

# Helping Physics Majors Prepare for Teaching Careers

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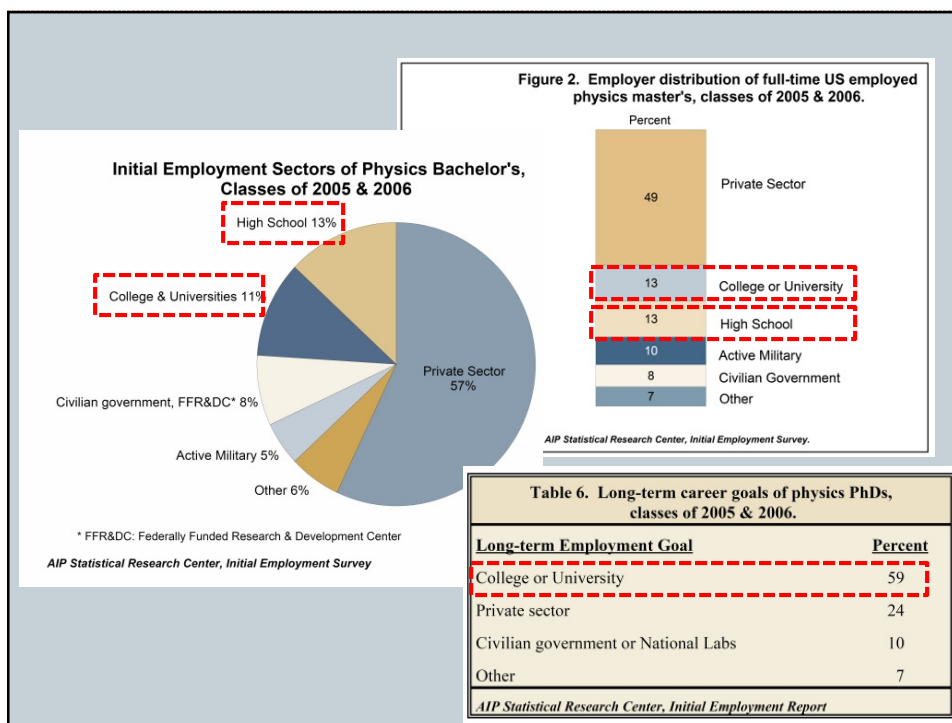
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## Overview

- Physics Department's Role in Preparing Teachers
- Study Description
- Paradigms in Physics
- The Teachers
- What they said...
- Mestre's List of Ideal Attributes
- Conclusions

## Physics Departments & Preparing Teachers

- Physics Content Knowledge
- Collaborations with School of Education
  - PhysTec
  - Learning Assistants
- APS & AAPT: “Double Physics Majors”
- More than just HS teachers



## Physics Departments & Preparing Teachers

Types of teacher knowledge (Ball, Thames, Phelps; 2008):

Knowledge of Teaching	}	Education Methods Courses
Knowledge of Students		
Common Content Knowledge	→	Physics Courses
Specialized Content Knowledge	→	Physics Courses? On the job?
Content Knowledge & Students	}	On the job?
Content Knowledge & Teaching		

## This Study

In what ways do the Paradigms in Physics address the needs of pre-service teachers?

What Paradigms experiences do teacher's point to as being useful in their training?

- Exploratory study
- Interviews with 3 teachers
- Analysis of Paradigms with Mestre's Ideal Attributes

## Paradigms in Physics

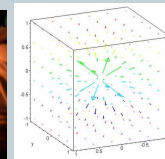
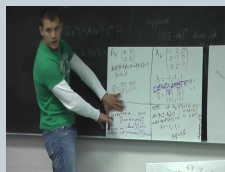
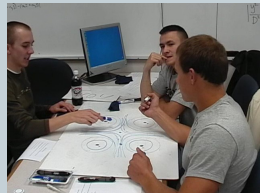
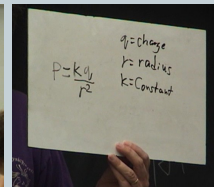
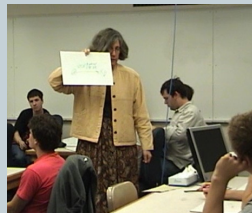
- Oregon State University
- Junior year courses for physics majors



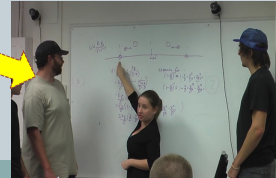
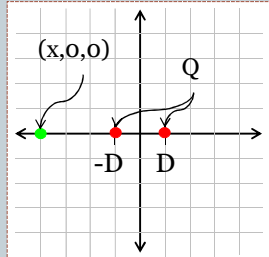
- Course restructuring
  - 6 courses – 10 weeks – 3 hrs/week - 2 per term - parallel
  - 9 courses – 3 weeks – 7 hrs/week - 3 per term - series
- Content Reorder
  - Mix & Match topics from traditional courses
  - Central Forces = Classical Orbits
  - Hydrogen Atom
  - Separation of Variables
  - Series Solutions

