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# Implementing Change in STEM Education

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# Implementing Change in STEM Education

Research and Desert Workshop

Nov 16, 2012

Charles Henderson

# Agenda

- A brief overview of strategies for creating change in undergraduate STEM education
- Developing Collaborations
  - Identifying areas of interest – research questions
  - Making connections
- Next Steps

# Strategies for Creating Change in Undergraduate STEM education

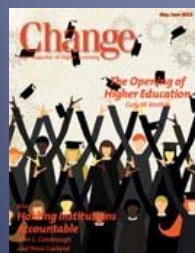
- Results of an interdisciplinary literature review of 191 Journal articles published between 1995 and 2008\*



Henderson, C., Beach, A., & Finkelstein, N. (2011) Facilitating Change in Undergraduate STEM Instructional Practices: An Analytic Review of the Literature, *Journal of Research in Science Teaching*, 48 (8), 952-984.



Henderson, C., Finkelstein, N. & Beach A. (2010). Beyond Dissemination in College science teaching: An Introduction to Four Core Change Strategies, *Journal of College Science Teaching*, 39(5), 18-25.



Beach, A., Henderson, C., & Finkelstein, N. (2012). Facilitating Change in Undergraduate STEM Education: Implications from an analytic review of literature, *Change: The Magazine of Higher Learning*, Nov/Dec, 48-55.

\*Supported by NSF DRL-0723699

# Three Groups Focused on Change in Undergraduate STEM Instruction

- Disciplinary STEM Education Researchers (SER)  
Housed in the STEM disciplines in College of Arts and Sciences or Engineering, Sometimes in College of Education or in STEM professional societies
- Faculty Development Researchers (FDR)  
Housed in Center for Teaching and Learning
- Higher Education Researchers (HER)  
Housed in College of Education, Administration, or Government

Each group has their own professional societies, conferences, journals, etc.

# Categories of Change Strategies Based on Two Dimensions

1. What does the change effort intend to directly impact?

<b>Individuals</b>	<b>Environments and Structures</b>
The change intends to directly impact personal characteristics of single individuals, such as beliefs, knowledge, behaviors, etc.	The change intends to directly impact extra-individual characteristics of the system such as rules, physical characteristics of the environment, norms, etc.

2. To what extent is the outcome prescribed in advance?

<b>Prescribed Final State</b>	<b>Emergent Final State</b>
The desired final state for the individual or environment is known at the beginning of the change process.	The desired final state for the individual or environment is developed as part of the change process.

# Four Categories of Change Strategies

Focus on Changing Individuals

**Tell/teach individuals** about new teaching conceptions and/or practices.  
e.g., dissemination (SER, FDR), focused conceptual change (FDR)

**Encourage/support individuals** to develop new teaching conceptions and/or practices.  
e.g., reflective practice, (FDR), action research (FDR), curriculum development (FDR, SER)

**Develop new environmental features** that require/encourage new teaching conceptions and/or practices.  
e.g., policy change (HER), strategic planning (HER)

