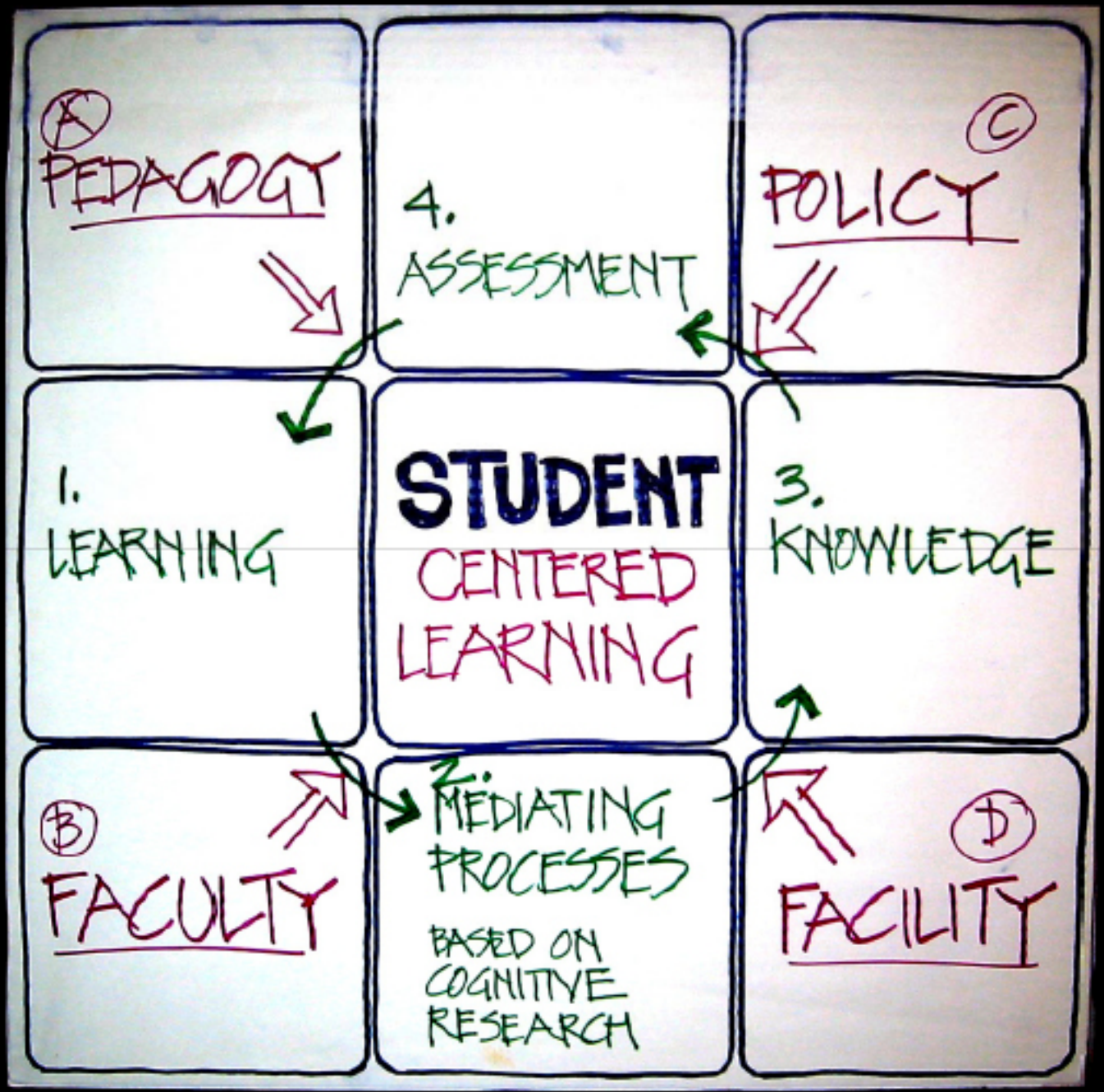
Panel of Thought Leaders:
Designing & Evaluating Innovation at Different Scales: From Individual Projects to Structural Reform

Jeanne L. Narum, Principal – LSC

Improving the Undergraduate STEM Experience
March 13 - 14, 2014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ASSESSMENT
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POLICY
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LEARNING
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FACULTY
2.
MEDIATING
PROCESSES
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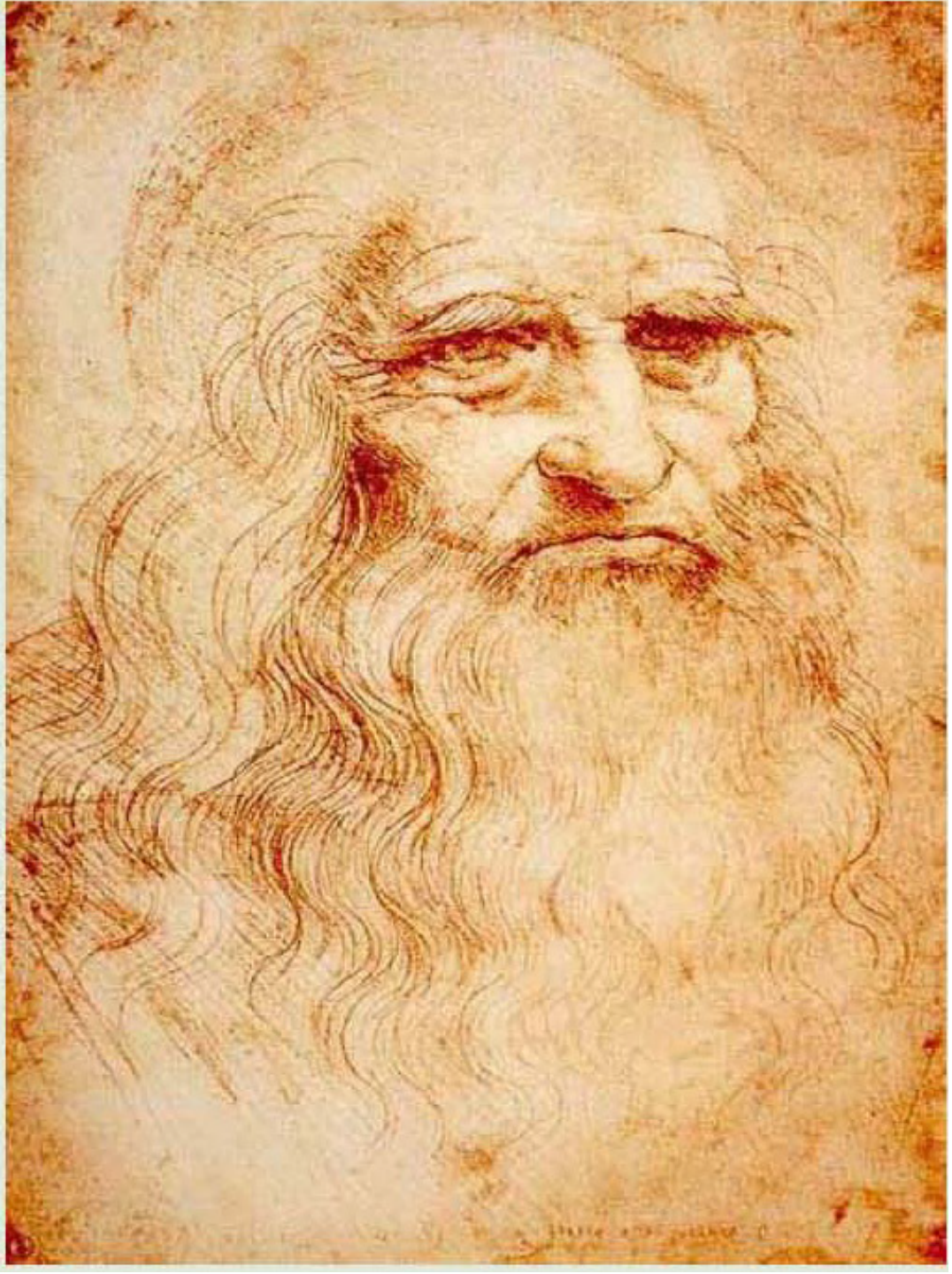
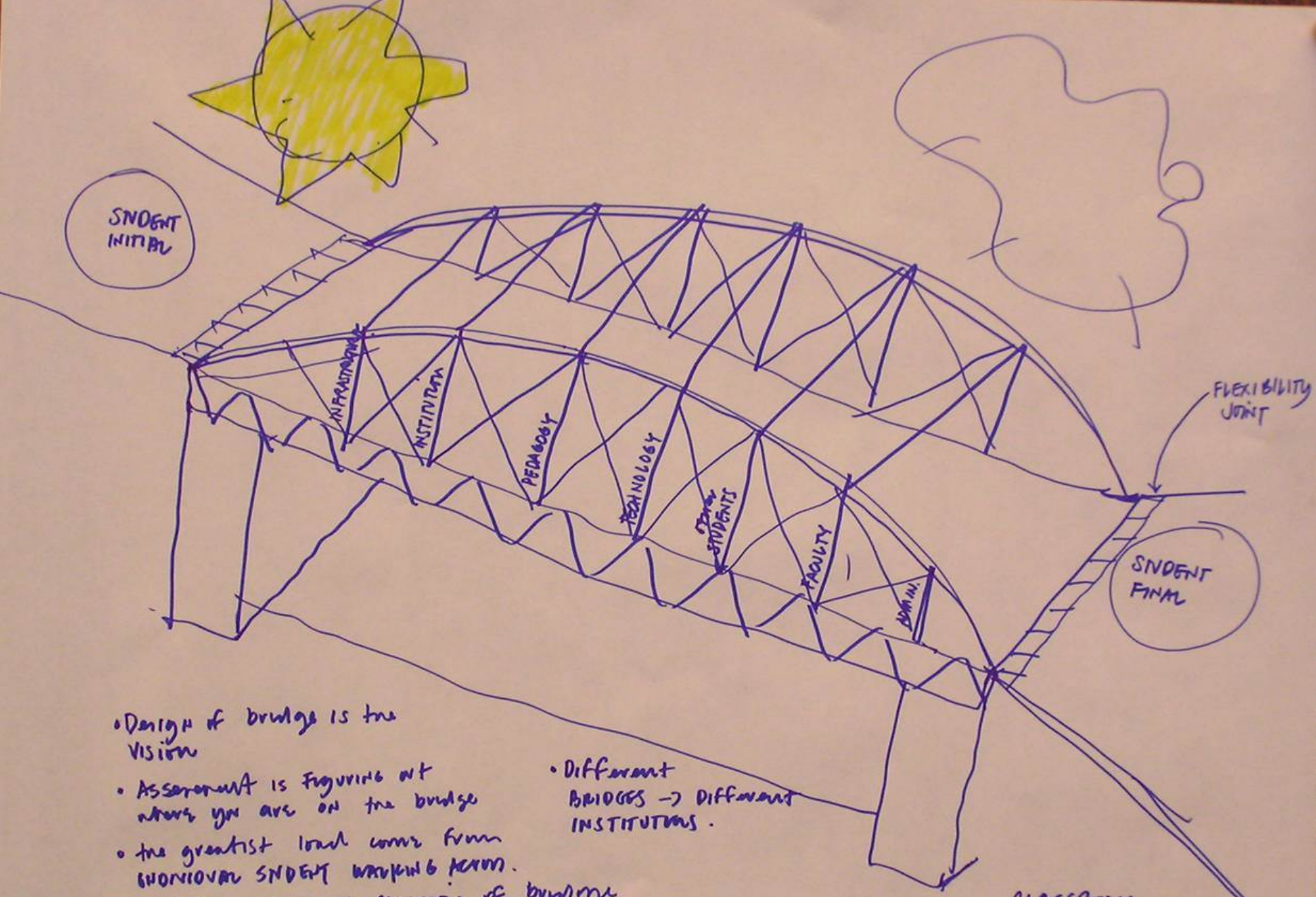




