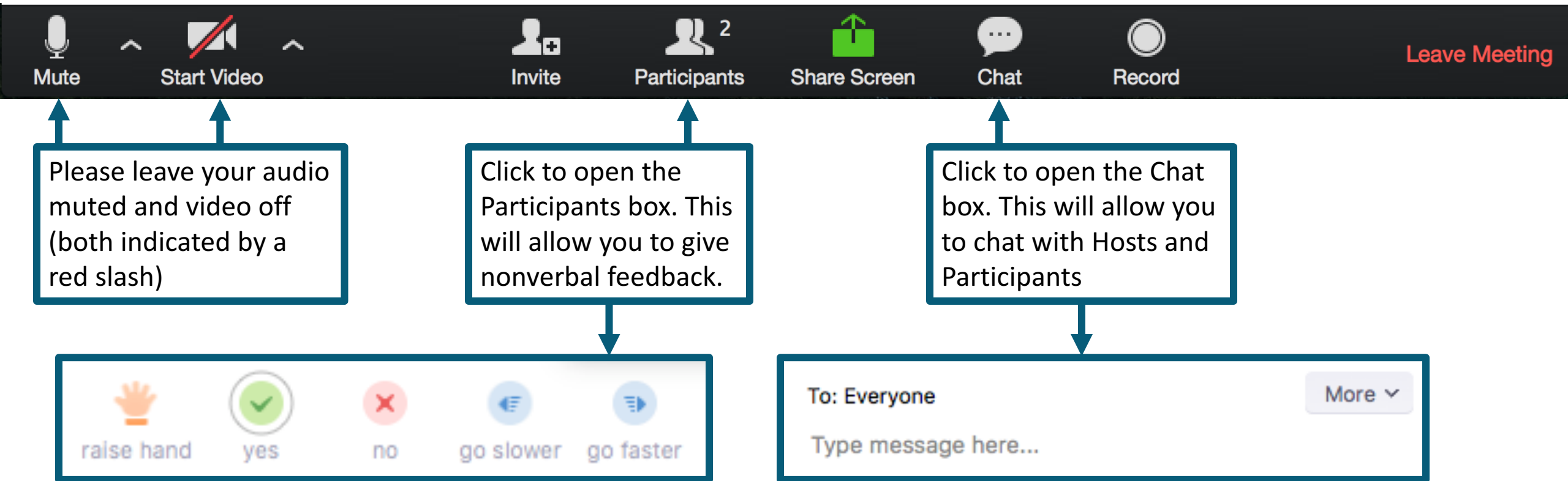


Welcome to the ASCN webinar:

## Faculty Adoption of STEM Education Reforms: From Constraint to Possibility



As you enter, please review the Zoom controls below. Leave your audio and video off, unless prompted by a host. You can post any questions in the chat box. Thank you!



The image shows a Zoom meeting controls bar with the following buttons from left to right: Mute, Start Video, Invite, Participants (showing 2), Share Screen, Chat, and Record. A red 'Leave Meeting' button is on the far right. Below the controls, three instructional callouts are shown:

- Mute and Start Video:** A box with the text "Please leave your audio muted and video off (both indicated by a red slash)" with arrows pointing to the Mute and Start Video buttons.
- Participants:** A box with the text "Click to open the Participants box. This will allow you to give nonverbal feedback." with an arrow pointing to the Participants button. Below this is a box containing five nonverbal feedback icons: "raise hand" (hand icon), "yes" (green checkmark), "no" (red X), "go slower" (blue left arrow), and "go faster" (blue right arrow).
- Chat:** A box with the text "Click to open the Chat box. This will allow you to chat with Hosts and Participants" with an arrow pointing to the Chat button. Below this is a chat input box with "To: Everyone" and a "More" dropdown, and a text field labeled "Type message here..."

# Faculty Adoption of STEM Education Reforms: From Constraint to Possibility

Cassandra Volpe Horii, PhD

Founding Director, Caltech Center for Teaching, Learning, & Outreach  
President Elect, POD Network in Higher Education



Accelerating Systemic Change Network  
Webinar: January 17, 2018



Thanks to  !

***Promoting knowledge development  
to support institutional change in higher education***

Find out more about how you can be involved in ASCN's work!

<https://ascnhighered.org/index.html>

# Welcome!





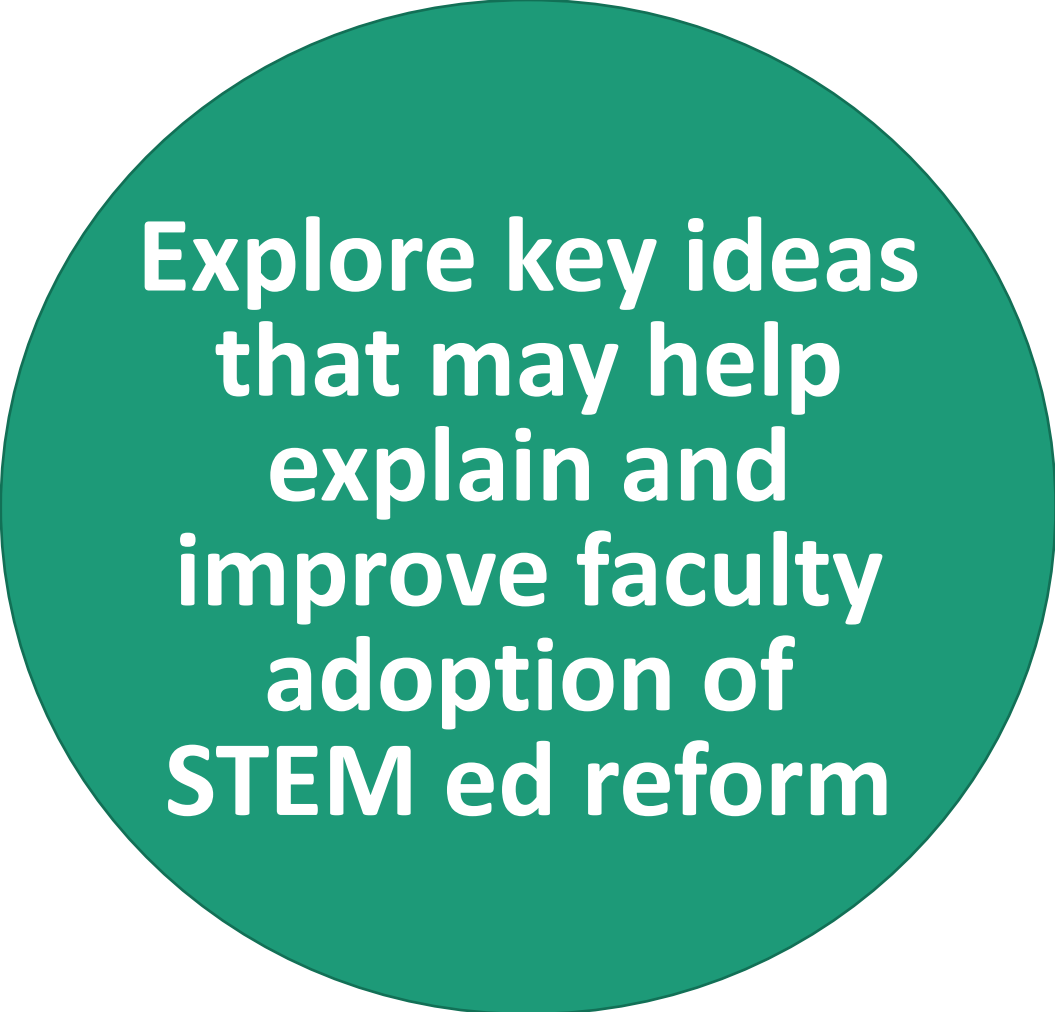
# My background and perspectives...



What roles do you bring to the webinar?  
(choose all that apply)

What perspectives/backgrounds?  
(choose all that apply)

# Webinar Goal:



**Explore key ideas  
that may help  
explain and  
improve faculty  
adoption of  
STEM ed reform**

# Participant Outcomes:

Explore key ideas that may help explain and improve faculty adoption of STEM ed reform

- Recognize the **complex interplay** between disciplinary/institutional STEM reform efforts and individual adoption.
- Diagnose **roadblocks to adoption** using a framework that includes concepts of faculty identity and work.
- Apply **tools for identifying and resolving tensions** that may influence faculty adoption at individual, departmental, institutional, and disciplinary scales.



# Plan:

1. Thinking about “adoption”
2. Diagnosis tools: Institutions & individuals
3. Discussion: tools and approaches

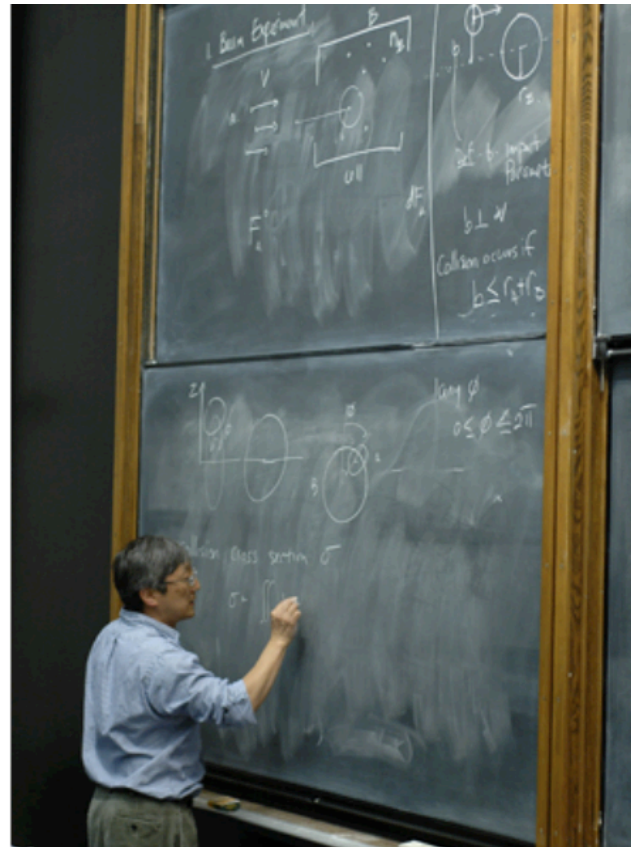
## Part 1:

### 1. Thinking about “adoption”

2. Diagnosis tools: Institutions & individuals

3. Discussion: tools and approaches

## Context:



## 1. “Adoption”



# Context:



## 1. "Adoption"



# RBISs

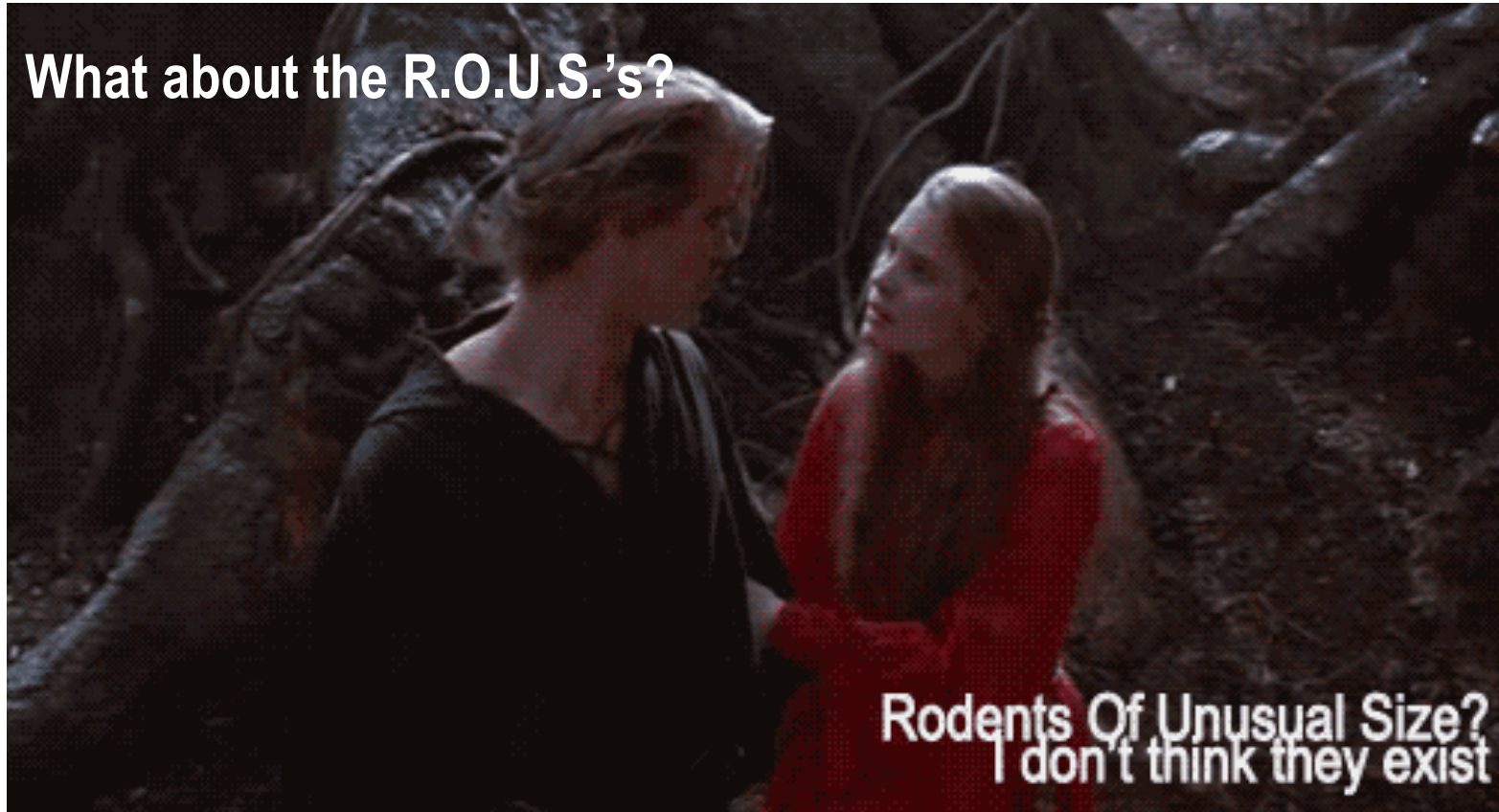
Research

Based

Instructional

Strategies

What about the R.O.U.S.'s?



*The Princess Bride, 1987*



# RBISs

Research

Based

Instructional

Strategies

Close relatives:

EBIPs

Evidence

Based

Instructional

Practices

In the chat window:

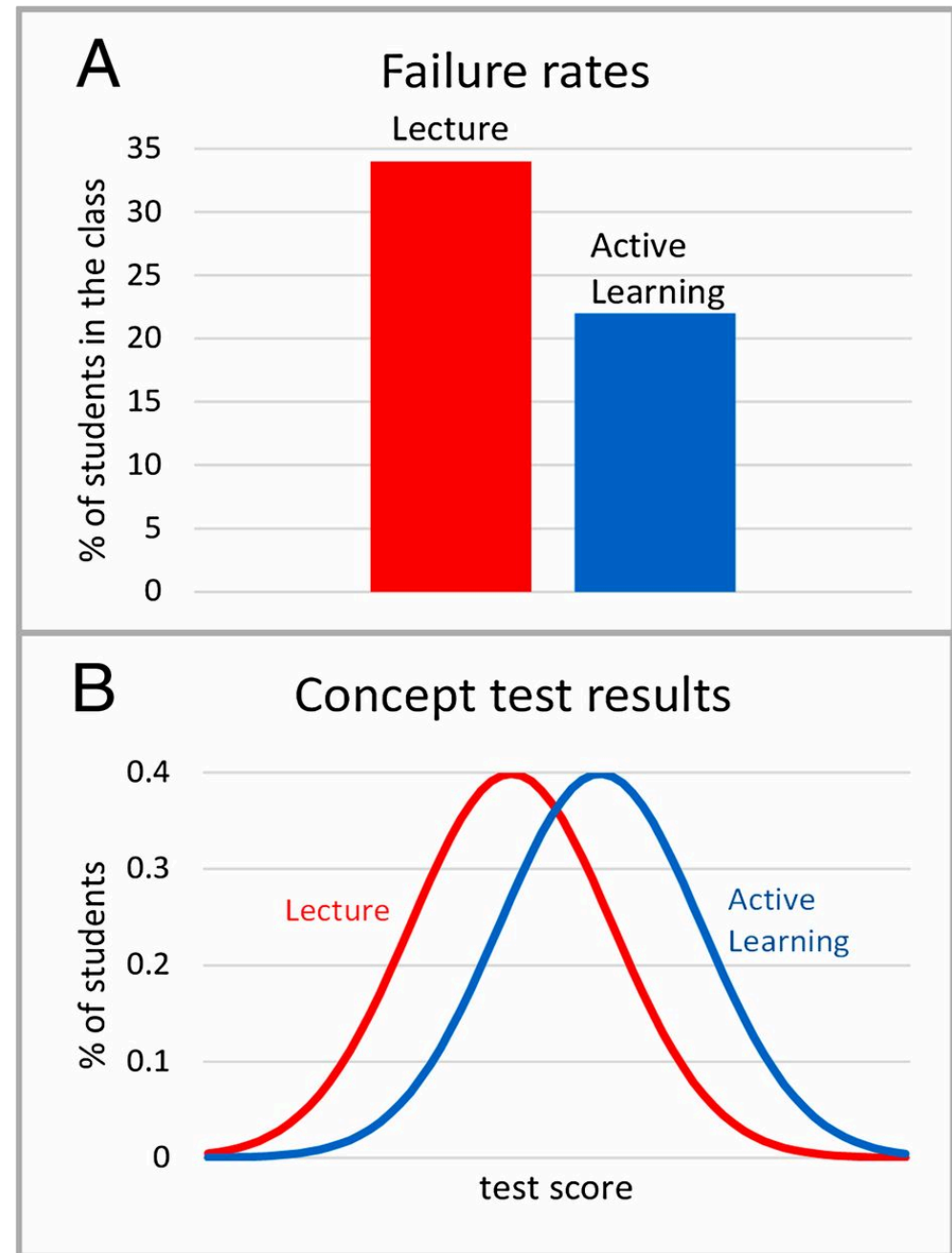
- What RBISs (Research Based Instructional Strategies) in STEM do you know about and/or use?

# Active learning increases student performance in science, engineering, and mathematics

Freeman et al. PNAS 2014, 111: 8410-8415.

Students **1.5 times more likely to fail** in lecture-only courses.

Students perform 0.47 standard deviations better with **active learning**.



