

Physics 5460/4460 - we know what to do in the classroom.. What next?

Day 27: Sustaining and Scaling Educational Transformations:
Challenges and opportunities
Models – (and SCHOLARSHIP)

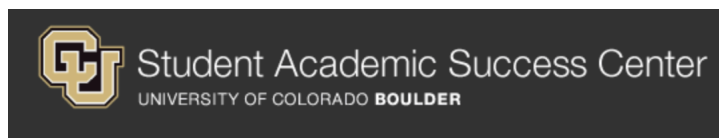
Learning Goals:

- identify a variety of models of educational change
- link curricular transformation to models of change
- apply models of change for various levels



And a brief word... opportunity

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Co-Seminar 18-20 students

Phys 1120/2020

MW 4-5p

Project Presentations

- Info online
- 7+2 format

- Anyone up for Thurs?

- Signup for
- Tues 12/8, Thurs 12/10
and Tues final time 12/15 (or earlier)?

We've Studied Curricular Tools

- Peer Instruction
- Tutorials
- JITT/ILDs
- PET/PBI
- PhET
- Ranking Tasks / TIPPERS
- Workshop/Studio Physics
- ...

Are you done?
What else do you need to effectively teach?

In practice, what are the leading (most used) models of educational change?

We know what works

- Why isn't it widespread?
- What is the most common theory of change?
- What is good about it? Bad about it?



Keeping the Good things Going: Study and Improvement of Change Strategies in STEM Education

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.



Starting Point: Current State of Knowledge

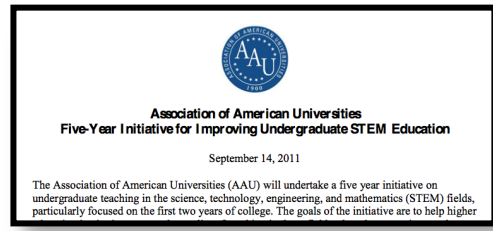
- We know a lot about:
 - effective teaching and learning of STEM subjects
 - how to apply this knowledge in individual classrooms

Now all STEM classrooms produce knowledgeable, skilled students who have positive attitudes toward science ...



The Big Question

How to encourage the spread of research-based ideas to all instructors/classrooms?



Why Change Strategies are Important Evolving Change Strategies of the Foundation Coalition*

