Experiences of New Faculty Implementing Research-Based Instructional Strategies

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Abstract. As part of an ongoing study to better understand and improve the diffusion of research-based pedagogies, we are following 15 faculty for 5 semesters after attending the Physics and Astronomy New Faculty Workshop. In this paper we report on the experiences of these faculty the first semester after the workshop. Faculty were interviewed both before and after the semester. Instructional artifacts and course outcome data were also collected. We discuss how the New Faculty Workshop experience impacted these faculty, the concerns and challenges the faculty encountered and how these faculty report spending their time. Implications for the diffusion of innovations are discussed.

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INTRODUCTION

While a great deal of effort in the Physics Education Research (PER) community has gone to developing and disseminating research-based practices, less effort has gone into understanding how typical, non-PER, faculty come to know about and use these products. Available evidence indicates that the uptake of research-based strategies is somewhat limited and that when faculty do attempt to implement a strategy they often modify the strategy in ways that are less consistent with what research suggests is ideal for student learning. We are engaged in an on-going project [1] to better document and understand the change process in order to develop a research-based model of educational transformation.

In this paper we report on the first semester of a three-year project in which we are following 15 faculty who participated in the Physics and Astronomy New Faculty Workshop (NFW) [2] in the summer of 2010.

METHODS

Participants: NFW attendees who indicated in a post-workshop survey that they were highly interested in implementing ideas from the workshop and would be regularly teaching an introductory course over the next five semester where asked to participate in the study (and were offered a $500/semester honorarium), resulting in fifteen study participants. The sample was designed to be diverse in both type of institution and gender. Additionally, our sample was selected in order to find faculty for whom personal and structural barriers were minimized: they have at least some institutional support for innovation (home institutions were required to provide travel support to the workshop), they have personal characteristics that make them likely innovators (they spent their own time attending the workshop, indicated a strong interest in implementing innovative techniques in the survey and are all new faculty in the process of developing their teaching style), they have knowledge of innovation and resources (they attended the NFW), and finally they have ongoing encouragement (it is expected that participation in this study, where they are regularly asked to reflect on their teaching regarding innovation and are paid for their continuing participation, is likely to encourage continuing change efforts). In short these faculty represent the "best-case scenario" for faculty change. Many of the often cited barriers to change are not present for these faculty – therefore any difficulties these faculty encounter are likely to be reflective of substantial barriers for the larger population of physics faculty.

Data Collected: Interviews lasting approximately one hour were conducted with the participants both before and after semesters in which they were teaching an introductory course. Interview questions spanned many topics including: previous teaching experiences, future plans, perceptions of the NFW and PER in general, beliefs about teaching, and departmental structures. Both authors participated in conducting the interviews. The interviews were audio recorded and

transcribed for analysis. Additionally, a number of teaching artifacts were collected: concept exam scores, student evaluation results, sample lecture notes, sample HW assignments, sample exams and syllabi. Periodic web-based short surveys were also administered during the semester to collect data on how participants were spending their time and real-time reflections on what they were doing in their course.

Analysis: Findings presented in this paper are based on an analysis of the first two interviews of each participant (pre and post their first teaching semester following the NFW). A spreadsheet was developed with topics of interest and organized so that participant responses to each topic could easily be seen over time and compared with other participants. Teaching artifacts were used to corroborate the participants self report of their instruction. Survey results were also tabulated and are reported in the following sections.

RESULTS

What instructional changes did faculty make after the NFW?

All of the participants reported that their attendance at the NFW was a positive experience. It is also encouraging to note that most of the participants were aware of and used at least one research-based innovation prior to the NFW (only four reported using none). However, their implementations were often with low fidelity to what might be suggested in the research literature. For example, eight participants reported using something similar to Peer Instruction (PI) but none of the participants implemented PI in the way suggested by Mazur.

All but one of the participants reported making research-based changes to their instruction as a result of the NFW. The one who did not was at an institution that had already converted to studio style instruction; hence his/her teaching was already strongly research-based. Among the other participants, the most common modification was to either start using PI or to modify their use of PI to be more consistent with Mazur's suggestions (nine participants). Another six participants starting using or refined their use of Just-In-Time-Teaching. Interactive Lecture Demonstrations also appear to have been influential, with four participants either using them directly or incorporating predictions into their use of standard demonstrations. Other changes made by a smaller number of participants included: integration of simulations, addition of group problem solving sessions, use of some tutorials, and simply trying to lecture less in lieu of more interactive activities in general.