- Design of bridge is the vision
- Assessment is figuring out where you are on the bridge
- the greatest load comes from GROWTH OVER STUDENT WORKING AGENCY.
- INCREASE CARRYING CAPACITY OF BRIDGE
- EACH ELEMENT MUST BE IN HARMONY/INTERDEPENDENT TO SUPPORT.
- Different BRIDGES → DIFFERENT INSTITUTIONS.

CLASSROOM UNIT

COURSE, MAJOR,

Problem-Driven Learning Spaces
Georgia Institute of Technology

WHAT DO WE WANT OUR LEARNERS TO *BECOME*?

- Agents of their own learning.
- Integrative thinkers and problem solvers.
- Empowered communicators and leaders.
- Model-based reasoners.
- Resilient experimenters.

WHAT EXPERIENCES MAKE THAT *BECOMING* HAPPEN?

- Tackling ill-structured, open-ended complex problems with others.
- Searching for, finding, and sharing relevant, reliable, and up-to-date data with team members.
- Blending disciplinary concepts, methods, representations toward solving problems.
- Creating, sharing, debating, and defending models (graphical, diagrammatic, mathematical).
- Trying, failing, and recovering.

WHAT SPACES ENABLE THOSE EXPERIENCES?

- Authorable, responsive, flexible spaces.
- Spaces that invite the articulation and representation of provisional ideas and hypotheses.
- Spaces that support changing, responsive, collective leadership.
- Spaces that support rebounding from impasses and failure.

WHAT DO WE WANT OUR INSTITUTION TO BE RECOGNIZED FOR BEING, FOR BECOMING BY PROSPECTIVE STUDENTS AND THEIR FAMILIES?

WHAT INSTITUTIONAL POLICIES, PRACTICES AND PROGRAMMING WILL MAKE THAT HAPPEN?

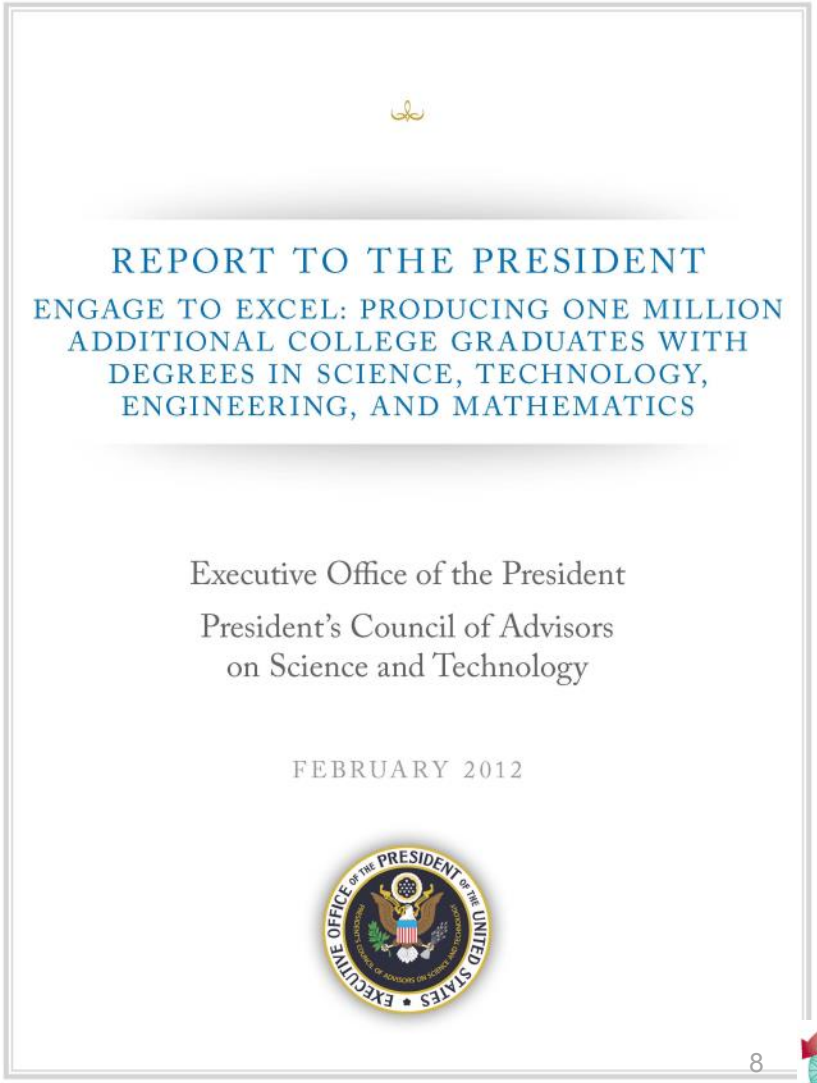
WHAT KIND OF SPACES WILL SIGNAL THAT VISION TO POTENTIAL STUDENTS AND THEIR FAMILIES, ILLUSTRATING OUR GOAL TO STRENGTHEN STEM LEARNING FOR ALL STUDENTS FROM THE VERY FIRST DAY?

