

Beyond the Individual Instructor: Systemic Constraints in the Implementation of Research-Informed Practices.

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Abstract. Anecdotal evidence suggests that findings of educational research and resulting curricula are, at best, only marginally incorporated into introductory physics courses. Based on interviews with four non-PER physics faculty we investigated why incorporation of research-based curricula is uncommon. Elsewhere [1], we report that these instructors have PER-compatible beliefs about teaching and learning, but largely traditional instructional practices. In this paper we explore the significant role that systemic influences play in this apparent discrepancy and present a theoretical model to describe the interplay between individual beliefs and systemic influences.

INTRODUCTION

Physics education research (PER) is a thriving field. Although we still have much work to do, our collective knowledge about how students learn (and fail to learn) physics is well formed. We now have numerous research-based and class-tested curricular packages for introductory level physics. Yet, despite evidence that many physics faculty are familiar with the products of PER [1,2], we still have not witnessed wide-spread adoption of PER-informed practices [3]. Dissemination efforts in PER have concentrated on holding workshops, distributing curricular material, publishing papers and books, and giving talks. All of these efforts focus on communicating ideas to individual instructors. The implicit assumption is that research data can convince instructors of a better way to teach, and that by providing them with ready to use curricula they will be able to incorporate the results of this research into their own classrooms. In this paper, we propose that this assumption is incomplete because it fails to acknowledge that instructors do not exist in isolation, they are part of a larger system. That system exerts forces on instructors that can support, but usually resists, a shift from traditional practice to practice consistent with PER.

DATA AND ANALYSIS

Semi-structured interviews were conducted with four senior, well-respected, physics faculty who are

thoughtful teachers and put significant effort into their teaching. These faculty represent the kind of faculty that would be expected to easily adopt PER methods. Elsewhere [1] we describe our finding that, although these instructors have beliefs about teaching and learning and instructional goals that are largely consistent with PER, their self-described instructional practices are largely traditional. We hypothesize that one factor impeding complete incorporation of PER is instructors' either misinterpreting or having a low opinion of the trustworthiness of educational research results. In this paper we examine this mismatch between beliefs and practices from the perspective of the situation in which these instructors teach.

Belief vs. Practice: A Jumble of Inconsistencies

Working from interview transcripts, we identified factors that either promoted or retarded the instructors' teaching in a PER-compatible manner. We found that, although there were individual factors resisting an alignment between these instructors' beliefs and practices (e.g., inconsistencies in their belief system, lack of knowledge about PER), many of these factors were situational.

For example, "Harry" described his belief in the value of having students work in groups. *"I like the idea of dividing the class into smaller sub-groups and*

work independently on projects...I want to try to turn the lecture into sort of a mini tutorial at various points. I think that has promise. In all the times in the past when I've done that, when I've gotten students to organize into small groups and talk to each other, at least they're talking physics to each other. You can see that there is some understanding going on, some transfer of knowledge taking place."

Although Harry believed it was beneficial for students to work in groups and had positive experiences with this method, he did not use the method in his practice as often as he would like: "Because I was racing to get through the curriculum I had to pretty much drop [the group work]."

Harry repeatedly talks in his interview about feeling pressure to present material, rather than use interactive methods, due to a need to cover content. He also talked about students' resistance to working in groups and a lecture room with fixed seating that is "not ideally configured for group work".

The finding of inconsistencies between beliefs and practice in and of itself is not particularly surprising. Sociologists [4] and educational researchers [5] have long been aware that beliefs are generally a poor predictor of practice. Based on a theoretical model developed by Warner and DeFleur to understand the discrepancies between stated attitudes and behaviors related to racial discrimination [4], we suggest a similar theoretical framework for understanding these instructors' inconsistencies (Figure 1). In this model, practice is consistent with belief when situational variables support the practice but may be inconsistent when situational variables are in opposition to a particular practice. For example, Harry has beliefs that might be characterized as being moderately PER-compatible. Given that his practice is often traditional, and inconsistent, the model predicts the existence of the incompatible traditional situational variables described above.

