Promoting Instructional Change: Beyond an Emphasis Curriculum

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Three Groups Focused on Change in Undergraduate STEM Instruction

Disciplinary Science Education Researchers (SER)  
Housed in the science disciplines in College of Arts and Sciences

Faculty Development Researchers (FDR)  
Housed in Center for Teaching and Learning (if at all)

Higher Education Researchers (HER)  
Housed in College of Education

How do these three groups compare in terms of?  
• Goals for changes  
• Focus of research  
• Actions designed to bring about change
Three Recent Literature Reviews

Disciplinary Science Education Researchers (SER)

Faculty Development Researchers (FDR)

Higher Education Researchers (HER)

First Observation

No overlap in references! → No communication between groups

<table>
<thead>
<tr>
<th>Field</th>
<th>Article</th>
<th>Number of References</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SER]</td>
<td>Seymour (2001)</td>
<td>77</td>
</tr>
<tr>
<td>[FDR]</td>
<td>Emerson &amp; Mosteller (2000)</td>
<td>34</td>
</tr>
</tbody>
</table>
Three Groups - One Common Goal

Transform undergraduate education from the instruction paradigm to the learning paradigm.

### Chart 1: Comparing Educational Paradigms

<table>
<thead>
<tr>
<th>The Instruction Paradigm</th>
<th>The Learning Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission and Purposes</td>
<td></td>
</tr>
<tr>
<td>➤ Provide/deliver instruction</td>
<td>➤ Produce learning</td>
</tr>
<tr>
<td>➤ Transfer knowledge from faculty to students</td>
<td>➤ Elicit student discovery and construction of knowledge</td>
</tr>
<tr>
<td>➤ Offer courses and programs</td>
<td>➤ Create powerful learning environments</td>
</tr>
<tr>
<td>➤ Improve the quality of instruction</td>
<td>➤ Improve the quality of learning</td>
</tr>
<tr>
<td>➤ Achieve access for diverse students</td>
<td>➤ Achieve success for diverse students</td>
</tr>
<tr>
<td>Teaching/Learning Structures</td>
<td></td>
</tr>
<tr>
<td>➤ Atomistic; parts prior to whole</td>
<td>➤ Holistic; whole prior to parts</td>
</tr>
<tr>
<td>➤ Time held constant, learning varies</td>
<td>➤ Learning held constant, time varies</td>
</tr>
<tr>
<td>➤ 50-minute lecture, 3-credit course</td>
<td>➤ Learning environments</td>
</tr>
<tr>
<td>➤ Classes start/stop at same time</td>
<td>➤ Environment ready when student is</td>
</tr>
<tr>
<td>➤ One teacher, one classroom</td>
<td>➤ Whatever learning experience works</td>
</tr>
<tr>
<td>➤ Independent disciplines, departments</td>
<td>➤ Cross-discipline/department collaboration</td>
</tr>
<tr>
<td>➤ Covering material</td>
<td>➤ Specified learning results</td>
</tr>
<tr>
<td>➤ End-of-course assessment</td>
<td>➤ Pre/during/post assessments</td>
</tr>
<tr>
<td>➤ Grading within classes by instructors</td>
<td>➤ External evaluations of learning</td>
</tr>
<tr>
<td>➤ Private assessment</td>
<td>➤ Public assessment</td>
</tr>
<tr>
<td>➤ Degree equals accumulated credit hours</td>
<td>➤ Degree equals demonstrated knowledge and skills</td>
</tr>
</tbody>
</table>

Three Groups – Three Foci

- **(SER)**
  - Conduct research and develop curricular materials
  - Disseminate these curricula to other faculty

- **(FDR)**
  - Motivate/empower individual teachers or small groups to focus on instructional improvement

- **(HER)**
  - Study how institutional structures influence teacher practices and student learning
Three Change Models

Important parts of the System

Disciplinary Science Education Researchers (SER): Bottom-Up Change Models (focus on curriculum)

Funding Agencies → Science Education Researchers

Funding for specific curriculum development projects

Curriculum developers conduct research and develop/test innovations

Strong Evidence

Innovation spreads to other faculty and continues to spread

Once enough faculty use innovation it begins to influence other parts of the system

Little or No Evidence
Faculty Development Researchers (FDR): Faculty-Directed Change Models (focus on teachers)

Interventions are effective when they are:
1. Collegial
2. Exist over an extended time
3. Focus on specific goals

No Evidence that this strategy can promote widespread change

*Emerson & Mosteller, 2000

Higher Education Researchers (HER): Top-Down Planned Change Models (focus on structures)

Significant evidence that institutional structures can prevent change, but no evidence that changing structures alone is enough to cause change.

Change institutional reward system to reward faculty for developing and using innovative instruction. Faculty change behavior because of this change in reward system.
## Strengths and Weaknesses

<table>
<thead>
<tr>
<th></th>
<th>SER</th>
<th>FDR</th>
<th>HER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Curriculum</td>
<td>Teachers</td>
<td>Structures</td>
</tr>
<tr>
<td>Strengths</td>
<td>Developing good curricula is beyond the skills and available time of most faculty</td>
<td>Treats faculty as professionals Customization of curricula is typically necessary</td>
<td>Traditional structures are barriers to change</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Faculty may use curricula inappropriately (or not at all) Most effective curricula conflict with traditional structures</td>
<td>Faculty working in isolation may reinvent the wheel Traditional structures do not reward faculty for a focus on teaching</td>
<td>Faculty may subvert structural changes External structures (e.g., disciplinary cultures) strongly shape faculty work</td>
</tr>
</tbody>
</table>

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### Each Group Focuses on an Important Part of the Problem

So oft in theologic wars, The disputants, I ween, Rail on in utter ignorance Of what each other mean, And prate about an Elephant Not one of them has seen!  
- John Godfrey Saxe  
(retrieved from: http://www.cs.rice.edu/~ssiyer/minstrels/poems/1179.html)
**Conclusion**

An appropriate change strategy should address all three aspects.

It should be explicit about:

• Which aspects are currently aligned with the proposed change and which will provide barriers.

• How to eliminate or work around the barriers.

**A Promising Approach:**

*Promote Teacher Customization*

Explicitly accept current structural constraints, but provide teachers assistance in customizing research-based techniques to their own unique situations.

**Examples:**

• *Weizmann Institute (Israel) – Ongoing teacher workshops focused on promoting student self-monitoring in problem solving*


• *University of Maryland – Open-source tutorials integrated with professional development materials*

  http://www2.physics.umd.edu/~elby/CCLI/index.html
Another Promising Approach: Department-Level Structural Change

Change departmental structures and curriculum. Ensure that changes do not conflict deeply with faculty or disciplinary beliefs and that it is easier for faculty to go along with changes than to teach traditionally.

Example:
• University of Illinois, Urbana-Champaign – Recreating university physics to align with educational research
  [http://www.aps.org/units/fed/newsletters/aug97/index.cfm#campbell]

The End

http://homepages.wmich.edu/~chenders/

Thanks to
Noah Finkelstein
R. Sam Larson

For their discussions on this topic.

Look for further discussion of these issues at a NSF-sponsored conference in June 2008 in Michigan:

“Facilitating Change in Undergraduate STEM: Integrating Multiple Perspectives”