



Beyond Instructor Beliefs: Additional Barriers to the Adoption of Student- Centered Instruction in Physics

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Educational Research in College Physics: The Current Situation

Physics Education Researcher (college level):

- **Strong knowledge base about teaching and learning of physics**
- **Many high-quality, research-based instructional strategies and materials**
- **Significant dissemination efforts**

Most instructional innovations are “progressive”:

- **Emphasize understanding more than quick and accurate performance**
- **Focus on developing thinking, learning, and problem solving skills**
- **Link course content to interests and needs of students**
- **Students expected to work collaboratively**



The Problem

Most physics instructors still teach traditionally.*

A few possible reasons [Fullan, 2001; Rogers, 1995]:

- 1. traditional beliefs about teaching and learning**
- 2. little exposure to educational research**
- 3. instructional goals inconsistent with progressive instruction**
- 4. satisfied with current instruction**
- 5. disbelief in progressive strategies suggested by educational research**
- 6. local situational factors not supportive of progressive instruction**

* We intend to more fully document actual levels of adoption in a future study.



Current Study

Open-Ended Interviews:

- **Four instructors, three institutions**
- **Tenured**
- **No formal connections with educational research**
- **Thoughtful, reflective, well-respected**

→ This type of instructor is most likely to be interested in educational research

Analysis:

- 1. Self-described beliefs, goals and practices**
- 2. Changes in practices over career**
- 3. Knowledge and attitudes about physics education research**



Self-Described Instructional Practices

Traditional	Progressive
1. Teacher ideas central, passive students allowed	1. Student ideas central, active students
2. Competitive/individualist	2. Cooperative learning
3. External Motivators	3. Internal Motivators
4. Assess for performance in solving familiar problems	4. Assess for thinking/problem solving skills
5. Grades/testing used to sort, rank, certify	5. Value all students, assessment for feedback
6. Decisions about what/how to learn made by teacher	6. Students contribute to decision-making (e.g., projects)
7. Teach only physics content	7. Teach learning, thinking, and PS skills and physics content

T	P
1. +++	1. +
2. +	2.
3. +++	3.
4. +++	4.
5. +++	5.
6. +	6.
7. +	7.

Gary

T	P
1. +++	1. +
2. ++	2. +++
3. ++	3. +
4. +++	4. +
5. +	5.
6. +++	6.
7. +++	7.