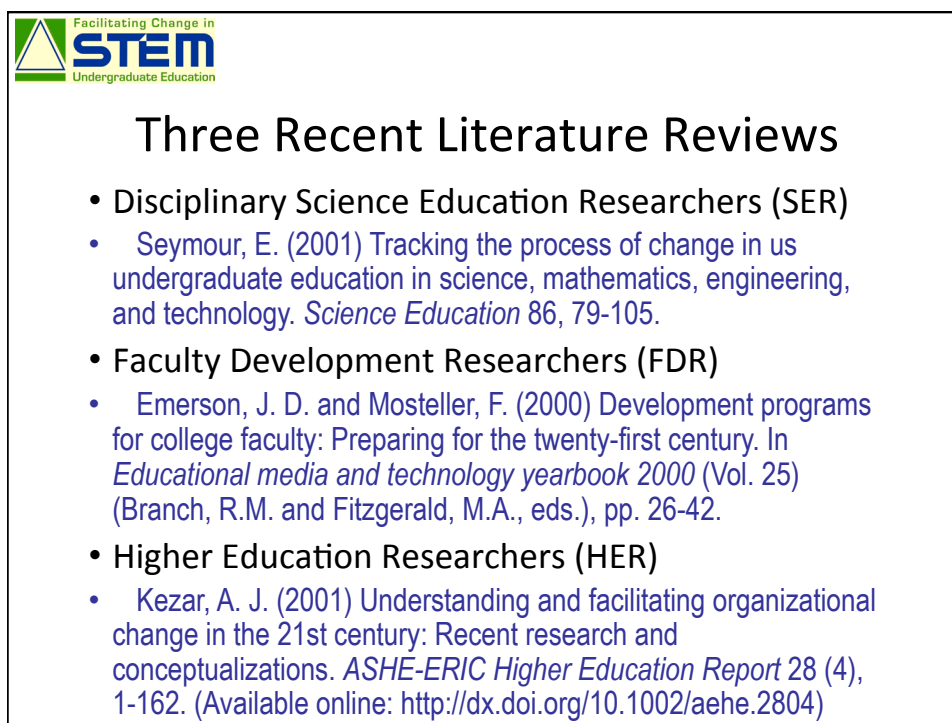
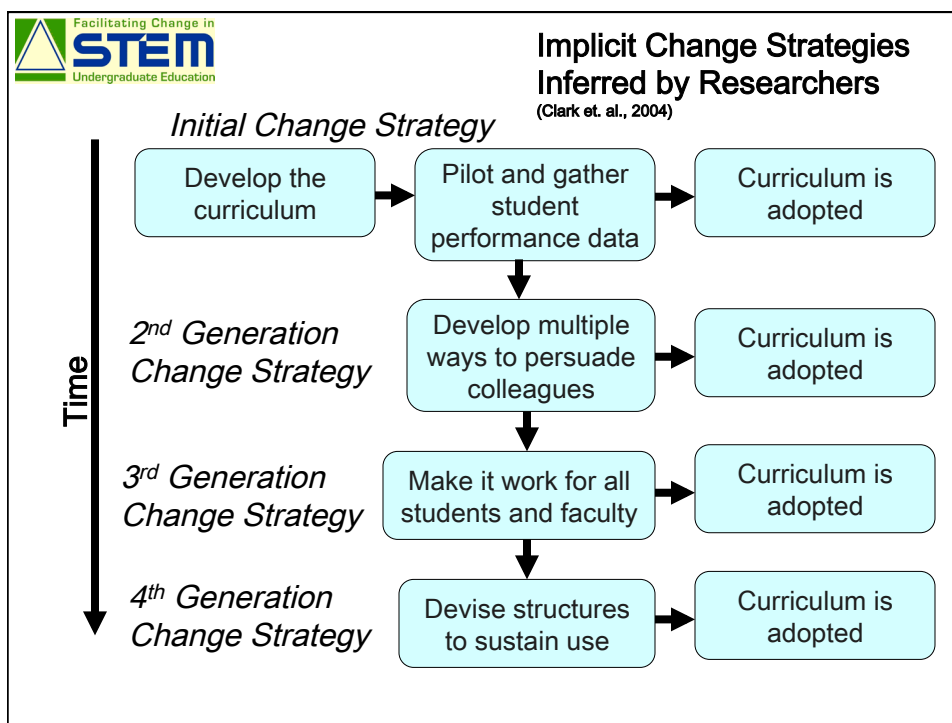
Foundation Coalition:

- What: 6 institutions to develop and implement a new 4-year engineering curriculum
- When: First grant – 1993-1998 (\$14M)



Award Number	Title	NSF Organization	Program(s)	Start Date	Principal Investigator	State	Organization	Awarded Amount to Date
9802942	Foundation Engineering Education Coalition	EEC	ENGINEERING EDUCATION	10/01/1998	Froyd, Jeffrey	TX	Texas Engineering Experiment Station	\$14,191,167.00
9221460	The Foundation Coalition	EEC	ENGINEERING EDUCATION	10/01/1993	Frair, Karen	TX	Texas Engineering Experiment Station	\$14,000,000.00

*C. M. Clark, J. Froyd, P. Merton and J. Richardson, "The evolution of curricular change models within the foundation coalition," Journal of Engineering Education. **93** (1), 37-47 (2004).





A review of reviews

No overlap in references! → No communication between groups

Field	Article	Number of References
[SER]	Seymour (2001)	77
[FDR]	Emerson & Mosteller (2000)	34
[HER]	Kezar (2001)	280



Three Isolated Research Communities
Each has a different and important perspective.