## Paradigms in Physics

- “Interactive Engagement” Teaching Strategies



## Compare & Contrast Activity



## The Teachers

“Dave”



“Larry”



“John”



## What they said...

- Self-report **using/planning to use interactive teaching strategies** seen in Paradigms (esp. small whiteboards, group problem-solving)
- Experience in Paradigms **aligns with Teaching Methods courses**
- Reported **“learning how to solve problems”** in Paradigms – unsolvable by individuals, collaboration essential
- Valued **interactions with peers & instructors** for learning physics and for **learning how to communicate about physics** (making clear explanations, asking questions, interpreting others)
- Valued interactions with peers for **experience with different learning styles/ideas**
- Valued interactions with peers for **learning about physics students**
- Would like to have had a **lower-division course** with Paradigms-like teaching strategies.

## Mestre's List of Ideal Attributes

Ideal Attribute	Paradigms
Course <b>integrates content and pedagogy</b> (PCK)	<b>Pedagogical strategies made explicit</b> but <b>instruction in pedagogy not</b> a part of the course
Students <b>construct and make sense</b> of their physics and pedagogical knowledge	Students construct their physics knowledge through <b>class activities and small whiteboard questions (SWBQ's)</b> . Students are exposed to multiple pedagogical strategies and their rationale, but <b>pedagogical knowledge is not</b> explicitly covered.
Course is content-rich, emphasizes <b>deep understanding of a few major topics</b>	Content order of Paradigms centers on <b>major ideas in physics. Varied, student-centered pedagogical strategies</b> encourage deep understanding

Mestre, 2000

## Mestre's List of Ideal Attributes

Ideal Attribute	Paradigms
Course provides opportunities for learning <b>the process of doing science</b>	Development of <b>professional skills and habits of mind are emphasized</b> (reports, projects, sense-making activities)
Students apply their knowledge <b>flexibly across contexts</b>	<b>Authentic problem-solving activities</b> encourage flexibility. <b>Themes across Paradigms</b> allow students to practice applying knowledge across contexts
Courses promote <b>organizing content knowledge</b> according to some <b>hierarchy</b>	<b>Paradigm content order</b> centers on major ideas in physics. <b>Concept-mapping</b> activities encourage awareness of knowledge organization

## Mestre's List of Ideal Attributes

Ideal Attribute	Paradigms
Students <b>practice constructing qualitative arguments</b> to explain to explain phenomena/ experimental findings or <b>highlight major components of a problem solution</b>	<b>Group problem-solving activities, class presentations, lab write-ups, and writing assignments</b> provide opportunities for students to practice making qualitative and quantitative explanations
Course attempts to teach <b>metacognitive strategies</b>	Metacognitive strategies explicitly addressed by instructor during <b>group problem solving activities</b> . Courses emphasize practice " <b>thinking like a physicist</b> "
<b>Formative assessment</b> should be used frequently	<b>Small whiteboard questions and table-top whiteboards</b> allow instructor to monitor students' progress and address students' ideas

## Summary

- Teachers more impressed by teaching strategies than by content order/presentation
- Teachers emphasized interactions with peers as important
- Paradigms aligns well with Mestre's list of Ideal Attributes – except no explicit discussion of PCK
- Interactive teaching strategies may serve our students well in preparing them for their future careers.

## Learn more about Paradigms

[www.physics.oregonstate.edu/portfolioswiki](http://www.physics.oregonstate.edu/portfolioswiki)

Search: **portfolioswiki**

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You are here: start

### Paradigms in Physics

*Teaching is the art of leading students into a situation in which they can only escape by thinking.*  
— Dr. C. T. Bassoppo-Moyo

The Paradigms in Physics team is embarking on a new project to put detailed information about the various activities that we have developed on the web to encourage adoption by faculty at other institutions. We have already described our program as a whole in two papers and a general website . We are currently experimenting with a wiki format so that users will be able to offer detailed feedback. We expect this site to be updated on a nearly daily basis. Check back often!

You may enter this website at six different levels: individual activities arranged by content, individual activities arranged by pedagogical strategy, sequences of activities that we have found work well together to achieve particular pedagogical goals, descriptions of our courses, descriptions of things we have learned about how students learn and descriptions of things we have learned about how departments and teachers change.

- [More about us and our partners](#)
- [Reading mathematics in this Wiki](#)

navigation

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