



# **Easier Said Than Done: A Case Study of Instructional Change Under the Best of Circumstances**

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# The Problem

- **Research-based instructional practices have been shown to produce better student learning outcomes than traditional instructional practices.**
- **Many instructors still use traditional instructional practices.**



# Possible Reasons for Continued Instructor Use of Traditional Instructional Practices

•Instructor happy with traditional instruction.

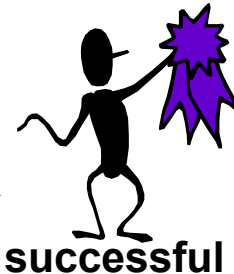


•Instructor not happy with traditional instruction, but does not know of anything that might be better.

•Instructor not happy with traditional instruction and aware of alternatives, but believes that he/she lacks necessary skills, resources, etc.



•Instructor not happy with current instruction and attempts to make changes.



successful



not successful



# What can be done to help more instructors be successful?

- We know that changing instructional practices is difficult.
- We don't know much about the instructional change process.

## Research Questions – A Case Study

1. How well do existing models of the change process describe the change process of one physics instructor?
2. What factors impeded the change process for this instructor?



# The Case - Dr. Holt

- Tenured faculty member at a research university
- 20 years teaching experience
- Planning to change his instruction to improve student learning (introductory calc-based E&M)
- Has taught the course ~30 times
- Course goals have always been to “have students develop a real understanding of physics concepts that they can use to solve novel problems”
- Expectations modified early in his career
  - “Students want to be given a formula they can plug things into, find an answer. And no matter how often I tell them that that’s not what the course is about it didn’t get through . . . Eventually, frankly, I had to make that what the course was about just in order to pass a reasonable number of students.”



# Dr. Holt had Characteristics Necessary for Successful Change

- Dissatisfied with outcomes of previous instruction
- Believed that changing instruction could have a significant impact on student learning
- Learned about PER-based instructional strategies and materials (reading, discussion, workshops, site visits)
- Participating in a national program to improve introductory physics teaching
  - **Support of a teacher-in-residence**
  - **Accountability**
- Forced reflection resulting from this study



# Basic Class Structure

- **Second Semester of Introductory Calculus-Based Physics (Electricity and Magnetism)**
- **5 Lectures/Week** (50 min. each)
  - **~70 students (mainly engineering majors)**
  - **Stadium-style seating**
- **1 Lab/Week** (2 hours)
  - **~20 students**
  - **Taught by TA's**



# Data Sources

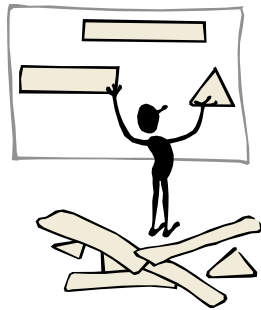
- **Weekly interviews** (15 interviews, 20-60 minutes each)
  - **Reflections on past week**
  - **Plans/goals for next week**
  - **Transcripts**
- **Daily class observations** (62 of 67 class days observed)
  - **Field notes**
- **Materials distributed to students** (syllabus, exams, HW)
  - **Artifacts**

## Focus of Data collection

- **Instructional materials**
- **Instructional strategies**
- **Beliefs about instruction**



# Data Analysis



## Time

Before week X  
(Plans)

After week X  
(Reflections, Practices)

## Topic

Individual instructional strategies, Instructor Concerns, Instructor satisfaction, etc.

## Data Sources

Interview  
(Materials)