There is little interaction between groups and minimal interaction within groups



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**
- **Faculty Development Researchers (FDR)**
 - **Housed in Center for Teaching and Learning**
- **Higher Education Researchers (HER)**
 - **Housed in College of Education or Administration**

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



Three Groups - One Common Goal

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


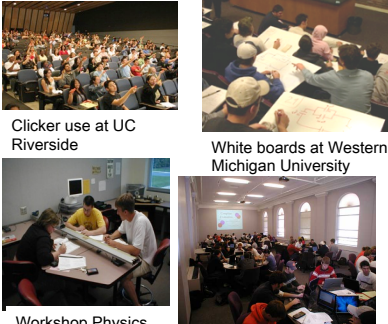
The Instruction Paradigm	The Learning Paradigm
<ul style="list-style-type: none"> •Deliver instruction •Achieve access for diverse students •Independent disciplines, departments •Covering material •Grading within classes by instructors •Degree equals accumulated credit hours ... 	<ul style="list-style-type: none"> •Produce learning •Achieve success for diverse students •Cross discipline/department collaboration •Specified learning results •External evaluations of learning •Degree equals demonstrated knowledge and skills ...

*From Barr, R. B. and Tagg, J. (1995) From teaching to learning - a new paradigm for undergraduate education. *Change* (November/December), 13-25.

Facilitating Change in
STEM
Undergraduate Education

Three Groups - One Common Goal

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

The Instruction Paradigm	The Learning Paradigm
 <p>Traditional Physics class at University of Rochester</p>	 <p>Clicker use at UC Riverside</p> <p>White boards at Western Michigan University</p> <p>Workshop Physics Classroom at Dickinson College</p> <p>SCALE-UP Physics class at Clemson University</p>

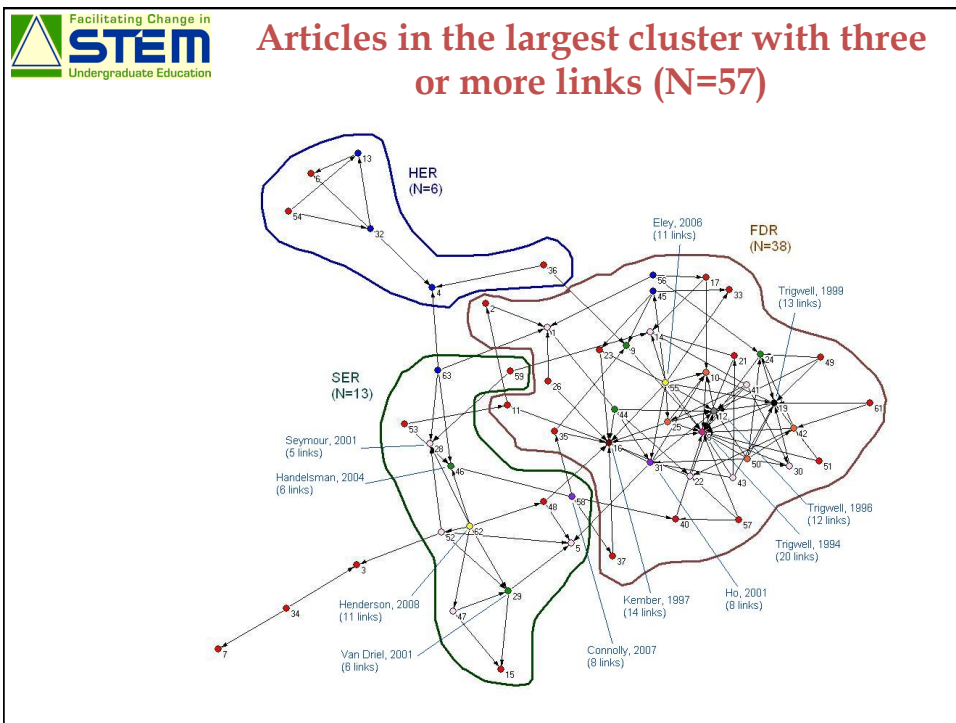
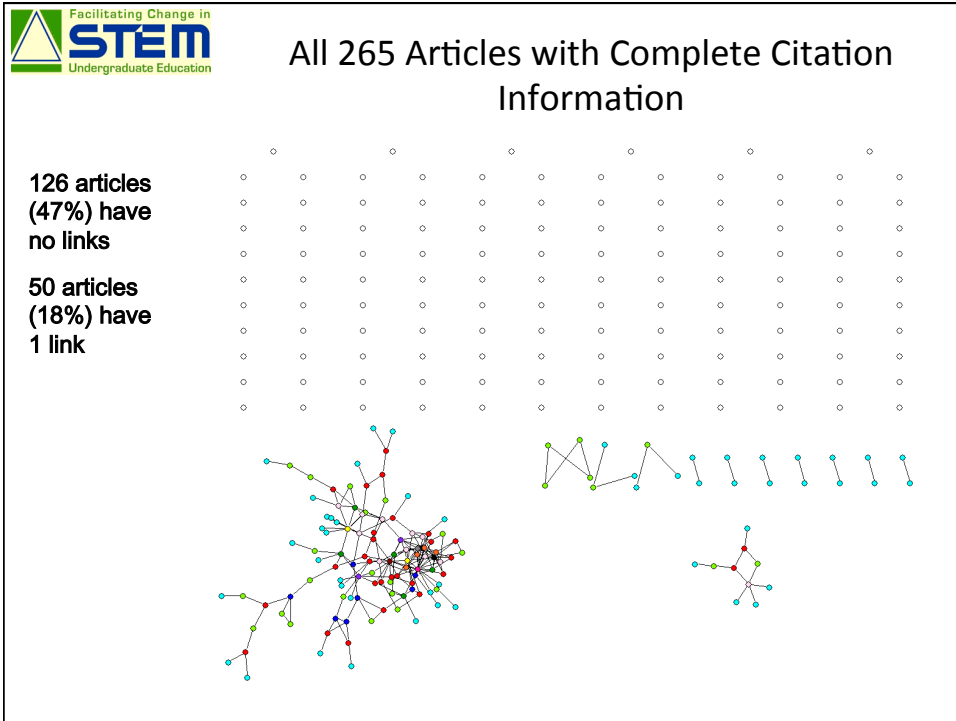
*From Barr, R. B. and Tagg, J. (1995) From teaching to learning - a new paradigm for undergraduate education. *Change* (November/December), 13-25.