Harry

T	P
1. +++	1. +++
2.	2. +++
3. ++	3. +
4.	4. ++
5.	5.
6. +	6.
7.	7. ++

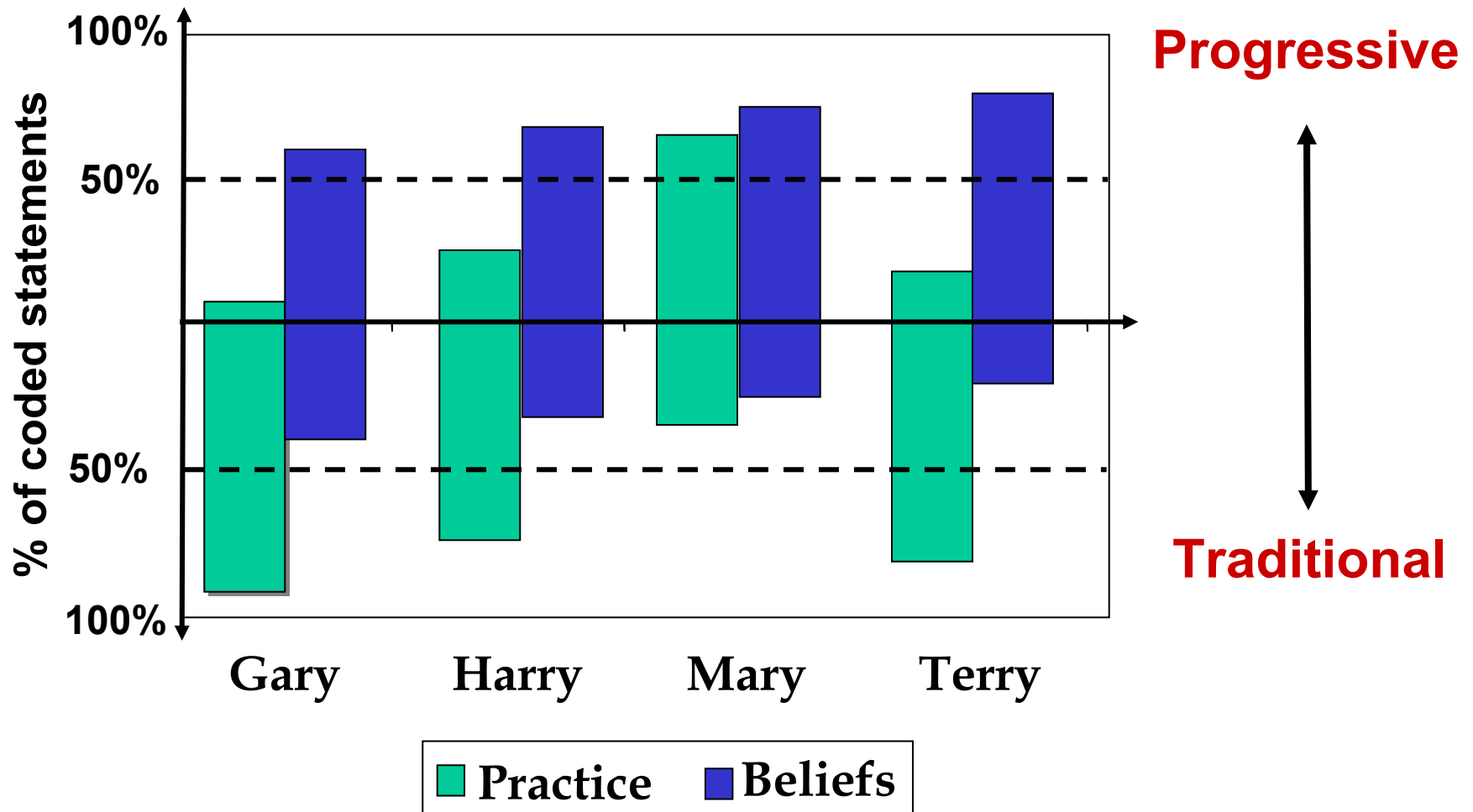
Mary

T	P
1. +++	1.
2. +	2.
3. +	3.
4. +++	4. +
5.	5. +
6. +	6.
7. +	7.

Terry



General Trend: Progressive Beliefs - Traditional Practices





Disagreement in the Literature

Inconsistent Beliefs and Practices

Progressive Beliefs - Traditional Practices

- Henderson & Dancy, 2004 (4 physics faculty) – **current study**
- Samuelowicz & Bain, 1992 (13 science and social science faculty)
“One of the mysteries of higher education – the disjunction between the stated aims (promotion of critical thinking) and educational practice (unimaginative coverage of content and testing for factual recall).” (p. 110)

Consistent Beliefs and Practices

Traditional Beliefs – Traditional Practices (70-80%)

Progressive Beliefs – Progressive Practices (20-30%)

- Kember & Kwan, 2002 (17 lectures in three departments -- engineering, social sciences, and paramedical)
- Prosser & Trigwell, 1999 (interviews with 24 university physics and chemistry faculty; written survey with 58 university physics and chemistry faculty)



Instructors Know about Educational Research

- All had some familiarity with progressive, research-based techniques.

Goals are Consistent with Educational Research

- Develop Students' **Problem Solving Skills**
- Develop Students' **Understanding of Basic Physics Principles**

Not Happy With Student Outcomes

- None believed that they were meeting these goals. All wanted to improve.



An Example - Gary

Goal: Students Learn Problem Solving Skills

"I think I'm teaching problem solving. And I'm probably teaching in the broader sense, I'm teaching problem solving in life as much as physics, physics is kind of incidental, almost."

Belief about Teaching: Subject matter is used to teach learning/problem solving skills

"I'm not teaching subject matter, the subject matter is a tool to help them [learn problem solving] . . . and I'm also teaching them how to learn."

Belief about Learning: Solving novel problem = problem solving skill

"If they are encountering a new application they're showing problem solving skills in physics, other than just repeating a solution they've done before, they've seen me do before."

Self-Described Instructional Practices: Lecture-based, most exam questions come directly from a study guide he provides.

Satisfaction: Not satisfied

"I know that most of my students are not learning problem solving. If I change the situation they think it's a whole new problem."



Possible Reasons Reconsidered

-  1. traditional beliefs about teaching and learning
-  2. little exposure to educational research
-  3. instructional goals inconsistent with progressive instruction
-  4. satisfied with current instruction
5. disbelief in progressive strategies suggested by educational research
6. local situational factors not supportive of research-based instruction



Image Problem for Physics Education Research

Educational Research is dogmatic and disrespectful.