Carl E. Wieman PNAS 2014;111:8319-8320

# All Disciplines: 2014 HERI Faculty Survey

Figure 5. Changes in Faculty Teaching Practices, 1989 to 2014  
(% Marking "All" or "Most" Courses)

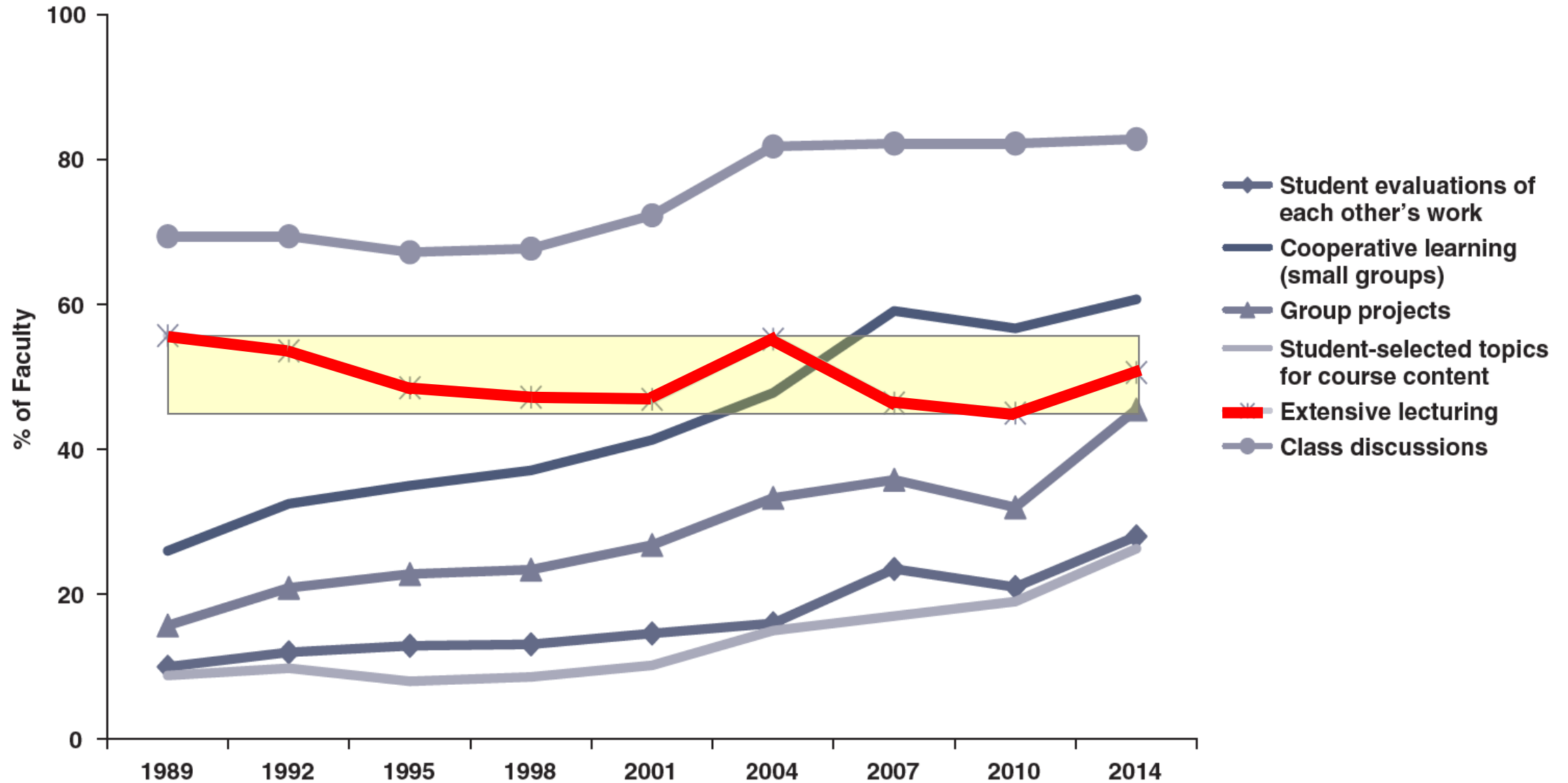
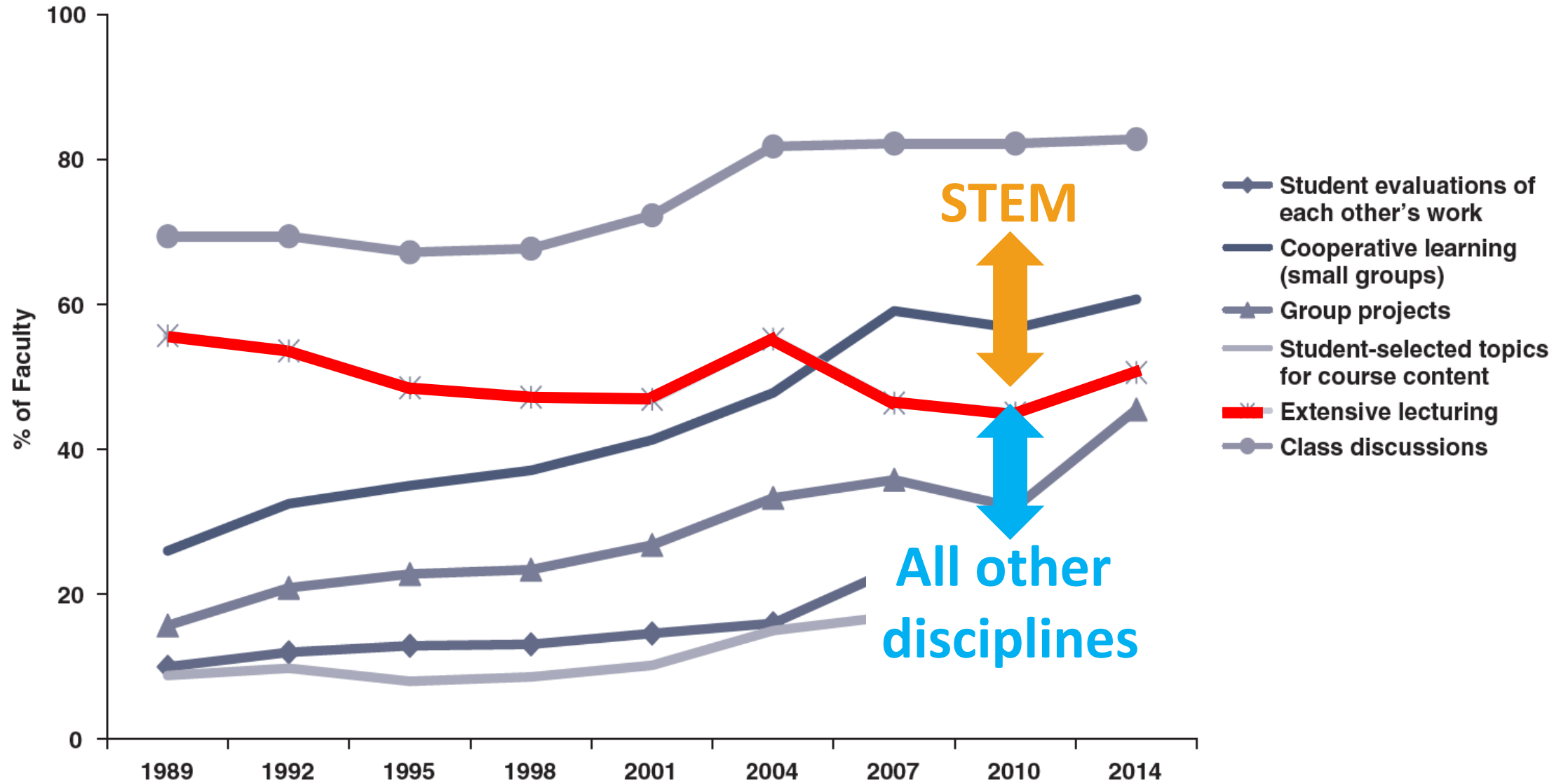


Figure 5. Changes in Faculty Teaching Practices, 1989 to 2014  
(% Marking "All" or "Most" Courses)





# EPIC model of adoption

**Exposure**

**Persuasion**

**Identification**

**Commitment**

# EPIC model of adoption: E.g....

87.1 %

Physics Faculty, 2009

48.1%

**Exposure**

**Persuasion**

**Identification**

**Commitment**

Familiar with RBISs

Using RBISs

# EPIC & Expertise

**Exposure**

**Persuasion**

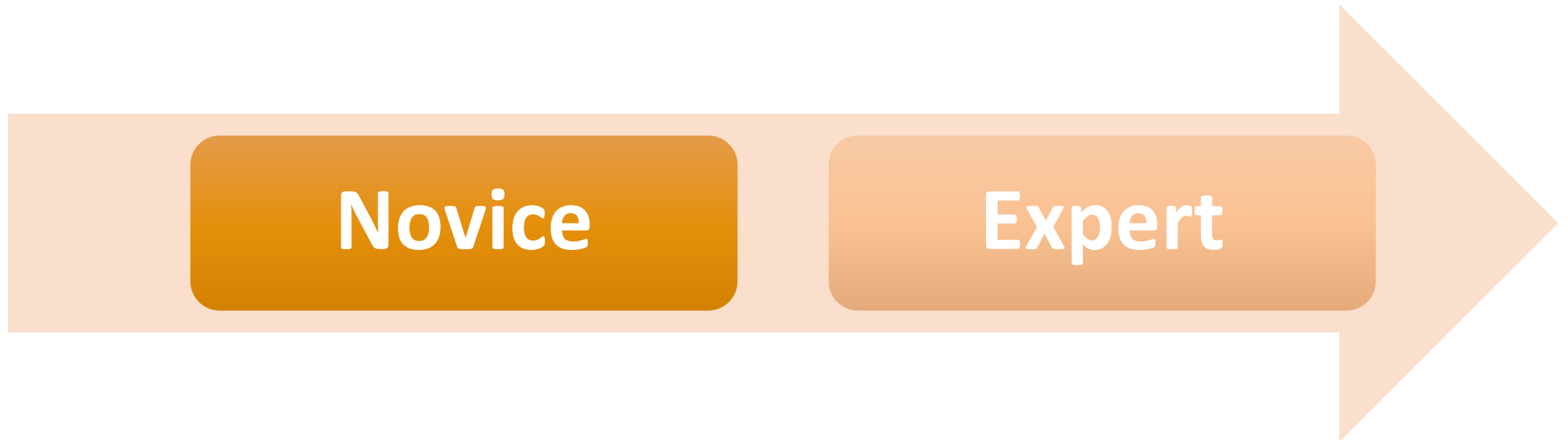
**Identification**

**Commitment**

**Novice**

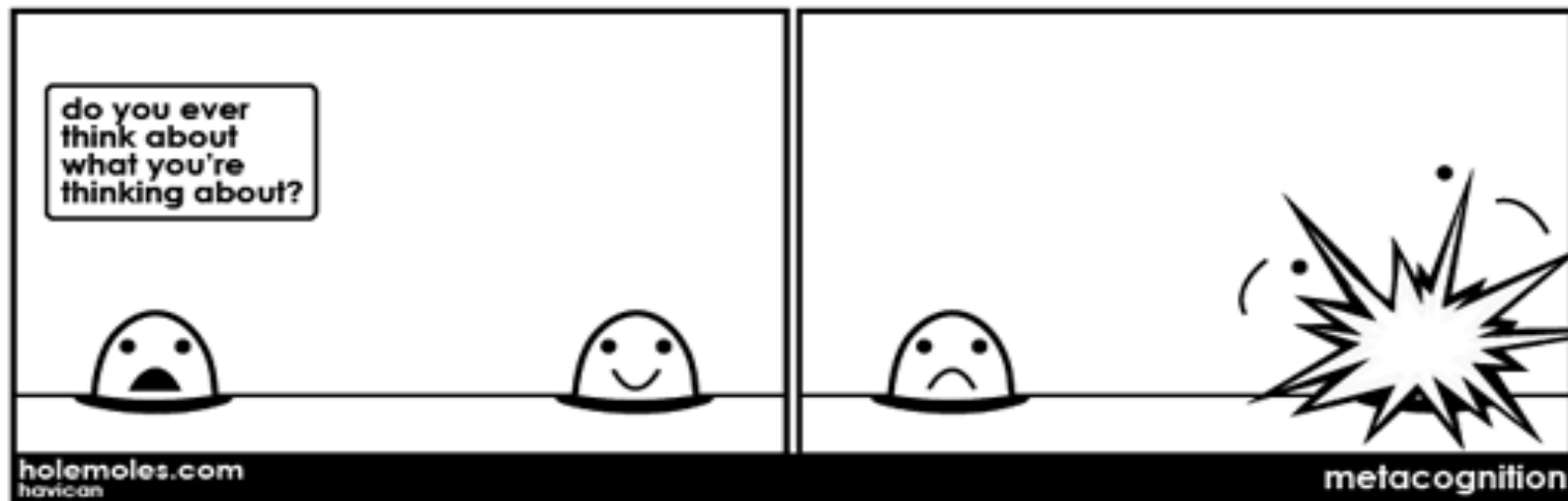
**Expert**

# *The importance of knowledge organization*



# On the way to expertise with STEM RBISs, faculty may...

- Struggle to organize new information effectively.
- Have few or no automated processes to rely on.
- Work harder & feel less efficient than usual.
- Revert to “doing school” vs. “sense-making.”



## 1. "Adoption"



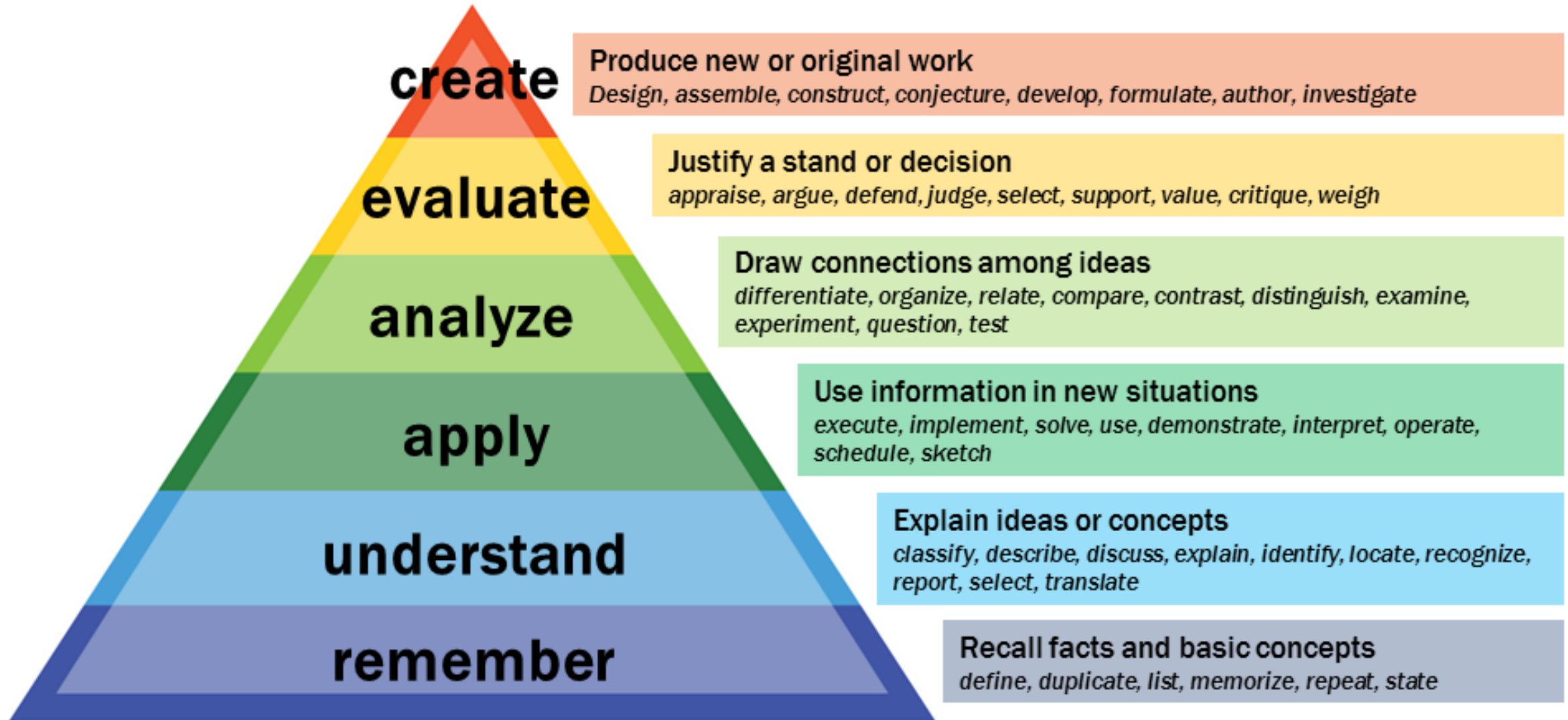
# Can we help faculty develop more expert knowledge organization about RBISs?

- **Why use this?**

What kinds of learning outcomes is it good for?

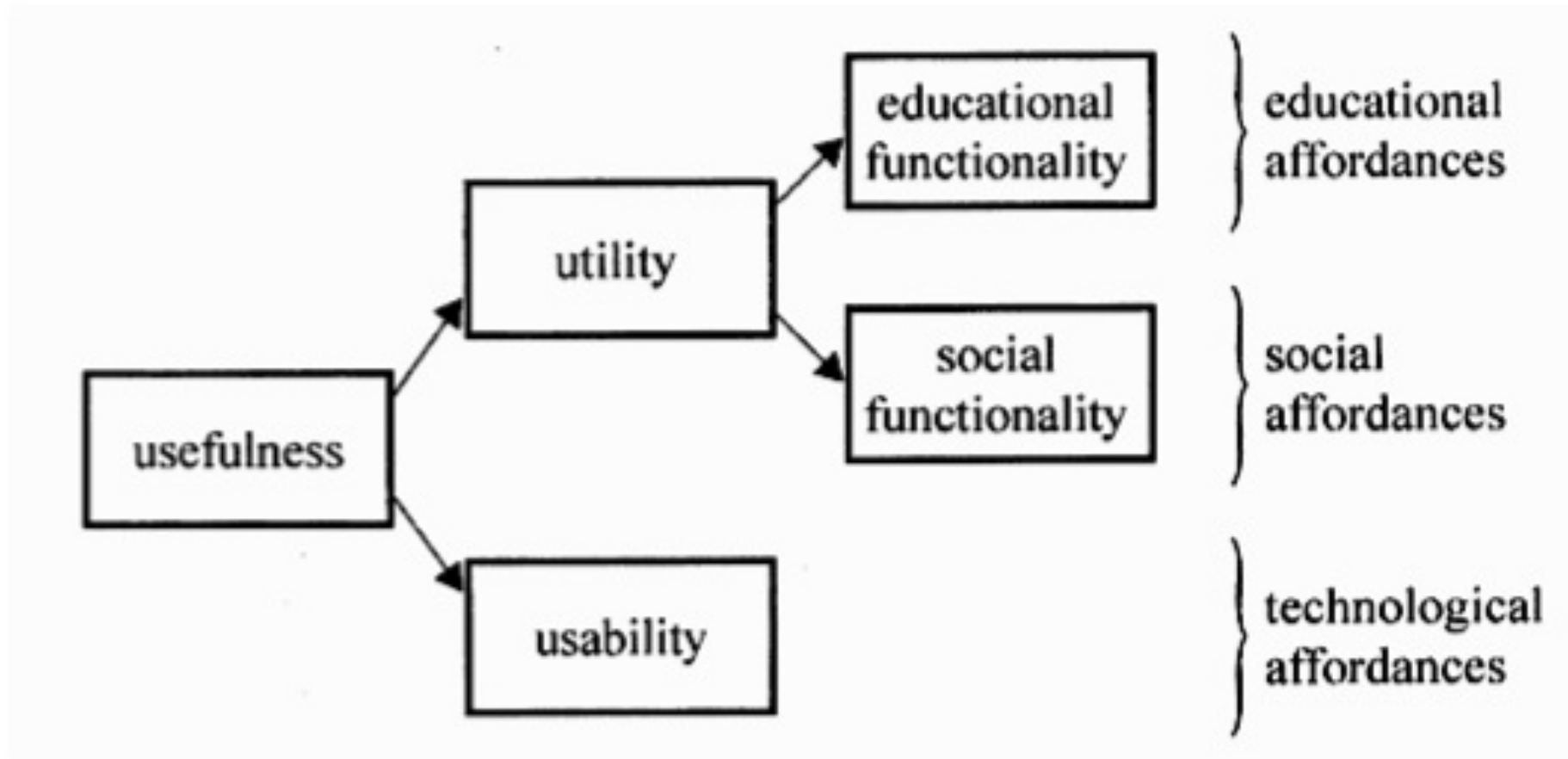


# Bloom's Taxonomy



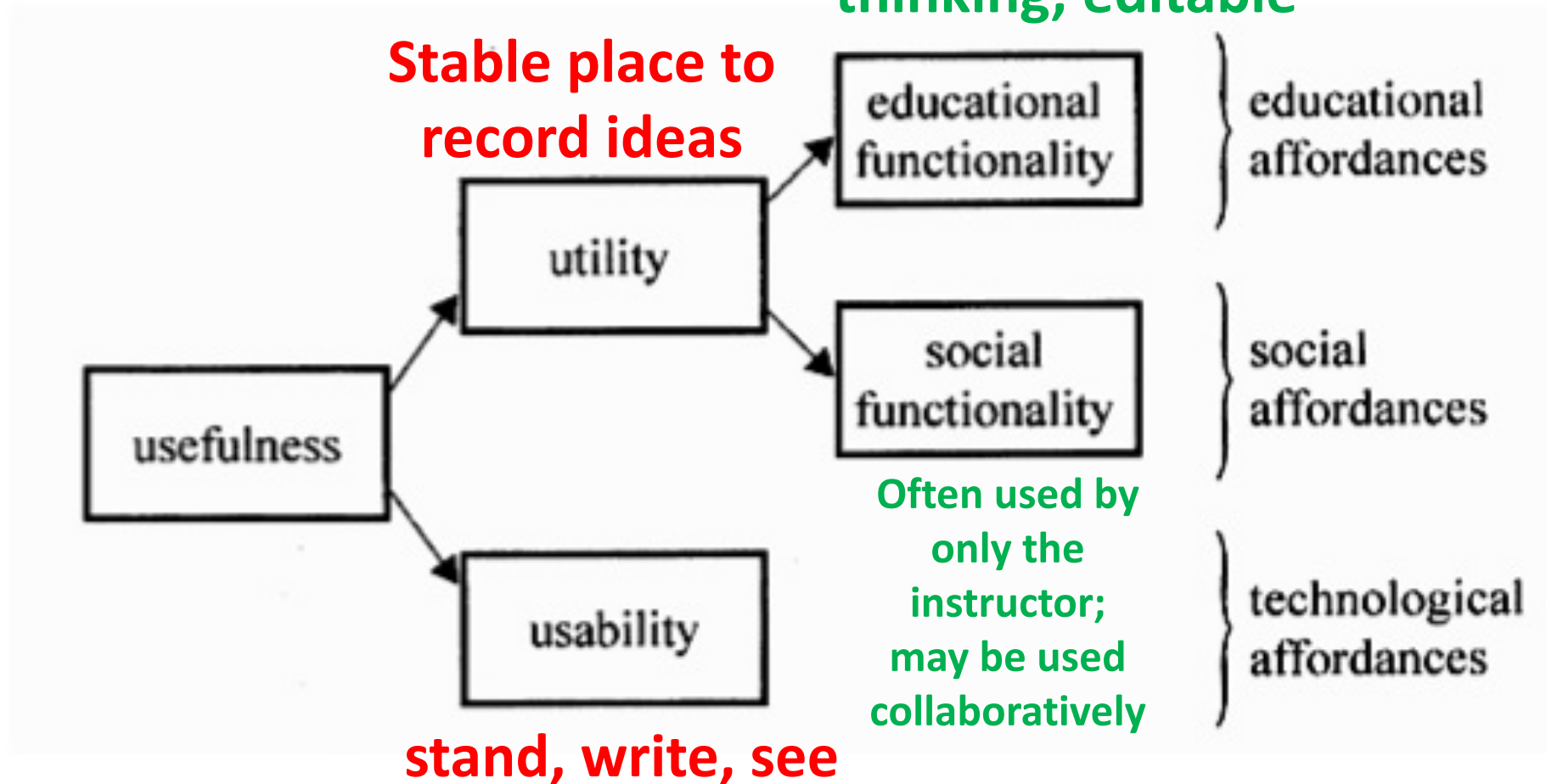
Vanderbilt University Center for Teaching

# Affordances



# Affordances: Chalk

Students see multiple  
panes/phases of  
thinking; editable



# Can we help faculty develop more expert knowledge organization about RBISs?

- **Why use this?**

What kinds of learning outcomes is it good for?