Facilitating Change in
STEM
Undergraduate Education

295 Articles

(in original data set)

- 108 Different Journals
- Most Common:
 - Innovative Higher Education (26 articles)
 - Higher Education (21 articles)
 - Journal of Research in Science Teaching (13 articles)
 - Studies in Higher Education (12 articles)
 - Change (10 articles)
 - College Teaching (8 articles)
 - Teaching in Higher Education (7 articles)
 - Journal of Faculty Development (6 articles)





Four Categories of Change Strategies developed from an interdisciplinary literature review

For more details:
 Henderson, C., Beach, A., Finkelstein, N., & Larson, R. S., (2008, June). Preliminary Categorization of Literature on Promoting Change in Undergraduate STEM. Paper presented at the Facilitating Change in Undergraduate STEM symposium, Augusta, MI.
<http://www.wmich.edu/science/facilitating-change/PreliminaryCategorization.pdf>



Categorized along two Important Dimensions

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

Individuals	Environments and Structures
personal characteristics of single individuals, such as beliefs, knowledge, behaviors, etc.	impact characteristics of the system such as rules, physical characteristics of the environment, norms, etc.



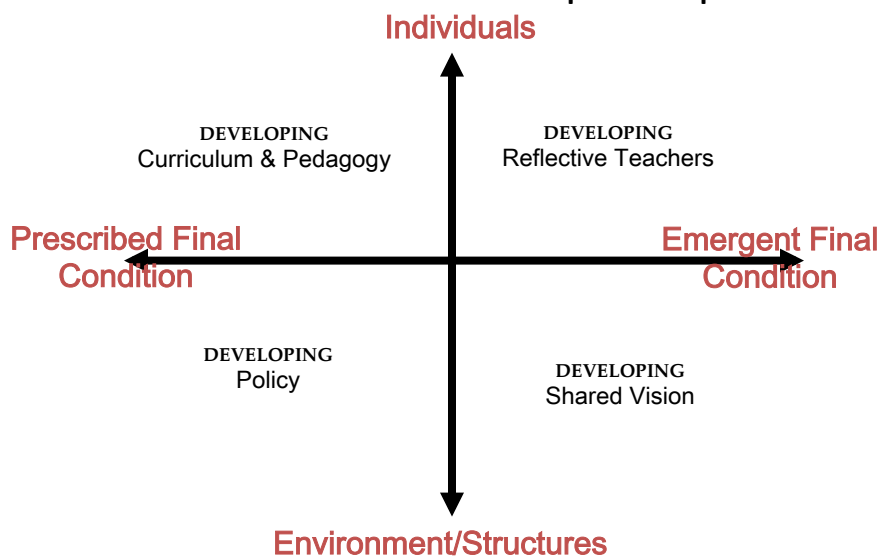
Categorized along two Important Dimensions