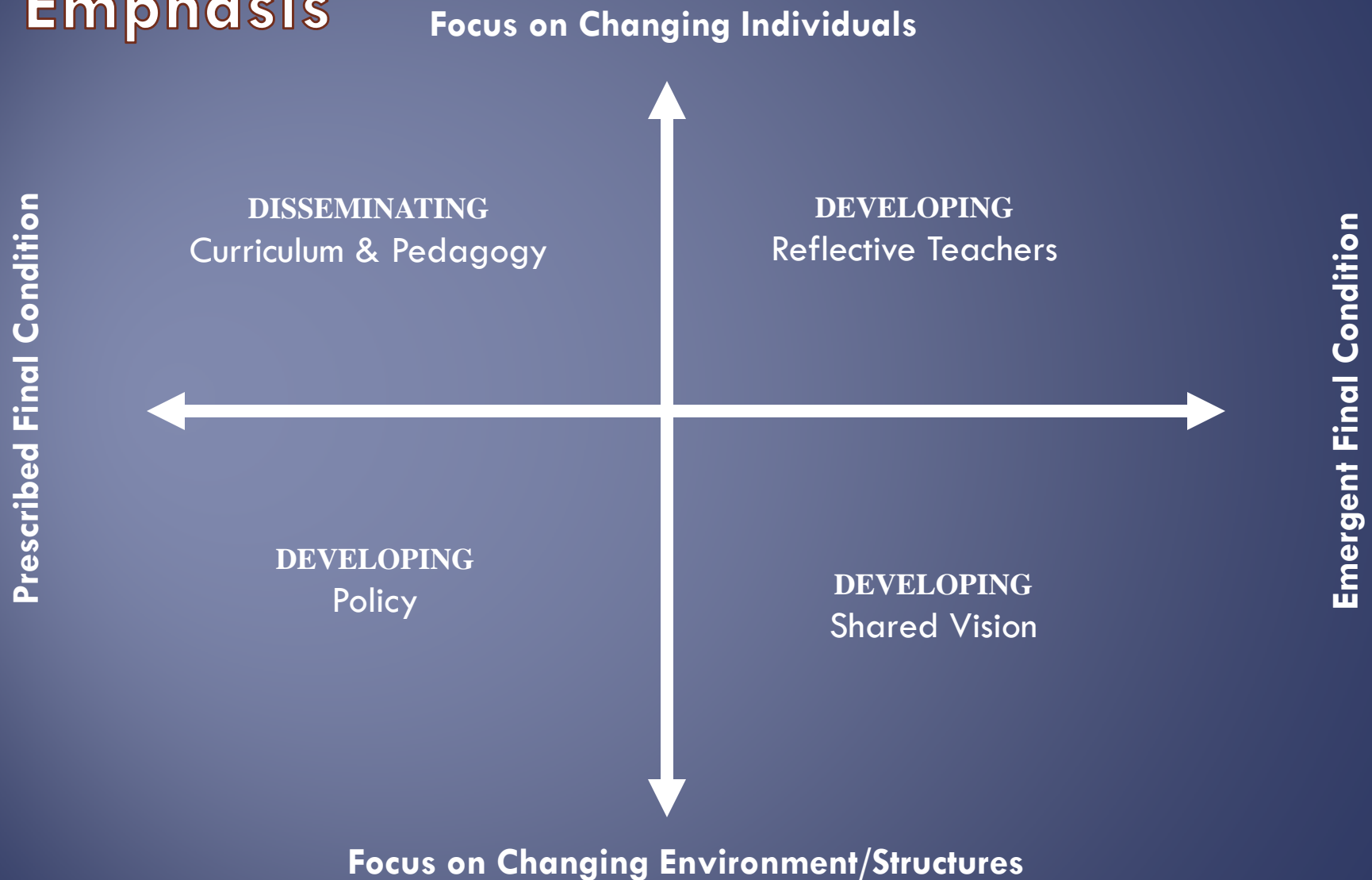
**Empower collective development** of environmental features that support new teaching conceptions and/or practices.  
e.g., institutional transformation (HER), learning organizations (HER)