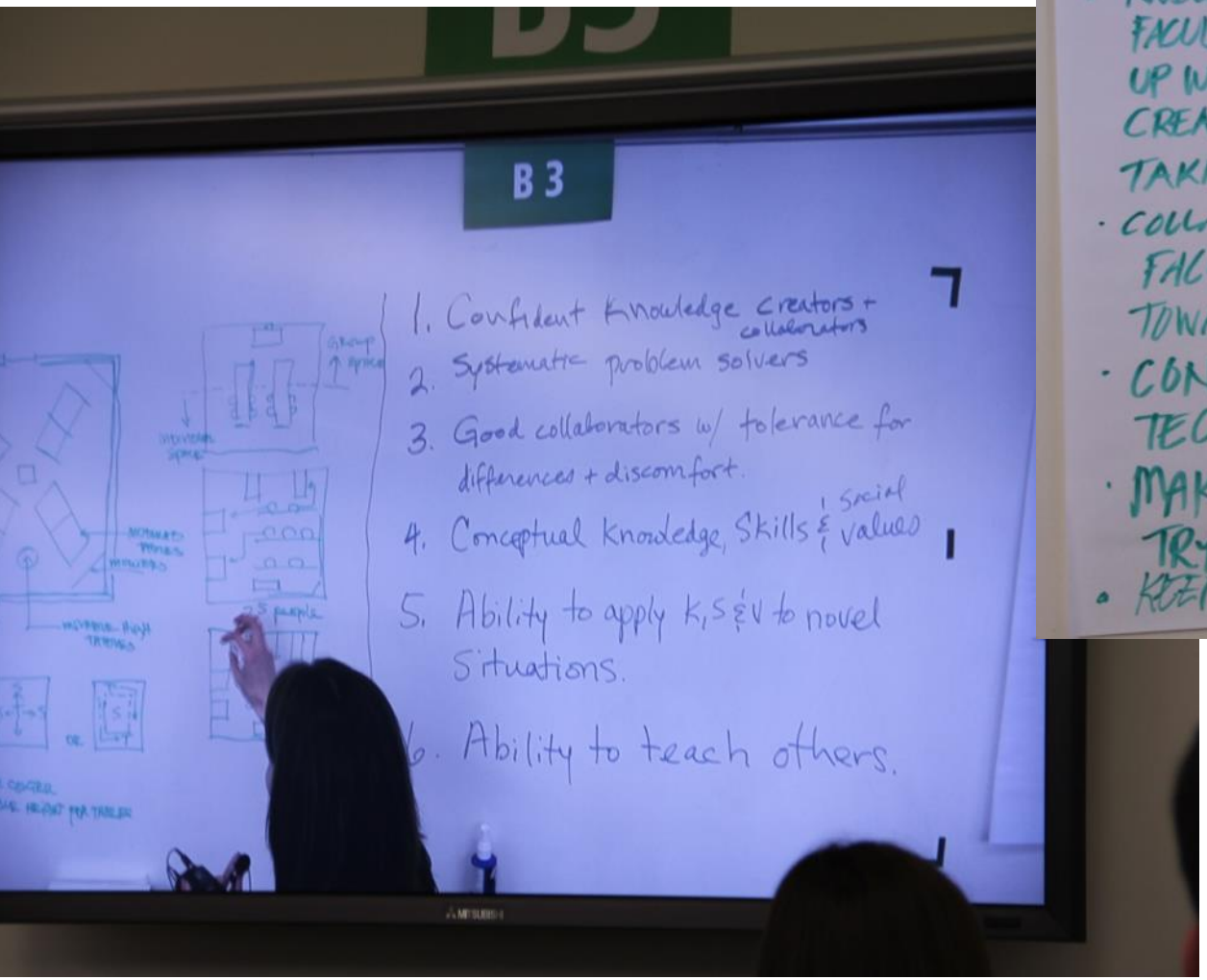
PCAST: Engage to Excel

The first two years of college are the most critical to the retention and recruitment of STEM majors. These two years are also a shared feature of all types of 2-and 4-year colleges and universities—community colleges, comprehensive universities, liberal arts colleges, research universities, and minority-serving institutions.

In addition, STEM courses during the first two years of college have an enormous effect on the knowledge, skills, and attitudes of future K-12 teachers.

For these reasons, this report focuses on actions that will influence the quality of STEM education in the first two years of college.

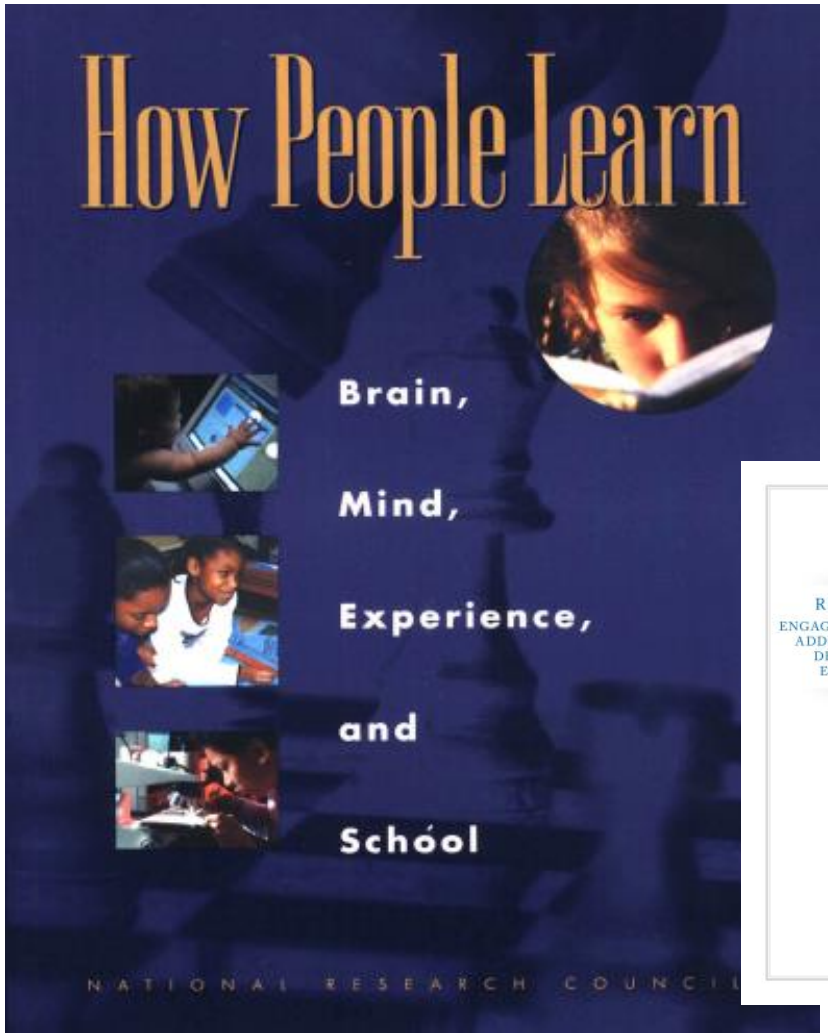


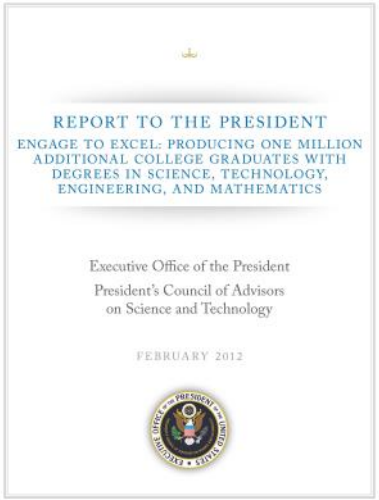


RESOURCES – PEOPLE, SPACE, FUNDING

- REWARD STRUCTURE FOR FACULTY DEVELOPMENT, INC. ADJUNCTS
- OWNERSHIP/UTILIZATION BALANCE KEEP TECHNOLOGY CONSISTENT
- NUDGE/SPARK A SHIFT FOR FACULTY TO MOVE. BACK THEM UP WITH A SAFETY NETWORK & CREATING AN ~~EXPERIENCE~~ ENVIRONMENT WHERE TAKING RISKS IS ACCEPTABLE
- COLLABORATIVE APPROACH BETWEEN FACULTY & ADMIN TO MOVE IT TOWARD FUNDING
- CONNECT FACULTY TO REDUCE TECHNOLOGY BARRIERS
- MAKING SPACE FOR FACULTY TO TRY THINGS OUT
- KEEP SOFT SPACES SACRED.

How learning happens (1999 & 2011)





—*How People Learn: Brain, Mind, Experience, and School,* National Research Council. Washington, D.C.: National Academy Press, 2000.

Learning:

- builds on existing knowledge
- requires active cognitive challenges
- is structured
- occurs in context
- is reflective
- is social.

- What is the biggest (most audacious) question we need to be asking in shaping and redoing 21st century STEM learning spaces for 21st century learners?

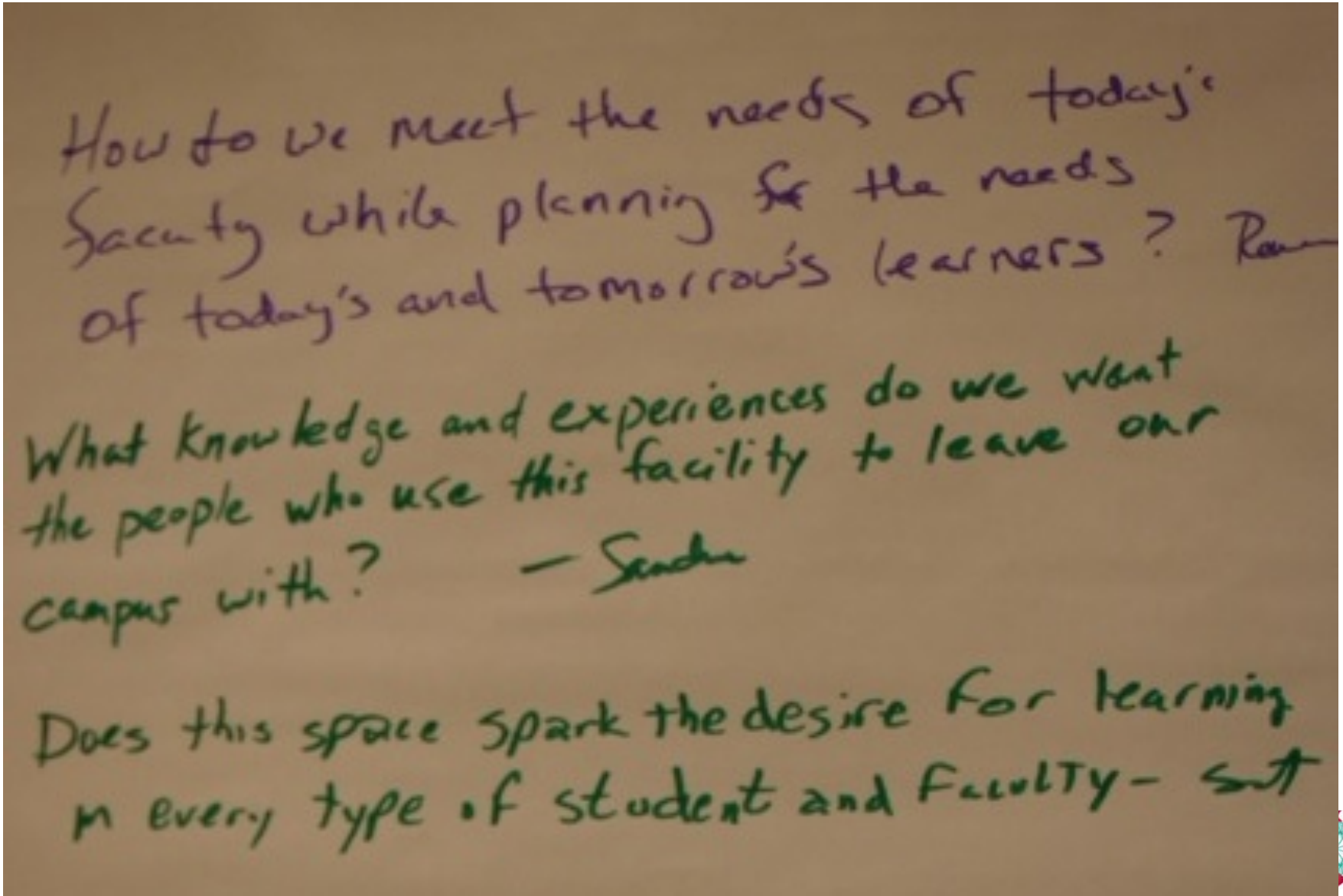
- What lessons can we share about how to identify and address such questions in the process of planning?