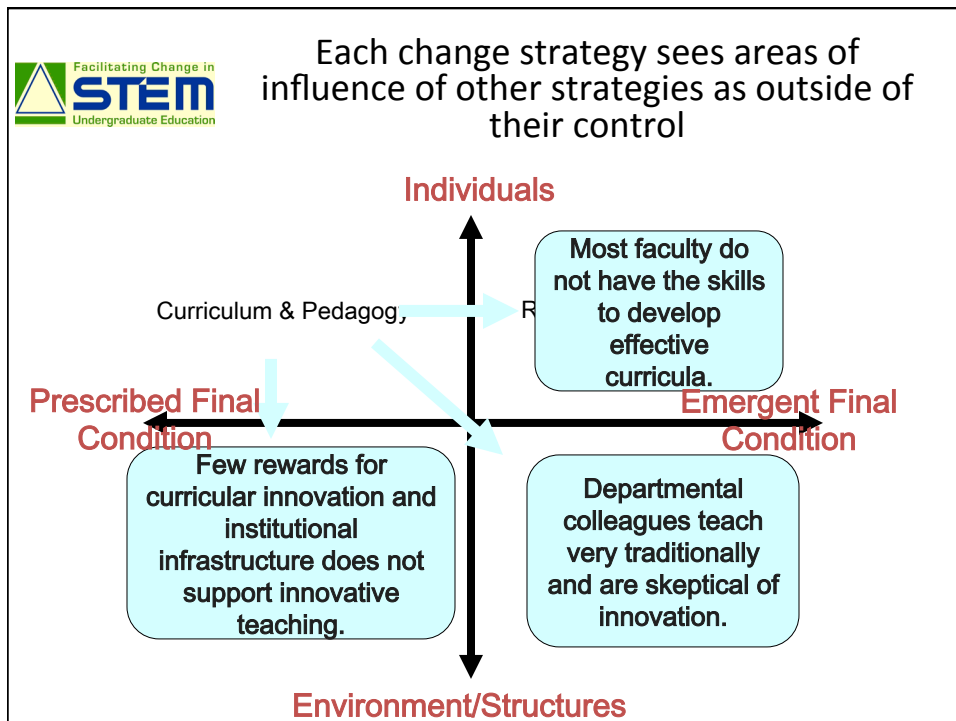
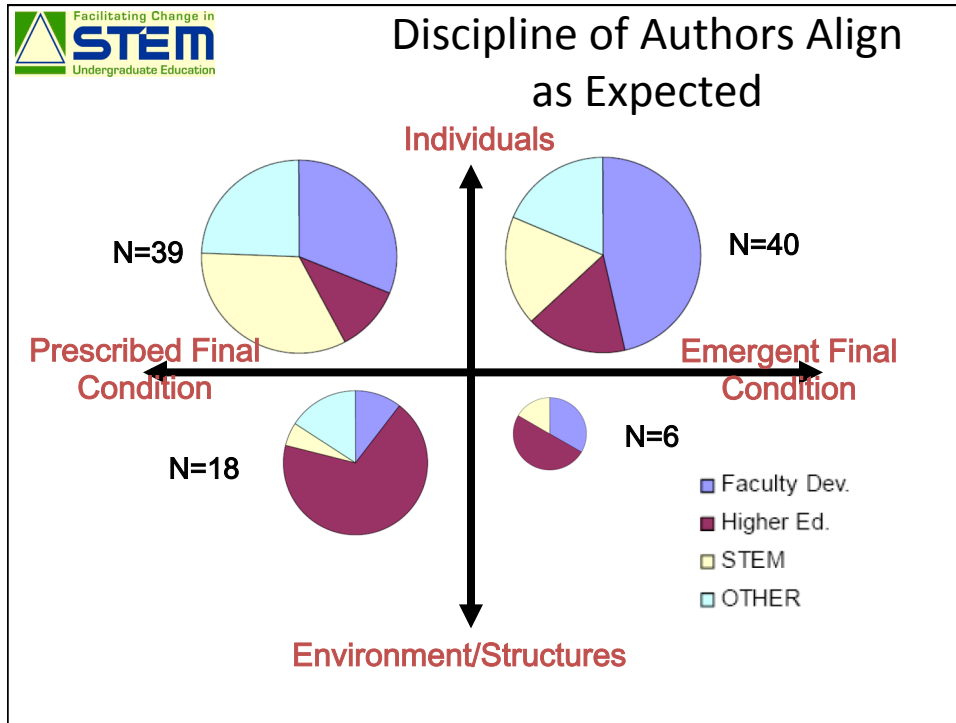
2. To what extent is the outcome prescribed in advance?

