

Motivation

“Physics education reform has been focusing largely on classroom-based innovation rather than on the more political and institutional conditions required for long-lasting change. There appears to be a presumption at work among reformers that innovation inevitably leads to change.”

Tobias, S. (2000). From innovation to change: Forging a physics education reform agenda for the 21st century. *American Journal of Physics*, 68(2), 103-104.

Research Questions

- 1) What core strategies are used to promote change in undergraduate STEM education instructional practices?
- 2) What are the similarities and differences in strategies used by STEM education researchers (SER), faculty development researchers (FDR), and higher education researchers (HER)?

Selection Criteria

Results presented here are based on an interdisciplinary literature review of journal articles published between 1995 and 2008. Multiple scans of key international databases were undertaken with different combinations of terms related to change, teaching, instruction and higher education. We then specifically examined the journals that appeared to produce the greatest number of articles that fit our inclusion criteria to ensure that we had gleaned all the relevant literature they offered. Finally, we examined the reference lists of the articles identified as most closely fitting our inclusion criteria. The final database contains 195 journal articles.

Two Categorization Criteria

Question 1: What is the primary aspect of the system that the change approach seeks to directly impact?

Individuals Environments and Structures

Definition: The change intends to directly impact personal characteristics of single individuals, such as beliefs, knowledge, behaviors, etc.

Definition: The change intends to directly impact characteristics of the system that are external to single individuals, such as rules, physical characteristics of the environment (e.g., room layout, technology), norms, etc.

Implicit Assumption: Individuals' actions are primarily influenced by their own volition

Implicit Assumption: Individuals' actions are primarily influenced by external environments

Question 2: To what extent is the intended outcome for the individual or environment known in advance?

Prescribed Emergent

Definition: The desired final state for the individual or environment is known at the beginning of the change process.

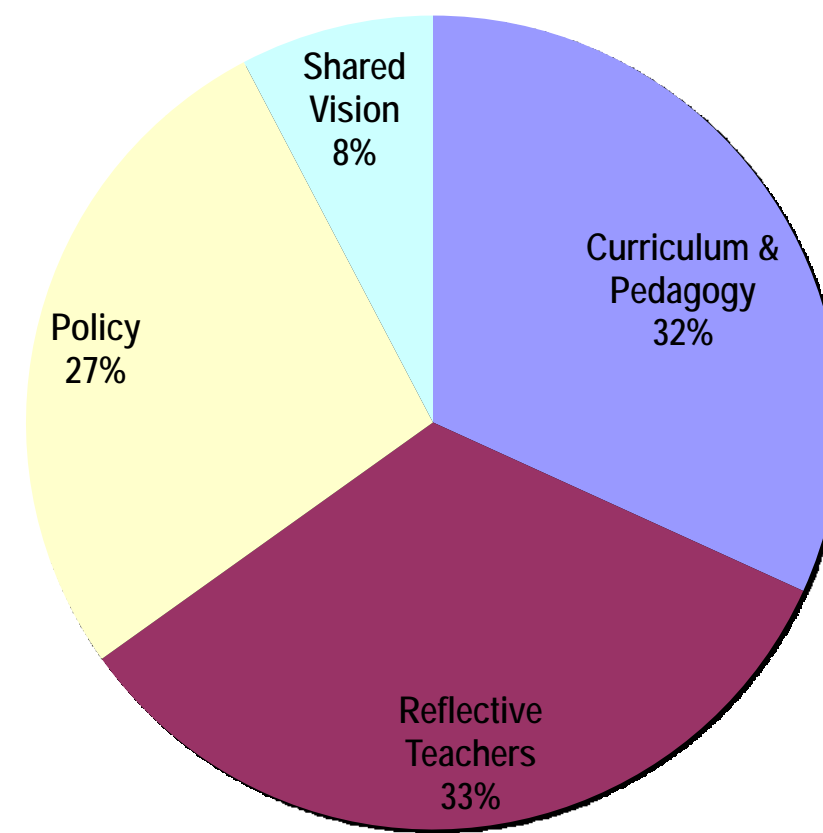
Definition: The desired final state for the individual or environment is developed as part of the change process.

Implicit Assumption: Important knowledge relevant to change outcome is known to a few people (e.g., experts). Therefore a small group should determine the intended outcome.

Implicit Assumption: Important knowledge relevant to change outcome exists in individuals throughout the system. Therefore a variety of stakeholders should be involved in determining the intended outcome.