It was striking that in every case, when there was an inconsistency between belief and practice, the instructor had PER-consistent beliefs but traditional practice. We found no instance of traditional beliefs and PER-consistent practice. This suggests that these instructors work in environments that are strongly supportive of traditional instruction and resist movement toward PER-consistent practice.

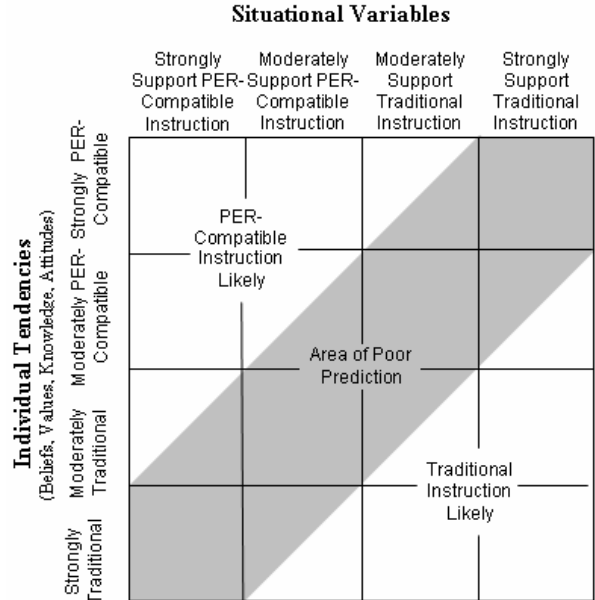


FIGURE 1. Model for predicting behavior based on beliefs and context. Adapted from Warner et. al. [4] p. 168.

Main Systemic Forces

To better understand an instructor's ability to implement PER-compatible instruction, we asked the interviewees to describe actual or attempted instructional changes throughout their careers. This allowed us to create a "free-body diagram" for each instructor identifying the main forces that either supported or resisted their attempts to change their instruction. Many of these forces were specific to the instructor, for example whether they held transmission ideas about learning or ideas based on constructivism. But many of the forces were systemic.

It is important to note that our data only illuminates self-reported resistive forces. It is likely that there are large resistive forces that are not noticeable because they are so pervasive. For example, the process of grading commands considerable time and attention in most classrooms and the requirement that an instructor give a final grade to each student must therefore significantly affect instruction. However, because the practice of giving grades is so pervasive and generally unquestioned, most instructors probably have not considered how this systemic requirement affects their practice. Since the system was built around and supports traditional practices, systemic constraints are likely only noticed by instructors when they attempt to move out of the traditional mode of instruction.

A discussion of the most common systemic forces found in our interviews follows.

Student Resistance: Students often do not support research-based methods. In particular, they do not like to interact with each other and are not prepared to think independently.

“What I want to do is to turn the class into a real working session. Where it’s just not possible for them to come there and sleep. That may turn off students and decrease enrollment, they may switch courses. I’m a little worried about attrition. That’s another aspect” .- Harry

Time Structure: Semesters are of a fixed length of time and do not allow for individual differences in learning needs. Also, since students are taking other courses the time they have available for one course is limited.

“I think time students can spend on a particular course is one thing [that prevents me from reaching my goals]. Time for every student in the course to reach the same level because they all start at different levels and they would all take different amounts of time to get to whatever level you want to call understanding.” - Terry

Departmental Norms: If other members of the department are integrating research-based methods it is easier for instructors to do so as well. It is much more difficult if traditional methods are the norm and there are no local role models to follow or be supportive.

“I am more comfortable with being more interactive and, of course, since we’ve started [a grant supported departmental reform]. I’m much more comfortable having them do group work in class, and feeling that that’s a valid way of spending time in class. And I’m more comfortable asking conceptual type questions instead of just problem solving type questions because you know there’s that extra validation of having a group of people doing this and that it is a grant and it’s a research project.”- Mary

Expectations of Content Coverage: Instructors may forgo research-based methods that are geared toward deep understanding if they feel they must cover a lot of material. Likewise, they may change their instruction if this expectation is diminished.