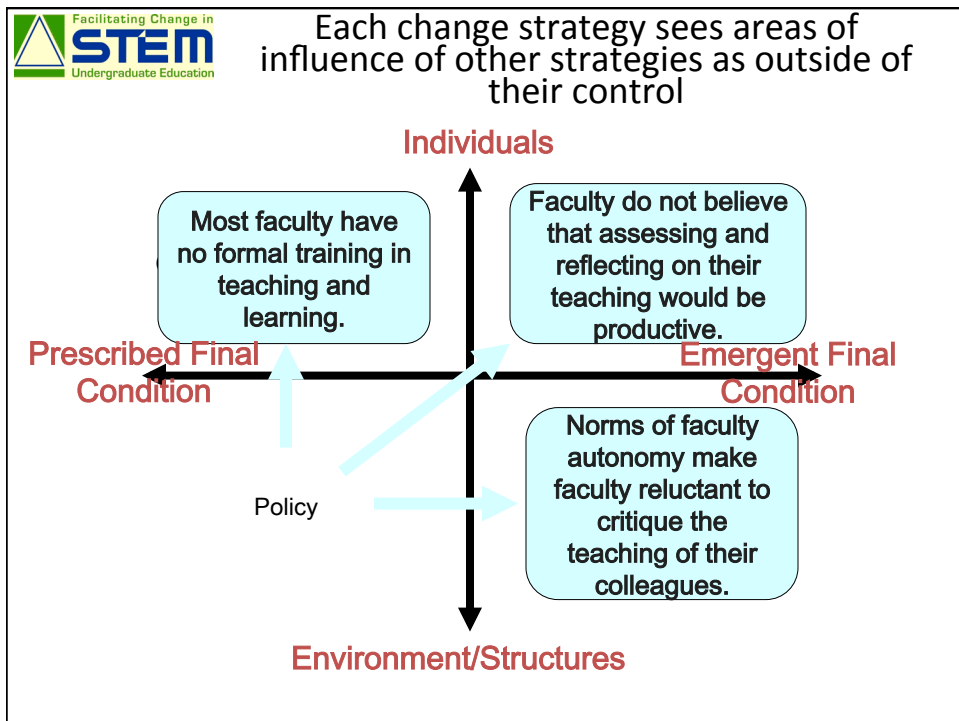
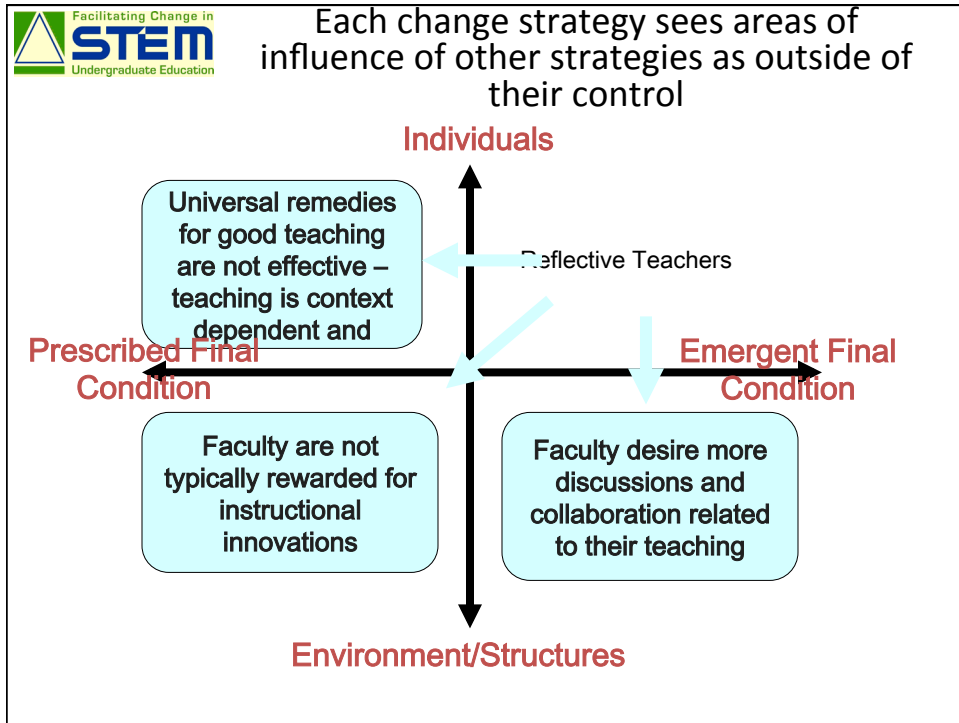
Prescribed Final State	Emergent Final State
final state is known at the beginning of process	final state is developed