Analysis – All Authors

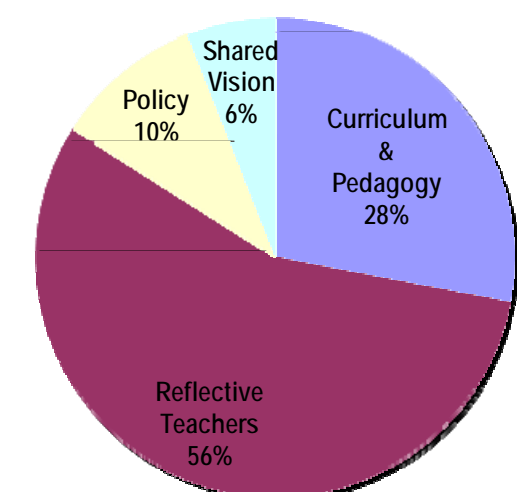
From the 195 articles which were reviewed in detail, they were roughly equally distributed amongst three quadrants: disseminating curriculum and pedagogy, developing reflective teachers, and developing policy. There were a much smaller number of articles coded as developing share vision.



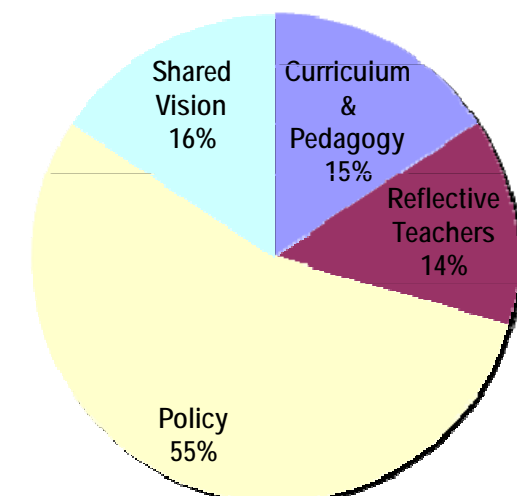
Analysis – FDR and HER Authors

Using the same method, we selected out articles that contained at least one FDR, or one HER author. Faculty development researchers focus on developing reflective teachers, while higher education research focus on developing policy.

FDR(N=50)

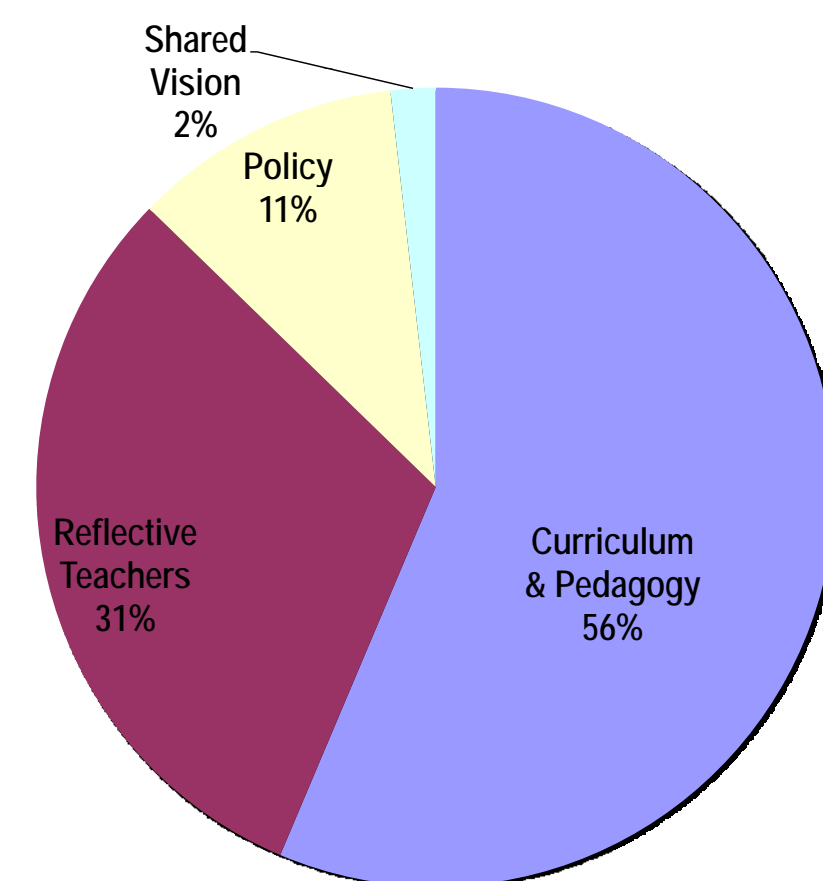


HER(N=51)