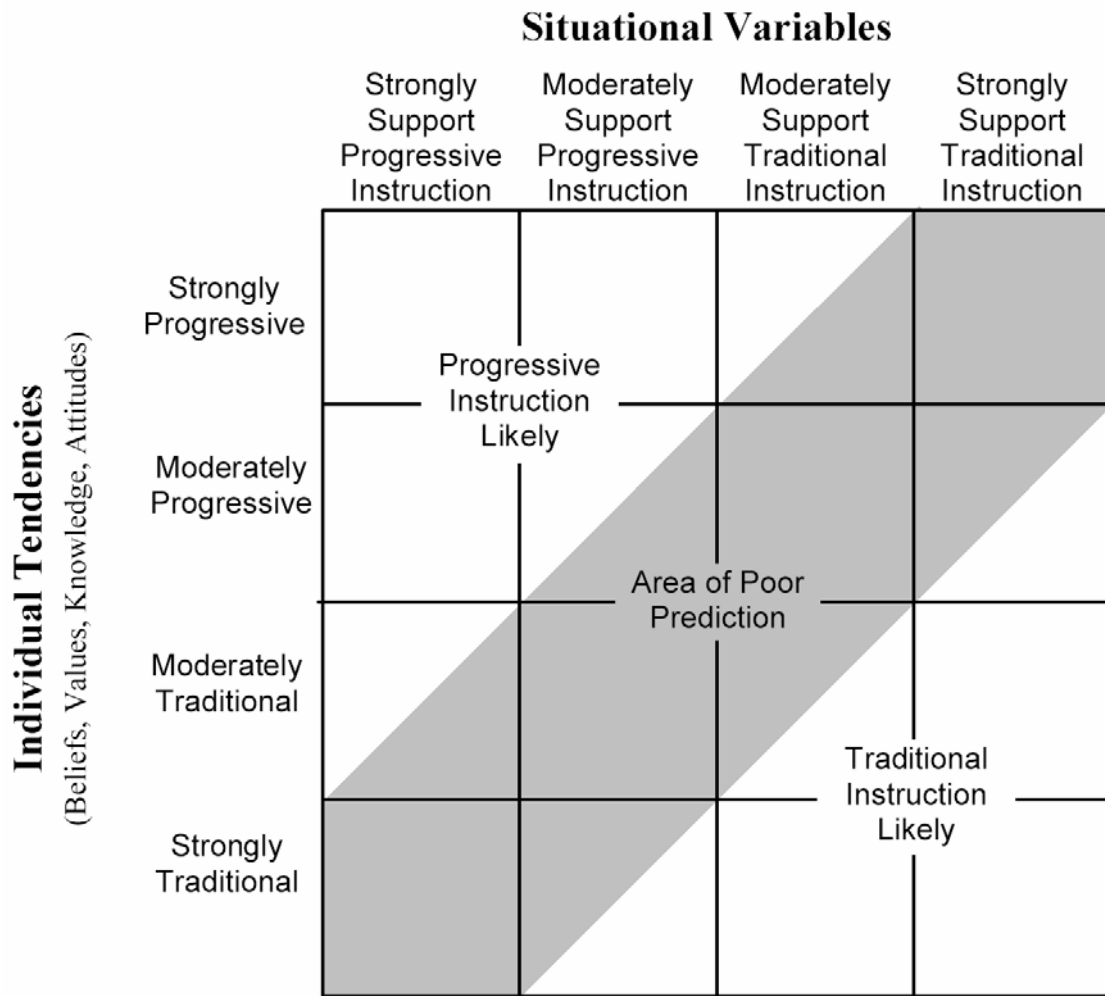
“All of those people [Physics Education Researchers] seem to think that their way is the only way...The first word out of their mouth is you’re not doing things right... If you tell me that you think my teaching is bad that automatically sets up a barrier... . . . I think there’s just too much of that going on right now.” - Terry

Educational research results cannot be trusted.

- **Use of non-scientific research methods.**
- **Placing too much emphasis on multiple-choice conceptual tests (e.g., FCI, CSEM).**
- **Curriculum developers only present good results and don’t present difficulties.**



Situational Variables - Theory



Progressive beliefs are not enough, the situation must also be supportive of progressive practice.

Model for predicting behavior based on beliefs and context.
(Adapted from Warner et. al. 1969, p. 168.)



Self-Described Situational Constraints: Situational Variables Strongly Support Traditional Instruction

Student Resistance: Students often resist progressive instruction.

- *“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: Semester system, demands on students’ time

- *“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”– Terry*

Departmental Norms: Colleagues teach traditionally

Expectations of Content Coverage: Pressure to cover content does not allow for progressive instructional methods

Lack of Instructor Time: Large teaching loads and/or research responsibilities



If the model is correct, then instructors with progressive beliefs should change practice if situational constraints change

Mary

- **Consistent progressive beliefs**
- **Past practice was generally traditional**
- **Situational Changes**
 - Department got a grant to do innovative teaching
 - Department decided to reduce content coverage expectations
 - Many faculty began to experiment with progressive instruction
- **Mary's practice is now much more progressive.**
 - *"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

Educational research dissemination efforts have largely concentrated on changing practice of individual instructors (e.g., by holding workshops, distributing curricular material, publishing papers and books, giving talks)

- **Assumption: instructors hold traditional beliefs and need to be convinced to replace these beliefs with progressive beliefs.**

This is not enough!

- **It creates an ‘us’ vs. ‘them’ mentality that divides instructors and educational researchers – these groups need to work together.**
- **Many instructors may already have moderately progressive beliefs.**
- **Progressive beliefs are no guarantee of progressive practices.**

Need to understand, classify, and change the situational factors

- **Situational factors currently are strongly supportive of traditional (teacher-centered) practices.**
- **Small changes in situational variables may lead to large changes in practice → situation should be at least neutral.**



More information: homepages.wmich.edu/~chenders

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