Understanding Instructor Practices and Attitudes towards the use of Research-Based Instructional Strategies in Introductory College Physics

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Big Picture

High quality research and curriculum development is only valuable if it is actually used.

Big Picture

Overview of Project

- Problem: Although substantial time and money has gone into developing Research-Based Instructional Strategies (RBIS) in physics, little effort has gone into understanding how typical physics instructors perceive and use these products – or even whether typical physics instructors use these products.
- **Goal: Understand the level of knowledge about, attitudes towards, and use of research-based instructional strategies by instructors in order to improve future dissemination and reform efforts.**

Research Questions

1) What RBIS do instructors know about, and how do they know it?
2) What motivates an instructor to try, or not try, a RBIS?
3) What RBIS have instructors tried, and how did they go about it?
4) Of the RBIS they have tried, what do they still use, and why?
5) Of the RBIS they have tried, what did they discontinue using, and why?
6) How do RBIS diffuse through individuals within a single department?

Phase 1: Web Survey

Phase 1: Web Survey (Fall '08): 1622 instructors, stratified by type of institution.

Individual Characteristics:	Local Characteristics:	Specific RBIS:
• Instructional Goals • Teaching Experience (years of experience, number of times taught intro quantitative course) • Employment/tenure status • Interactions with physics education community (conferences, journals, colleague with physics education specialization) • Demographics (gender, age, highest degree)	• Context ○ Class size ○ Course structure ○ Support staff for course (grading, demos, etc.) • Teaching Load • Topics covered in introductory sequence • Textbook used • Other instructional materials (web resources, lab manuals, etc.)	(For each of the 24 RBIS) • Self-reported Level of Use • If used, Length of use and Innovation Configuration • Self-reported level of knowledge • How knowledge obtained (reading, attended talk, workshop, etc.) • Attitude towards

Study Design

Phase 2: Telephone Interviews

Phase 2: Phone Interviews (Fall '09): Random sample of 96 respondents to Phase 1.

Users, N=32 (16 from each RBIS):

- Level of Use
- Implemented Innovation Configuration
- Perception of innovation
- Why started use?
- Support received during implementation (equipment, technical assistance, release time, etc.)
- Satisfaction/difficulties
- Instructional changes during career

Former Users, N=32 (16 from each RBIS):

- Highest Level of Use reached
- Innovation Configuration when used
- Perception of innovation
- Why started/stopped use?
- Support received during use
- Current instructional practices
- Instructional changes during career

Knowledgeable Nonusers, N=32 (16 from each RBIS):

- Current instructional practices
- Perception of innovation
- Why not used?
- Instructional changes during career

Sample

Study Design

Type of Institution	Population Estimates[1-4]	Phase 1: Web Survey Random sample, with representation enforced from Minority Serving Institutions	Phase 2: Phone Interviews Phone interviews focused on the two most widely known RBIS: RBIS1 and RBIS2
Associate's Colleges	1600 Faculty in 1025 institutions (~100% of faculty regularly teach introductory physics)	386 Faculty in 242 institutions	24 Faculty RBIS1: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users RBIS2: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users
Four-Year w/o Physics Degree	2300 Faculty in 768 institutions (~100% of faculty regularly teach introductory physics)	405 Faculty in 135 institutions	24 Faculty RBIS1: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users RBIS2: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users
Bachelor Degree in Physics	2700 Faculty in 503 institutions (~90% of faculty regularly teach introductory physics)	412 Faculty in 85 institutions	24 Faculty RBIS1: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users RBIS2: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users
Graduate Degree in Physics	6300 Faculty in 257 institutions (~50% of faculty regularly teach introductory physics)	419 Faculty in 35 institutions	24 Faculty RBIS1: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users RBIS2: 4 Users, 4 Knowledgeable Nonusers, 4 Former Users