Interview  
Materials  
Observations

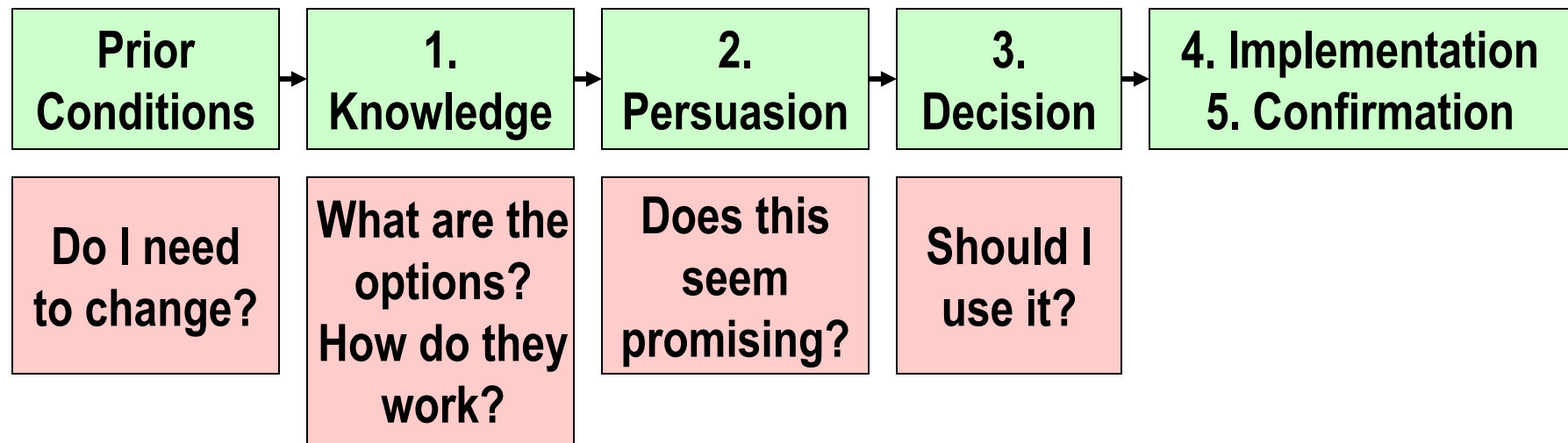
## Matrix Display to identify

- changes in ideas or practices in time
- relationship between practices, goals, and reflections

**Validity:** Dr. Holt reviewed and commented on all results/hypotheses



# The Change Process: A Typical Model\*



**Felt needs/  
problems**

**Types of  
Knowledge**

**Innovation  
Characteristics**

**Previous  
Practices**

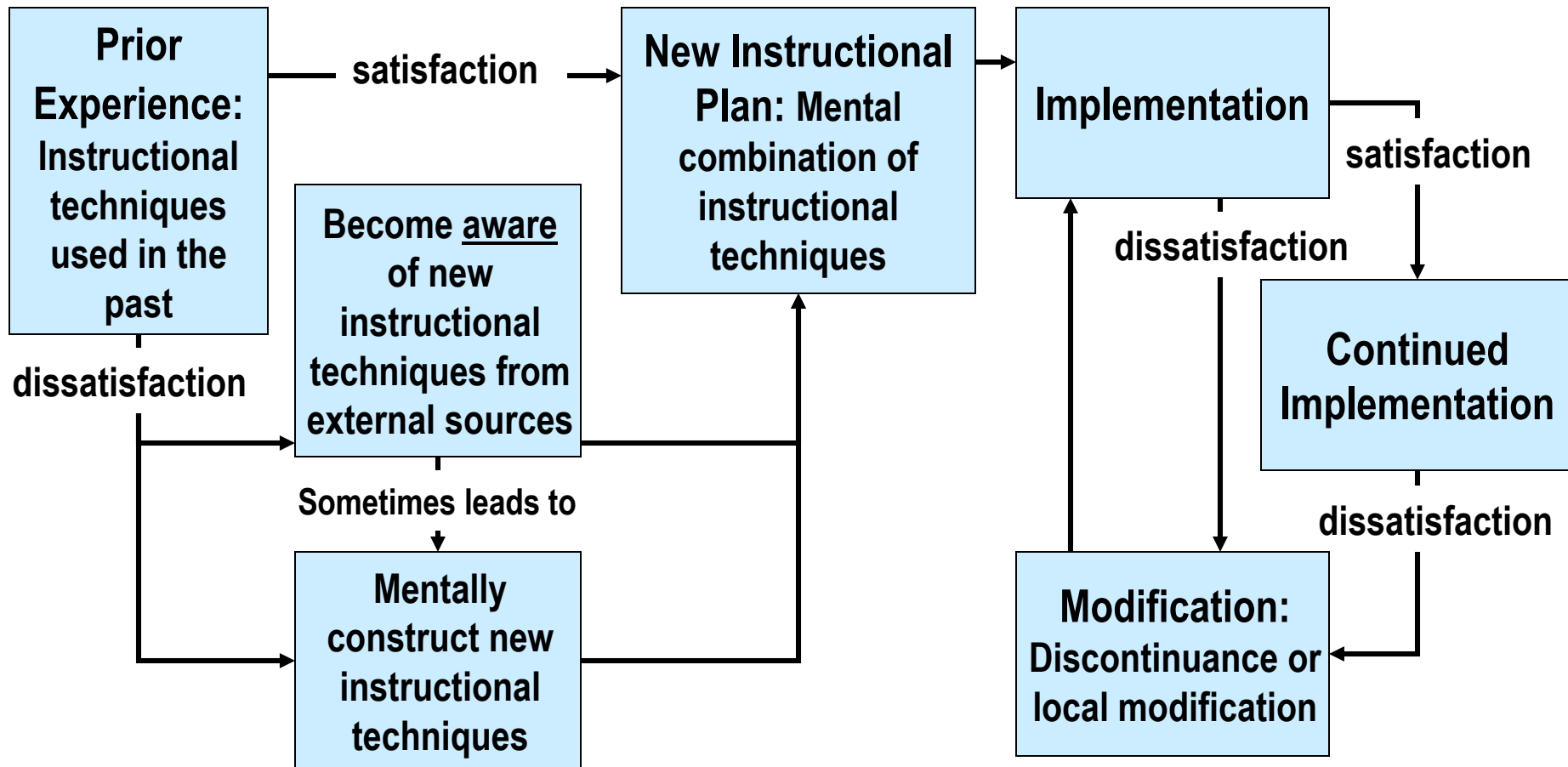
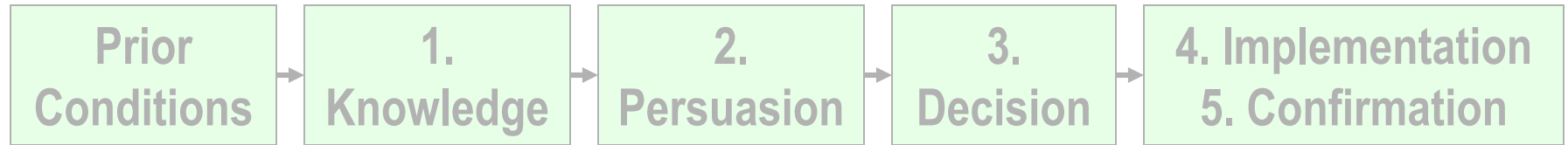
- Awareness
- How-to
- Principles