Prescribed Final Condition

Emergent Final Condition

Focus on Changing Environment/Structures

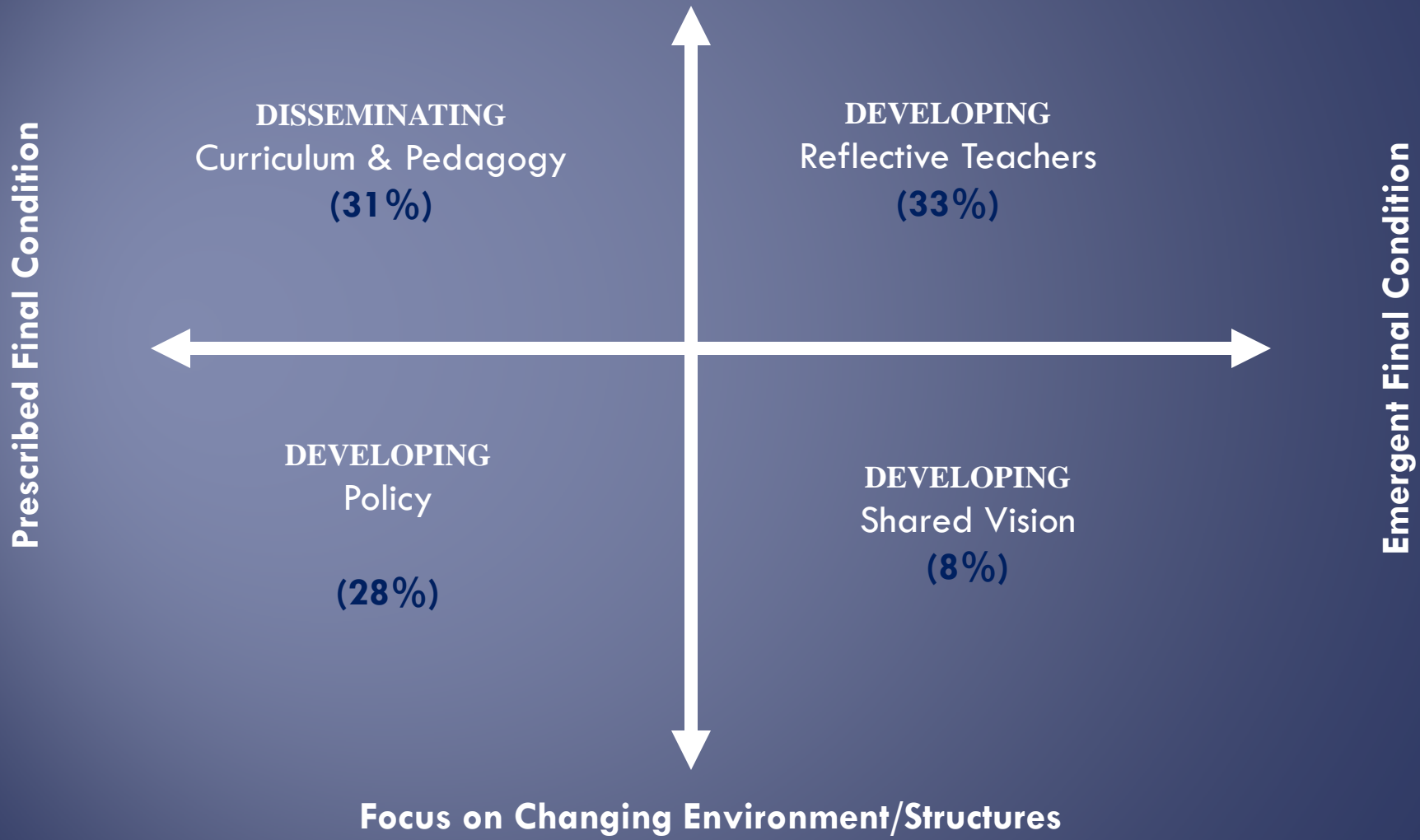
# Each Type of Strategy has a Unique Emphasis