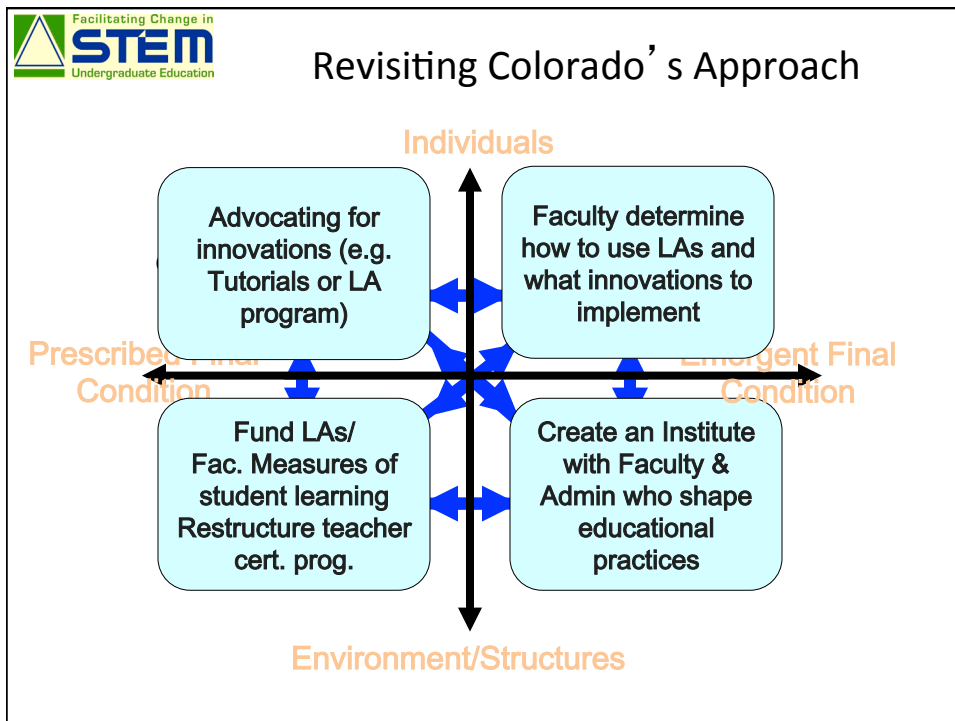
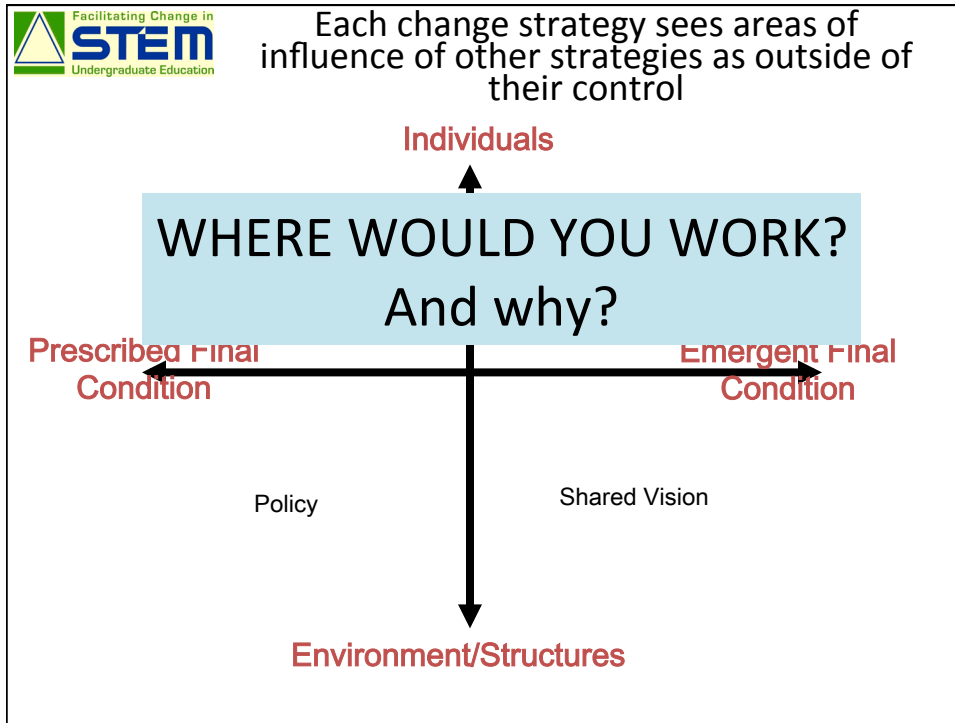