How does the changing context influence our shaping of 21st century STEM learning, learning experiences, and learning spaces?

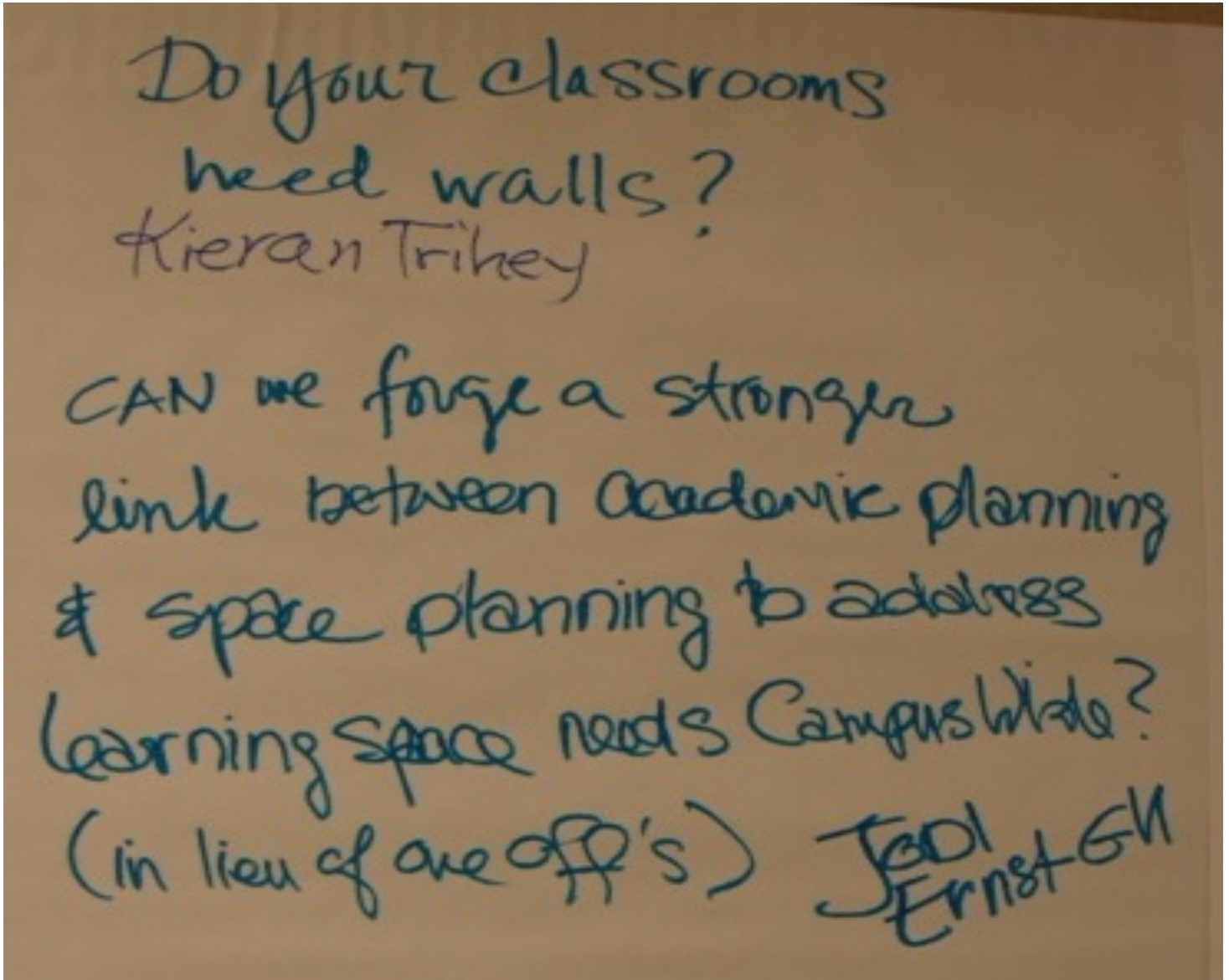
At-the-table discussions and reporting out.

LSC/AI 2014

Audacious "take-home" questions



Audacious "take-home" questions



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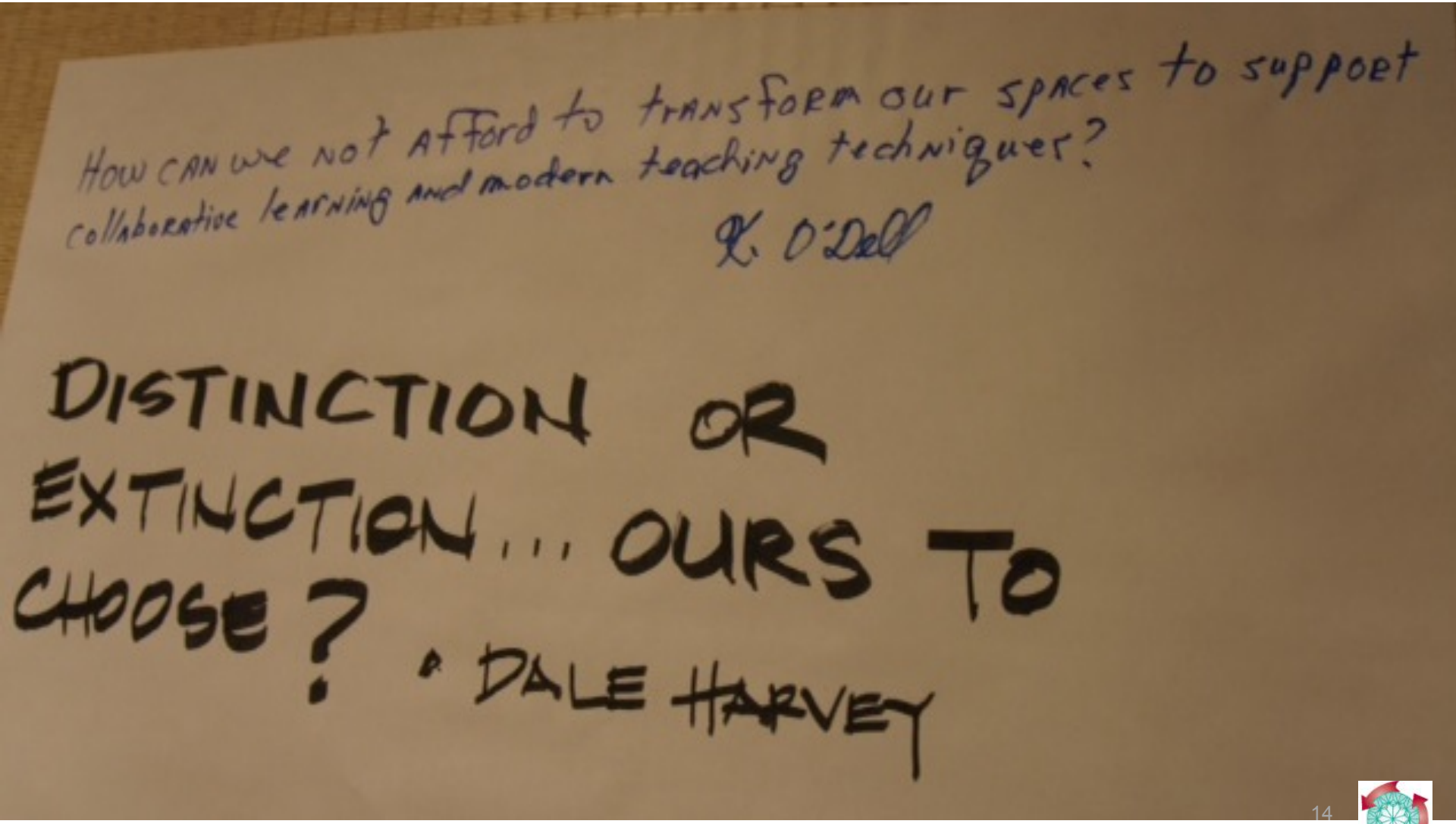