“The fact that we cut out a lot of the material that we need to cover. Because before, I’d think gee if I don’t cover fluids and the next instructor is expecting it I’m really crippling these students, handicapping them. But as a whole department we said OK, it’s alright for us to cut this material out and spend the time on what you feel is necessary to go more in depth on.... And so

the pace was so much quicker that to take a whole class period and potentially have them be a little floundering with group work was just so big of a risk. You know I would have them do some, but it was much more focused and shorter periods of time and I was still much more tentative about how many of them I ended up doing.” - Mary

Lack of Instructor Time: Instructors are sometimes too busy with large teaching loads and/or research responsibilities to have the time to learn about and integrate new techniques.

“It kinda depends on how lazy I am, I will try to write those [test questions that students have not seen before] as much as possible. If I’m in a hurry then I will tend to pick more from the old questions.” - Gary

Systemic Change Affecting Practice

If our theoretical model (Figure 1) is correct, when systemic resistive forces are removed, then instructors with PER-compatible beliefs should change their practice. We found evidence of this in our interview with Mary, who indicated that she had always held predominantly PER-compatible beliefs but was better able to follow through with them when the structural forces changed. Her two comments in the previous section illustrate her increased confidence when “Departmental Norms” changed due to a new program and her increased ability to implement changes when “Expectations of Content Coverage” changed.

This instructor described her changes in instruction as being precipitated by situational changes, rather than changes in personal beliefs.

“I would say that it’s not just one thing. There’ve got to be at least three things. It was the release of time so that I had more flexibility in how to cover a lesser amount of material more in depth. Two that there is a group here doing it. And three that I was exposed to more research on how [cooperative learning] works.” - Mary

IMPLICATIONS

If a goal of PER is to impact mainstream physics teaching, it is not enough to simply research how students learn physics, develop curriculum based on that research and then disseminate the results. We found that even if instructors believe in PER-informed practices, there are systemic forces that resist the

adoption of those practices. This result is consistent with others reports [6].

Our interviewees held moderately to strongly PER-compatible beliefs. Thus, the theoretical model (Figure 1) predicts PER-compatible instruction if they are in a setting where the situational forces are at least neutral. As discussed earlier, we saw evidence of such a change in Mary's instructional practices when her situational variables became more PER-compatible.

The PER community has focused a majority of its efforts on moving instructors' individual tendencies to become more PER-compatible. For instructors like the ones that we interviewed, we argue that changing their beliefs from moderately to strongly PER-compatible is not only very difficult but also no guarantee of change in practices. We suggest that some of the emphasis be placed on attempting to understand, classify, and change the systemic forces that inhibit changes in instructor practices.

History [7] and the current situation tell us that the structure of educational systems is often not strongly based on educational research, but rather on "such factors as real or alleged economic considerations, national ideals, social change, the way in which schools are structured, gender, racial, and class distinctions, as well as symbol and ritual" (p. 157). Since successful systemic changes are more likely if all of these factors are considered, we will conclude this paper by offering some brief thoughts based on a historical [7,8] and structural analysis.

Historically, educational reform movements in the United States have followed major shifts in the economic and social structure of society. Public schools were formed, in large part, to address concerns about the "proper" socialization of the large immigrant population and also to meet the need for factory workers. Therefore, early pedagogical methods were often authoritarian and teacher-centered in nature.

Around the turn of the century, there were two competing educational reform movements that parallel our current situation. The progressive movement (associated with John Dewey) which called for more humanized, child-centered education and the social efficiency movement which pushed for structures such as testing and tracking. The social efficiency movement was backed by business leaders and directed at changing policy. In contrast, the progressive movement (like PER) did not focus directly on policy, but worked to change the practice of individual teachers. In the end, the progressive

movement had a considerably smaller impact on actual practice.

It may be argued that the system is changing ... just slowly. However, the historical account indicates strong connections between educational policy (and therefore practice) and economic reality. Others have explored this connection more in depth [8a, 9] and argue that our current system is the result of neither incompetence, accident, nor slow changes.

Our finding, that systemic forces play a large resistive role in research-based change, indicates that the nature of "traditional" structures must be critically questioned. It is not enough to develop and disseminate curriculum, we must work toward understanding and changing the structures that oppose research-based reforms.

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