugaj used a survey of physics faculty to examine the variables that correlate with faculty adoption of research-based practices, as well as the percentage of faculty who use or stop using innovative pedagogies at various stages of their adoption[9]. Hazen, Wu, and Sankar also studied factors that influence dissemination of new strategies and materials and identified several of the factors specified by Rogers[4] and listed above[10]. Using the four categories of change strategies previously established[3] as a framework, Henderson and Dancy addressed how innovations in STEM education can be more broadly disseminated and adopted[11]. Borrego and Henderson explored how eight change strategies, again framed within the same four categories[3], can be used in the context of reforming STEM education[12].

The studies described above differ in focus from the work we present here in that the existing studies focused on factors that influence department or faculty-level decisions about whether or not to use (or continue using) evidence-based innovations. In contrast, we consider instructors who have identified a need for pedagogical change in their courses, and we focus on the factors that influence individual instructors' decisions about which research-based strategies to adopt. We move beyond the question of whether instructors change their thinking generally to consider how they decide from among a menu of possible strategies. The model is one of differentiated faculty development; instructors may enter the pipeline at any point, i.e., they have varying levels of awareness of and experience with pedagogical innovations. Results of the existing work do support the use of the SIMPLE long-term faculty development model, however. Among the recommendations made in Borrego, Froyd, and Hall, for example, is that change should focus on faculty needs rather than on promoting a specific innovation[8]. The results in Henderson, Darcy, and Niewiadomska-Bugaj reveal that a large percentage of faculty try research-based innovations but later stop using them, implying that faculty development should focus on supporting long-term implementation[9]. Henderson and Darcy conclude that, rather than prescribing pedagogical reform, effective change must involve faculty as part of the reform process[11]. Finally, the long-term faculty development groups used in this study draw from the Scholarly Teaching and Faculty Learning Communities strategies (both of which fall within the category of Reflective Teachers) described by Borrego and Henderson[12].

## Methodology

The data used in this paper were collected as part of a three-year project studying long-term faculty development groups in engineering. The purpose of the groups was to broaden the use of evidence-based teaching practices in engineering courses. In particular, the project was focused on broadening the use of interactive teaching and formative assessment. Most of the instructors were interested in finding ways to engage students during class and learn more about students' learning process. Each group was led by a facilitator who was a faculty member with a history of innovative teaching using evidence-based pedagogical practices. Groups of 4 to 8 engineering instructors were formed at four geographically disparate institutions. Nearly all participants in the long-term faculty development groups were engineering instructors, though there was also a physics instructor. Each group met on a regular basis (anywhere from weekly to monthly) over the course of an academic year, sometimes longer.

The structure of the groups included readings about teaching and learning, and each participant committed to trying a new teaching strategy in his/her class(es). Through meetings and discussion, participants learned about various evidence-based techniques that could be implemented in their courses. Learning about such practices was scaffolded by texts or videos on the topic[13–15]. Each instructor identified a need (or needs) in his/her course(s) and selected an intervention to address that need. Participants implemented the chosen interventions and used the development group meetings as a forum for sharing their experiences and soliciting support and feedback. Group meetings also served as a form of accountability, as it was expected that each member was implementing a new pedagogical technique. Based on initial results and feedback from other participants, instructors modified and refined their implementation of chosen techniques.

Meeting notes from group leader meetings and survey data were collected to study participants' experiences and the evolution of the groups. The work presented here focuses on the survey data, which was collected from group participants (not facilitators) at the end of the study. Of the 17 participants, 8 responded to the online survey. There was at least one survey response from each of the four institutions involved. The open-ended questions that specifically addressed participants' choice of teaching innovation and experience in implementing the new strategy were:

- What strategy did you try in your class?
- Why did you select this strategy?
- What did you learn from this strategy?

To code the survey responses using the diffusion of innovations framework, each response was reviewed for aspects of the framework. A table was constructed to classify which elements of each response matched an aspect of the framework in a theoretical coding process[16] that began with the factors identified in the diffusion of innovation framework. We arrived at the diffusions of innovations framework after an organizational coding process that looked for the types of strategies participants were using and their reasons for selecting particular teaching strategies to try[16]. We followed with a content analysis[17] and the theoretical coding[16] looking for comments in the surveys that reflected the qualities of the diffusion of innovations framework.

**Results**

| Pedagogical Innovation Type | Number of Adopters |
|---|---|
| Muddy point/feedback cards | 2 |
| Interactive questions/hands-on activities<br>In-Class Problems<br>iClicker Questions<br>Hands-on Activities | 5 |
| Flipped Classroom | 1 |

Table 1: Pedagogical Innovations Adopted by Study Participants

The innovations selected by the faculty who responded to the survey can be grouped into three general types: muddy point/feedback cards, interactive questions/activities, and flipped classrooms, as summarized in Table 1. Within the general area of interactive questions/activities were group conceptual questions, student response system (iClickers), and hands-on or data-driven problems. In the following, participant survey responses are used to frame each of these types of strategies within the characteristics of Rogers' Diffusion of Innovations.