What are its key affordances?

- **What are the essential aspects of implementation?**



# Fidelity of adoption



High Quality  
Reproduction

What's  
essential?  
What's  
adaptable?



# Minimum increment



# Can we help faculty developing more expert knowledge organization about RBISs?

- **Why use this?**

What kinds of learning outcomes is it good for?

What are its key affordances?

- **What are the essential aspects of implementation?**

Fidelity of adoption?

Minimum increment?

- **What are the potential pitfalls?**

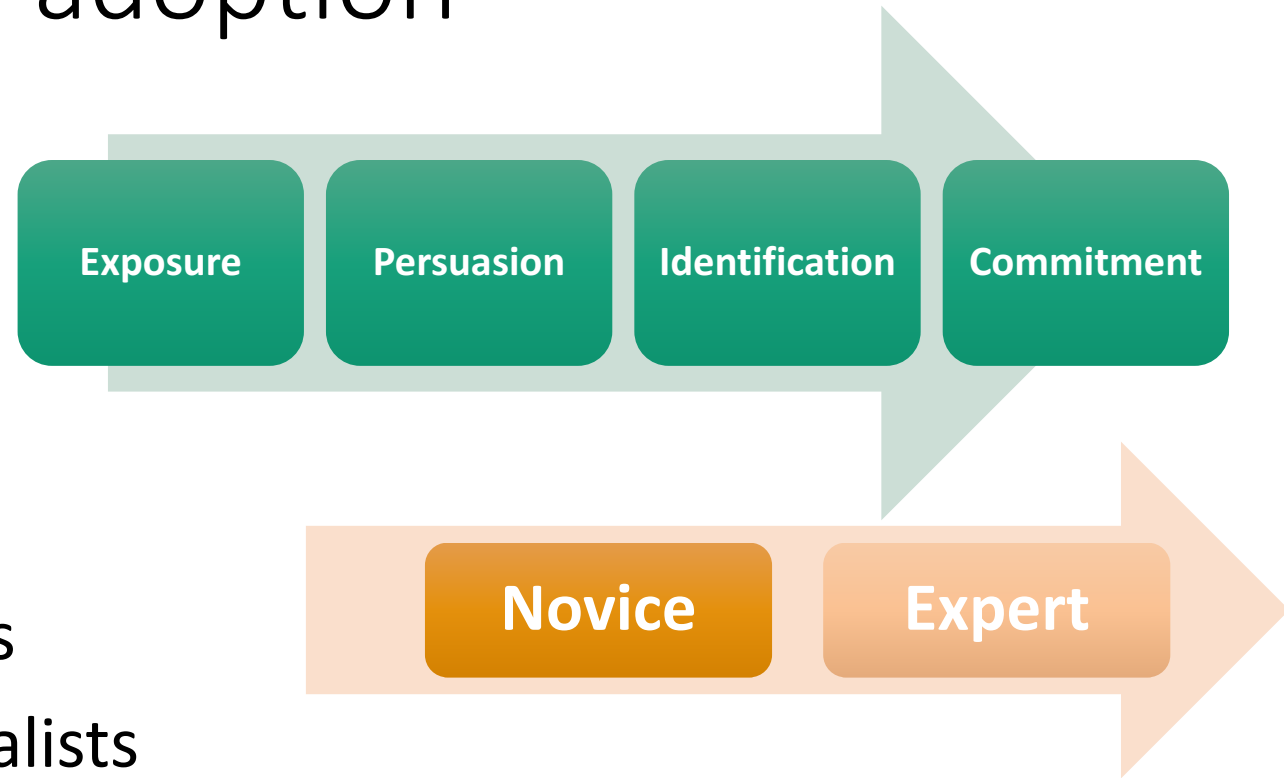
Common “mistakes” (non-optimal implementations)?

Ways to avoid them?



# Top theme among webinar participant questions: issues with “adoption”

- Busy faculty
- Culture that values teaching
- Encouraging experimentation
- Learner-centered orientation
- Manageable instructional changes
- Early adopters, skeptics, traditionalists
- Collaboration/discussion across sections of the same course



## Part 2:

1. Thinking about “adoption”

**2. Diagnosis tools:  
Institutions and individuals**

3. Discussion: Tools and approaches

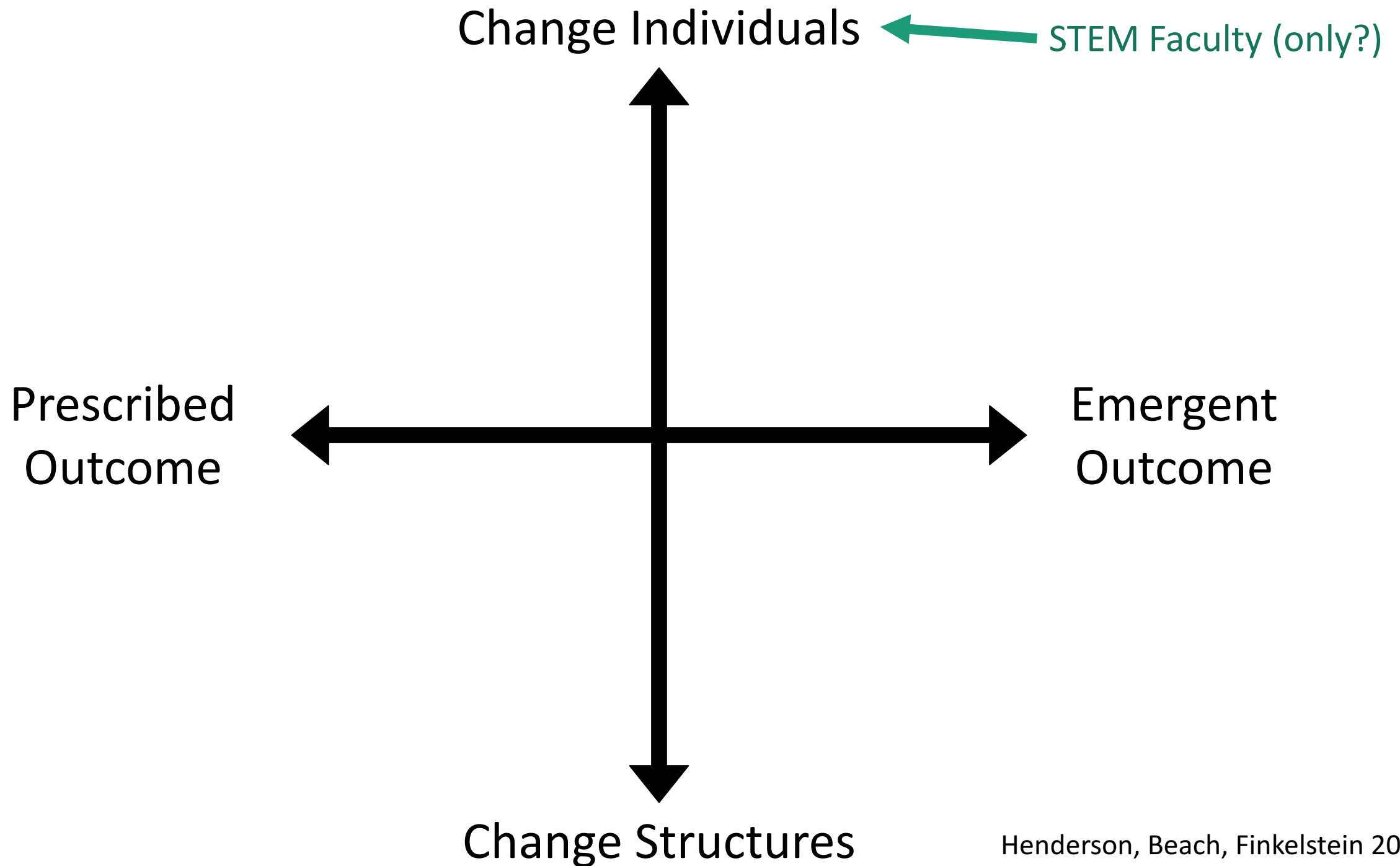
# Research: Change Strategies

Location for change?

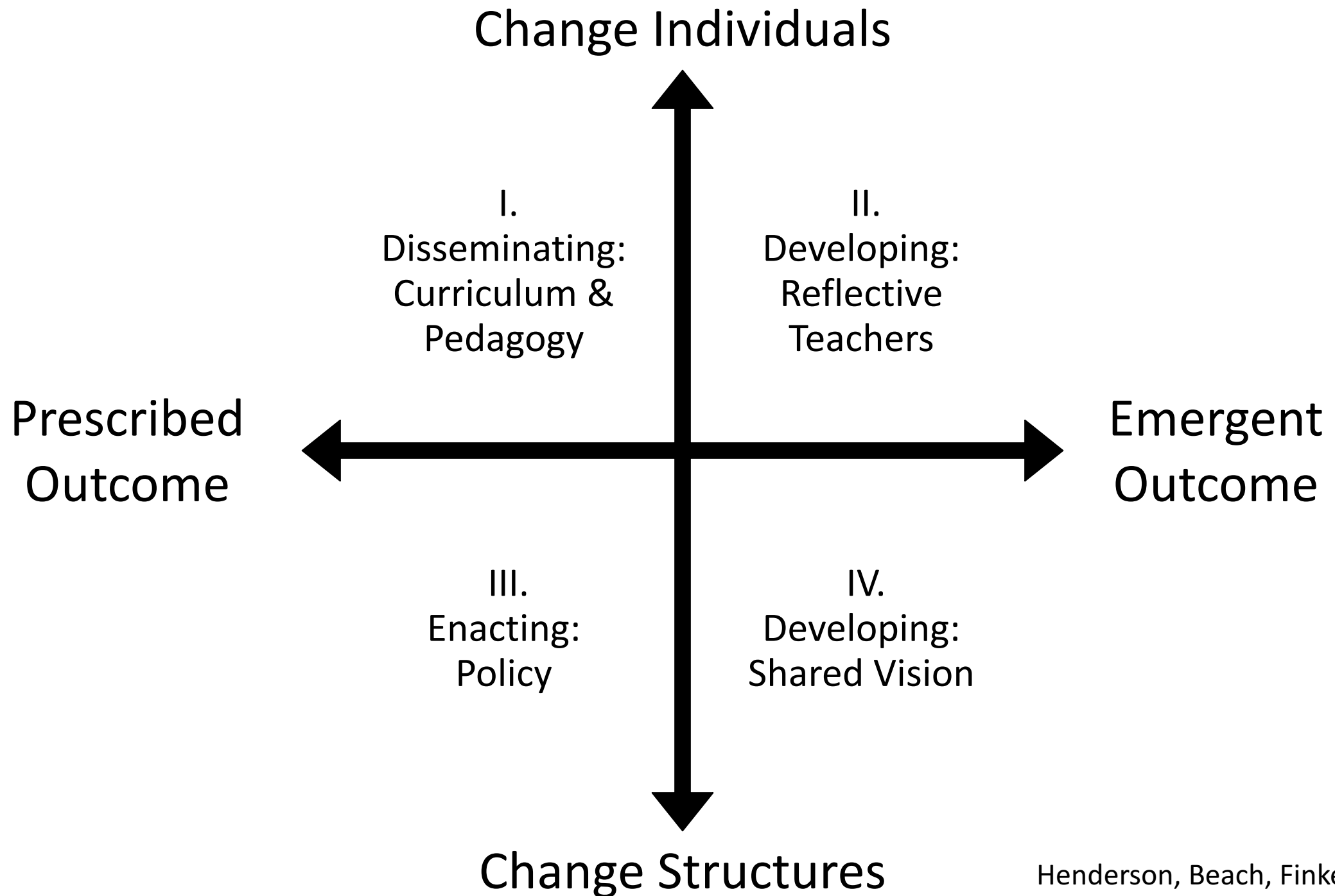
- Change individuals  
or
- Change environments  
& structures

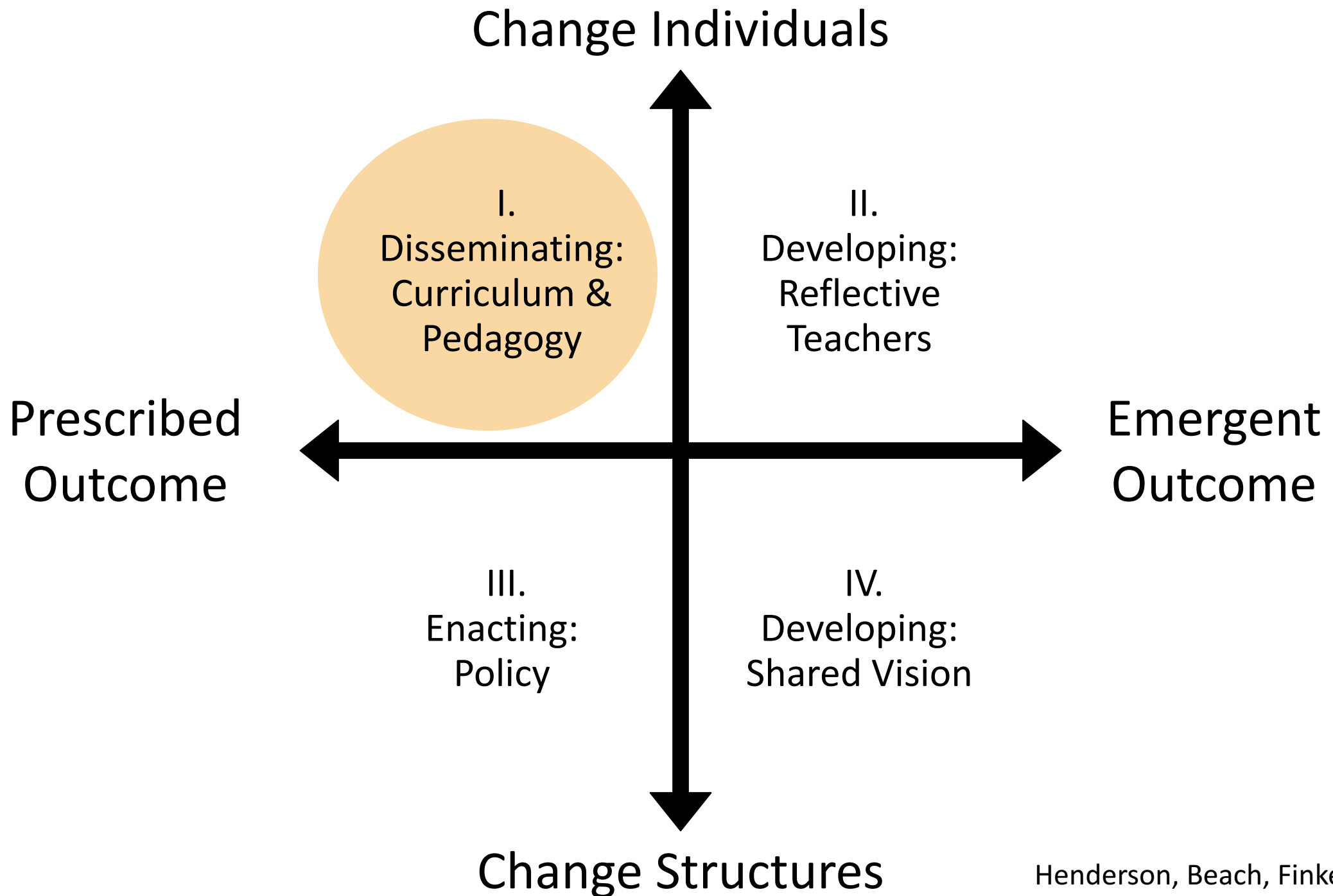
Nature of change?

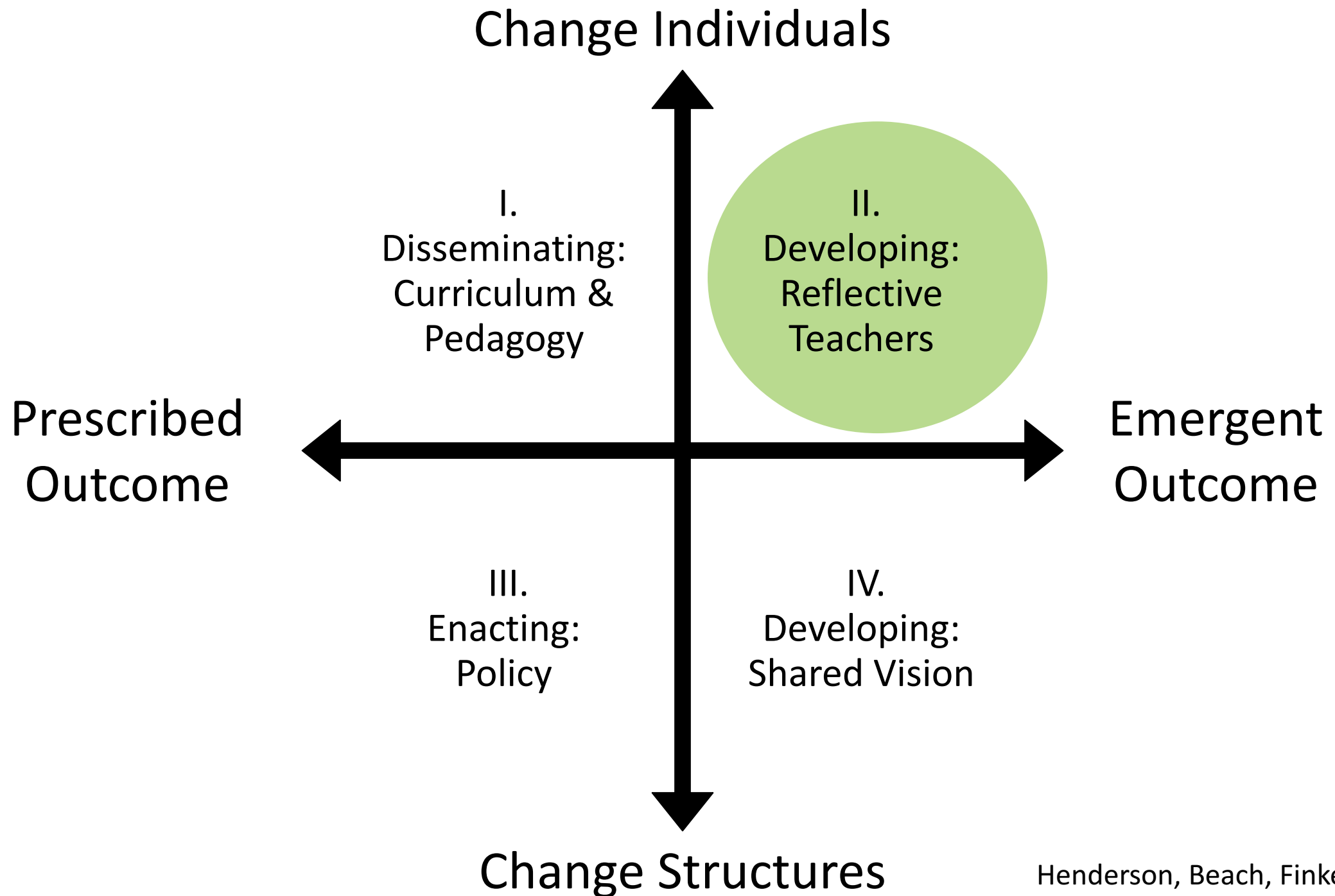
- Prescribed outcome  
or
- Emergent outcome

