

Diffusion of Educational Innovations via Co-Teaching

Charles Henderson^{*}, Andrea Beach[†], and Michael Famiano^{*}

^{*}*Department of Physics*

[†]*Department of Educational Leadership, Research, and Technology
Western Michigan University, Kalamazoo, MI, 49008, USA*

Abstract. Physics Education Research (PER) is currently facing significant difficulties in disseminating research-based knowledge and instructional strategies to other faculty. Co-teaching is a promising and cost-effective alternative to traditional professional development that may be applicable in many situations. This paper discusses the rationale for co-teaching and our initial experience with co-teaching. A new instructor (MF) co-taught with an instructor experienced in PER-based reforms (CH). The pair worked within the course structure typically used by the experienced instructor and met regularly to discuss instructional decisions. An outsider (AB) conducted interviews and class observations with each instructor. Classroom observations show an immediate use of PER-based instructional practices by the new instructor. Interviews show a significant shift in the new instructor's beliefs about teaching and intentions towards future use of the PER-based instructional approaches.

Keywords: Dissemination, Educational Change, Higher Education

PACS: 01.40.Fk, 01.40.Jp

INTRODUCTION

Many models for promoting educational reform in the teaching of college science courses are based on the premise that an individual or group of faculty develops and tests a new instructional strategy and then disseminates it to other instructors. Dissemination typically involves transmission-oriented activities such as talks, workshops, and publications. In this paper we identify some of the difficulties with this model and describe an alternative model that may be helpful in overcoming some of these difficulties.

INSTRUCTIONAL CHANGE

Some proposed instructional innovations seek to make the current structure more efficient (surface changes) while others seek to alter core beliefs, behaviors, and structures (fundamental changes). Most reforms in science teaching call for fundamental changes [1]. This distinction between fundamental and surface changes is important because fundamental changes always face significant resistance while incremental changes often do not [2].

A major obstacle to the implementation of a fundamental instructional change is that instructors attempting to change traditional practices are already acculturated into and surrounded by a system that

reflects their current practices and views [3]. Thus, they must undergo a learning (or reacculturation) process to incorporate the new skills and assumptions into their existing mental structures [3].

Even when instructors are able to successfully make internal changes they are typically still immersed in their current situation. Many aspects of this situation likely conflict with their new teaching culture. Commonalities such as large classes, content coverage expectations, classroom infrastructure, scheduling constraints, poor student preparation, and institutional reward structures all appear to favor traditional instruction. In addition, students often resist new instructional strategies.

Most instructors recognize that it is unlikely for any set of instructional materials, no matter how carefully developed, to match the constraints of their specific classroom situation. Local customization is always necessary. Because of the conflicts with existing cultures (both personal and institutional), new instruction that calls for fundamental changes is often altered by instructors during the customization process and implemented as surface changes. Although such implementation may keep some of the surface features of the innovation, it is essentially traditional instruction [4]. Henderson and Dancy have developed the term *inappropriate assimilation* to describe this type of "adoption" [5]. One unfortunate result is that instructors who think that they have adopted an

instructional strategy may incorrectly conclude that the strategy is ineffective.

Problems with Standard Dissemination

Common methods of dissemination include talks, papers, and workshops aimed at convincing individual faculty to change their instruction and giving them information and materials in support of a specific research-based strategy. While such strategies may be suitable for the promotion of incremental changes, it is unlikely that such a transmissionist approach can promote fundamental changes. This is for the same reasons that transmissionist instructional strategies for science students typically do not promote significant changes in student mental models. An additional barrier to standard transmissionist dissemination strategies is the complex nature of teaching itself. Similarly to any complex task, much of a teacher's decision-making is implicit [6]. It would be an overwhelming task for a curriculum developer to make all of the necessary implicit decisions explicit and equally overwhelming for an instructor to attempt to internalize these decisions. In contrast, apprenticeship-based models have been shown useful in the development of such tacit knowledge.

Although cost data is not commonly reported in the educational research literature, cost effectiveness of dissemination strategies is clearly an important consideration. In terms of traditional dissemination strategies, cost figures are available in an evaluation of the NSF Undergraduate Faculty Enhancement (UFE) program [7]. According to the evaluation, between 1991 and 1997, UFE made \$60,963,917 in awards for faculty development workshops. This funded over 14,400 undergraduate faculty from all types of institutions to attend over 750 workshops. In telephone interviews, 40% of faculty participants said that they had made at least moderate changes in their teaching methods. Thus, each change cost ~\$10,600 (not adjusted for inflation). This is a low estimate for a fundamental change since not all changes in teaching methods are fundamental changes and self-report data can be biased in terms of over-reporting changes.

CO-TEACHING

The practice of co-teaching was developed by Roth and Tobin as an alternative to the standard student teaching practice associated with most K-12 teacher preparation programs [8]. In standard student teaching, the student teacher typically first observes a number of the master teacher's classes and then takes over the class on their own. Roth argues that student teachers do not often develop the tacit knowledge

necessary to be good teachers under this arrangement [8]. During co-teaching the student teacher and master teacher share responsibility for all parts of the class. Student teachers "begin to develop a feel for what is right and what causes us to do what we do at the right moment" [ref [8], p. 774]. Although we are aware that co-teaching activities have occurred at the college level at other institutions, we are not aware of any other studies that have sought to document the results of such an arrangement.