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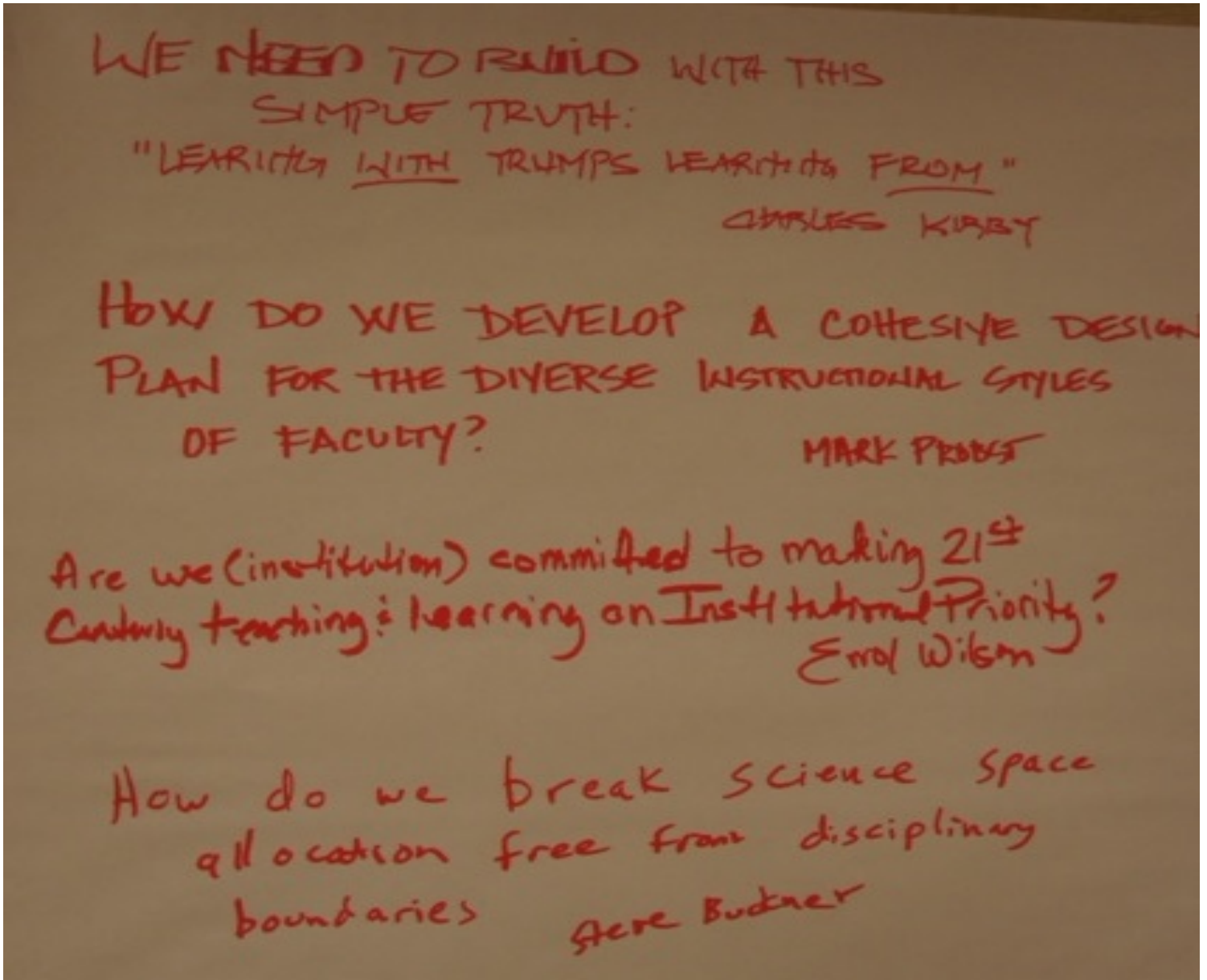

Discovery Learning Research Center (DLRC)
Purdue University

WHAT DO WE WANT OUR LEARNERS TO *BECOME*?

- Our "learners" are faculty who will become:
- Reflective practitioners of well-researched pedagogies.
- Aware of the many ways that learning spaces can influence student learning and creativity in their use of space to support learning.
- Knowledgeable about the evolving learning preferences of students.
- Willing to approach their teaching in a scientific way— gathering evidence and using it to influence their own practice.
- Empowered to think about the needs of their curriculum and how those needs can be met by different uses and configurations of learning spaces.

WHAT EXPERIENCES MAKE THAT *BECOMING* HAPPEN?

- Having opportunities to study the effects of a teaching innovation in a pilot setting.
- Seeing data about the benefits of different pedagogies on student learning.
- Having access to a "laboratory" space to experiment with innovative pedagogies with flexible furnishings, lighting, layout, and configuration.
- Learning from the space, not just *in* the space.

WHAT SPACES ENABLE THOSE EXPERIENCES?

- Flexible, black-box spaces that invite creativity.
- Infrastructure that serves present technologies and also enables the exploration of technologies of the future.
- Spaces able to adapt and evolve, as users continue to experiment with pedagogies and technologies that enhance learning and teaching.
- Spaces with usable lifetimes that outlast the current "standard" configurations of classroom spaces.

From LSC Guide: *Discovery Learning Research Center*—Purdue University

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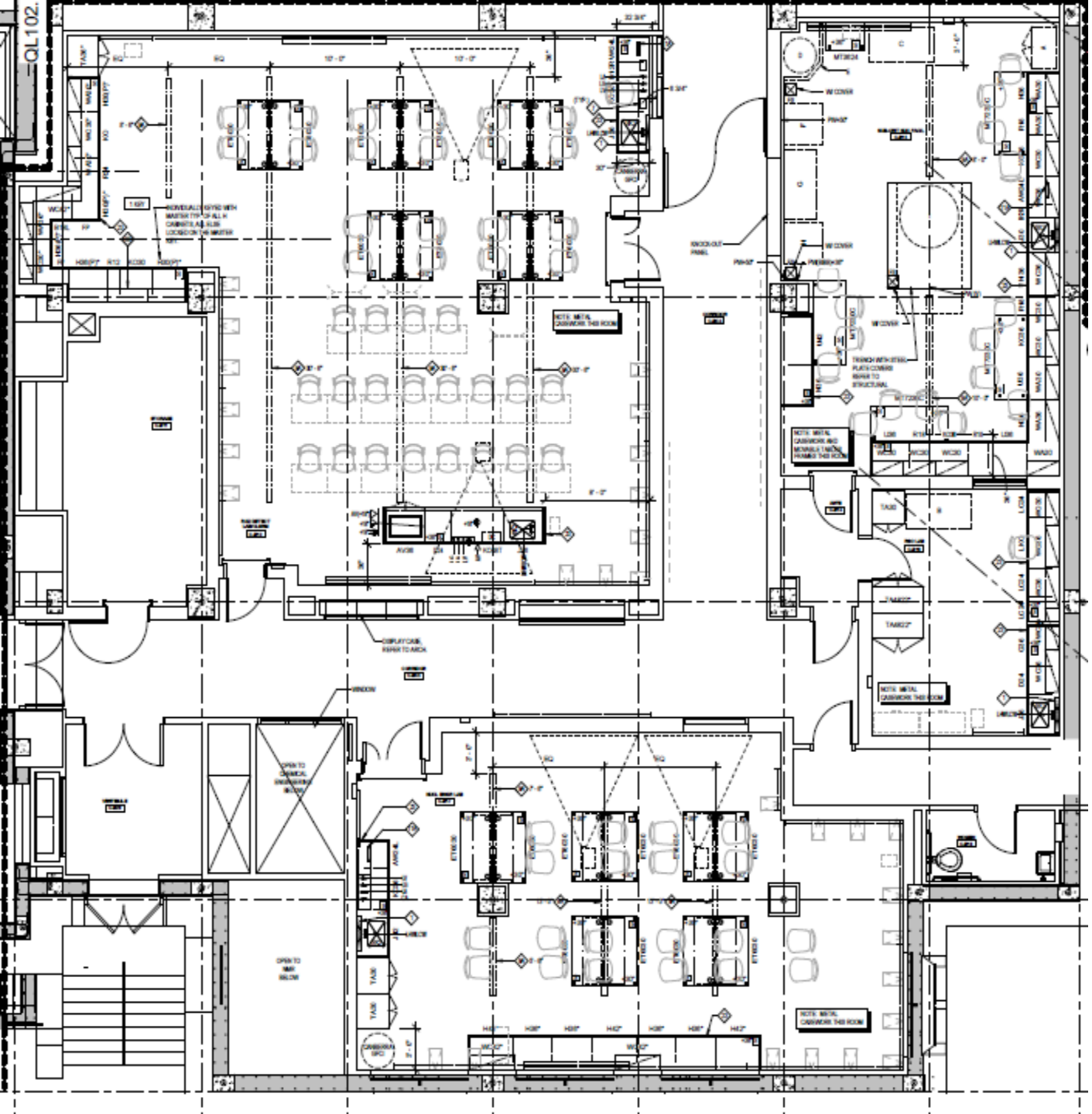
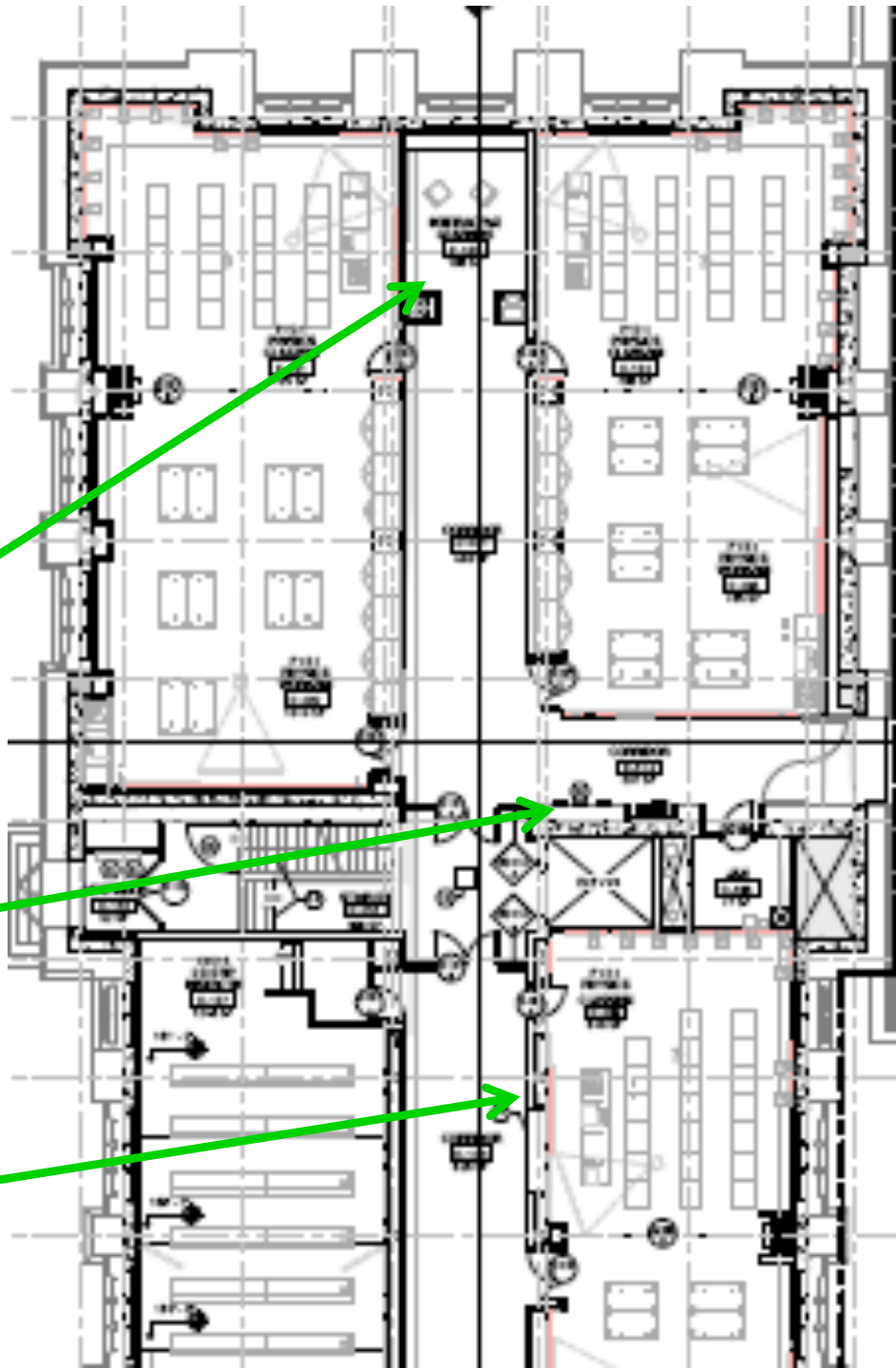