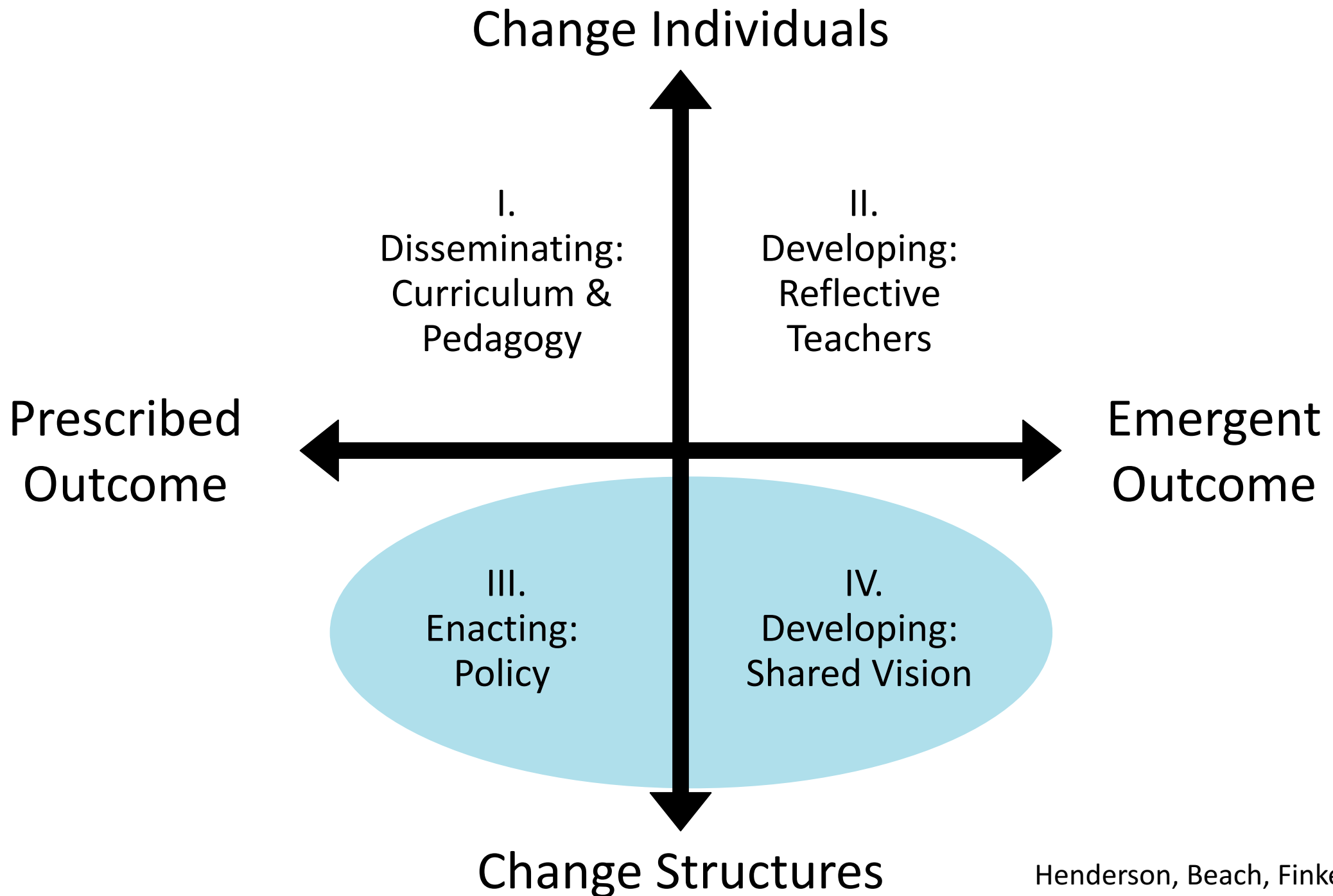












Change Individuals

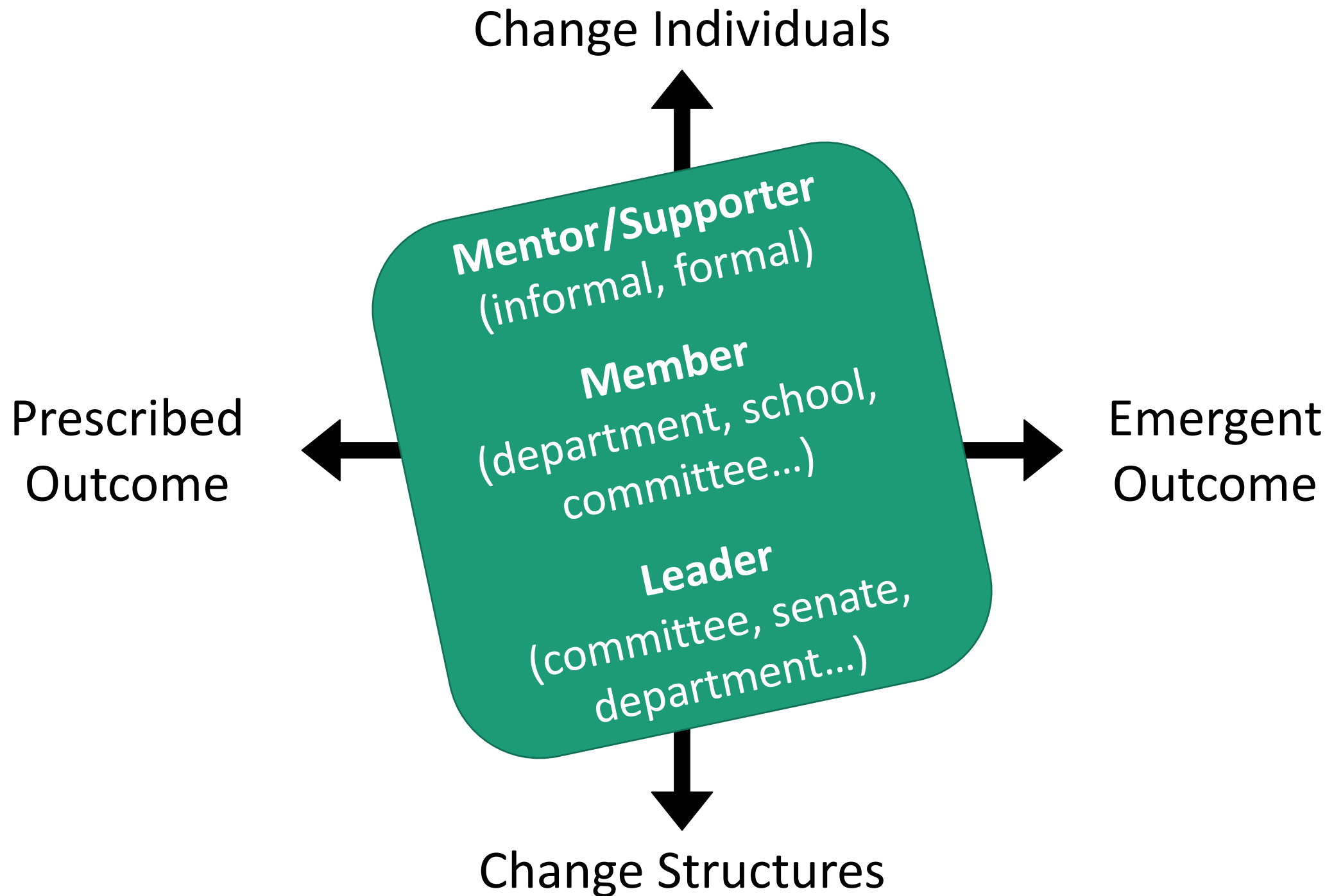
Prescribed  
Outcome

Who are the  
change agents?  
Who should be?

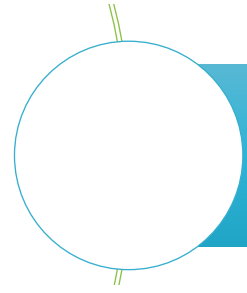
Emergent  
Outcome

Change Structures

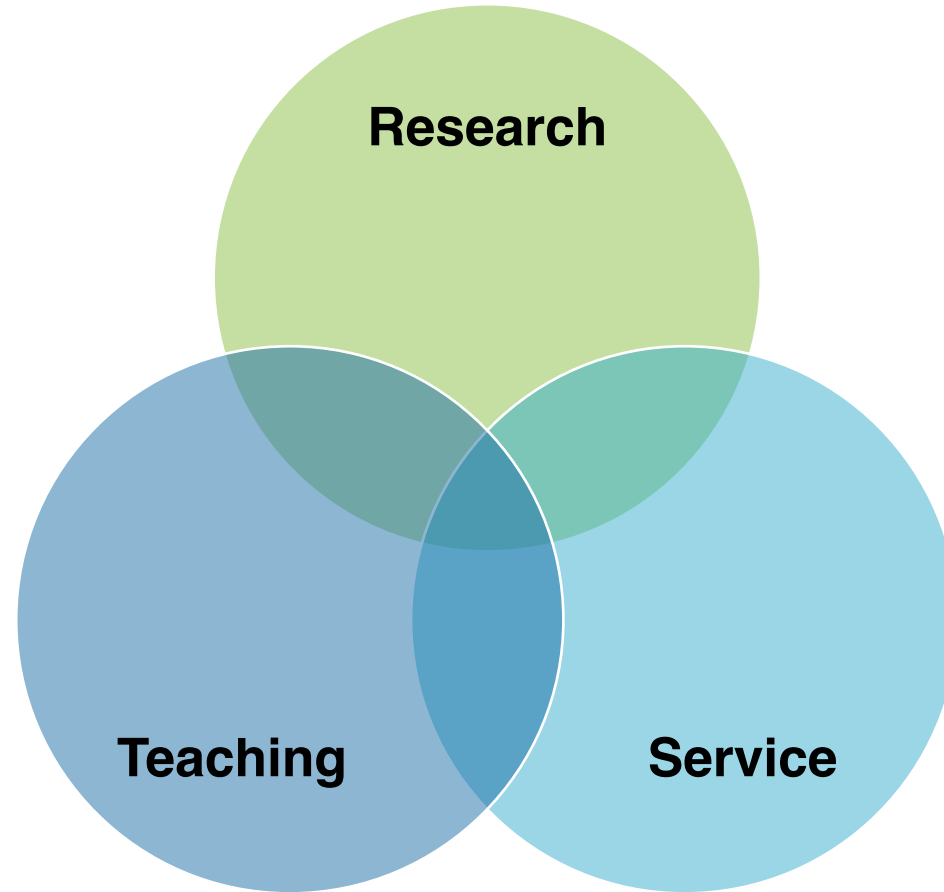




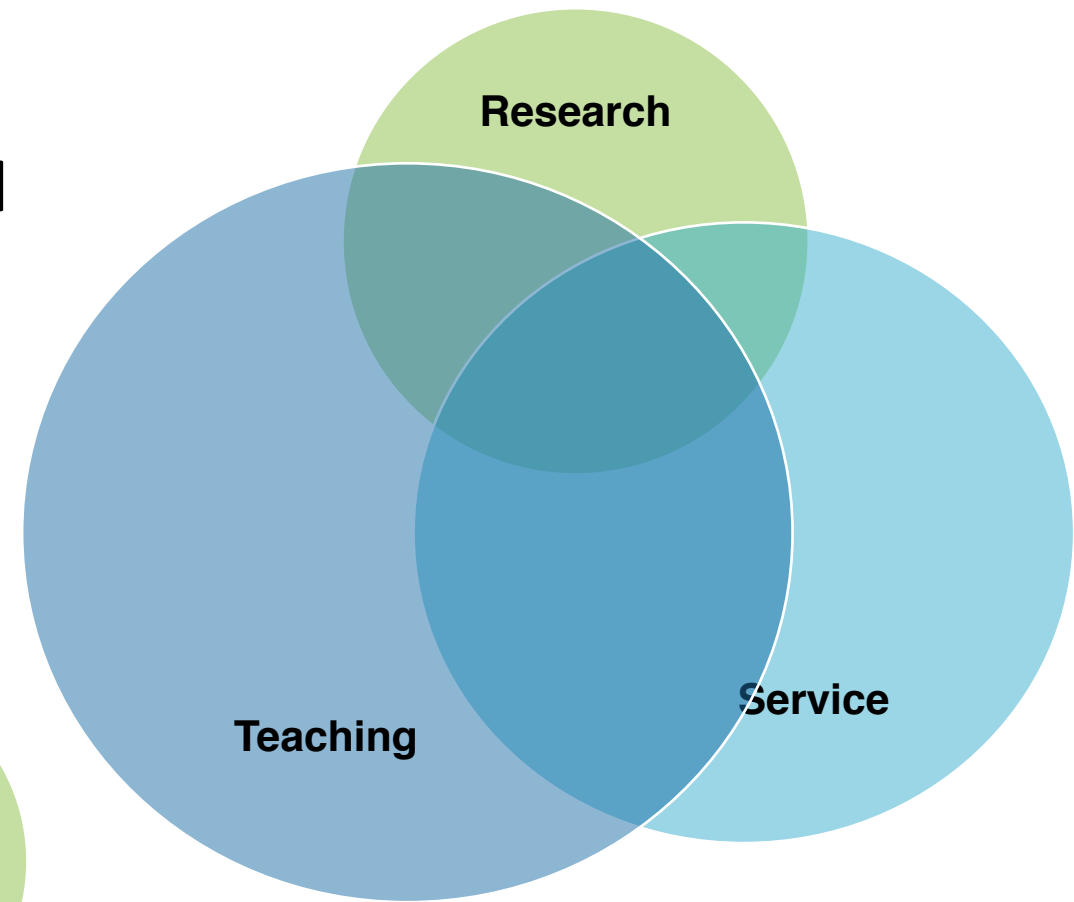
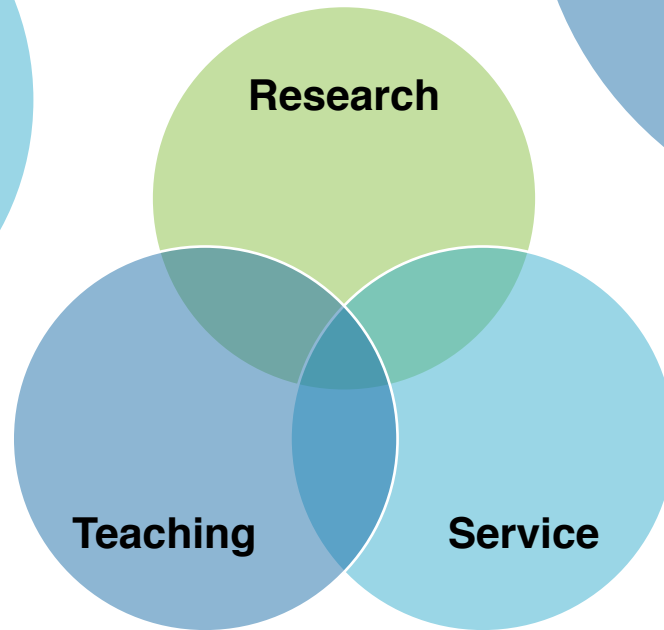
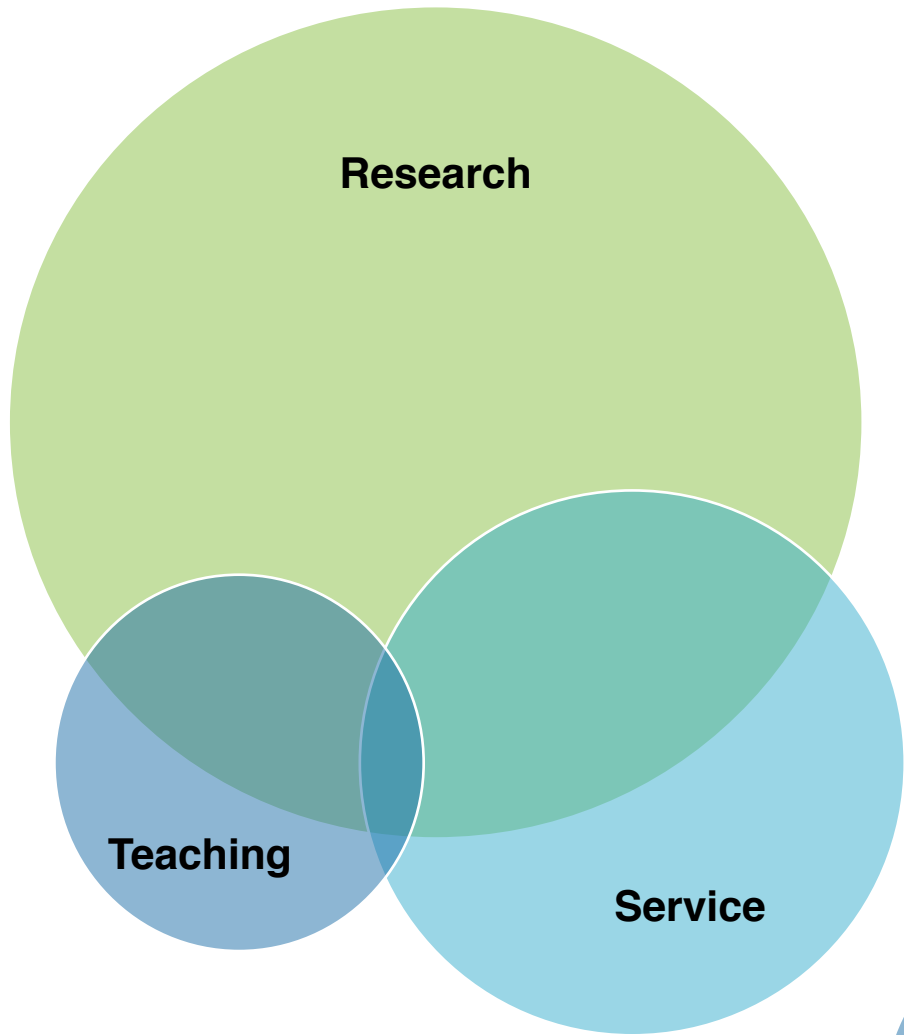




