WIP: Faculty Perceptions of Change Efforts in Department-Based Teaching Reform

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Introduction

This work-in-progress paper studies the perceptions of physics faculty as they engage in departmental efforts to transform teaching in highly enrolled gateway courses. While the benefits of evidence-based teaching practices for student learning, engagement, and persistence are well documented (Freeman et al., 2014), adoption of such practices in STEM courses is slow (Stains, et al., 2018). This paper documents departmental efforts to overcome the slow adoption of active learning. In doing so, it describes an investigation of how physics faculty perceive the purpose and value of active learning, specifically adopting a student-centered tutorial model for recitations.

This study is part of a larger project that uses department-based communities of transformation to effect change in the teaching of gateway courses and to develop a departmental (and university) culture that values evidence-based teaching practices. Specifically, the NSF-funded project aims to make active learning (AL) the default method of instruction in early STEM courses across the institution. The project builds on existing work on grassroots change in higher education (Kezar and Lester, 2011) to study the effect of communities of practice on changing teaching culture. Within departments, the project leadership has created course-based communities of practice that include instructors for the targeted courses, as well as other department faculty interested in broadening adoption of evidence-based teaching practices.

The Physics and Astronomy Department at the R-1 institution at which this study takes place began engaging in change efforts in Fall 2019. The department's efforts target the first two semesters of calculus-based physics: (1) Mechanics and (2) Electricity and Magnetism. One or two large enrollment (100-250+) sections of each course are typically taught each semester. Each section includes 3 hours of lecture and a 1 hour, ~25 student, recitation class each week. With the pandemic pivot, both lectures and recitations were moved online. Starting in Fall 2021, some of the lectures and recitations returned to in person formats while some remained online.

This project has focused on transforming the recitation sections from an instructor solving problems at the board to a more active format in which students work together to solve problems and discuss their results. Tutorials developed by faculty at the institution have provided the foundational materials to be used by students as they engage in this problem solving.

Methods

As part of the effort to study teaching culture change in the department, physics faculty who have been teaching the targeted introductory courses and/or participating in the discussions described above are invited by email to participate in interviews on a roughly yearly basis. Nine faculty members have been interviewed this year (2022). In these semi-structured interviews in January 2022, faculty were asked to describe how they structure lectures and recitations and if/how they use active learning strategies in their teaching. Among other questions, interviewees were asked 1) how they defined active learning, 2) their thoughts on the purpose and value of

active learning, 3) if and how their teaching of recitations has changed over time, 4) if and how they used tutorials in their recitations over the past few semesters, and 5) challenges and benefits they observed in implementing the tutorials. An open coding scheme (Saldaña, 2021) was used to identify themes in interviewees' perceptions of active learning, challenges faced in implementing tutorials, and methods to address those challenges.

The results in this paper consider the data collected in three of those interviews. These three interviews were chosen for initial analysis because they are representative of the relevant roles (tenured, contract, and adjunct faculty) and of a variety of perspectives on active learning and approaches to integrating tutorials in recitations.

Results

Perceptions and Use of Active Learning

The three instructors considered for this paper were all engaging in some active learning practices in their lectures and recitations before the department-led movement to use tutorials. That said, their individual definitions of active learning (AL definition), the types of active learning in which they engaged (AL usage), and their identification as users of active learning practices (AL identity) varied between instructors and were not always consistent for an individual instructor. In spite of instructors' previous use of AL, the department endeavored to create greater coherence in approaches to AL and student experience.

Two of the instructors (I1 and I2) defined active learning as dependent on what the student was doing, not the instructor, indicating that active learning could happen in any course format. As one of these instructors (I1) noted, "active learning is a state of mind." The third instructor (I3) spoke more to the idea of getting feedback from students and understanding where they are with the material, "I cannot imagine teaching, for example, Newton's laws, without getting continuous active feedback from my students…You build upon where they are."

The usage of active learning techniques across the three instructors was quite different, but also differed for individual instructors depending on teaching modality. When I1 teaches in an active learning classroom there are no lectures, they "just give some introduction, give some summaries and then students start to solve the problems that they display on the whiteboards in groups." In contrast, in the more traditional course format I1 moved away from having students solve tutorial problems during the recitation to showing them how to solve the problems. On the other hand, I2 talks about their practice evolving from only solving problems at the board towards a hybrid model that includes putting students into groups to solve them. I3 also uses group problem solving, but assigns students tasks and has them report their results and notes "I like for them to argue their point of view."

When asked if and how their perception and use of AL has changed over time, instructors described how their AL identity had developed. I1 noted that they engaged in student-led problem-solving sessions during their own studies and hence had always seen the value in AL. I3 described themselves as a physics education "guinea pig" as their mentor had been a physics education pioneer and they "grew up … surrounded by this movement." I2 expressed the most

ambivalence that AL resulted in improved student learning even though they had been implementing AL in recitations since nearly the beginning of their teaching career.