- Grouping like labs in a single area
- Gives the majors a sense of ownership
- Gains synergy between courses

LSC Archives - West Point

Comfortable Building

- Why should the building look like a prison?
- Soft seating at the end of halls
- Make science visible items in “dead space”
- Adding “bumper spaces”



LSC Archives - West Point

From the LSC Archives: *Maker Space* —University of Michigan Library (found/repurposed space) LSC Webinar 10/13

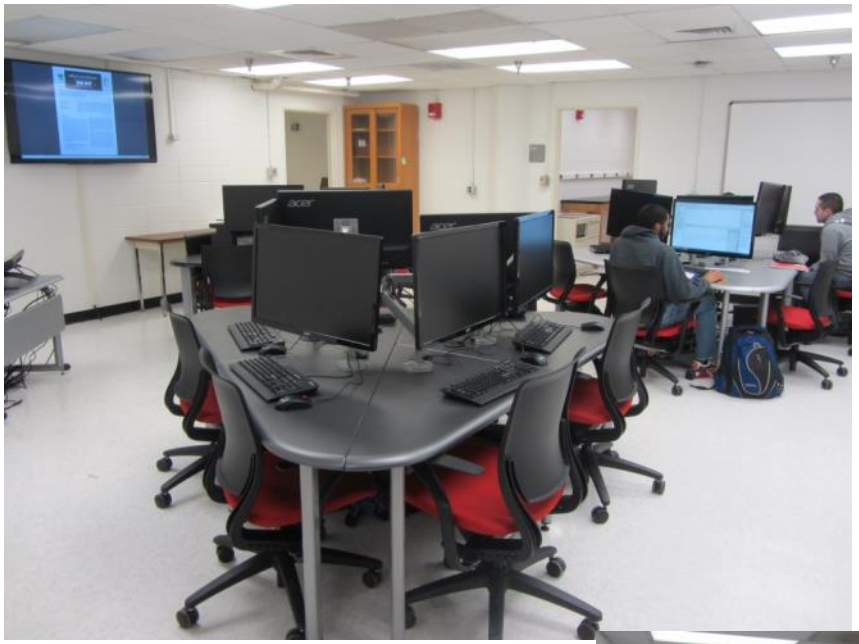
They can learn to translate challenges into opportunities…. (Council on Competitiveness)

From the LSC Archives: *Maker Space* —University of Michigan Library (found/repurposed space). LSC Webinar 10/13

They can develop communication skills to describe their innovation. (Council on Competitiveness)

Collaborative Learning Lab for my new theme- based laboratory course, bioinformatics and cell biology. I sought to develop a hybrid computational/ molecular laboratory for students that fosters team research. The computer lab is flanked by 2 ~200fr^2 molecular biology labs in which students will validate their analyses.

Georgia State University – Vision and Change



Carl Wieman. "Applying New Research to Improve Science Education."

Issues in Science and Technology. Volume XXIX Number 1. Fall 2012.

- …the value of the educational experiences should be measured by their effectiveness at changing the thinking of the learner to be more like that of an expert when solving problems and making decisions relevant to the discipline…
- Specific elements, collectively called "deliberate practice,: have been identified as key to acquiring expertise across many different areas of human endeavor….
- …those cognitive processes that are explicitly and strenuously practiced are those that are learned…

From the LSC Guide: Discovery Learning Center
University of Maryland Baltimore County

From the LSC Guide: Discovery Learning Center
University of Maryland Baltimore County