Co-Teaching Reduces Risk

New instructors are typically risk averse and afraid of making mistakes that may hurt their chances of getting tenure. Thus, any departure from traditional instruction must be made as risk-free as possible – both in terms of student satisfaction and time demands. Co-teaching, as enacted in this project, does this in two ways. First, it allows the experienced instructor to set up a course structure that is known to work in the particular context. This gives the new instructor a safe place to practice new ways of interacting in the classroom and minimizes the risks of problems arising while switching cultures. In terms of required time, during the co-teaching semester, the new instructor has the benefit of previously-used materials and only has to prepare for being in charge of the class about half the time. This leaves additional time and energy available for some of the other more reflective aspects of co-teaching.

Cost of Co-Teaching

In the co-teaching model described in this paper, the only cost is a replacement instructor to teach one class. This allows two instructors to co-teach a single class and have time for additional discussion and reflection without increasing the total amount of time spent on teaching duties. The recommended part-time rate for a 4-credit class at WMU in Fall 2005 was \$2,800.

WMU CO-TEACHING PROJECT

The goal of co-teaching in the current study was to acculturate MF into research-based physics instruction as embodied in the design principles developed and enacted by the WMU Physics Teachers Education Coalition (PhysTEC) faculty. The co-teaching took place in the lecture portion of an introductory calculus-based physics course at Western Michigan University. The 4-credit course met each weekday for 50 minutes and contained about 70 students, mostly engineering majors, in a stadium-style lecture hall. CH and MF

were both listed as the instructor of record for the course. There were five basic co-teaching activities.

(1) CH and MF alternate being in charge of class. Although both of the instructors were present during each class session, they alternated being “in charge” of the class on a weekly basis. The person in charge would typically preside over whole-class discussions or presentations. Much of the class time was spent by students working in assigned small groups. During this time both instructors would circulate around the lecture hall and interact with groups. The first draft of weekly quizzes or exams were developed by the instructor in charge.

(2) Weekly meetings between CH and MF. Each Friday, CH and MF met for approximately 1 hour. During that time they talked about how things went during the past week and any difficulties that arose. The instructor in charge of the following week would then present his initial plans, which were discussed. In addition to this weekly scheduled meeting, CH and MF frequently had shorter discussions about the course at other times.

(3) Course structure set up by CH to support PhysTEC design principles. The research-based course structure was specifically designed so that much of class time would be used having students working together in small groups while discussing important physics ideas.

(4) MF had access to materials used by CH in previous offerings of the course. At the beginning of the semester, CH gave MF a CD with electronic copies of all the course activities and assignments used in the previous semester. MF typically used, with minor modifications, about half of these and developed the other half of the course activities himself.

(5) MF teaches course on his own during subsequent semester. MF taught the same class on his own during the following semester -- Spring 2006.

DATA COLLECTION AND ANALYSIS

A faculty member from the college of education (AB) conducted individual interviews with CH and MF at the beginning, middle, and end of the co-teaching semester. Interviews focused on thoughts about how the course was going, general beliefs about teaching and learning, and perceptions about co-teaching. A final interview was conducted with MF at the end of Spring 2006 once he had taught the course on his own. AB also observed class sessions at the beginning, middle, and end of the co-teaching semester.

CH and AB independently analyzed the interview transcripts and observation field notes looking for three things: 1) evidence related to MF’s instructional

practices; 2) evidence related to MF’s beliefs about teaching and learning; and 3) evidence related to MF’s intentions towards future instruction. There was a large degree of agreement between the two analyses and all disagreement was resolved through discussion.

RESULTS

Teaching Practices: During the observations by AB, both CH and MF were judged to be working with similar effectiveness within the interactive PhysTEC class structure. She did notice some more subtle differences, though. For example, in her first observation of MF she writes “*MF was somewhat more structured than I saw CH . . . MF presented concepts and then problems that exemplified them. Less of having students generate concepts.*”

Although noticeable, these differences were considered by AB to be minor compared to the large difference between the co-taught course and traditional science courses. There no noticeable changes in MF’s instructional practices during the semester. These observations suggest that the scaffolding provided by the course structure was effective, right from the start, in helping MF teach in a non-traditional way.

Without this structure it is likely that MF would have put much more emphasis on facts and principles lecturing. The likelihood of this was confirmed by MF during the first interview “[*If I were teaching the course by myself*] I would probably treat it more like a lecture.” (MF1#222-223)

Beliefs About Teaching and Learning: MF’s beliefs about how students learn appeared to be consistent throughout the semester and largely aligned with the beliefs behind the PhysTEC course structure. Thus, even though MF envisioned his teaching as some variation of a traditional lecture, he did not think that students would get a lot out of such a lecture. “*A student sitting in a lecture listening to you is going to do what most students do, and that is, fall asleep or walk away and not learn something.*” (MF1#128-130). This disconnect between beliefs about learning and instructional practices appears to be common in all types of faculty [9].