*Muddiest Point/Feedback Cards*

Two respondents implemented muddiest point/feedback cards in their courses. In this strategy, students are asked at the end of each class period to submit on a notecard the "muddiest" (or most unclear) point in the day's lecture, as well as any questions they have. The cards are typically anonymous and give students a chance to voice concerns about unclear material, as well as instructors a chance to receive near-immediate feedback on how well students are absorbing the course material. Instructors who chose the muddiest point card strategy identified two needs that were addressed by the cards: giving everyone in the class a voice ("I had the feeling of a pretty silent class, where a lot of students would be too shy to ask questions, as the classroom was dominated by few students of the more vocal type"), and providing continual feedback to the instructor ("I particularly wanted to gauge what students were (and weren't) getting out of a particular set of extended classroom exercises I was having them do.") Muddiest point cards, by their nature, are easy to integrate into a traditional course, as they require no specialized technology and are implemented in the last few minutes of the course period without interfering with other aspects of the course. Similarly, the cards require no special training for the instructor and are reasonable to collect and review for a small-to-medium sized course. (An electronic or sampled approach might be necessary to meet instructor time constraints in a very large lecture course.) Trialability is also inherent for feedback cards; they can be implemented in just a few lectures or throughout a semester-long course. There is little to no risk and no requirement for additional infrastructure beyond the cards themselves. Finally, the results are immediately observable in the form of class-wide (not just the most vocal students) feedback about what students do and do not understand. Modification to teaching to address muddy points can happen as quickly as the next class period. From a diffusion perspective, their complexity is low and they are highly compatible with existing practices. This probably accounts for their popularity as an initial choice for instructors attempting a small, accessible change to their teaching.

*Interactive In-Class Activities*

Another two survey respondents implemented interactive in-class problems in their courses. In this technique, students are asked to work in groups to solve problems related to the material covered in a particular class period. Depending upon the nature of the material and the goals of the instructor, these interactive problems may be procedural in nature (methods for solving a certain type of problem) or they may ask students to think conceptually about the topic at hand. Both instructors saw the primary relative advantage (compared to traditional lecture) of this strategy as helping students remain engaged: "Student attention span is less than 25 minutes, a well documented fact. The refocusing activities interrupt the monotony of pure lecturing and inject some energy and diversion into the class discussion." Increasing the frequency of feedback was also seen as an advantage: "It is easier for students when you divide your lecture into mini lectures. You can get immediate feedback from students while you are walking around in the class watching them solve the in-class problems." While in-class problems require somewhat more restructuring of a traditional lecture than do muddy point cards, the interactive problems are compatible with the course as long as instructors are willing to structure their lecture in mini-lectures, a change these instructors were willing to make. The main complexity inherent in learning and implementing the technique is in developing in-class problems with the desired length, difficulty, focus, amenability to group work, etc. The technique clearly exhibits trialability, as in-class problems can be incorporated incrementally with feedback from first efforts used to inform revisions and development of additional in-class problems. Results of implementing in-class problems are truly immediately observable, as instructors can watch students engage with the material in real-time and identify any challenges or misconceptions to be addressed within the same class period.

One participant incorporated the iClicker student response system into class sessions. The instructor had been teaching in a traditional style (lecture accompanied by a set of slides) with students primarily listening to the lecture during class. The instructor viewed iClickers as a mechanism to improve student engagement in the course: "It encourages the students to pay better attention to the lecture materials, it forces them to think about what is being presented, and, to a certain extent, makes the learning environment more interesting and enjoyable." Like many of the other participating instructors, more immediate feedback (to both the instructor and the students) was seen as a relative advantage of the chosen innovation: "It…provides immediate feedback about what the students do and do not understand, and holds the students accountable for class attendance and participation." Student response systems were compatible with this instructor's current course structure in multiple ways. First, examples that were in the existing lecture slides could be converted easily to problems for which students could submit solutions via iClicker. (iClicker software is designed to interface with Powerpoint, making this process particularly smooth.) Second, using a student response system allowed the instructor to quickly collect responses from students in a relatively large course and adjust teaching based on aggregate results. Incorporating iClicker or a similar student response system does require slightly more change to infrastructure than the techniques discussed previously (students must purchase devices, the instructor must be familiar with software), but the instructor lessened the learning curve somewhat by selecting a student response system that was already in use in other courses at the same institution. Like in-class problems, student response systems provide real-time observability, as instructors are immediately able to identify students' misconceptions, as well as observe improved engagement and attendance.

Two instructors adopted interactive classroom innovations focused on solving hands-on problems and engaging with real datasets in class. These instructors were motivated to employ these strategies to improve student engagement in the classroom and to introduce new opportunities for formative assessment. In one case, the purpose of the course was to help students understand the different types of engineering, making hands-on engagement in activities representative of various types of engineering highly compatible with the course. The instructor who incorporated real datasets was already using in-class problems and simply modified them to include real data; hence, there was only a step in complexity rather than a leap. Both instructors were able to trial the strategies in their classroom in an incremental manner, introducing a new problem or two and analyzing the results of the implementation before going forward. In addition to real-time observations of students' engagement with data and hands-on activities in class ("Students were very engaged and prefer to "do things" rather than to attend a lecture/presentation"), these instructors also noted longer-term changes: "I found that the students were more engaged and also performed better on summative assessments."