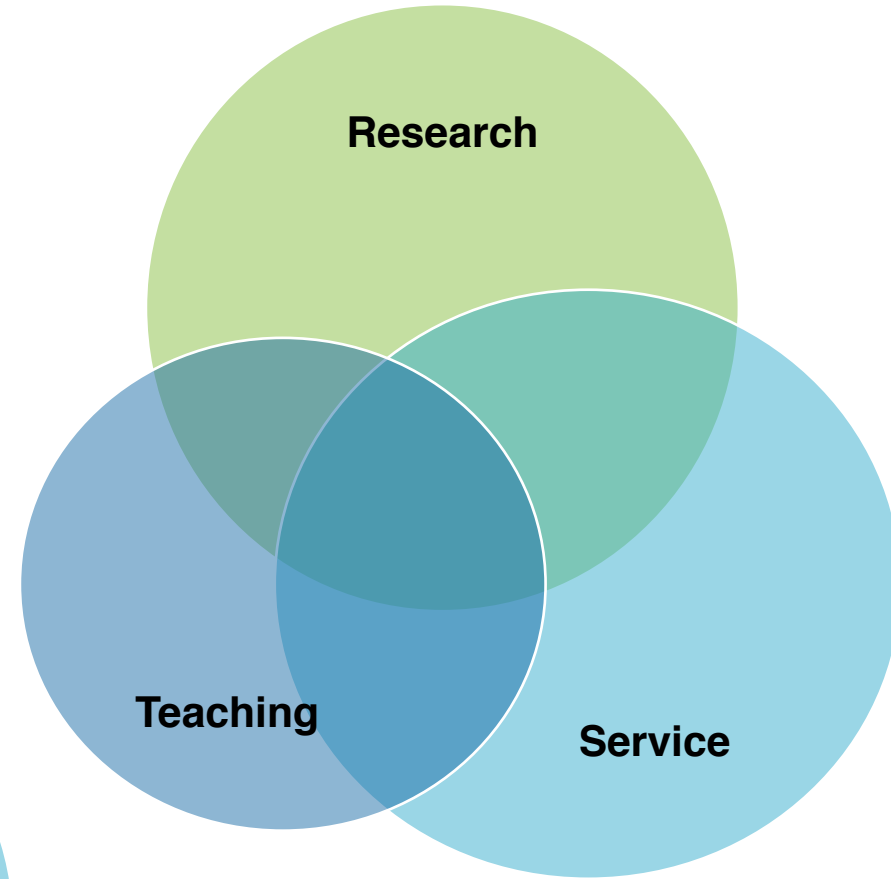
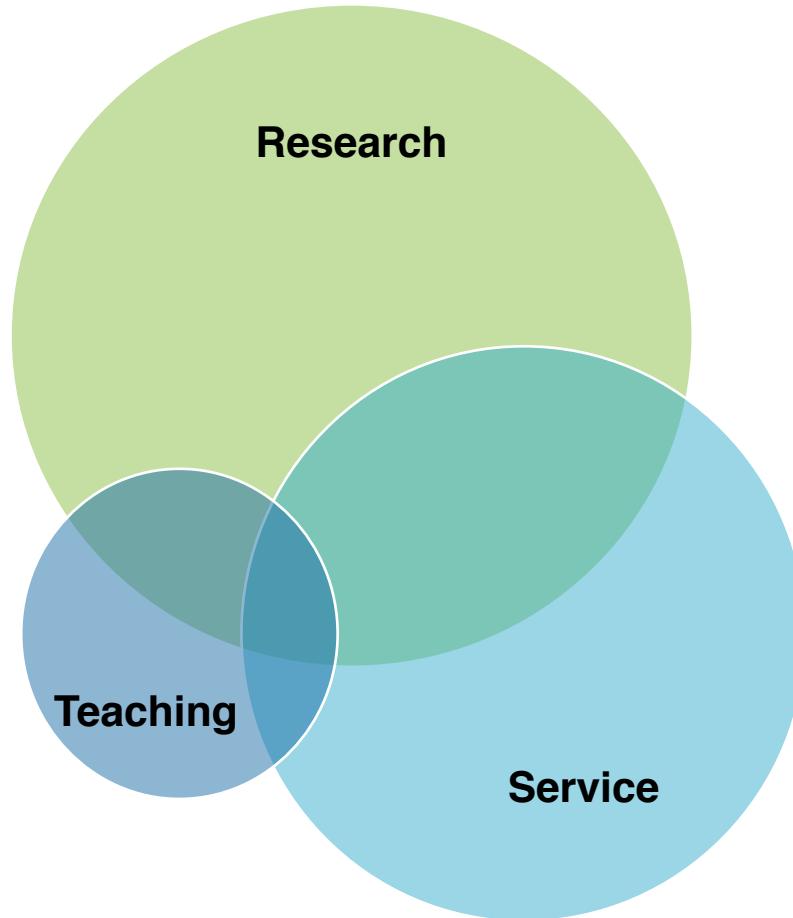
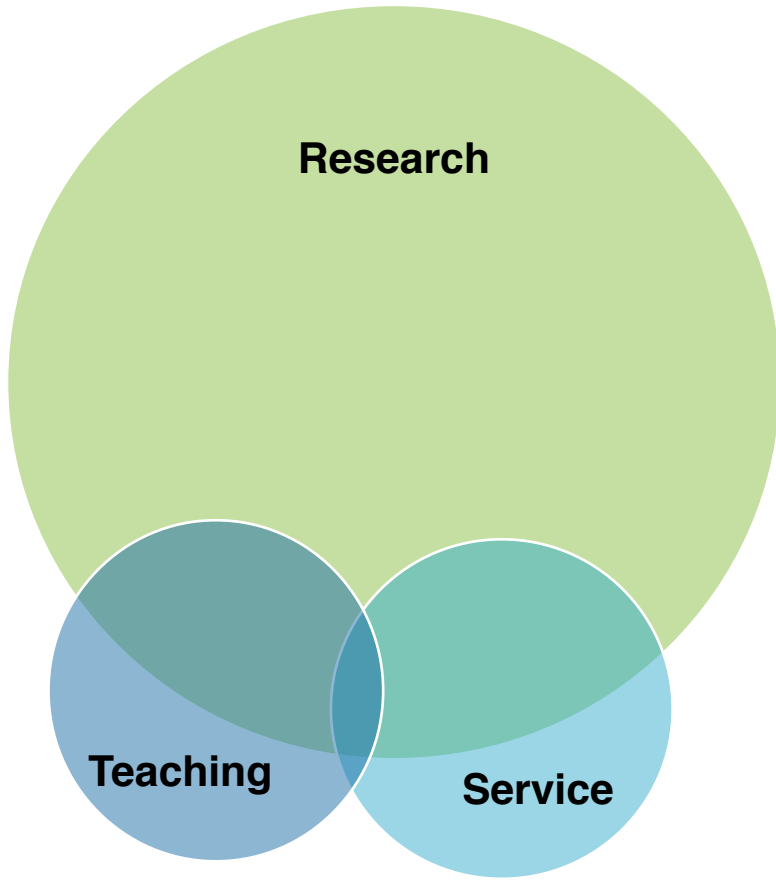
# Institutional context & faculty work



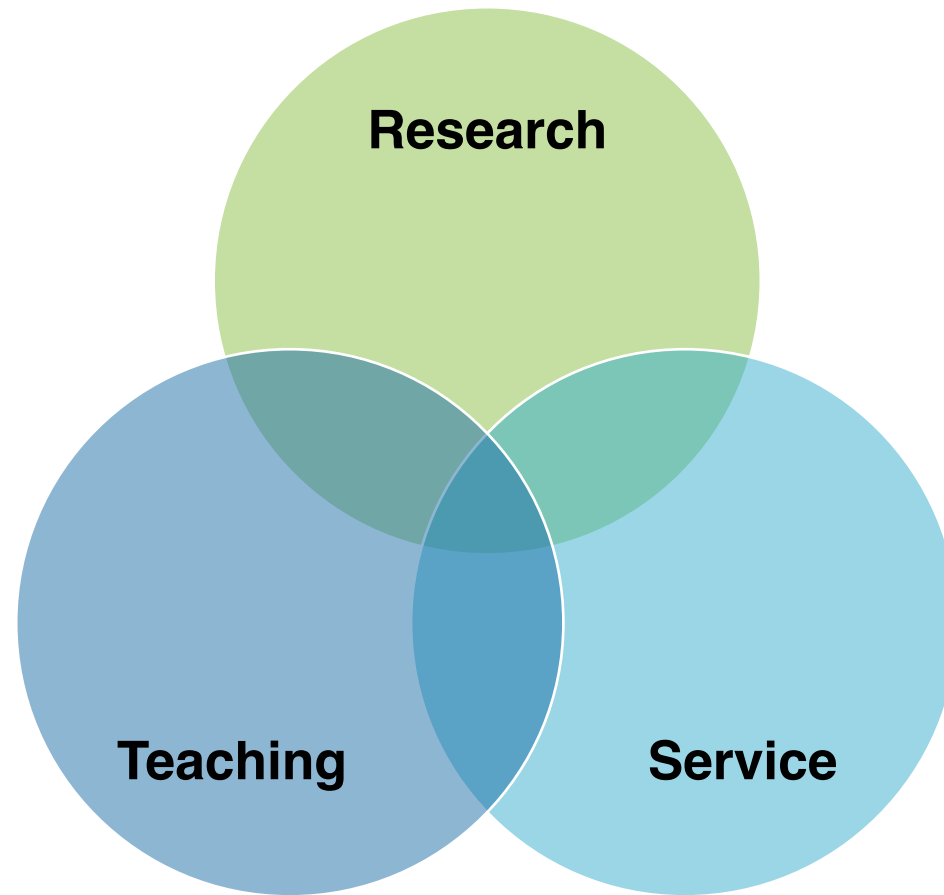
## Context: Institutional Differences

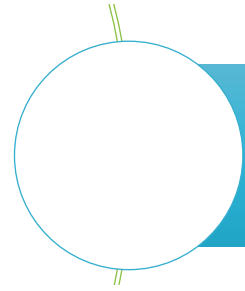


## Context: Career Stage Differences



# Evaluation Criteria (Promotion/Tenure)

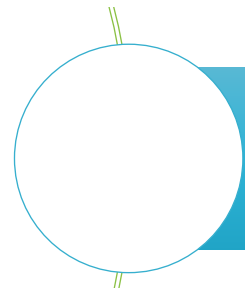




# Institutional context & faculty work

- Narrative of Constraint:
  - Barriers
  - Limited resources/time
  - Survival; “treading water”
  - Isolation

*How faculty work has been often  
been framed and discussed...*



# Institutional context & faculty work

- Narrative of Constraint:

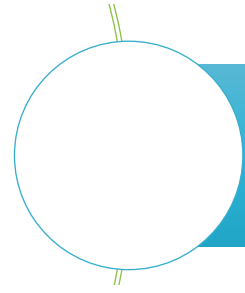
- Barriers
- Limited resources/time
- Survival; "treading water"
- Isolation

*How faculty work has been often been framed and discussed...*

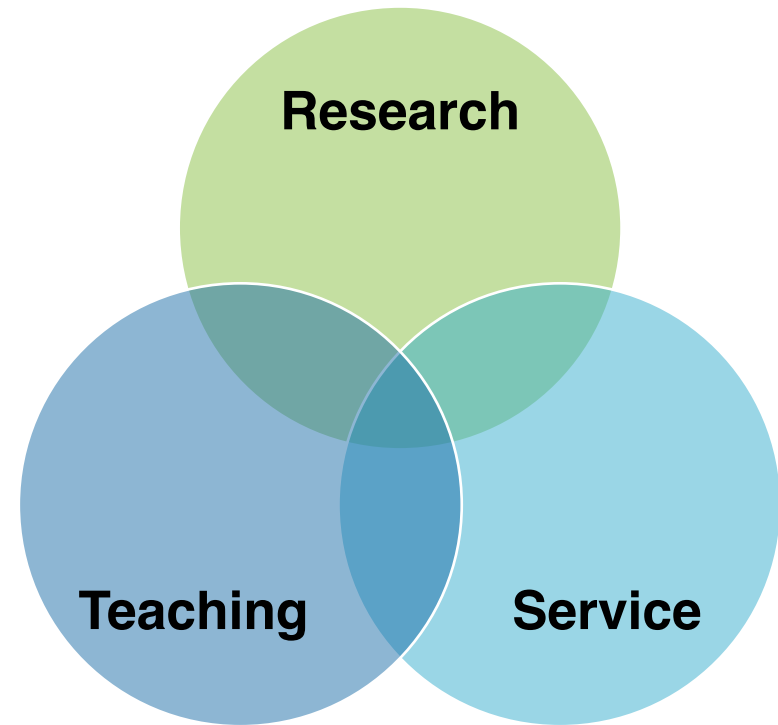
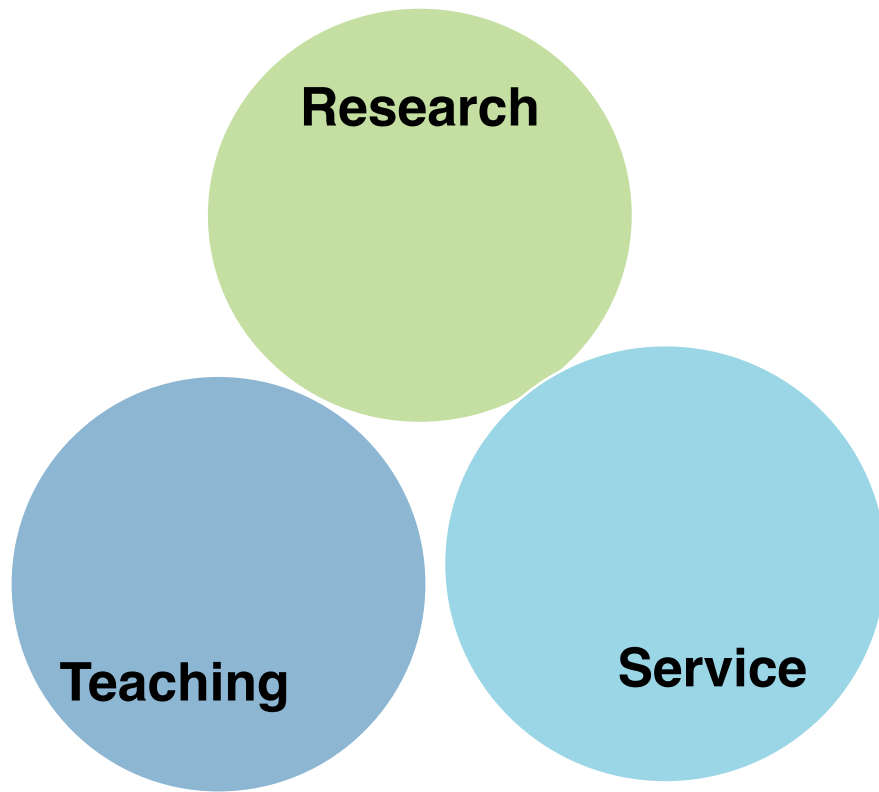
- Faculty Growth & Learning:

- Choice, commitment, agency
- Personal meaning
- Change and development
- Professional Networks

*...also a common underlying experience: meaning, connection, and collegiality.*



# Institutional context & faculty work





# Faculty – authentic individual humans

## **Professional & Personal Identity Matters**

- Who one wants to be as a scientist, educator, mentor, colleague...?
- Under what circumstances one best expresses enthusiasm and passion?

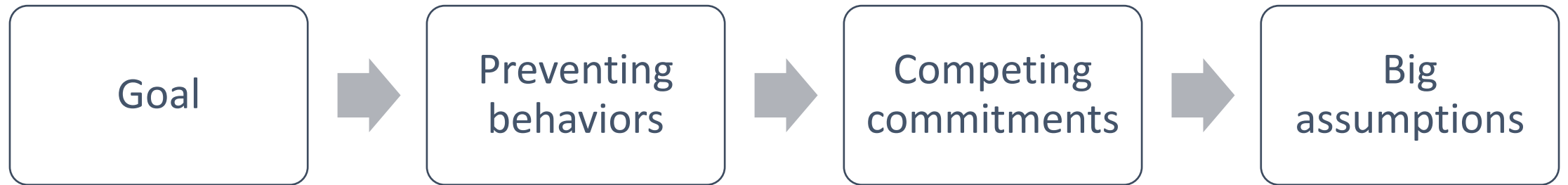
**“Best fit” RBISs**



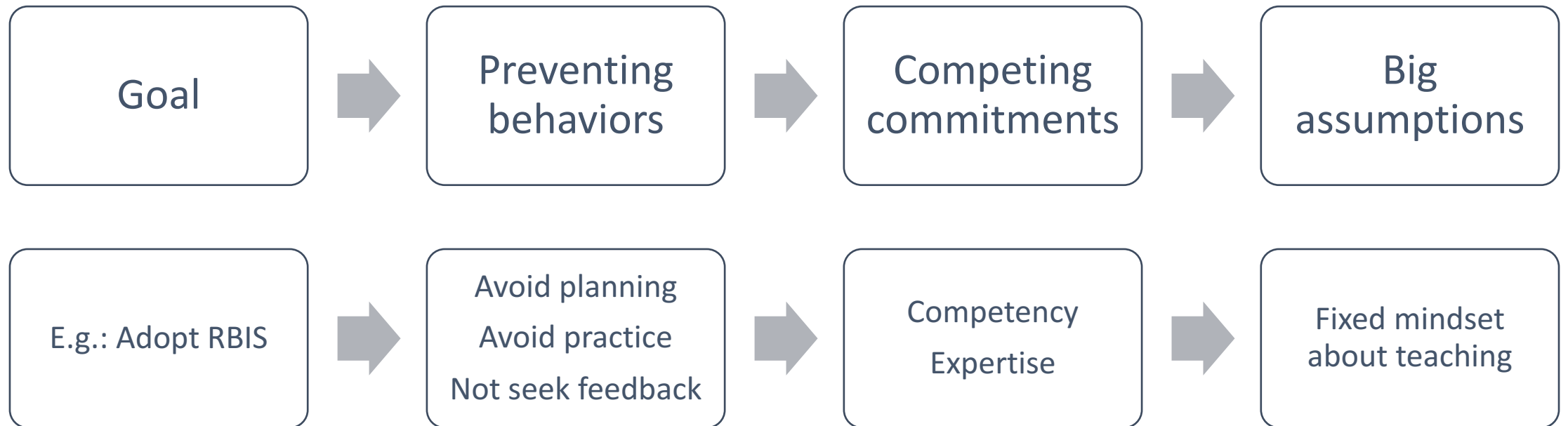
## 2<sup>nd</sup> most common question theme: Dealing with skepticism, resistance, etc.

- Skepticism about educational research; not perceived as “credible”
- Fear of negative student feedback
- Resistance to investing time
- Resistance to/fear of change generally
- Lack of perceived need to change
- Motivation, buy-in

# “Immunity to Change”



# “Immunity to Change”



# Autonomous vs. controlled motivation

- Acting due to interest vs. due to expected reward
- 1970s: “corruption effect” of external rewards; undermine autonomous motivation
- Newer evidence: piddling rewards, “insufficient justification” theory



**Derek Bruff**

@derekbruff

Following



You should be jealous of my  
[@polleverywhere](#) socks.



**Cassandra V. Horii** @cvhorii · 1m



Replying to [@derekbruff](#) [@polleverywhere](#)

Obviously [@polleverywhere](#) has solved the knotty, perennial challenge of motivating change in higher education! [#socksofhighered](#) [#sockstatus](#) [#socksforchange](#) [#SockItToMe](#)



**Mr. John Damaso** @MrJohnDamaso · Jan 8

Replying to [@derekbruff](#) [@polleverywhere](#)

What do I need to do to rise to sock status, [@polleverywhere](#)?



1

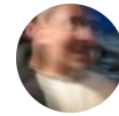


2



**polleverywhere** @polleverywhere · Jan 8

Did you not receive socks? You rose to sock status years ago. Let me s  
where we went wrong...



**Matthew Roberts** @mmcr · Jan 8

Replying to [@derekbruff](#) [@polleverywhere](#)

I'm guessing you have to use [@polleverywhere](#) a lot more than I do to qu  
receive socks. Or was this a corporate wedding present? 😊



1



2



**polleverywhere** @polleverywhere · Jan 8

Socks are awarded for exemplary Poll Everywhere usage innovations. Yo  
could someday be honored with the coveted Poll Everywhere sock award  
[#dreambig](#)



**polleverywhere** @polleverywhere · Jan 8

We all believe in you.



2



1



**D Christopher Brooks** @DCBPhDV2 · Jan 8

Replying to [@derekbruff](#) [@polleverywhere](#)

Dude. Want.



2



# Autonomous vs. controlled motivation

- Interest, recognition of importance vs. expected reward
- 1970s: “corruption effect” of external rewards; undermine autonomous motivation
- Newer evidence: piddling rewards, “insufficient justification” theory:  
***Small rewards don’t justify the effort, so people are less likely to attribute their behavior to the external gains; instead, they may construct internal, autonomous justifications.***

# I want to be super clear:

- WE MUST STILL PURSUE institutional reward structures that align...

**AND**

- We do not yet know the scale of importance of institutional “big rewards,” nor how far we might get with smaller rewards.