Study Design

Target RBIS

Whole Course	Specific Strategies for Lecture/Recitation		Strategies for Lab
• Cooperative Group Problem Solving (Heller & Heller[1]) • Investigative Science Learning Environment (Etkina & Van Heuvelen[2]) • Modeling Physics (Hestenes & Wells[3]) • Overview, Case Study Physics (Van Heuvelen[4]) • Scale-Up, Studio Physics (Beichner[5], Wilson[6]) • Workbook for Intro. Phys. (Meltzer et. al.[7]) • Workshop Physics (Laws[8])	• Activity-Based Physics Tutorials (Cooney et. al.[9]) • Active Learning Problem Sheets (Van Heuvelen[10]) • Realistic Problems: Context-Rich Prob. (Heller[11]); Experiment Prob. (Van Heuvelen[12]); Thinking Prob. (Redish[13]) • Cooperative Learning Groups[14] • Interactive Lecture Demonstrations (Thornton & Sokoloff[15]) • Just-In-Time Teaching (Novak et. al.[16]) • Peer Instruction (Mazur[17]) • Physlets (Christian & Belloni[18])	• Ranking Tasks (Maloney et. al.[19]) • Research-Based Textbooks: Chabay & Sherwood[20], Touger[21], Knight[22], Moore[23], Reif[24], Cummings et. al.[25] • Students discuss question/problem with neighbor(s) during lecture[26] • TIPERS (O'Kuma et.al.[19,27]) • Tutorials in Intro. Physics (McDermott[28]) • Web-based homework/tutoring[29]: CAPA[30]; Mastering Physics[31]; OWL[32]; UT-Austin[33]; WebAssign[34]	• Real Time Physics/Tools for Scientific Thinking Labs (Thornton et. al.[35]) • Socratic Dialog Inducing labs (Hake[36]) • Video-Based Labs (Beichner et. al.[37]; Zollman et al.[38])

Study Design

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See also: http://homepages.wmich.edu/~chenders/rbis.htm

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Levels of Use (LoU)

Instructor Behavior Related to a New Instructional Strategy

LoU 0: Non-Use	Instructor is neither using the instructional strategy nor taking any action to get involved.
LoU I: Orientation	Instructor is learning about the instructional strategy.
LoU II: Preparation	Instructor is getting ready to use the instructional strategy for the first time.
LoU III: Mechanical	Instructor is focusing most effort on day-to-day use of the instructional strategy.
LoU IVa: Routine	Use of the instructional strategy has stabilized.
LoU IVb: Refinement	Instructor is considering changing the instructional strategy to improve learning outcomes.
LoU V: Integration	Instructor coordinates use of the instructional strategy with colleagues.
LoU VI: Renewal	The instructor reevaluates the instructional strategy and seeks major modifications.