What hindered reform efforts?

The participants expressed a number of concerns about their teaching efforts and identified difficulties encountered. Those mentioned by more than one participant are listed in Table 1 below. It should be noted that we did not ask about a specific set of difficulties, but rather categorized those difficulties that were mentioned. Therefore, a lack of mention by a particular participant does not indicate a lack of experience with that difficulty.

TABLE 1 – Expressed Difficulties

Difficulty	N
Not feeling implementation was going well.	**6**
Quotation: *"What didn't work too well was the sharing part of the flashcards. …One of the biggest issues, and I still haven't quite figured out how I want to handle it is that the class was clumped …so this whole idea of quickly having them turn to a neighbor [didn't] work because all of their neighbors had the same answer."*	
Students responding unfavorably to innovation.	**5**
Quotation: *"Some of the students initially were somewhat alarmed by the new teaching technique [and complained to other faculty] … it definitely felt like there was some hesitation both from students and from other members of the faculty."*	
Difficulty finding resources / need to develop own material increases preparation time.	**4**
Quotation: *"I ended up I think wasting up a lot of time making up my own questions and, you know, I'm not doing a good job about it because it's difficult."*	
Concerns about content coverage due to time spent in activities.	**3**
Quotation: *"The other issue is, I need to reduce the amount of material to make up for the loss of lecture time. So that's another significant change in how the course is to be structured."*	
Desire to be more interactive in general but unsure how to accomplish effectively.	**2**
Quotation: *"I wanted to make it (class) more interactive … I think the change may be to difficult to implement."*	

What supported reform efforts?

The participants reported a number of things that helped them to implement research-based teaching. In addition to the NFW, which they all found to be helpful, there were two structures that came up as being highly supportive. They are discussed below.

Local Colleagues – An overwhelming majority of participants (n=11) reported that they were encouraged and supported by local colleagues who were already using some aspect(s) of a research-based innovation or

who encouraged them to be more innovative. While our participants' colleagues were generally not making extensive use of research-based techniques, the local presence of someone else who was at least interested in innovation encouraged the participants by helping them to find resources and motivation. Additionally, the presence of supportive colleagues helped the participants to have a sense of acceptance for their attempts to use research-based strategies and in some cases established an expectation for innovation. For example one participant commented about the hiring process *"So they heard about all of [my past innovation use] in my cover letter and I think were interested. When I gave a talk I implemented some techniques that I use or have tried in the past, they seemed to appreciate that."*

Local structures to support innovation – Four participants reported that technology for in class voting was already available and use was encouraged by their institution. This made the use of Peer Instruction easier for these faculty (three of the four were already using PI prior to the NFW, for the fourth the technology had just become available and his quick adoption helped him to be viewed favorably by his administration). Additionally three participants reported that they were teaching in a classroom that had been redesigned for interactive/activity-based teaching. All three of these participants were using numerous research-based innovations prior to the NFW but were able to refine their use after the workshop.

How do faculty report spending their time?

In prior work, we found that lack of time is the most common reason faculty give for not making use of more research-based teaching practices [3]. Thus, one of our goals in this project was to document how much time faculty spend while attempting to make instructional changes and how they allocate their time. To collect this information we asked participants to complete a web survey during the middle of the first semester.

Respondents reported, on average, that they spent 52 hours per week on job-related tasks. This is consistent with the 54 hours per week reported in a larger study of science and engineering faculty [4]. The average amount of time allocated to teaching was 30 hours per week. However, since respondents were from a variety of institutions with varying emphases on teaching, the amount of time spent on teaching ranged from 18 to 50 hours per week. On average, they reported 5.4 contact hours per week, with a range of 2.5 to 11 hours.

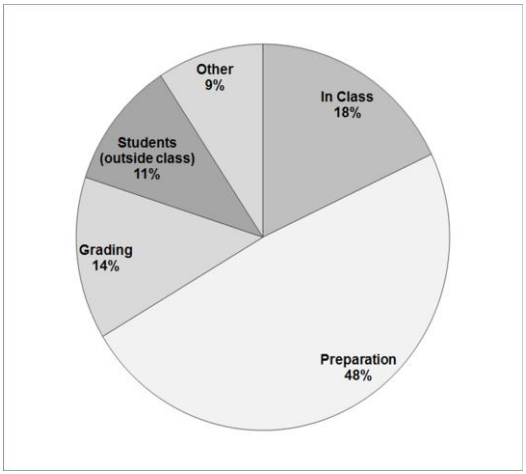

FIGURE 1. How respondents report spending their teaching-related time.

