A Post-Positivist Perspective on Physics Education Reform

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**Abstract**

- Most instruction is content oriented, transmission based and individual while most PER-based reforms are process oriented, constructivism based and cooperative. We suggest that this contradiction can be understand though post-positivism and that positivism is a large force acting against fundamental reforms in science education such as those generally supported by the PER community.
Contradictions

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Reformed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Focused</td>
<td>Process Focused</td>
</tr>
<tr>
<td>Transmissionism</td>
<td>Constructivism</td>
</tr>
<tr>
<td>Individual or Competitive</td>
<td>Cooperative</td>
</tr>
</tbody>
</table>

- Are these random associations?
- What larger belief system might tie these together?

<table>
<thead>
<tr>
<th>Positivism (Modernism)</th>
<th>Post-Positivism (Post-Modernism)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Truth” is objective, knowable, separate from human thought.</td>
<td>Knowledge is tied to culture, political context, social status, etc.</td>
</tr>
<tr>
<td>Valid knowledge is testable, based on empirical observation of reality, and falsifiable.</td>
<td>Value-free knowledge doesn’t exist.</td>
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</table>
But an apple will fall in every culture this is an objective fact, right?

- But our **understanding** of the essence of “gravity” and the way we **use** that understanding, is not separate from our culture, our values, our social status.

“Truth” in Science

- What questions are asked, what questions are not asked (or not allowed)?

To: Dept of Energy, NSF, DOD website's (6/29/06)
• What methods are acceptable for asking questions? What “truth” is excluded by disallowing other ways of asking questions?

II. HOW TO EVALUATE WHETHER AN INTERVENTION IS BACKED BY "STRONG" EVIDENCE OF EFFECTIVENESS.

This section discusses how to evaluate whether an intervention is backed by "strong" evidence that it will improve educational outcomes in your schools or classrooms. Specifically, it discusses both the quality and quantity of studies needed to establish such evidence.

A. Quality of evidence needed to establish "strong" evidence of effectiveness: Randomized controlled trials that are well-designed and implemented.

As discussed in section I, randomized controlled trials are a critical factor in establishing "strong" evidence of an intervention’s effectiveness. Randomized controlled trials...
Knowledge and values can not be separate!

- Post-positivism doesn’t claim that there is no objective reality, only that reality can’t be known or understood separate from culture/values.
  - Why are students required to study “gravity” but not small engine repair, woodworking, piano performance, or yoga?
- The concept of gravity is valued, our understanding of it is influenced by our culture.
## Two Perspectives on Education

<table>
<thead>
<tr>
<th></th>
<th><strong>Positivist</strong> (Traditional)</th>
<th><strong>Post-Positivist</strong> (Research-Promoted)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View of Knowledge</strong></td>
<td>Knowledge is objective, Scientifically constructed</td>
<td>Knowledge is dynamic, Socially constructed</td>
</tr>
<tr>
<td><strong>What should be taught?</strong></td>
<td>Content</td>
<td>Process</td>
</tr>
<tr>
<td><strong>Role of the Teacher</strong></td>
<td>Expert</td>
<td>Collaborator</td>
</tr>
<tr>
<td><strong>Role in Society</strong></td>
<td>Certify/Credential</td>
<td>Foster intellectual growth</td>
</tr>
<tr>
<td><strong>Role of Classmates</strong></td>
<td>Not necessary/intrusive</td>
<td>Essential for knowledge construction</td>
</tr>
<tr>
<td><strong>Teaching Methods</strong></td>
<td>Transmission of Knowledge</td>
<td>Constructivism and Inquiry</td>
</tr>
</tbody>
</table>

## Shifting the Paradigm

- Post-Positivism provides a philosophical framework to understand contradictions.
  - Why do most physics teachers list problem solving as a very important goal then teach only content?
  - Why do they say they want students to learn to think independently but then only provide highly structured activities?
Mixed Paradigm Thinking → Inconsistencies

Positivism

Region of Inconsistency

Post-Positivism

Drill-n-Practice
Teacher Centered
Content Focus
Inquiry
Cooperation
Physics for All

Lecturing
Competition
Physics for Few
Discussion
Real-World Problems
Process Focus

Physics for All