- Relative Advantage
- Compatibility
- Trialability
- Observability

\* E. M. Rogers (1995). Diffusion of Innovations (Simon & Schuster, New York)

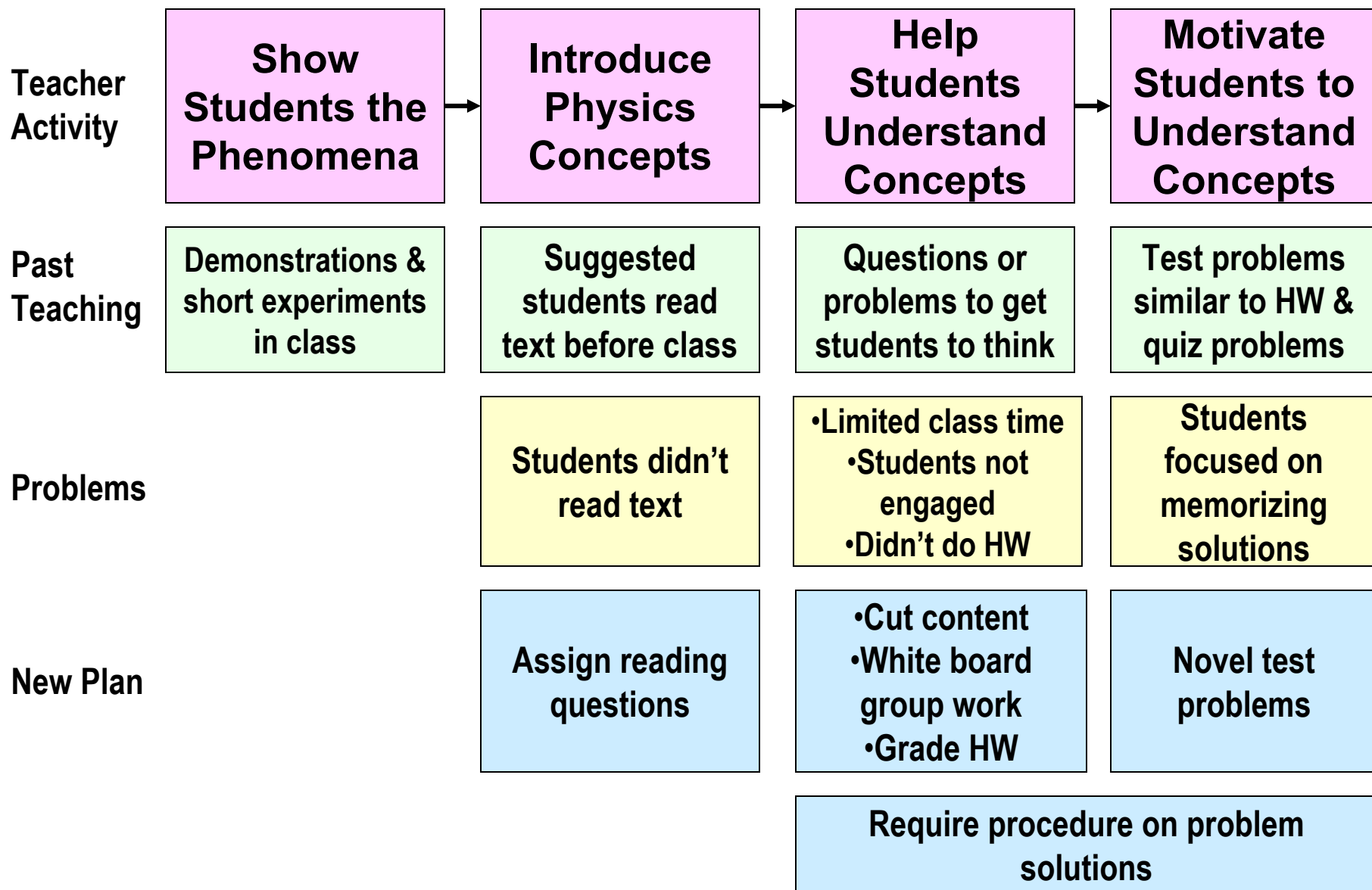


# Dr. Holt's Change Process





# Instructional Model Guided Change Process





## **Important Features of Change Process**

- **Dr. Holt had a basic instructional model that guided/constrained the change process**
- **Dr. Holt looked for or developed new instructional techniques to solve specific problems that kept him from fully implementing his instructional model in the past.**
- **Dr. Holt developed a new instructional plan before the course started.**
- **After initial implementation of his new instructional plan, Dr. Holt made local modifications.**



# Comparison of Dr. Holt's Change Process to Roger's Model

## Similarities

- General stages and sequence of stages

## Important Differences

- Innovations did not all come from external sources.

**Ex: Reading Questions**

- All innovations from external sources were changed significantly.

**Ex: White board group work, problem solving procedure**

- Implementation decisions were made based on minimal knowledge about the innovations.



# Course Outcomes

<b>CSEM Scores</b>	<b>Pre</b>	<b>Post</b>
Dr. Holt (N=43)	33%	60%
Comparison* (N~1000)	31%	47%

## Final Exam Scores (TA graded)

Similar distribution as previous years.

(Dr. Holt believes that student final exam performance is similar to that of previous years.)

## Student satisfaction

\*Data from calculus-based physics courses reported by: Maloney et. al. (2001) Surveying students' conceptual knowledge of electricity and magnetism. AJP Supplement 69(7).



# Success in Instructional Change

New Instructional Technique	Plan	Success
<b>Instructional Sequence</b> (manage instruction based on instructional model)	Show students phenomena one day, students read text that night, use concepts next day	Mixed success
<b>Reading Questions</b> (encourage students to read text)	Students turn in question about the assigned reading	Success
<b>White board group work</b> (engage students in class)	Have students work on questions in small groups.	Major problems