Figure 1 shows how respondents allocated their teaching-related time. The most important thing to note is that only 18% of this time is actually spent in classroom. Most of the time spent on teaching is spent on preparation. Thus, these new faculty appear to be very similar to the new faculty studied by Boice [5], in that they spend a large amount of time in the teaching aspect of their work. The large time spent in preparation indicates that, contrary to the sometimes stated belief that faculty shortchange their teaching duties in favor of their research, they are concerned teachers who are willing to put a lot of effort into doing a good job, perhaps even to the detriment of their research.

IMPLICATION: PROVIDE ONGOING SUPPORT

Comments from the participants indicate that the NFW is effective at increasing knowledge and motivation to try innovations. For example, one participant, when asked about the workshop, commented on its need, *"I didn't even know where to start looking for help [before the workshop] … I knew there was a lot of improvements I could make in my courses".* It is also clear that their experience with the NFW helped faculty improve their instruction. For example, after being inspired by the NFW to use more interactive techniques a participant commented *"So this was my first time to really do introductory physics being very deliberate about doing peer instruction and other interactive things. And overall I noticed a huge difference in kind of the level of student engagement. Last year when I taught this class … everyone was going to sleep. [The Peer Instruction is] keeping people, you know, awake and engaged and involved. And it's been kind of a wonderful distinct difference."*

The faculty we followed were all enthusiastic teachers who desired to create an environment where their students could learn, believed that students learn best in an environment where they are active participants in the learning process, spent a great deal of time thinking about their teaching, were interested in learning about teaching innovations, and put effort into changing their instruction to better meet the learning needs of their students. The largest barrier they encountered is most simply described as a **lack of support** for their change efforts. Inspired by the NFW and motivated internally to maximize their students' learning, they generally found themselves without adequate support, struggling to learn about innovations and to overcome implementation difficulties as they tried to integrate innovations into their local environment. Locally, they generally did not have colleagues who were teaching in ways that varied substantially from the traditional mode (though, as mentioned previously, many of their colleagues were interested in using more interactive techniques and were sometimes trying to do so). At best this meant there was inadequate local support for their efforts to learn and change their instruction effectively. At worst, they sometimes felt their efforts where viewed unfavorably by their colleagues. As one participant expressed, *"Here I am putting in this extra effort into trying something that's new and …some reaction that I got was skeptical."* Those few who had local colleagues who were also engaged in substantial and informed efforts to teach using more active learning techniques explicitly noted the importance of local support. For example one participant commented *"We are all kind of rolling this out together and it's really nice having other people in the department who are doing this to help and support and brainstorm and work through how to make this work well."*

Many faculty find themselves in environments where reformed teaching is not the norm, and where even if local colleagues are interested in reform they often are also lacking in the experience and knowledge needed to implement effectively. Therefore the physics education research community needs to do a better job of providing ongoing support to faculty as they work toward integrating research-based reforms in their teaching. We see two obvious ways this support is needed.

First, provide better and easier access to teaching resources (for example, conceptual questions for Peer Instruction, already written tutorials and/or discovery based labs, etc.). Interviewees explicitly commented that the time and effort they spent either finding resources or trying to come up with their own materials was a hindrance. For example one participant commented a major concern was "*how much I'm going to be able to turn to other people or other resources for things like figuring out what are good peer instruction type questions and what not. … I could [come up with all on my own given enough time] but the question is you know whether they aren't already ones that are proven in the classroom and so I need to figure that out."* As reported above, faculty are already spending large amounts of time preparing for and reflecting on teaching. This makes it difficult to spend even more time finding resources. By making it easier to find and access teaching resources it is likely faculty will use more.

Second, provide ongoing support to help faculty overcome implementation difficulties. Often, our interviewees would attempt to implement a research-based innovation and would either modify it toward traditional instruction or would drop it due to their perception that it was not going well. For example, one interviewee stated *"Last year I tried more inquiry type labs in my mechanics course and because it didn't work … I'm replacing those with traditional lab write-ups."* The education research community has a tendency to present innovations as being easier to implement than they actually are in practice. When faculty run into implementation difficulties they need help trouble shooting as well as support and encouragement to persist in what is often a difficult transition.

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