From the LSC Guide: Active Learning Classroom
University of Minnesota

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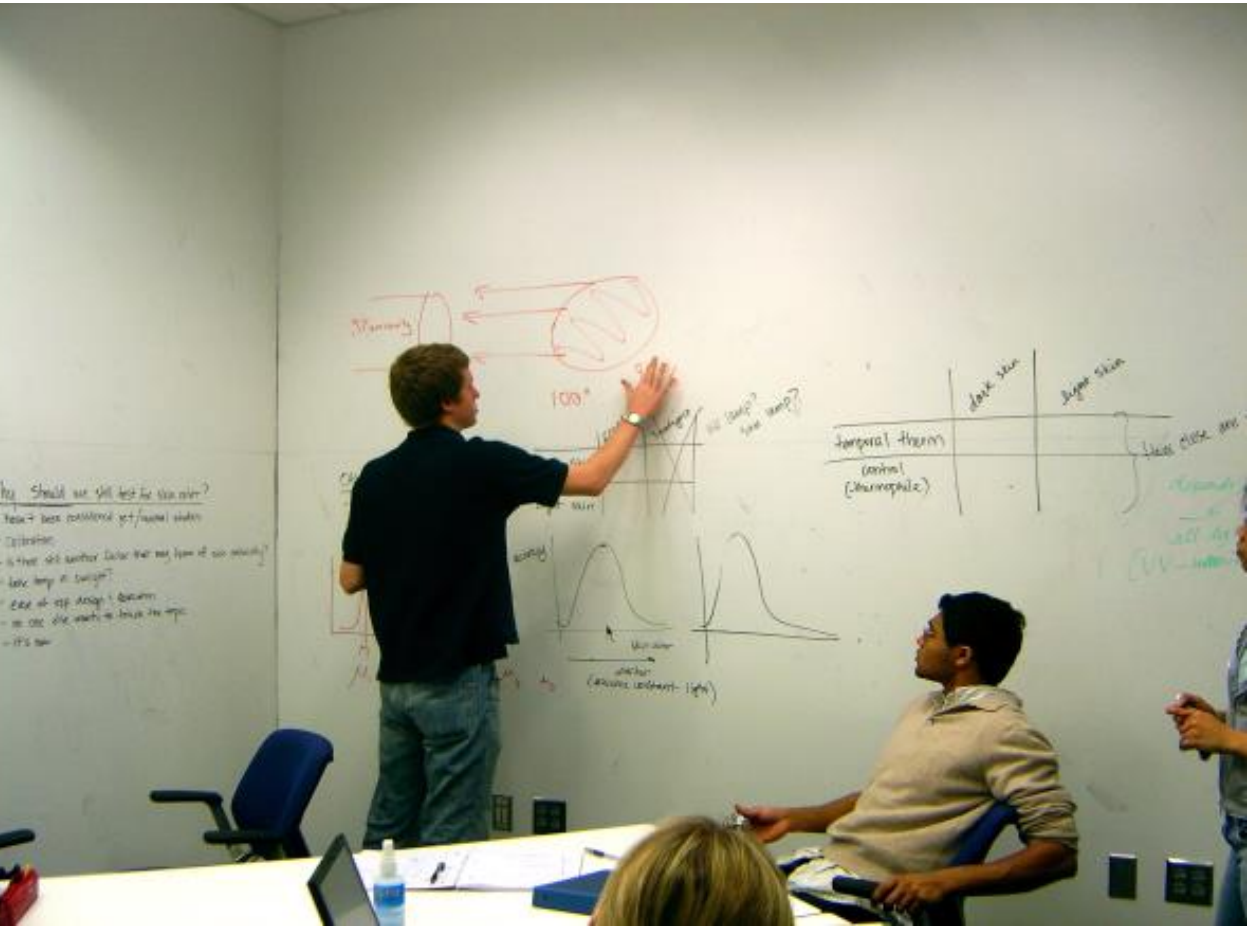
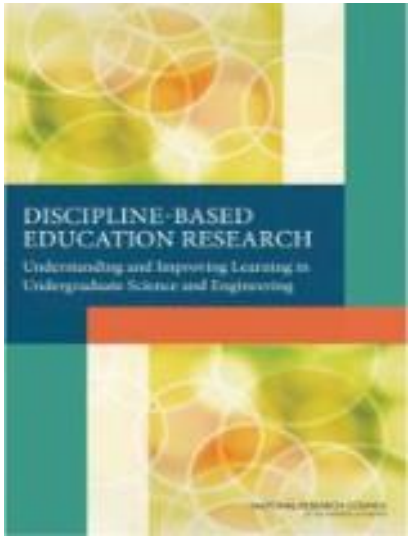
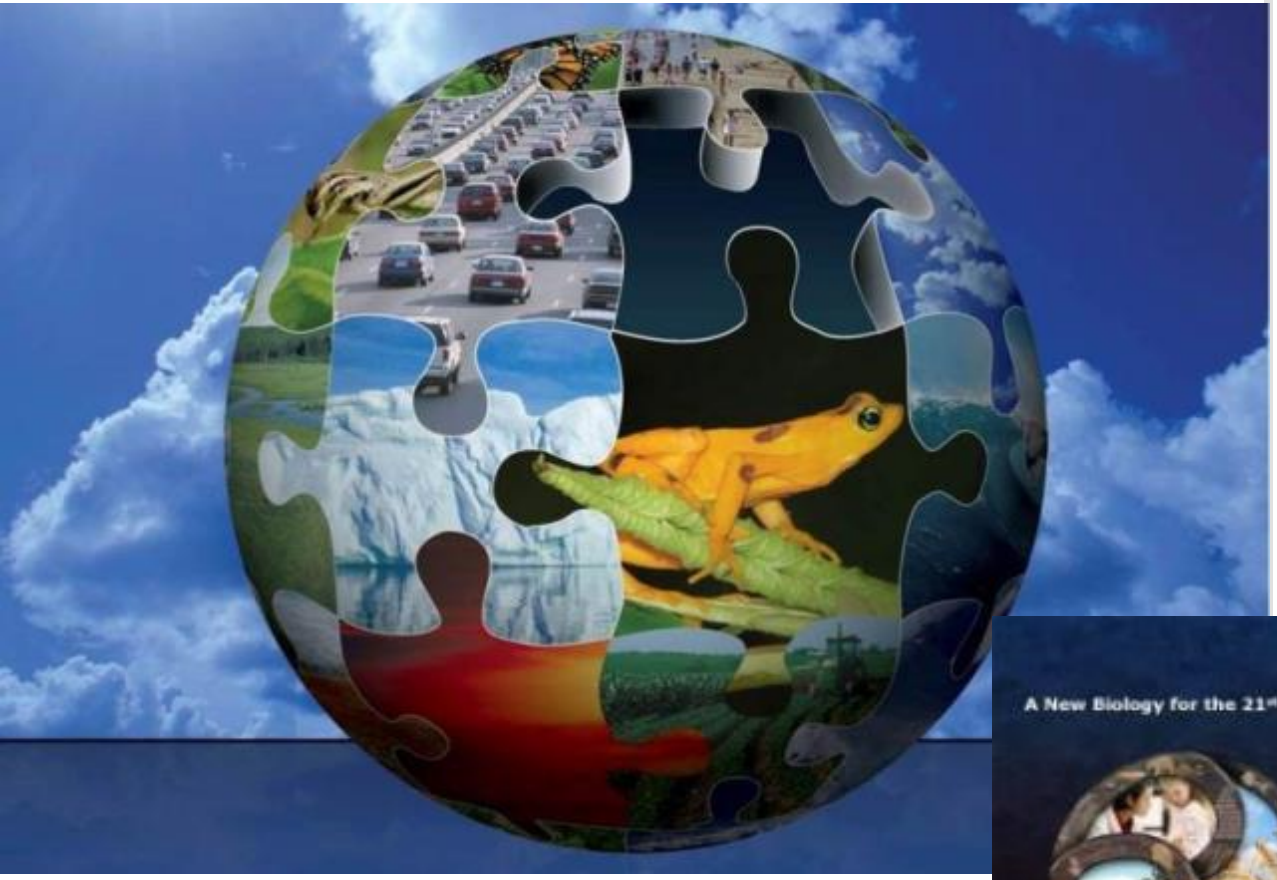


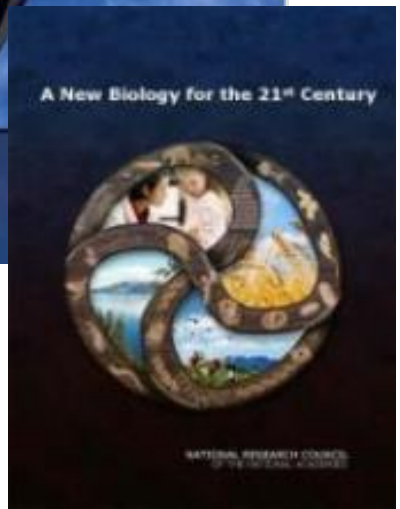
Discipline-based Education Research (DBER)

- Problem-solving may be the quintessential expression of human thinking.
- Society's most important problems are usually ill-defined in some way.