# 3rd most common theme in webinar questions: rewards & institutional structures

- Rewards that are misaligned with attention to effective teaching:
  - Overall and in the culture
  - In tenure and promotion
- Role/consequences of student evaluations of teaching
- Strategies for talking with deans and provosts
- Institutional structures addressing tensions experienced by faculty



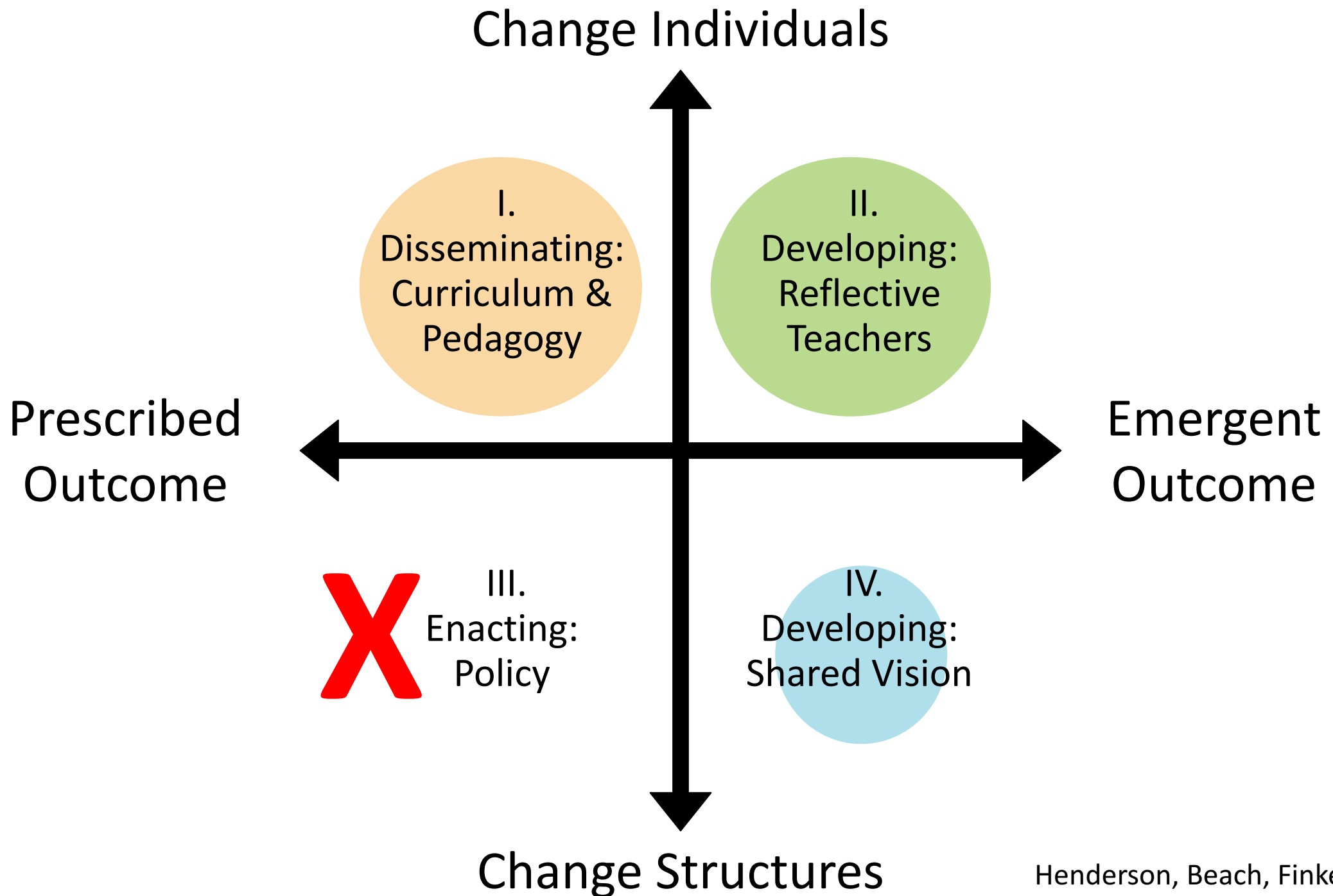
# Caltech

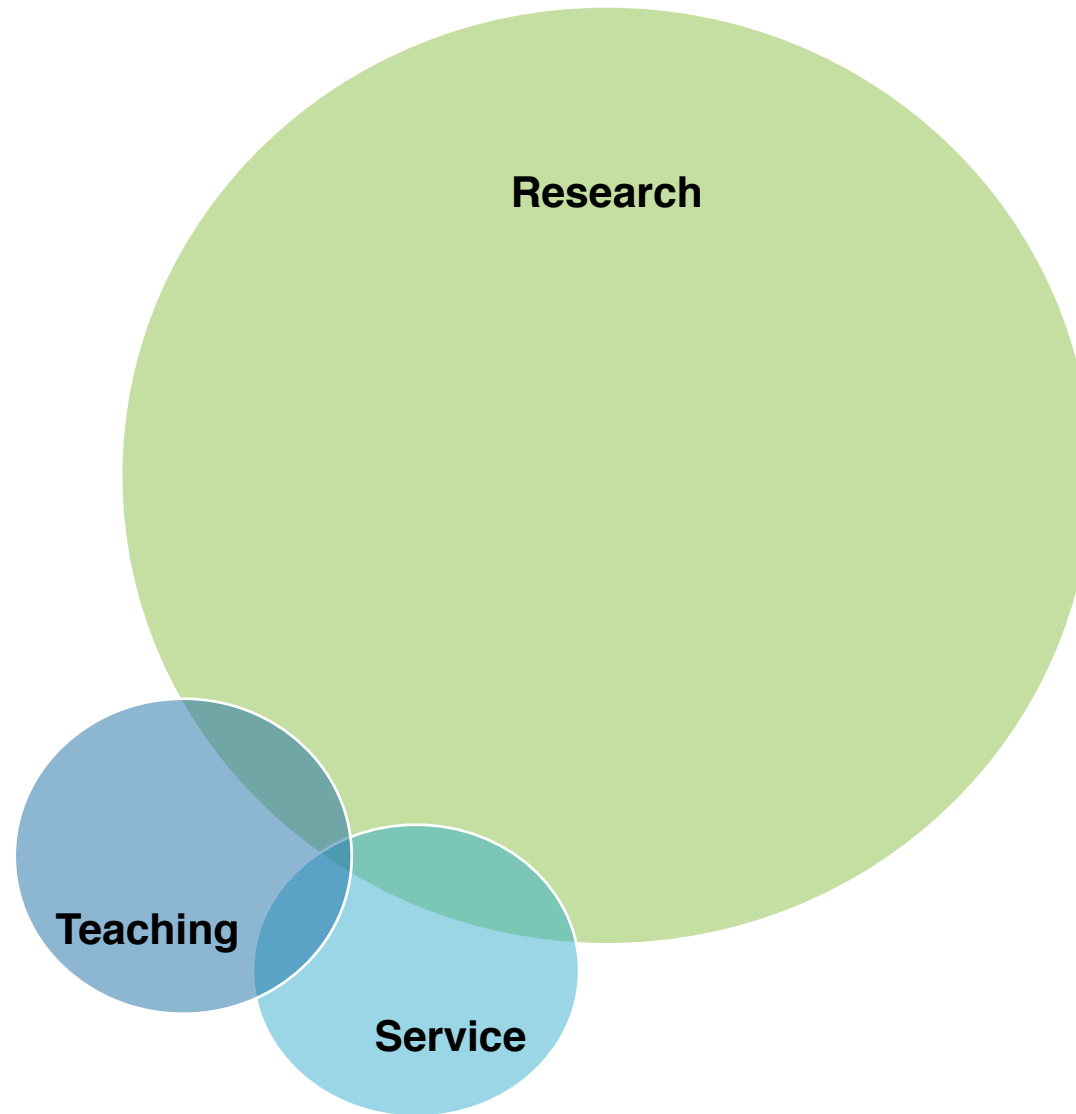
<http://ctlo.caltech.edu>

Test and apply ideas about institutions & individuals

- Change quadrants
- Faculty work; narratives
- Individual “best fit”
- Immunity to change
- Autonomous/controlled motivation; reward size

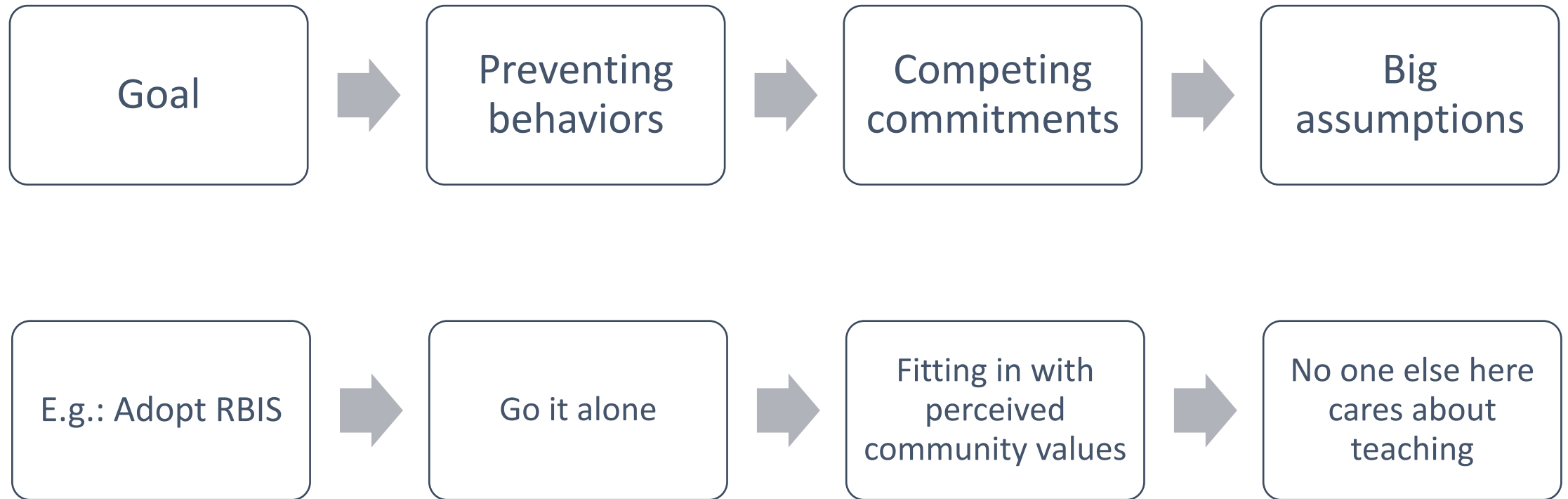






## 2. Institutions and Individuals

# “Immunity to Change”

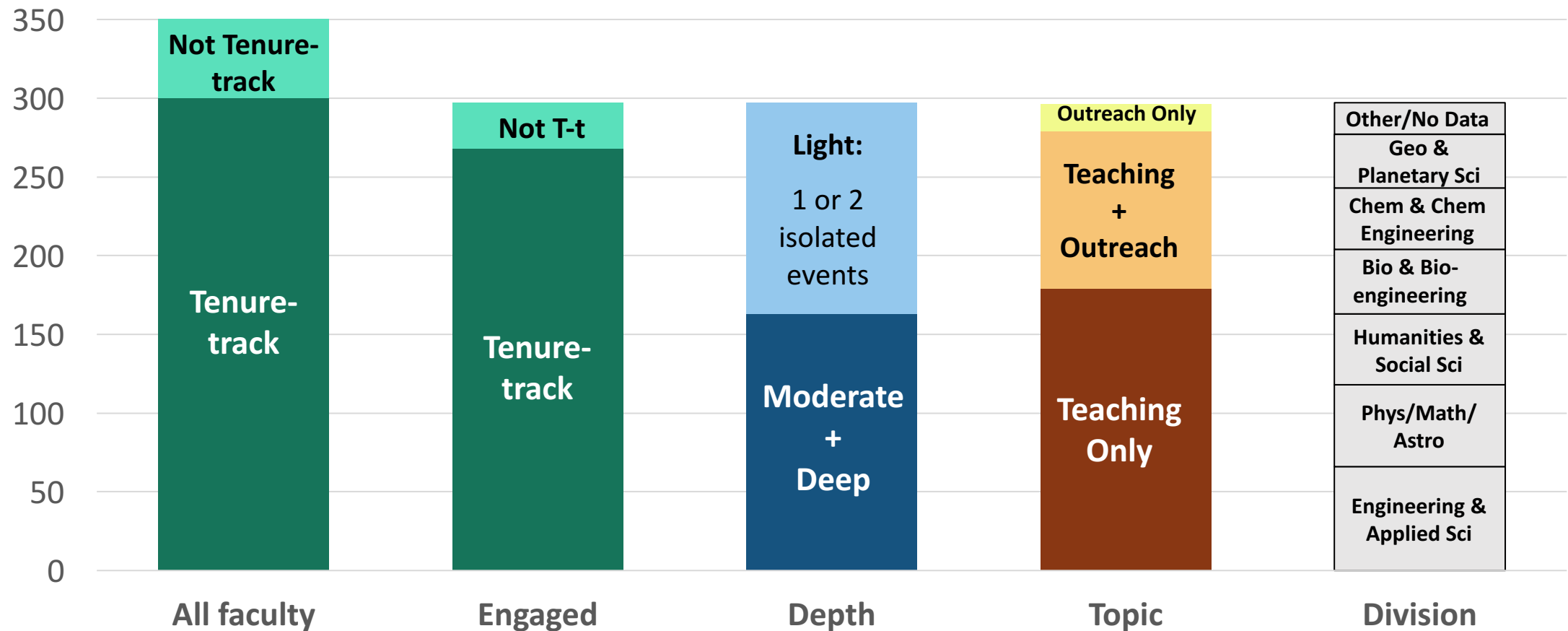


# External Rewards

- No big rewards: promotion, tenure (also no real penalties)
- One moderate size reward: Feynman Prize for Excellence in Teaching
- A few small rewards: student-nominated teaching awards
- Some funds to support innovation in education projects (actual costs only – no stipends/buy-outs/etc.)