<b>Multiple-choice ConcepTests</b> (engage students in class)	Students discuss and vote on answers (Mazur-style).	N/A (rarely used)
<b>Grade HW</b> (encourage students to do HW)	Collect HW set and grade 1 problem.	Success
<b>Novel questions on tests</b> (discourage rote problem solving)		Major Problems
<b>Problem-Solving Procedure</b> (discourage rote problem solving)	Require students to include a procedure with most problem solutions.	Mixed Success



# Impediments to Change

## 1. Dr. Holt's instructional model constrained his instructional choices.

e.g., Believed that students could solve problems if they really understood concepts → placed little emphasis on modeling/teaching problem solving skills.

## 2. Dr. Holt did not seek to gain much knowledge about new instructional techniques.

e.g., Implementation of group work not based on how-to and principles knowledge. Students became progressively less engaged in group activities.

## 3. Planning was overly optimistic.

Planning did not anticipate possible problems. Planning did not anticipate the considerable time and energy change requires.

## 4. The implementation of the new instructional plan was overridden by perceived external constraints.

Most notably the need to cover material.



# Implications

## For Curriculum Developers:

**Innovative instructional strategies and materials may be reinvented for each implementation.**

- **Innovations must be robust.**
- **Innovations are more likely to be used if it is easy to use certain parts and/or make modifications.**
- **Innovations should clearly identify the essential elements.**

## For Professional Development Providers:

**An instructors' instructional model appears to be very important in determining what changes will be considered and how these changes will be implemented.**

- **It is important to find out about these models.**

**Instructional change is a long-term evolutionary process.**

- **To be successful, instructors need different types of support at different times.**



# The End

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