*Flipped Classroom*

Finally, the flipped classroom model was adopted by one participating instructor who was motivated to give students more time in class to engage in problems. The instructor saw this as an advantage over the passive lecture model used in prior implementations of the course. While a flipped classroom is a drastic change from the traditional lecture model and creating off-line versions of lectures represents a large requirement in terms of the development of infrastructure, the complexity of the innovation was not as large for this instructor who had previously taught an online version of the course. "I had already taught distance education courses before so I wanted to use my recordings in trying out this approach." With recorded lectures in place, the effort required to make the leap to a flipped classroom was greatly reduced. In fact, having recordings ready to go made the flipped approach easily trialable, as the instructor could choose to have the students view a particular video lecture in preparation to engage in problem solving during the class period. At least some effects of the flipped classroom were immediately observable through watching students engage in problem solving. The instructor did note that the trial revealed certain challenges to the flipped classroom approach: “Students need to be motivated in some way to view the recordings before coming to class. They need to be made aware of the larger amount of time they will need to spend outside of the classroom.” The ongoing nature of the faculty development structure used in the study gave the instructor an opportunity to discuss these challenges with fellow participants and revise implementation as needed.

| | Muddy Point Cards | Hands-on/In-Class Problems and iClickers | Flipped Classroom |
|---|---|---|---|
| Relative Advantage (Degree to which the new strategy is more interactive) | Low | Medium | High |
| Compatibility | High | Medium | Low |
| Complexity | Low | Medium | High |
| Trialability | Easy | Moderate | Challenging |
| Observed effects | Almost immediate | Class to class | Long-term |

Table 2: Interactive Teaching Strategies and the Diffusions of Innovations Framework

Table 2 provides a summary of how the three general types of evidence-based practices adopted by participating instructors can be characterized in terms of the five factors identified by Rogers[4]. The three approaches can be viewed as points on a continuum of engagement/risk, ranging from simple, low risk, and low impact to complex, risky, and potentially transformative. Instructors who were new to interactive approaches in the classroom tended to adopt low-risk innovations (muddy point cards), while those with more experience were willing to implement more disruptive techniques (hands-on activities, flipped classroom). We have interpreted relative advantage in this case to be how much more interaction the strategy is providing for the instructor and students. If interactive teaching is more advantageous than pure lecture, how much of that advantage is being taken up with the method? In the case of muddy point cards, this is low since they are only a small increase in interaction over lecturing. Flipped classroom models are high because they are moving toward high levels of student interaction during class time. We are proposing that innovations be categorized not in terms of their likelihood of adoption but rather in terms of the characteristics that make them appealing to certain instructors and under varied conditions. As can be seen, all three approaches were used by some faculty in our study and are growing in interest and use. However, more investigation is needed about how faculty make decisions about what practices to adopt.

## Discussion and Conclusions

The faculty survey results pointed to the participants finding value in their chosen changes in their courses. Every instructor who responded to the survey defined a clear need (or motivation) in their class that would be met by the chosen innovation. Several respondents also detailed how they were able to observe the changes that occurred as a result of implementing the new pedagogical strategies. While the innovations selected by the faculty participants varied greatly in overall complexity, the incremental effort and learning curve for each individual instructor remained reasonable. This points to the importance of framing pedagogical innovation as something that can be tackled in small steps, realizing that a series of small steps leads to significant change over time.

One potential concern in broadening the adoption of evidence-based practices is how to address external challenges that impact widespread adoption of pedagogical innovations (e.g. large programs in which each course is taught by several instructors, either rotating or in parallel sections). The participants in our study were teaching in small to medium-sized programs and were focused on mid-level (sophomore and junior) courses. Hence, they were the instructor for the particular course in most, if not all, offerings over time. However, a unique element of the faculty development model we use is that instructors created design memos that document the process of implementing new strategies in their courses. In the memos, instructors described the innovation they chose, why they chose it, how they implemented, assessed, and revised it, lessons learned, and suggestions for future improvement. These artifacts can be shared with other instructors teaching the same or similar courses to ease the time investment required to make pedagogical change. In the most recent set of faculty development groups, we have seen examples of such sharing among multiple instructors of a general education astronomy course. Both sharing of instructional resources (design memos and assignments/activities in this context) and availability of ongoing support and accountability through faculty development groups provide mechanisms to increase knowledge of research-proven pedagogical innovations and improve persistence in continued adoption of pedagogical change.

The long-term faculty development groups have provided a setting that is rich in conversation about evidence-based instruction and allows faculty to select from a menu of options when identifying pedagogical innovations to meet the needs in their classrooms. We have recently expanded from our original study to a larger number of groups spanning various STEM fields at our university. In this expansion, leaders have the freedom to recruit participants in a targeted fashion, providing a second level of autonomy in the faculty development process. A study of these groups is ongoing and will provide additional insight into how and why instructors select and implement particular innovations as they work to enhance their classroom teaching.

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