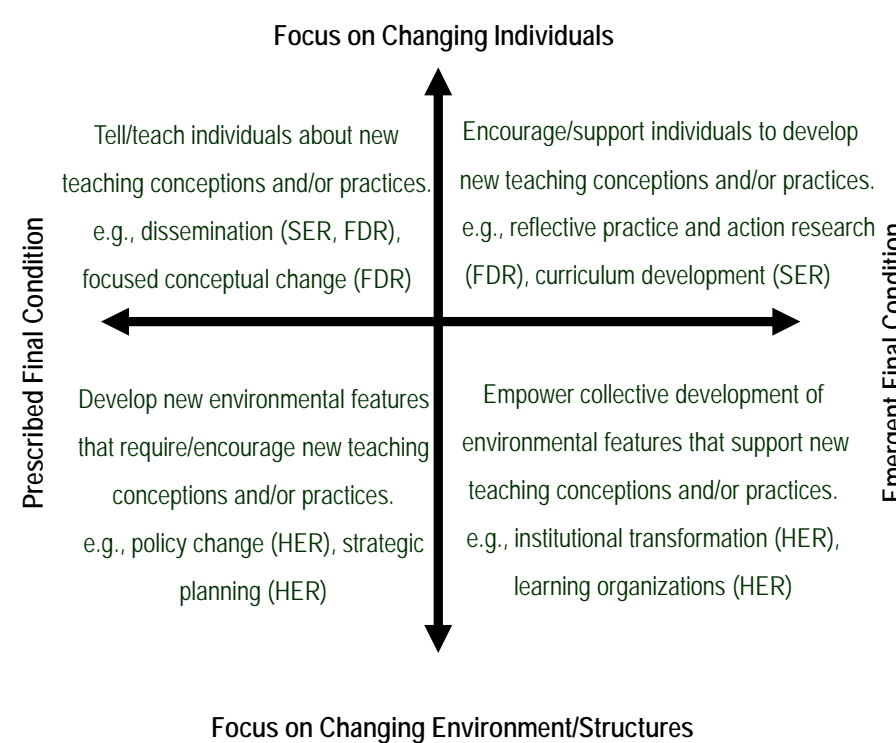


Analysis – STEM Authors

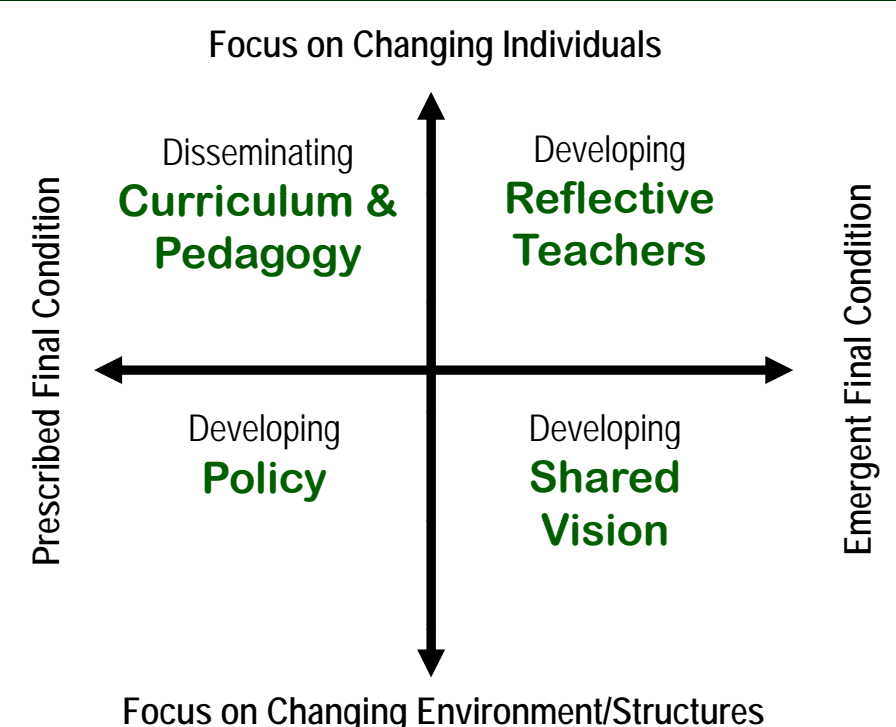
There were 55 articles with at least one author who is a science education researcher (PER is included). The distribution of these 55 articles is very different from the overall distribution. More than half of the articles fell into the category disseminating curriculum and pedagogy. About a third of articles are about developing reflective teachers. Only a small percentage of them fell into either developing policy or developing share vision.



Four Categories of Change Strategies



Category Labels



Discussion

Tobias is concerned that physics education researchers focus more on developing new curricula but do not apply other strategies to promote instructional change. Namely, strategies that target institutional culture and belief systems. By reviewing STEM change literature, we found that science education researchers mostly take the approach of developing and disseminating innovative curricula and pedagogy, but rarely consider developing policy or share vision. For achieving long term sustainable change in STEM education, physics education researchers should look for opportunities to cooperate with researchers from faculty development and higher education, and also include developing policy and share vision into their approach.

More Information

<http://www.wmich.edu/science/facilitating-change>
<http://homepages.wmich.edu/~chenders>

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