Each Strategy has a Unique Emphasis

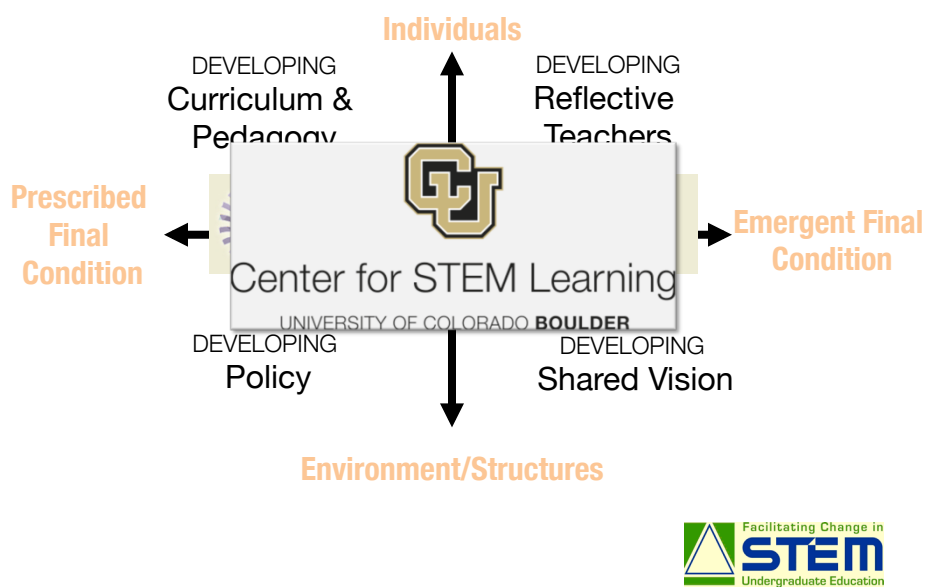








Program Activities – Theoretical Foundations



Probably for Thurs

- You are an administrator (chair or dean) interested in promoting [insert favorite RBIS]
- What do you do?
- What resources do you need? Provide?