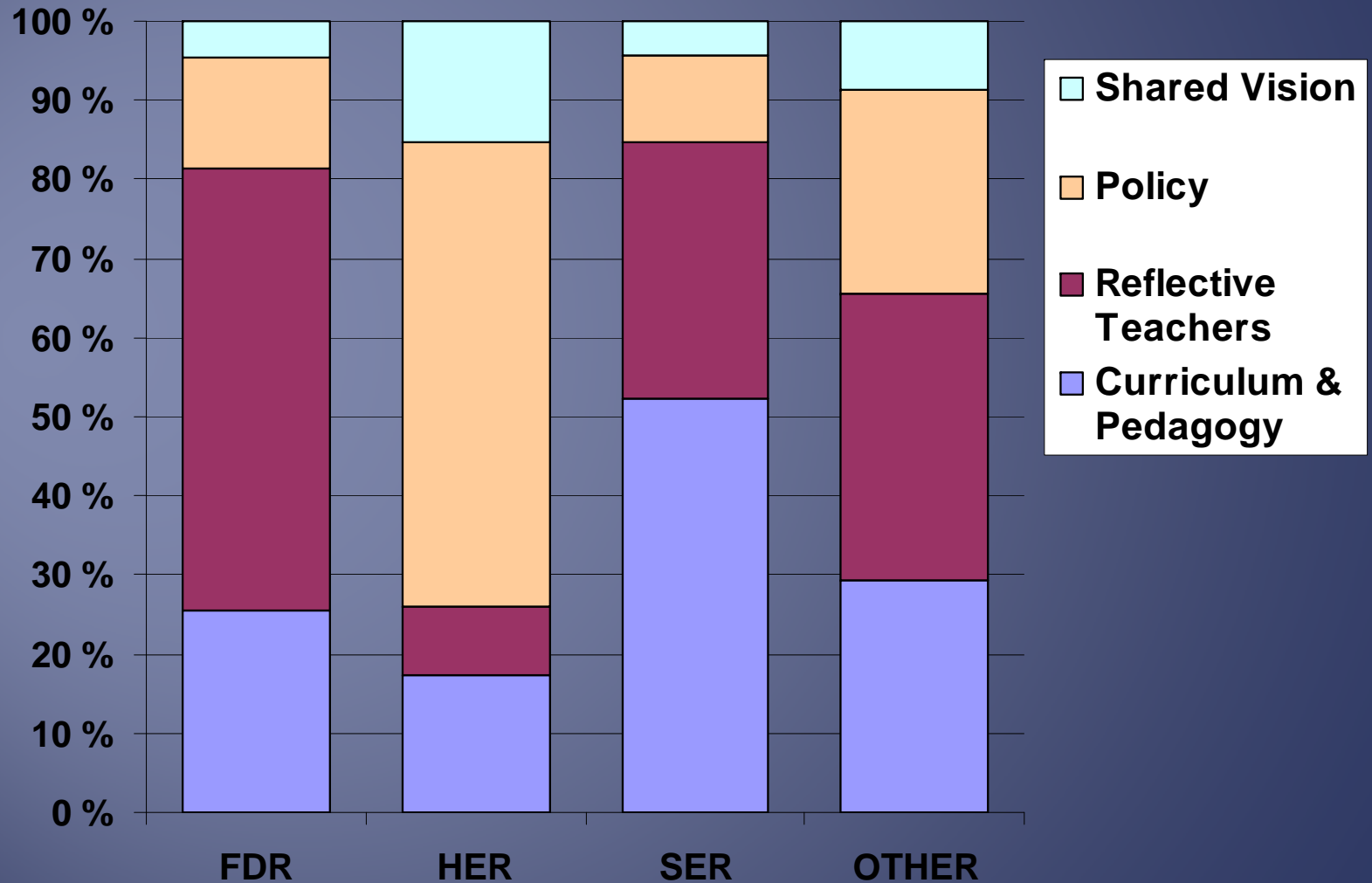


# 191 Articles in Final Analysis

Focus on Changing Individuals



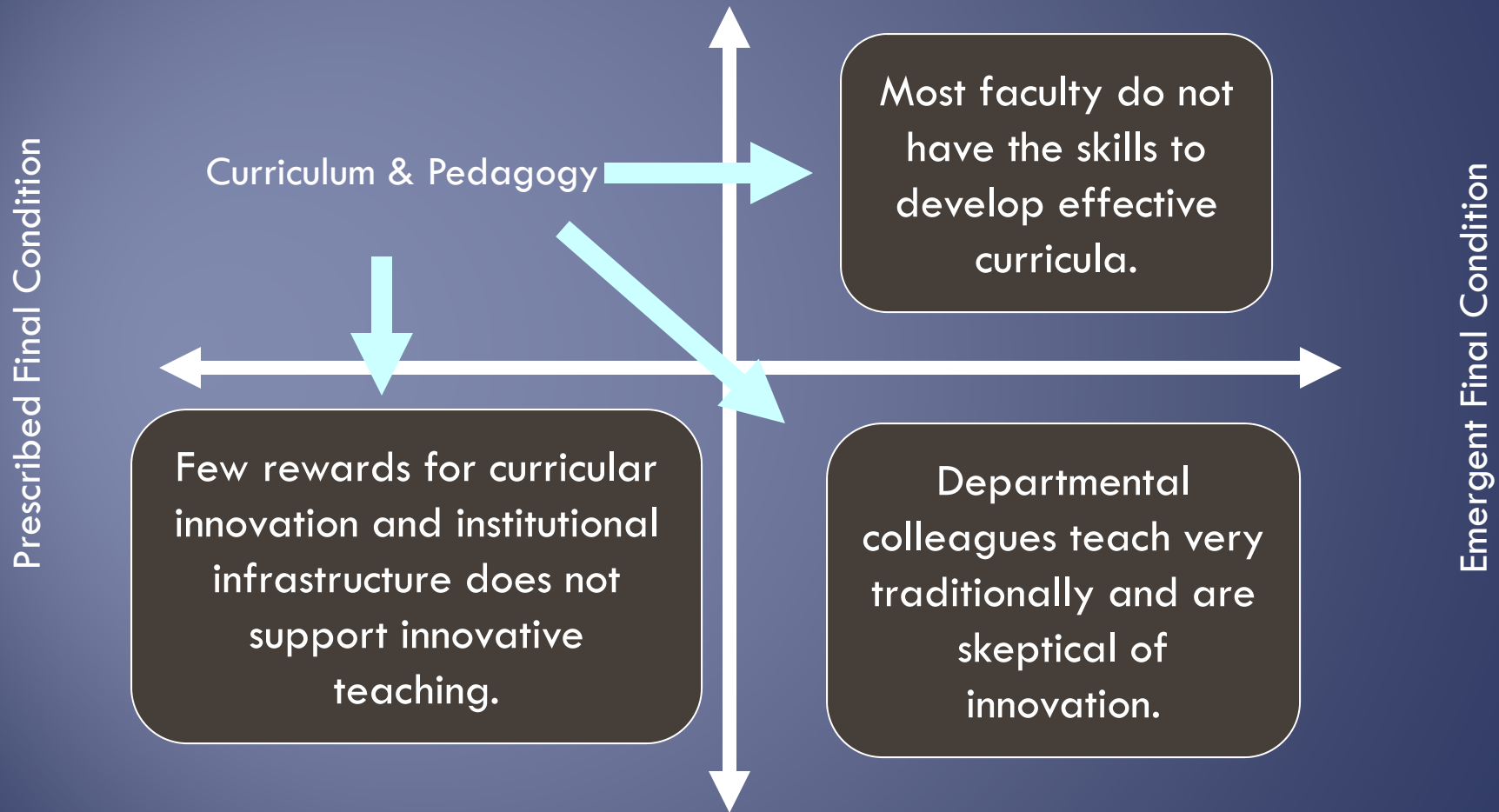
## Each research community favors a different category of change strategy



<sup>9</sup>  
\*Research community is defined based on the position of the first author at the time of publication.

# Each change strategy sees areas of influence of other strategies as barriers to change.

Focus on Changing in Individuals



Focus on Changing in Environment/Structures

# Conclusion

## Three Isolated Research Communities

- SER
- FDR
- HER

## Four Incomplete Change Strategies

- Curriculum and Pedagogy
- Reflective Teachers
- Policy
- Shared Vision

Improvement of change strategies in higher education is a crucial area in need of careful interdisciplinary work.