Although MF’s beliefs about student learning were consistent throughout the semester, his beliefs about teaching appeared to change. He was initially concerned that the PhysTEC course structure was too much of a departure from the lecture method. This changed by the middle of the semester. “*It really seems to be a good method.*” (MF2#88) His largest initial concern appeared to be student resistance to such an interactive class structure. Thus he did not envision such methods being successful until he experienced the students being engaged.

Intentions Towards Future Instruction: As MF's beliefs about teaching changed, his intentions towards future instruction also began to change. MF was initially skeptical about the course design where much of the class time was used having students work together on problems. By the mid-term interview, he was beginning to become comfortable with the course design, but was still largely non-committal about his future instruction. "You know, it [the co-teaching experience] taught me something that I am going to adopt aspects of in future courses." (MF2#196-197) By the end of semester, though, he seemed to have shifted his perception to be very favorable towards the course structure. "My class [next semester] is going to be very similar to what we did last semester. . . .It's going to be almost identical." (MF3#272-273)

Even though at the end of the Fall co-teaching experience, MF indicated that his Spring 2006 course would be "almost identical" to the co-taught course, he later decided to make some changes to the course structure. Although the Spring 2006 was well within the PhysTEC structure, all movement was towards a more traditional course. In addition, almost all changes were made in order to reduce the instructor time required or to reduce perceived student dissatisfaction. For example, in Spring 2006, MF decided to change the written homework from a group to an individual assignment. This was largely based on his perception that students did not like the group homework assignments. In contrast, although quiz corrections were quite popular with students, MF decided not to use quiz corrections in Spring 2006 due primarily to the extra time required for grading.

The final interview at the conclusion of the Spring 2006 semester revealed that MF was unhappy with many of the changes that he made and planned to go back to a course structure more closely aligned to the Fall 2005 course. He indicated that his direct experience with co-teaching followed by teaching alone convinced him that the course elements were important enough in promoting student learning that they were worth extra time and possible student dissatisfaction.

CONCLUSIONS

Co-teaching appears to have been successful in creating a fundamental instructional change -- more closely aligning MF's beliefs and instructional practices with the WMU PhysTEC design principles.

Co-teaching is a cost-effective model that shows significant promise for the dissemination of instructional innovations. It appears to be able to provide a much larger change for much less money than common workshop models since the only cost is a

replacement to teach one course so two instructors can team up without increasing their workload. Co-teaching is effective because it immerses an instructor in the new instructional context and provides scaffolding and modeling to ensure success. An interesting question for future study would be to examine the effectiveness of co-teaching in promoting instructional change in experienced faculty.

Of course, co-teaching is only appropriate when there is a teacher available who is experienced in teaching the target course in a research-consistent manner. Thus, co-teaching cannot solve all dissemination problems. Yet, when the conditions are right, it should not be overlooked. With the expanding presence of PER researchers/teachers in physics departments, it could have a significant impact.

ACKNOWLEDGEMENTS

This project was supported, in part, by the Physics Teacher Education Coalition (PhysTEC), which is funded by the National Science Foundation.

REFERENCES

1. J. Handelsman, D. Ebert-May, R. Beichner, P. Bruns, A. Chang, R. DeHaan, J. Gentile, S. Lauffer, J. Stewart, S. M. Tilghman and W. B. Wood, "EDUCATION: Scientific Teaching," *Science*. **304**, 521-522 (2004).
2. R. F. Elmore, "Getting to Scale with Good Educational Practice," *Harvard Ed. Review*. **66** (1), 1-26 (1996).
3. M. Fullan, *The New Meaning of Educational Change*, New York: Teachers College Press, 2001.
4. J. P. Spillane, *Standards Deviation: How Schools Misunderstand Educational Policy*, Cambridge, MA: Harvard University Press, 2004.
5. C. Henderson and M. Dancy, "When One Instructor's Interactive Classroom Activity is Another's Lecture: Communication Difficulties Between Faculty and Educational Researchers," (Paper presented at the AAPT Winter Meeting, Albuquerque, NM, 2005).
6. D. C. Berliner, "Ways of thinking about students and classrooms by more and less experienced teachers," in *Exploring Teachers' Thinking*, edited by J. Calderhead, London: Cassell Publishing, 1987.
7. C. Marder, J. McCullough and S. Perakis, *Evaluation of the National Science Foundation's Undergraduate Faculty Enhancement (UFE) Program*, SRI International, 2001.
8. W.-M. Roth, D. Masciotra and N. Boyd, "Becoming-in-the-classroom: A case study of teacher development through coteaching," *Teaching and Teacher Education*. **15**, 771-784 (1999).
9. L. Norton, J. T. E. Richardson, J. Hartley, S. Newstead and J. Mayes, "Teachers' beliefs and intentions concerning teaching in higher education," *Higher Education*. **50**, 537-571 (2005).