Theoretical Perspectives

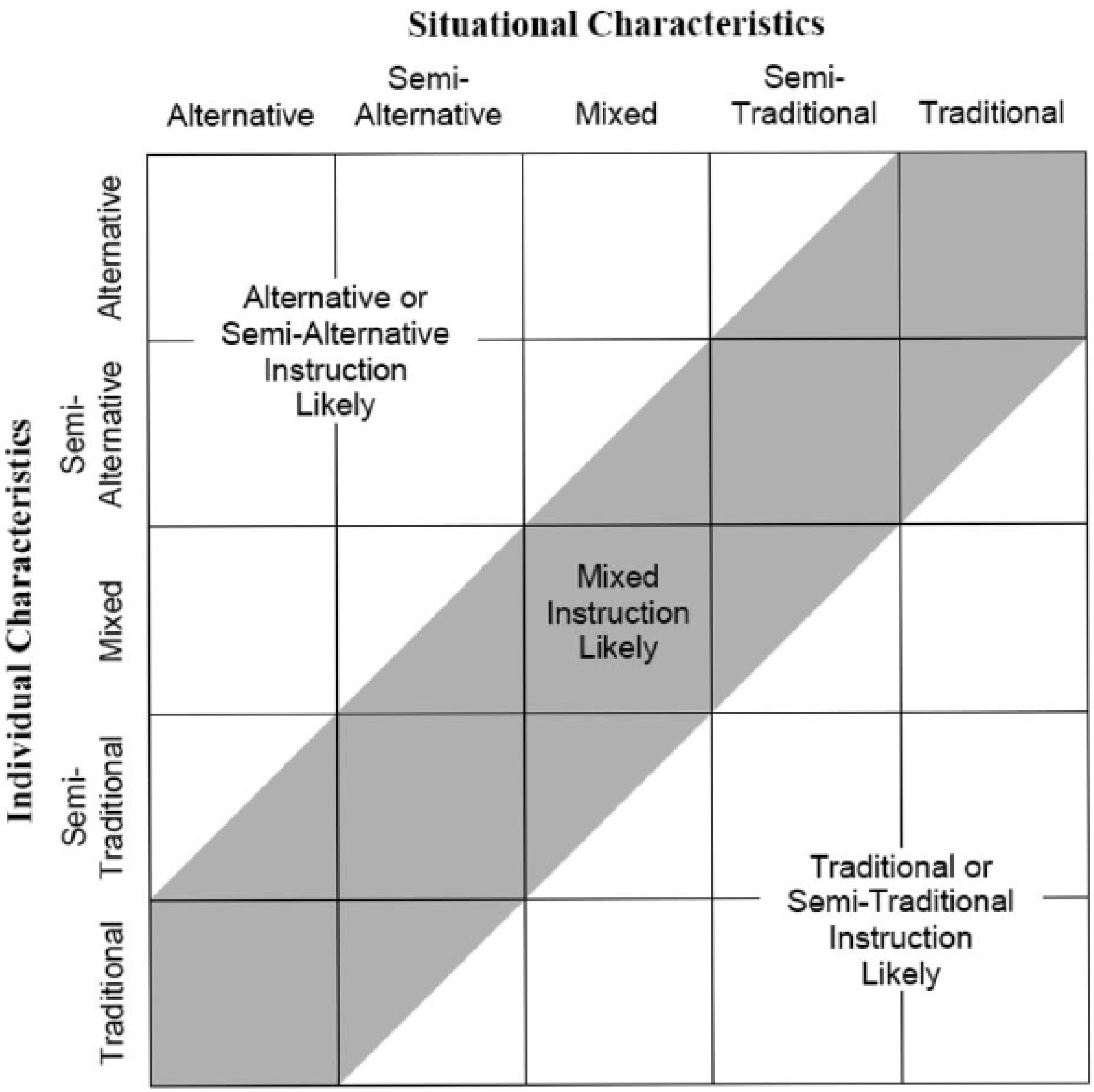
Innovation Configuration (IC)

How an Instructor Implements a New Instructional Strategy

An example IC checklist for the RBIS of "Peer Instruction". Shaded area represents use recommended by the developer.

Use of multiple-choice conceptual questions during lecture.	Never used.	Used less than once during every lecture or used only when covering certain topics.	Used about once each lecture.	Used several times during each lecture.
After asking a multiple-choice conceptual question.	The instructor answers the question immediately (with or without calling on a student volunteer.)	Students given a short time to consider the question individually. Instructor answers question or calls on student volunteer.	Students asked to consider the question individually and then all students vote on their choice. If most students are incorrect instructor conducts a whole-class discussion.	Students asked to consider the question individually and then vote on their choice. If most students are incorrect they are asked to discuss with a nearby classmate.
Planning for lecture.	A set lecture sequence is prepared in advance.	Basic idea for lecture is set in advance. Student questions are the biggest factor that determines how the lecture proceeds.	Basic idea for lecture is set in advance. Student responses to conceptual questions determine how the lecture proceeds.	No set plan for lecture, but allow student questions to determine how the class should proceed.
Conceptual questions on exams/tests.	Test contains no conceptual questions.	Less than 25% of score comes from conceptual questions.	Between 25% and 75% of score comes from conceptual questions	Over 75% of score is from conceptual questions.
Students reading textbook before class.	Students not expected to read text before class.	Students expected to read the text before class, but reading quizzes (or other similar method) are not used to enforce this.		Students expected to read the text before class. A short reading quiz is administered to enforce this.

Influence of Individual and Situational Characteristics



Change efforts often focus primarily on individual characteristics.

This is not likely to be effective if faculty work in traditional situations.

Adoption-Invention Continuum

Interactions Between Educational Researchers and Faculty

Educational Researchers expect adoption/adaptation.
Faculty engage in reinvention/invention.

Adoption	Adaptation	Reinvention	Invention
The change agent develops all of the materials and procedures and gives them to the instructor to implement as is.	The change agent develops the materials and procedures and gives them to the instructor who modifies some of the details before implementation.	The instructor uses the ideas or materials of the change agent but changes them significantly (i.e., changes a principle) or develops fundamentally new procedures or materials based on the change agent ideas.	The instructor develops materials and procedures that are fundamentally based on his/her own ideas.

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