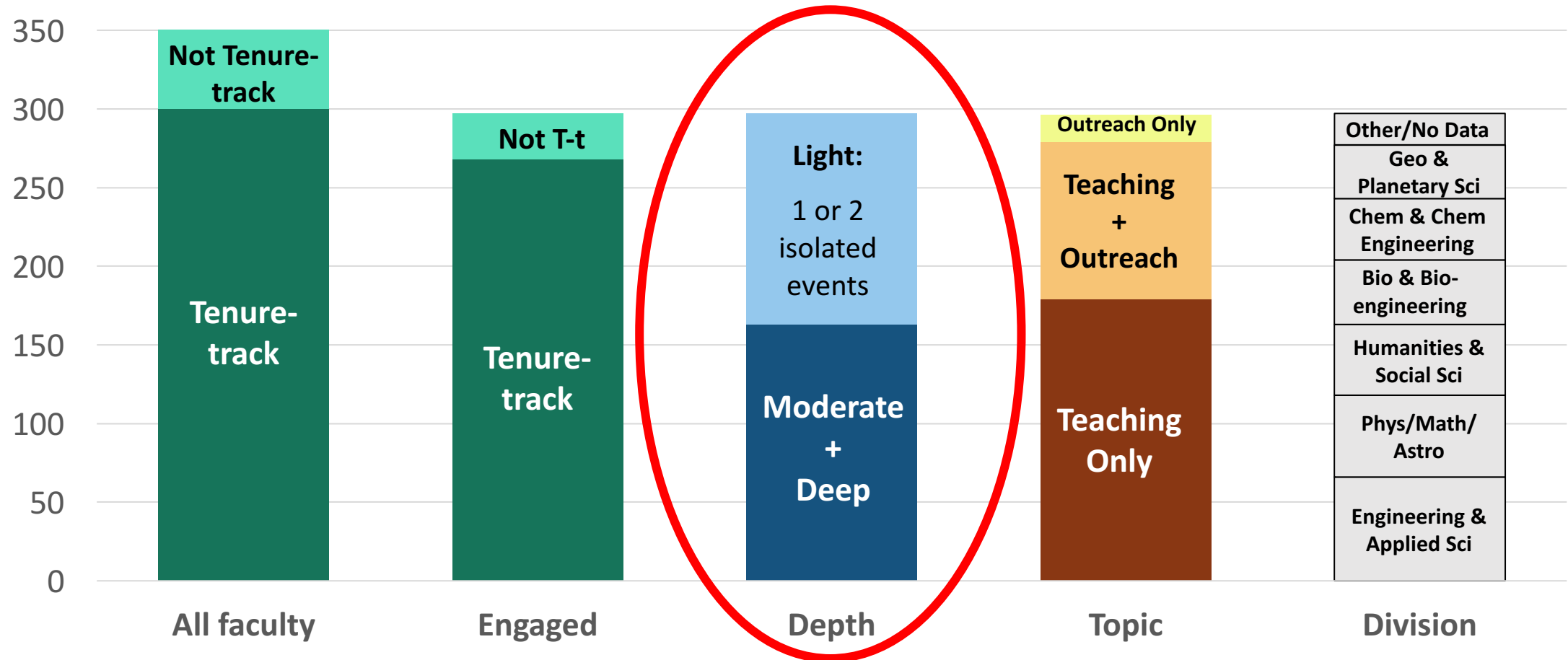
# Engagement in educational change

## Five-year period, 2012-2017

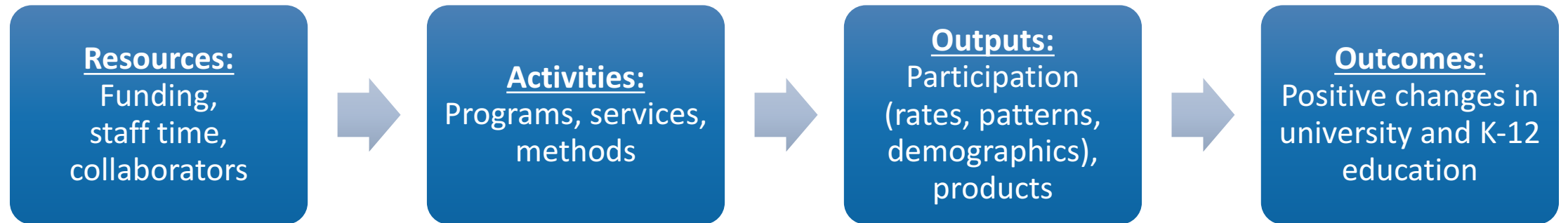


# Engagement in educational change

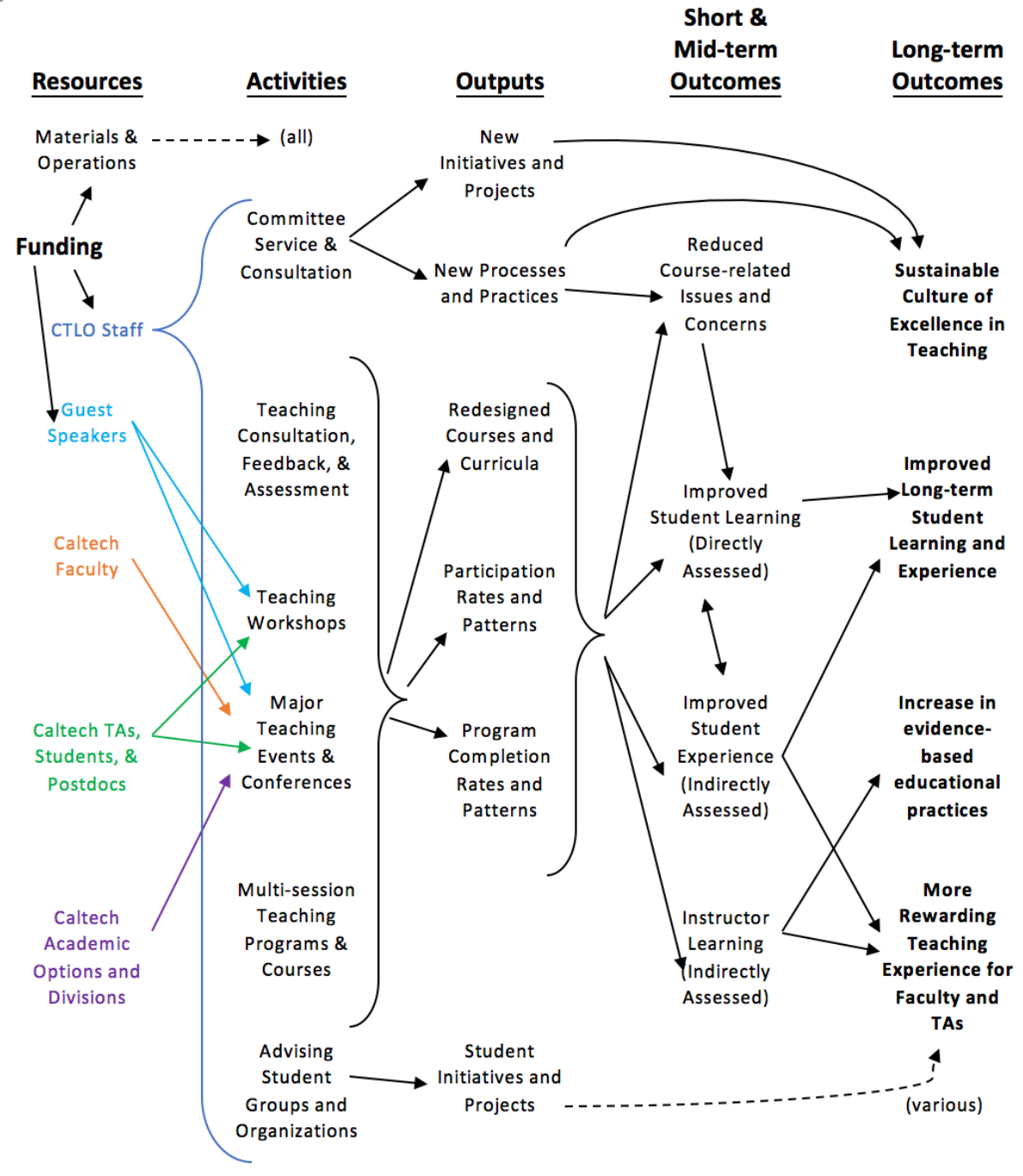
## Five-year period, 2012-2017

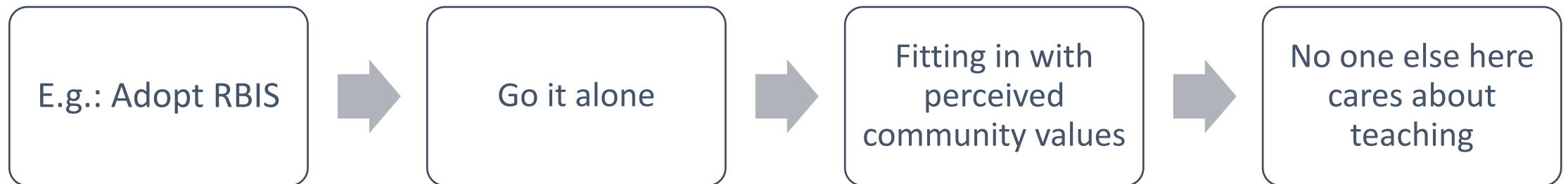
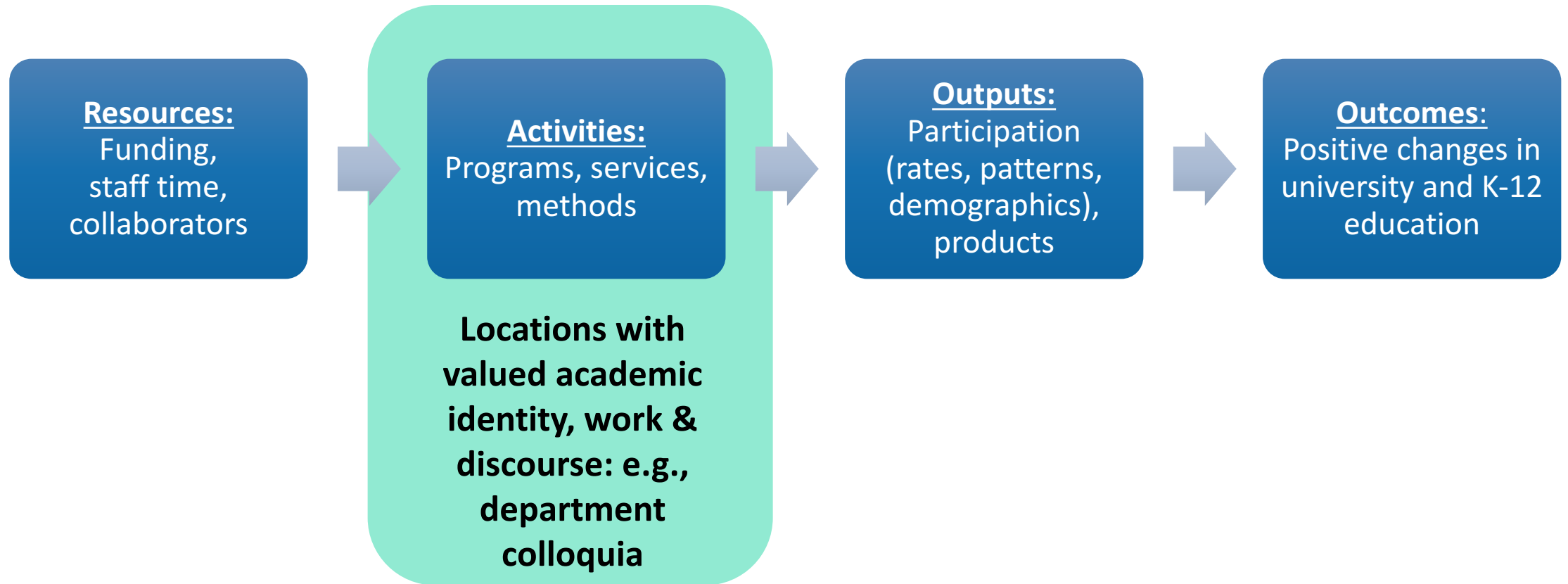


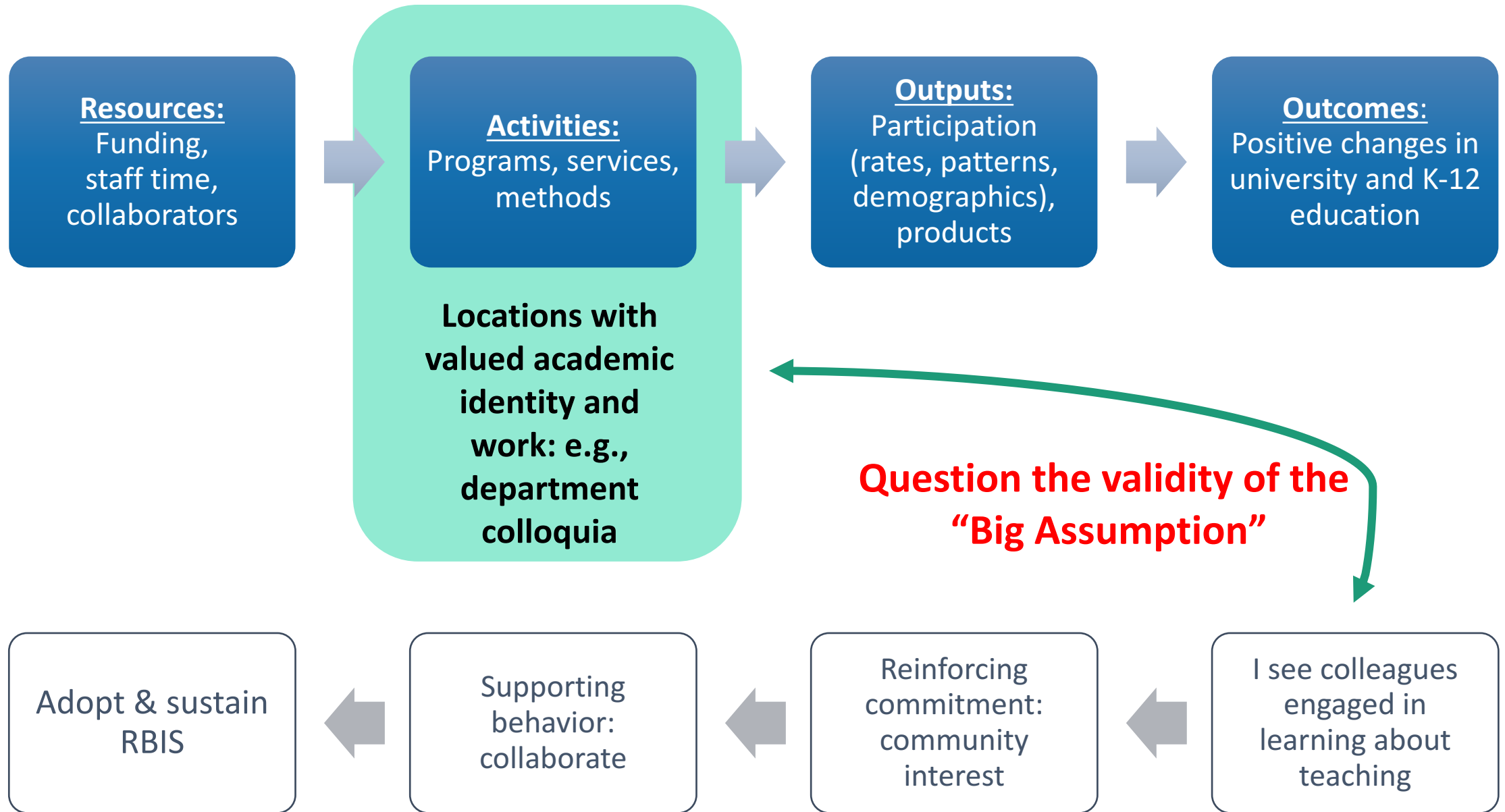
# Logic models



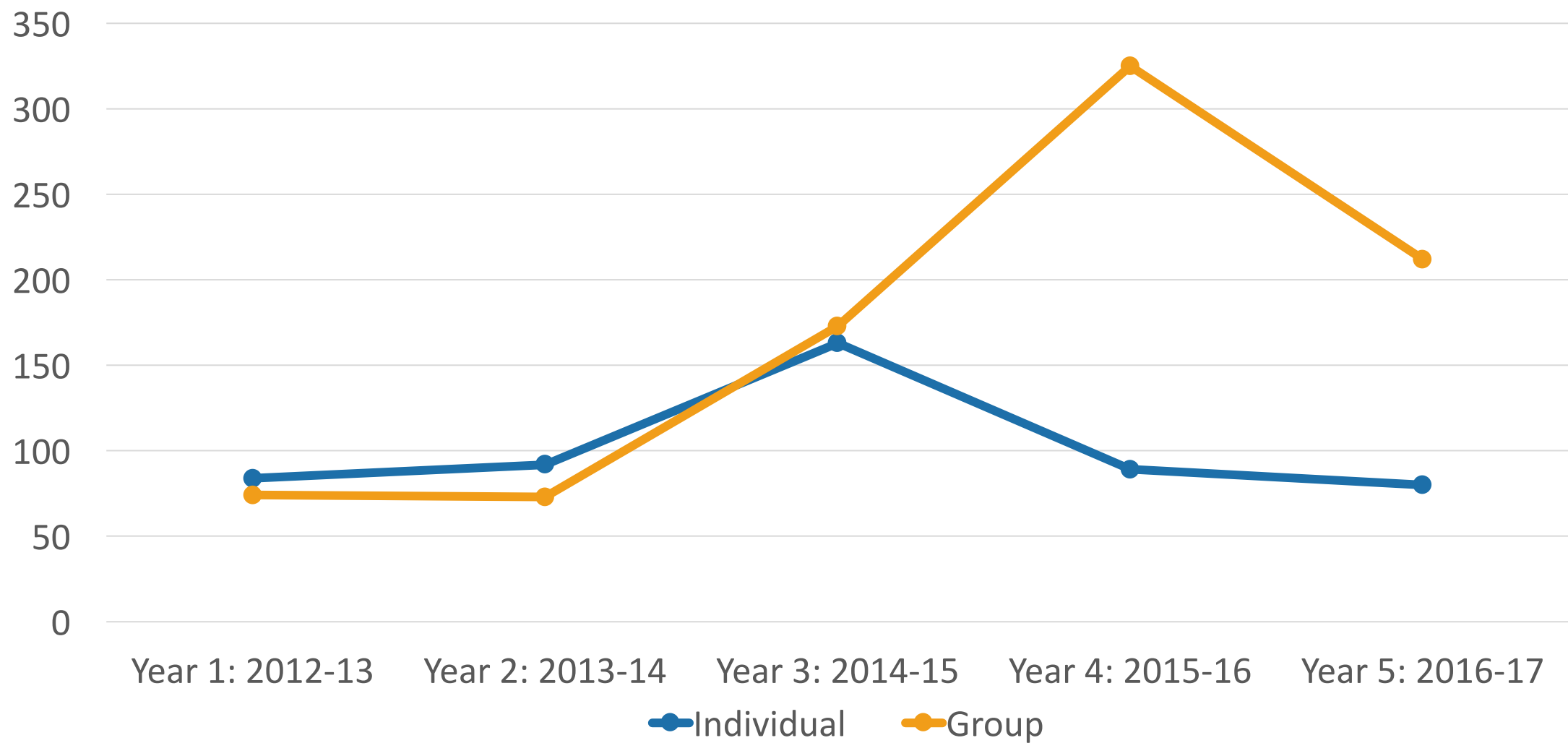






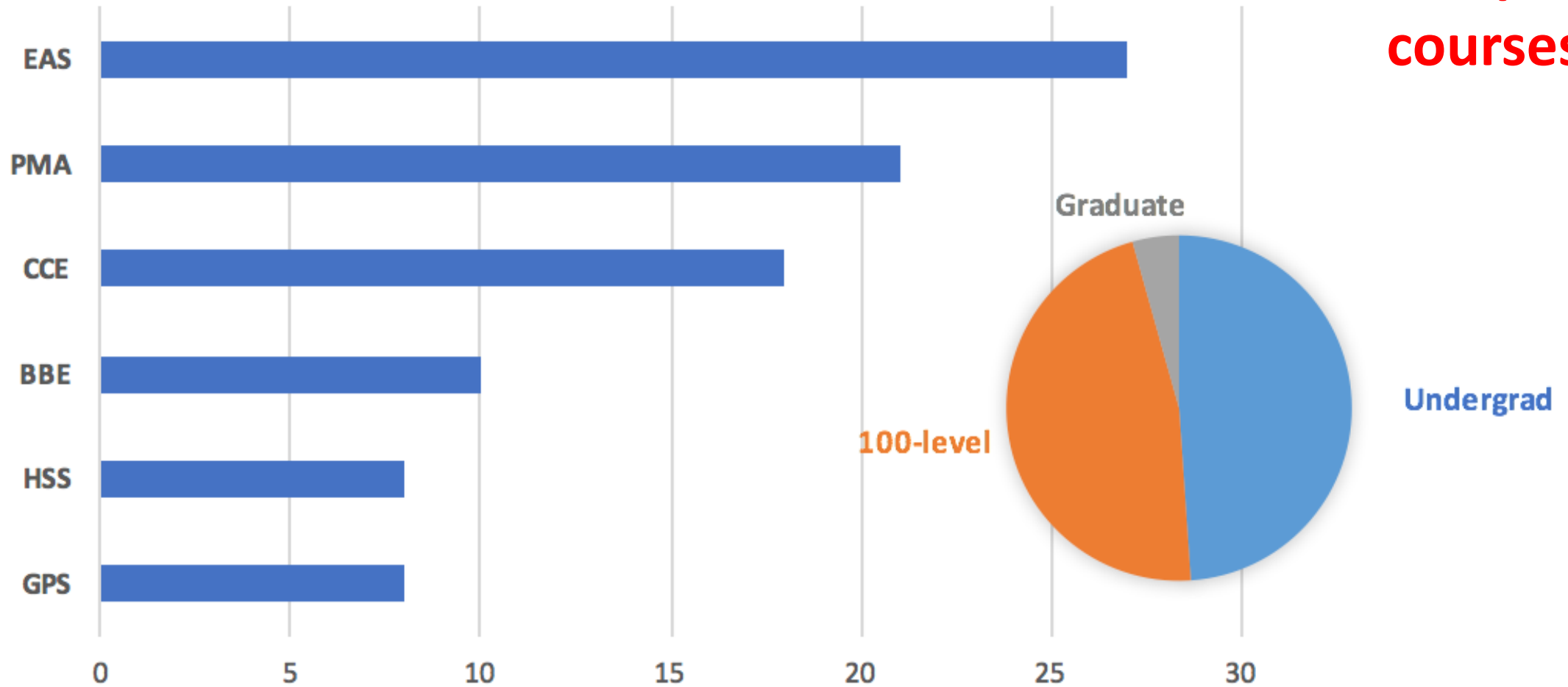


## Faculty Services by Type

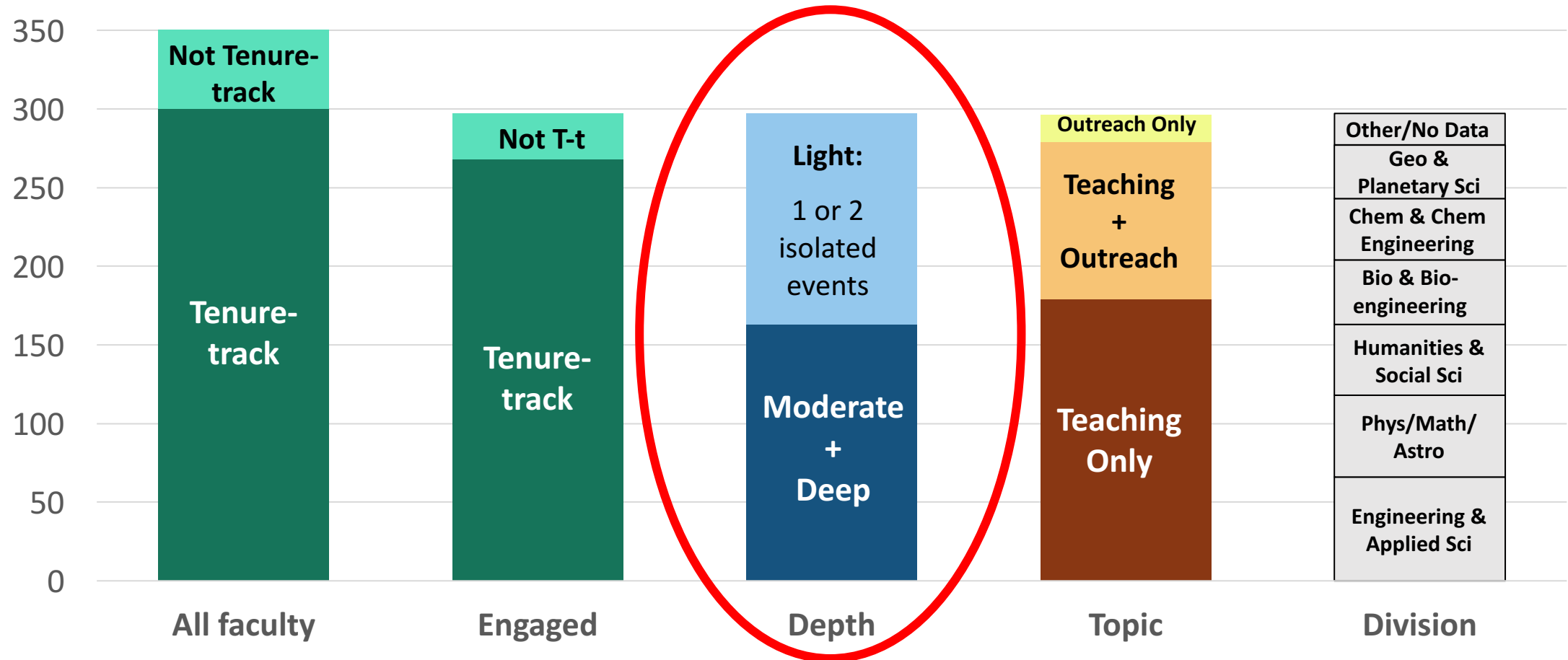


**COURSES DESIGNED OR REVISED WITH CTLO SUPPORT  
BY DIVISION AND LEVEL**

**92  
unique  
courses**



Do we need some additional nudges (Small rewards? Big rewards?) to reach a critical mass?



## Part 3:

1. Thinking about “adoption”

2. Diagnosis tools: Institutions and individuals

**3. Discussion: tools and approaches**

# Reflection (~1 minute)

- Which of the aspects of adoption, institutions, & individuals “clicked” (made sense) for you and your context? Why?
- What is one strategy or idea you could imagine trying?



# Reflection (~1 minute)

- Which of the aspects of adoption, institutions, & individuals “clicked” (made sense) for you and your context? Why?
- What is one strategy or idea you could imagine trying?



## Why use this?

What kinds of learning outcomes is it good for?

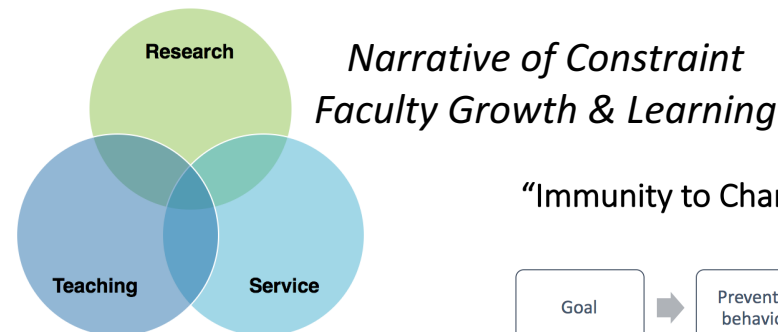
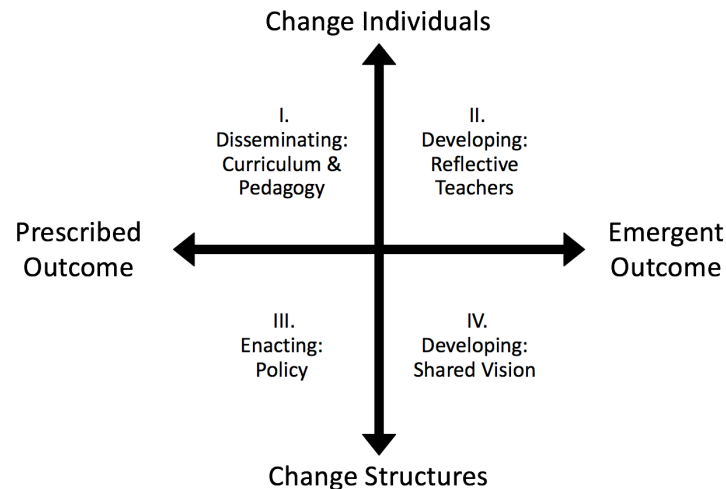
What are its key affordances?

**What are the essential aspects of implementation?**

Fidelity of adoption? Minimum increment?

**What are the potential pitfalls?**

Common “mistakes” (non-optimal implementations)?