When asked about the value of AL in general, and specifically group problem solving in recitation, instructors all identified the development of student's physics understanding as a benefit. I3 noted the importance of students talking about material as a way of making sense of it. I1 cited the value of AL for helping students develop lasting knowledge that won't "evaporate" when they leave the class, and I2 viewed group problem-solving as a way to help undergraduate students gain experience solving problems, increase their independent problem-solving skills, and increase student engagement.

Implementation of Tutorials: Approaches and Challenges

As noted above, tutorials have provided a basis for the change effort underway in intro physics recitations. By providing materials that could be used to facilitate active learning and particularly group problem-solving, change agents aimed to smooth the path for instructors to use this pedagogical practice rather than solving problems for the students at the board. Because tutorial writing was still in progress when classes moved online in Spring 2020, the materials shifted toward more comprehensive coverage (to support asynchronous learning) than was initially intended.

As part of the interviews, instructors were asked if and/how they used the newly designed tutorials in their recitations and what they perceived to be the challenges and benefits of using them. All three instructors reported using the tutorials, though all in slightly different ways. When asked why they chose to use tutorials, they responded either that they had been explicitly asked to do so or that they had inferred that tutorial use in recitation was a departmental norm. All were open to trying new approaches if those approaches could be beneficial to students.

One challenge raised by all three instructors was that the tutorials were much too long to cover in a single 50-minute recitation period. Instructors remarked that when students were asked to solve the tutorial problems in groups the recitation period provided time to solve roughly two problems, about half the number that could be solved by an instructor at the board. Most of the tutorials included at least four problems. Hence, a student-centered implementation of the tutorials required that not all material be covered during the recitation section. Rather than viewing this as a shortcoming of the tutorials, instructors largely identified the amount of recitation time as an issue, noting that students needed to cover all material in recitation that they were expected to know for an exam. Since lengthening recitations was not an option, however, instructors needed to adjust tutorial implementation to address the misalignment between tutorial length and class length.

The instructors we consider in this paper took different approaches to fit the long tutorials in a short recitation period. I1, concerned that "giving students less" would require the undesirable effect of reducing the level of exams, reverted to a more instructor-centered approach in which they set up and solved problems on the board to increase the material covered. I2 noted that "they found those tutorials very useful to continue learning," but time constraints meant that

problems needed to be prioritized. They suggested that identifying learning outcome(s) would allow instructors to select problems according to the outcomes they aimed to prioritize and would make the adoption of these materials easier for new instructors. However, they did not engage in identifying the learning outcomes of the tutorials to meet this goal. I3, by contrast, noted that problems not solved in class provided additional practice for students outside of class. While they saw the same issue with length as the others, they saw less of an issue managing the problem and indicated that they made the tradeoff for depth rather than breadth of coverage.

The differing responses to the same challenge seem to relate to the instructors' differing views of the nature and value of active learning. The instructors who saw active learning as useful but also as something possible in any course format were less likely to make use of group work when it meant that they were unable to complete the desired tasks. For the instructor who saw engagement in discussions and group problem solving as an important component to deepening knowledge and understanding, the inability to complete the materials did not make them change format, but instead had them look for alternate uses for the material. In the work going forward we will explore these themes with other instructors and monitor how these approaches change with time and with the revision of the materials.

Limitations

Results presented here are drawn from an initial analysis of three interviews. Continuing analysis will involve a larger set of interviews within the department. Additionally, the data are drawn from a single department within a single institution. Additional findings from other departments, institutions, institutional types, locations, and with larger participant samples would improve generalizability.

Discussion and Next Steps

The implementation of tutorials has provided a concrete way for recitation (and lecture) instructors to think about their goals for recitation and how recitation structure and content can best support those goals. Evaluating and revising the tutorial model now forms the backbone of a discussion amongst instructors that, ideally, will result in a shared set of prioritized student learning outcomes and materials to support the development of those outcomes.

The misalignment of tutorial and recitation length provided an opportunity to observe how instructors approached solving instructional challenges that arise in the change process. The three instructors considered here provided examples of reverting to traditional methods, suggesting change (learning outcomes) but not initiating them, and leveraging uncovered material for independent work.

Looking beyond this paper, continued interviews will provide longitudinal data that allow us to characterize the paths instructors follow as they transition (or not) to AL approaches designed and implemented in collaboration with other faculty. Longitudinal data will also allow us to further study if and how instructors engage in intentional action (Hauk et al., 2021), as well as exploring the importance of students' in-class social interactions in instructors' decisions about class format and their readiness for change.

Acknowledgement

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