## Individual Work: Identify Research Questions or Topics

[5 minutes]

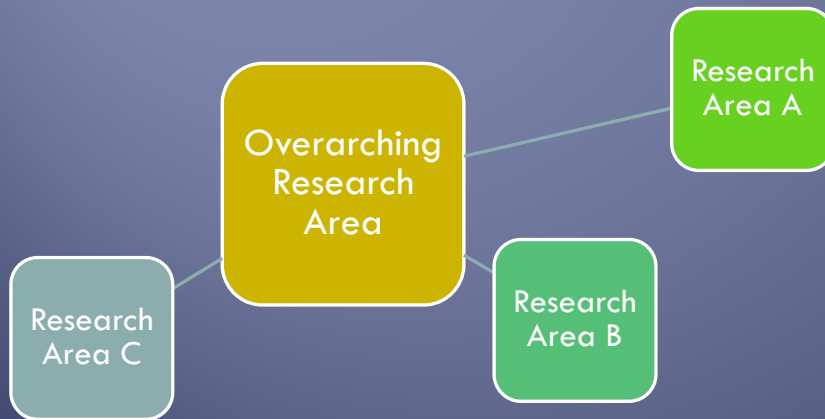
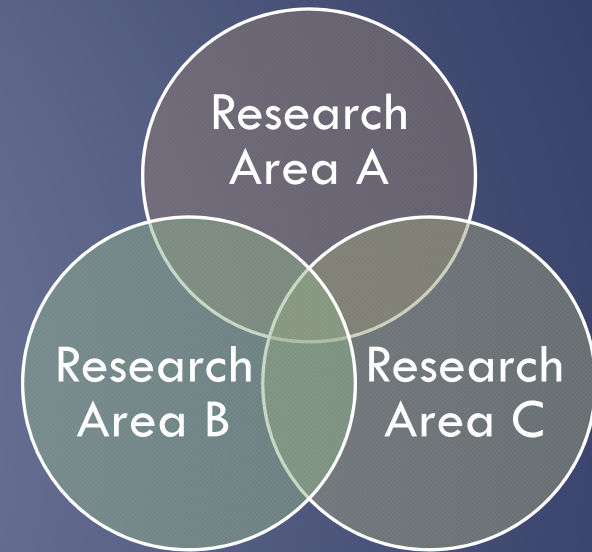
- Write as many research questions or topics as you can think of that are at least vaguely related to the session topic, “Implementing Change in STEM Education”.
- Write each question or topic on a single note card.

# Small Group Work:

## Group the Questions/Topics into Research Areas

[10 minutes]

- Make and name groups



# Large Group Work:

## Finalize Set of Research Areas

- A. Bridges of linkages (between 3 communities, why are communities divided, what can be done to bring them together?)
  - A. Action
  - B. Discovery
  - C. Student Roles/Outcomes (students as part of change process)
- B. Transformation (how do you create change?)
  - A. GTAs as educators
  - B. Role of various stakeholders in change
    - A. What is the role of intrinsic motivation vs. repetition of best practices in promoting development of an educator identity?
    - B. How do faculty members learn new/more effective ways of teaching
    - C. Student Roles/Outcomes (students as part of change process)
  - C. Thinking outside the box
    - A. STEM to STEAM
    - B. Use of serious gaming As a tool for innovation?
- C. Funding (how do you fund these things)

## Large Group Work: Finalize Set of Research Areas

- A. STEM to STEAM (adding arts back into STEM)
- B. GTAs as educators (getting non-science ed graduate students to be more effective educators)
- C. Gaming in STEM education (especially with middle school students)
- D. How can history and philosophy of science be used in promoting the teaching of science



# Continuing Discussion

- Write your name and email address on a notecard.
- Write the letter corresponding to any research area that you would like to continue discussions about.

**Thank You**