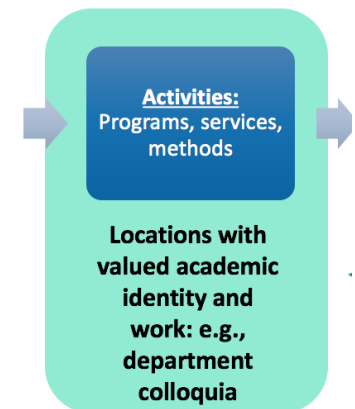
“Immunity to Change”



**Question the validity of the “Big Assumption”**



Small rewards & autonomous motivation



# Share in chat window

- Which of the aspects of adoption, institutions, & individuals “clicked” (made sense) for you and your context? Why?
- What is one strategy or idea you could imagine trying?



## Why use this?

What kinds of learning outcomes is it good for?

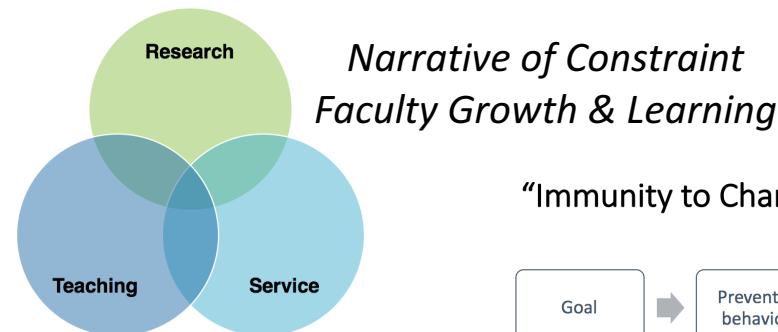
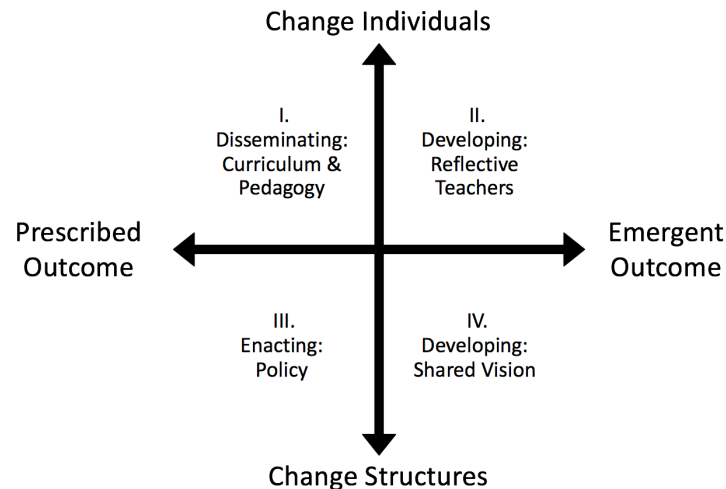
What are its key affordances?

**What are the essential aspects of implementation?**

Fidelity of adoption? Minimum increment?

**What are the potential pitfalls?**

Common “mistakes” (non-optimal implementations)?



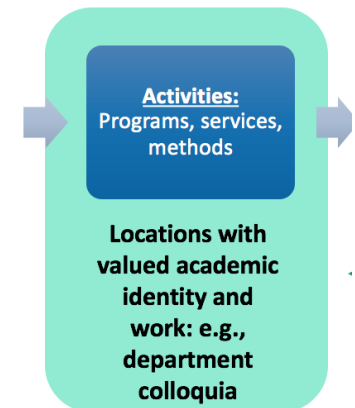
“Immunity to Change”



**Question the validity of the “Big Assumption”**

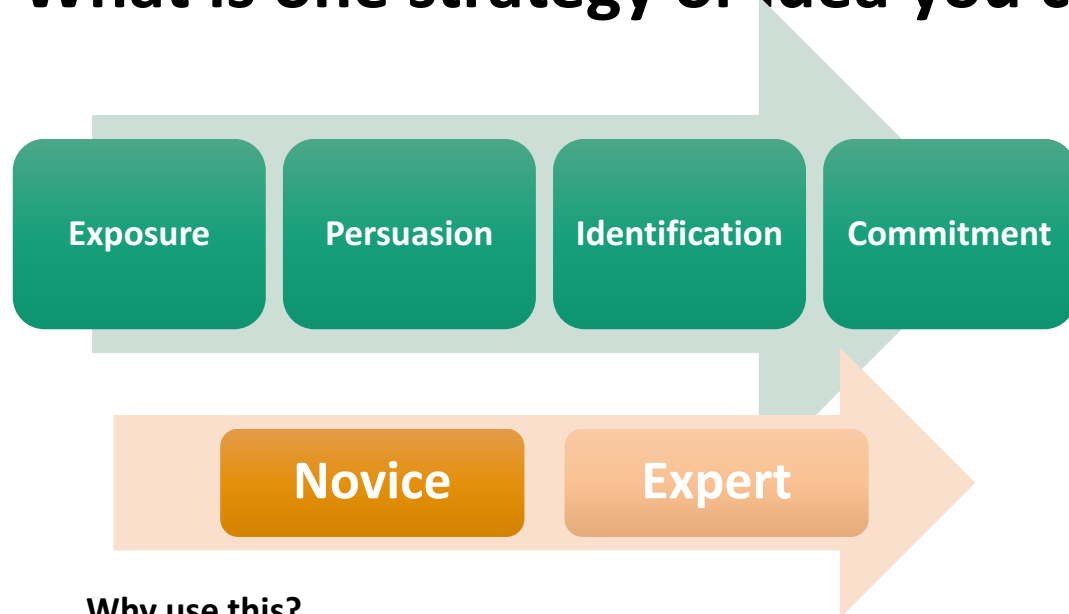


Small rewards & autonomous motivation



# Share in chat window

- Which of the aspects of adoption, institutions, & individuals “clicked” (made sense) for you and your context? Why?
- **What is one strategy or idea you could imagine trying?**



## Why use this?

What kinds of learning outcomes is it good for?

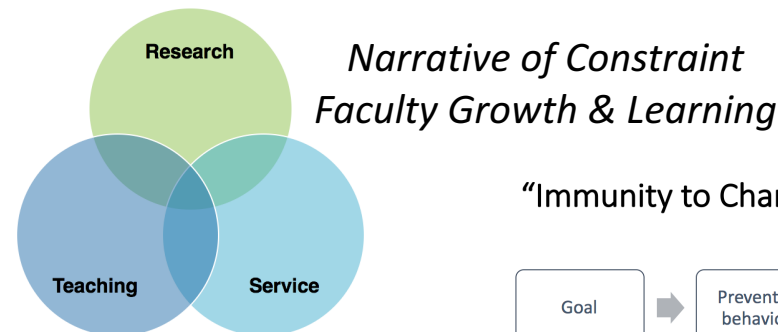
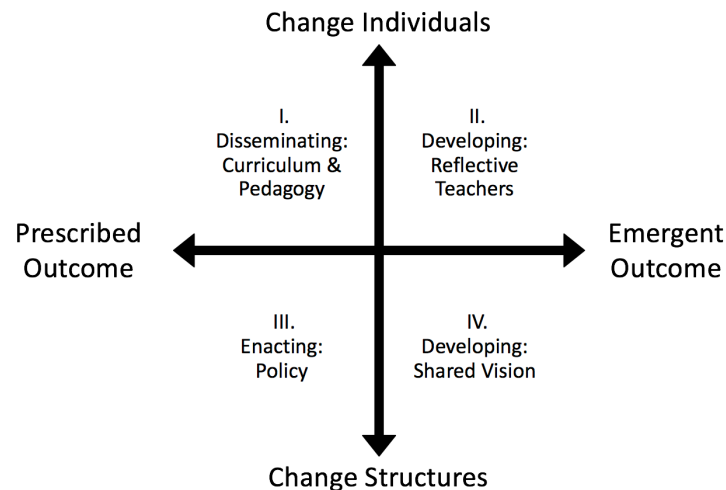
What are its key affordances?

**What are the essential aspects of implementation?**

Fidelity of adoption? Minimum increment?

**What are the potential pitfalls?**

Common “mistakes” (non-optimal implementations)?



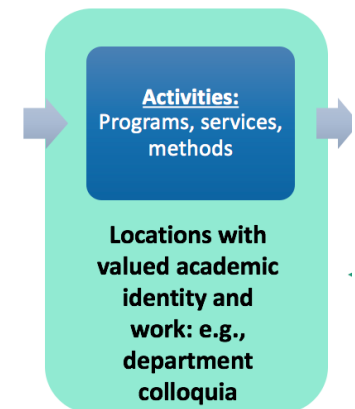
“Immunity to Change”



**Question the validity of the “Big Assumption”**



Small rewards & autonomous motivation



Another theme in pre-webinar questions: Concerns about inside/outside status and disciplinary differences

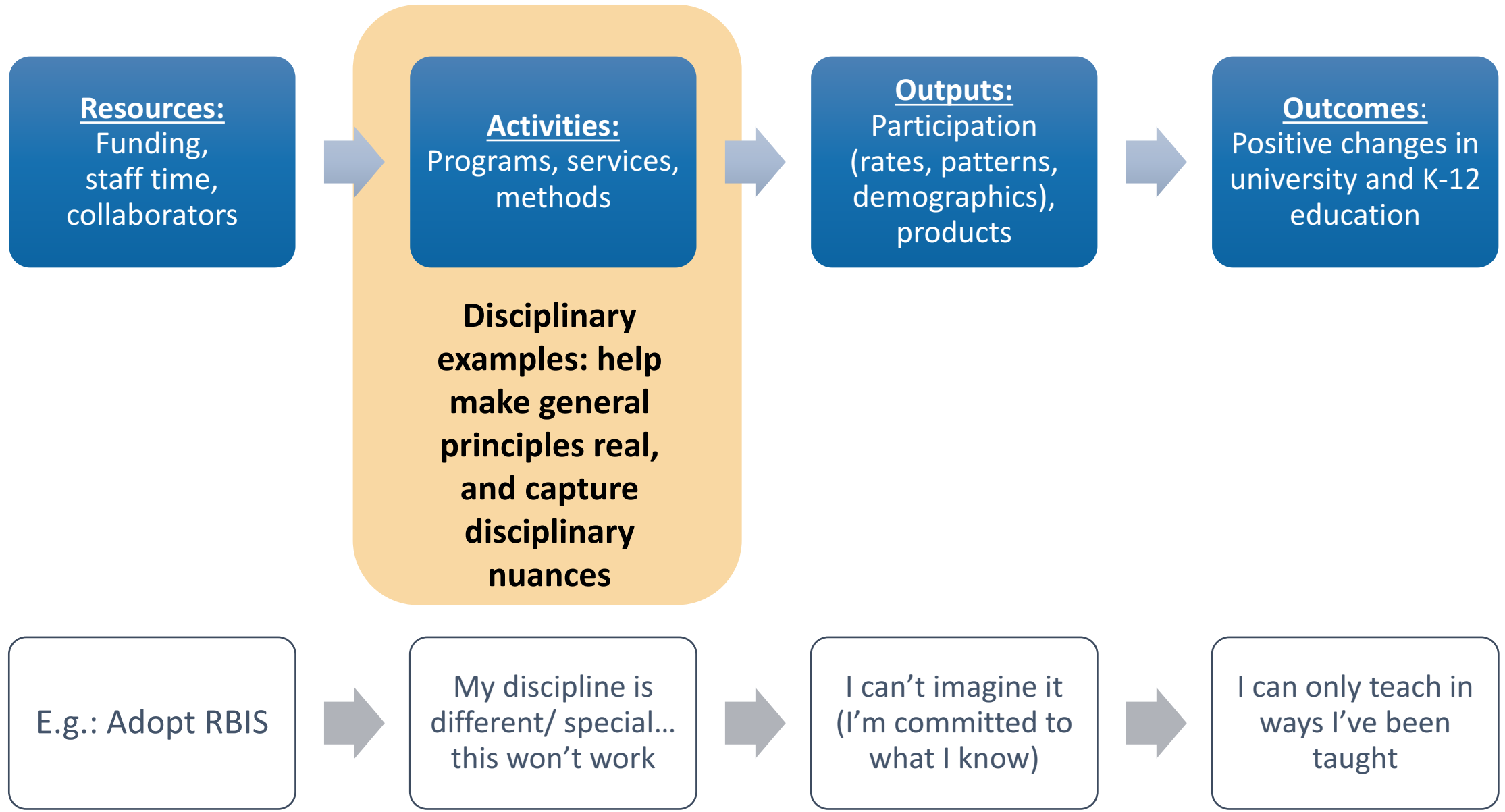
- Working with faculty when positioned outside the department.
- Ways in which faculty developers can work with STEM departments.
- Divisions within departments between teaching and research faculty.
- Common issues: teaching STEM and Humanities, Social Sciences.
- How to help STEM faculty connect quantitative fields and active learning.
- Experts in STEM subject matter; help with pedagogy.
- Transdisciplinary

# Collaborating at the Centers

REPORT FROM A STEM EDUCATION TRANSFORMATION  
WORKSHOP INVOLVING LEADERS OF CENTERS FOR TEACHING AND  
LEARNING AND STEM EDUCATION CENTERS

CASSANDRA HORII, KACY REDD, MATHEW OUELLETT, NOAH FINKELSTEIN,  
ANDREA BEACH, DEBORAH CARLISLE, SUSAN SHADLE, AND GABRIELA  
WEAVER





# “I’m convinced, but I have no ideas what that would look like...”

- Demonstrations
- HGSE Instructional Moves:  
<https://instructionalmoves.gse.harvard.edu>



# Sustaining Engagement and Change

- How can the adoption be sustained? Put in practice in classroom across years/courses?
- What can we do to help form teaching circles (or communities of practice) that extend beyond initial intervention?
- Are there strategies for turning one-time meetings into an ongoing relationship? Sustaining engagement generally?



## Discussion:

- What other insights or ideas do you have about inside/outside status, disciplinary differences, and sustaining change/engagement?

# Other questions beyond our scope today:

- Methods for facilitating multi-role (faculty, graduate students, postdocs, etc.) learning communities in STEM.
- Research on large (110+ students) STEM gateway courses -- are large lectures a barrier?
- STEM faculty concerns with breadth/amount of content as a hindrance to STEM education reform (i.e., there is no time for anything except lecture).
- Community colleges' course content is determined by institutions where students will transfer, and this limits capacity for creativity/reform.
- Enhancing value for faculty development across campus.
- How do we get general education science curricula to successfully convey to students what distinguishes science as a way of knowing?

# Participant Outcomes:

Explore key ideas that may help explain and improve faculty adoption of STEM ed reform

- Recognize the **complex interplay** between disciplinary/institutional STEM reform efforts and individual adoption.
- Diagnose **roadblocks to adoption** using a framework that includes concepts of faculty identity and work.
- Apply **tools for identifying and resolving tensions** that may influence faculty adoption at individual, departmental, institutional, and disciplinary scales.

# Please provide feedback on this webinar!

- [https://ascnhighered.org/ASCN/webinars/fac ed reform/eval.html](https://ascnhighered.org/ASCN/webinars/fac_ed_reform/eval.html)
- The link will be emailed to you after the webinar



**References & Resources: In bold are several useful and free resources with free full-text available online:**

- Aragón, O. R., J. F. Dovidio, & M. J. Graham. 2017. Colorblind and multicultural ideologies are associated with faculty adoption of inclusive teaching practices. *Journal of Diversity in Higher Education*, 10(3), 201-215.
- Bradforth, Stephen E., Emily R. Miller, William R. Dichtel, Adam K. Leibovich, Andrew L. Feig, James D. Martin, Karen S. Bjorkman, Zachary D. Schultz & Tobin L. Smith. 2015. University learning: Improve undergraduate science education. *Nature* 523, 282–284. doi:10.1038/523282a. <http://www.nature.com/news/university-learning-improve-undergraduate-science-education-1.17954>
- **Beuning, Penny J., Dave Z. Besson, Scott A. Snyder. 2014. *Teach Better, Save Time, and Have More Fun: A Guide to Teaching and Mentoring in Science*. Tucson: Research Corporation for Science Advancement.**  
<http://rescorp.org/gdresources/uploads/files/publications/RCSA-Teach-Better-Book.pdf>
- Brownwell, Sara E. & Kimberly B. 2012. Barriers to Faculty Pedagogical Change: Lack of Training, Time, Incentives, and. . .Tensions with Professional Identity? *CBE—Life Sciences Education* 11, 339–346.
- Cavanagh, Andrew, Oriana R. Aragón, Xinnian Chen, Brian Couch, Mary Durham, Aiyana Bobrownicki, David I. Hanauer, & Mark J. Graham. 2016. *CBE—Life Sciences Education* 15:76, 1–9.
- Chasteen, Stephanie. November 2017 Pre-workshop Survey Report, Workshop for New Faculty in Physics and Astronomy.
- Eagan, M. K., E. B. Stolzenberg, J. Berdan Lozano, M. C. Aragon, M. R. Suchard, & S. Hurtado. 2014. *Undergraduate teaching faculty: The 2013–2014 HERI Faculty Survey*. Los Angeles: Higher Education Research Institute, UCLA. <https://www.heri.ucla.edu/monographs/HERI-FAC2014-monograph.pdf>
- Garaus, Christian, Gerhard Furtmuller, and Wolfgang H. Guttel. 2016. The Hidden Power of Small Rewards: The Effects of Insufficient External Rewards on Autonomous Motivation to Learn. *Academy of Management Learning & Education*, 2016, 15(1): 45–59.  
<http://dx.doi.org/10.5465/amle.2012.0284>.
- Henderson, Charles., Andrea Beach, and Noah Finkelstein. 2011. Facilitating change in undergraduate STEM instructional practices: An analytic review of the literature. *J. Res. Sci. Teach.*, 48: 952–984. doi:10.1002/tea.20439
- Henderson C. & M. Dancy. 2009. The impact of physics education research on the teaching of introductory quantitative physics in the United States. *Phys Rev Spec Top: Phys Educ Res*. 5(2):020107.
- **Horii, C., K. Redd, M. Ouellett, N. Finkelstein, A. Beach, D. Carlisle, S. Shadle, G. Weaver. 2016. *Collaborating at the Centers*. POD Network and NSEC.** <https://podnetwork.org/content/uploads/Collaborating-at-the-Centers-Workshop-Report-20July2016.pdf>

**References & Resources: In bold are several especially useful and free resources with free full-text available online:**

- Hurtado, S., M. K. Eagan, J. H. Pryor, H. Whang, & S. Tran. 2012. Undergraduate teaching faculty: the 2010-2011 HERI faculty survey. Los Angeles: Higher Education Research Institute, UCLA. <https://www.heri.ucla.edu/monographs/HERI-FAC2011-Monograph.pdf>
- Kegan, Robert and Lisa Laskow Lahey. 2009. *Immunity to Change: How to Overcome It and Unlock the Potential in Your-self and Your Organization*. Boston: Harvard Business Press.
- Kirschner, P., R. L. Martens, & J-W. Strijbos. CSCL in higher education?: a framework for designing multiple collaborative environments. In J. W. Strijbos, P. A. Kirschner & R. L. Martens (eds.), *What we know about CSCL*, 3—30.
- Li, Sissi L., G. Serna, J. S. Read, J. R. Smith, H. Chilton, M. Loverude. 2015. A collaboration to support novice instructors in research-based astronomy teaching. <https://arxiv.org/pdf/1411.5738.pdf>
- **National Research Council. 2015. *Reaching Students: What Research Says About Effective Instruction in Undergraduate Science and Engineering*. Washington, DC: The National Academies Press. doi: <https://doi.org/10.17226/18687>.**
- Neumann, Anna. 2009. *Professing to Learn: Creating Tenured Lives and Careers in the American Research University*. Baltimore: Johns Hopkins University Press.
- Olmstead, Alice & Chandra Turpen. 2017. Pedagogical sensemaking or “doing school”: In well-designed workshop sessions, facilitation makes the difference. *Phy Rev Phys Ed Res* 13, 020123.
- O'Meara, KerryAnn , A. LaPointe Terosky, & A. Neumann. 2009. Faculty Careers and Work Lives: A Professional Growth Perspective. *ASHE Higher Education Report*, 34(3).
- Sorcinelli, Mary Deane and Jung Yun. 2007. From Mentor to Mentoring Networks: Mentoring in the New Academy. *Change: The Magazine of Higher Learning*, 39:6, 58-61, DOI: 10.3200/CHNG.39.6.58-C4.
- Winkelmes, Mary-Ann , Matthew Bernacki, Jeffrey Butler, Michelle Zochowski, Jennifer Golanics and Kathryn Harriss Weavil. 2016. A Teaching Intervention that Increases Underserved College Students' Success. *Peer Review*, 18(1/2). <https://www.aacu.org/peerreview/2016/winter-spring/Winkelmes>.