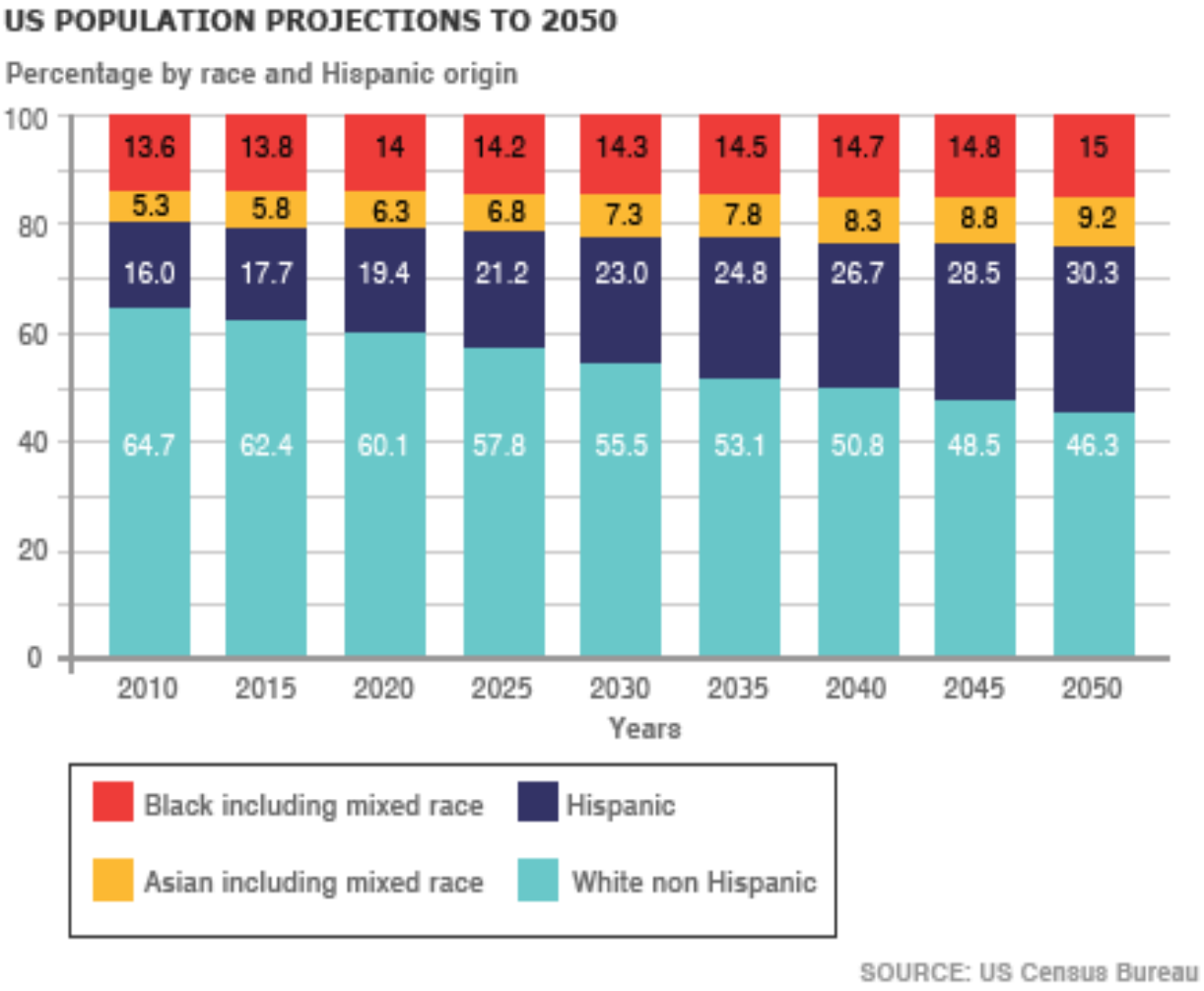
A New Biology for the 21st Century





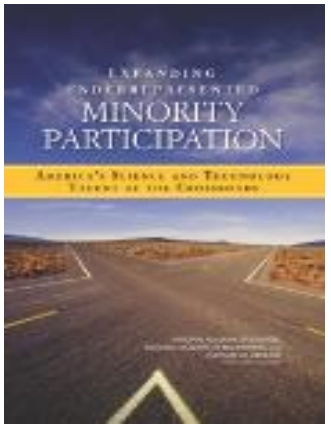
- Purposefully organized around problem-solving this approach…brings together researchers with different expertise… coordinates efforts to ensure gaps are filled, problems-solved, and resources brought to bear at the right time.

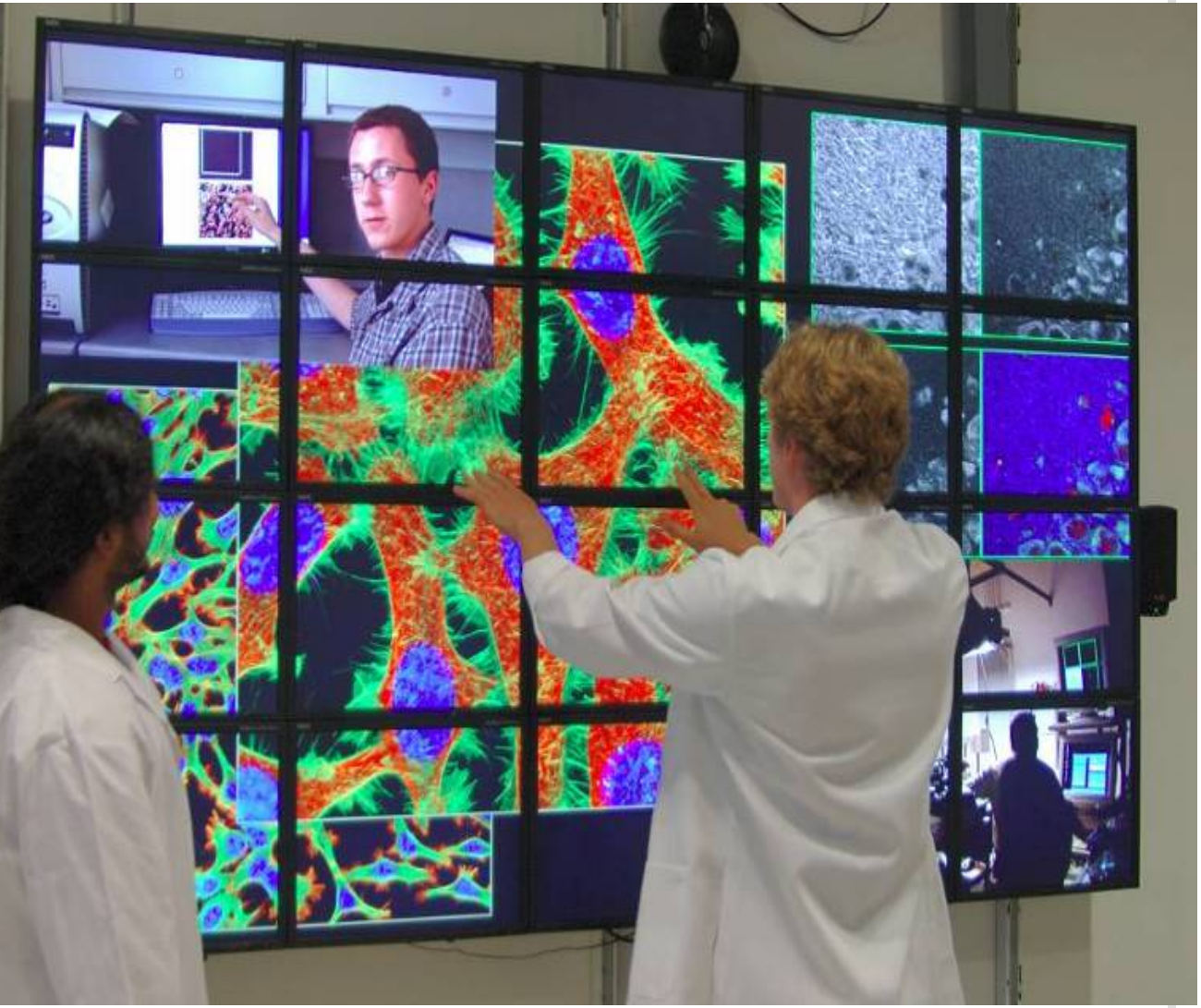
Expanding Under-represented Minority Participation



SOURCE: US Census Bureau

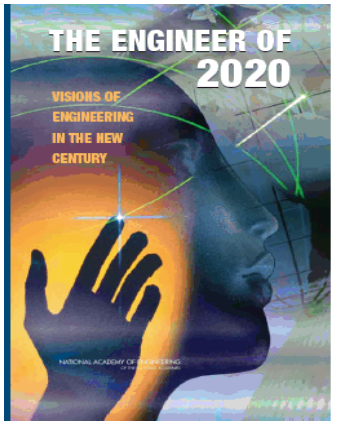
- Success may also hinge on the extent to which … students participate in activities— such as peer-to-peer support, study groups, social activities, tutoring, and mentoring programs—that can promote academic success and social integration.





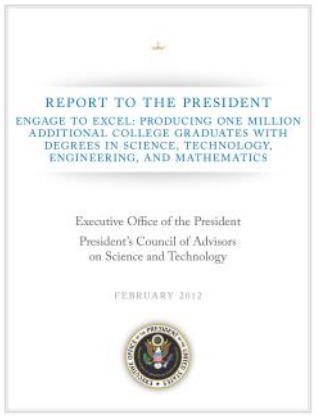
Engineer of 2020: Visions of Engineering in the New Century

- … it will not be this or that particular knowledge that engineers (scientists, allied health professionals) will need but rather the ability to learning new things quickly and the ability to apply knowledge to new problems and new contexts.



Engage to Excel (PCAST)

- Research indicates that…compared with students in traditional lectures, students who play an active role in the pursuit of scientific knowledge learn more and develop more confidence.


REPORT TO THE PRESIDENT

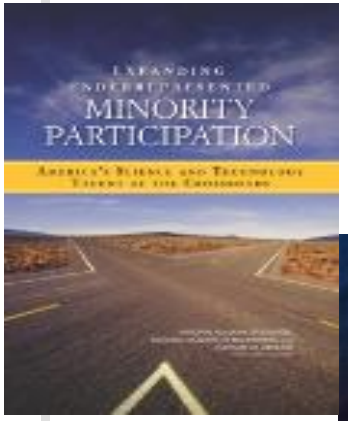
ENGAGE TO EXCEL: PRODUCING ONE MILLION ADDITIONAL COLLEGE GRADUATES WITH DEGREES IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

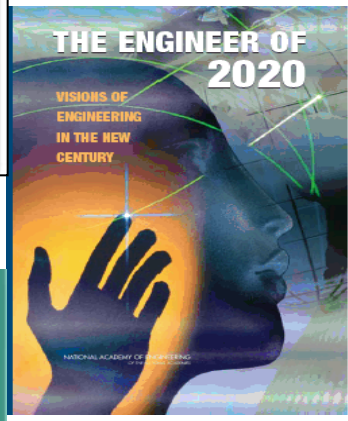
Executive Office of the President
President's Council of Advisors on Science and Technology

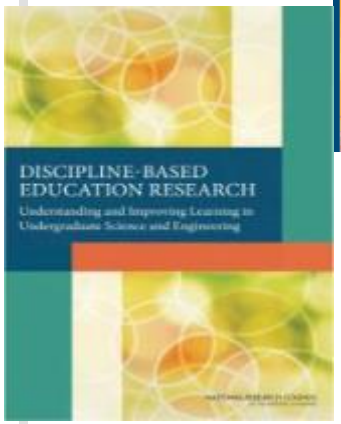
FEBRUARY 2012

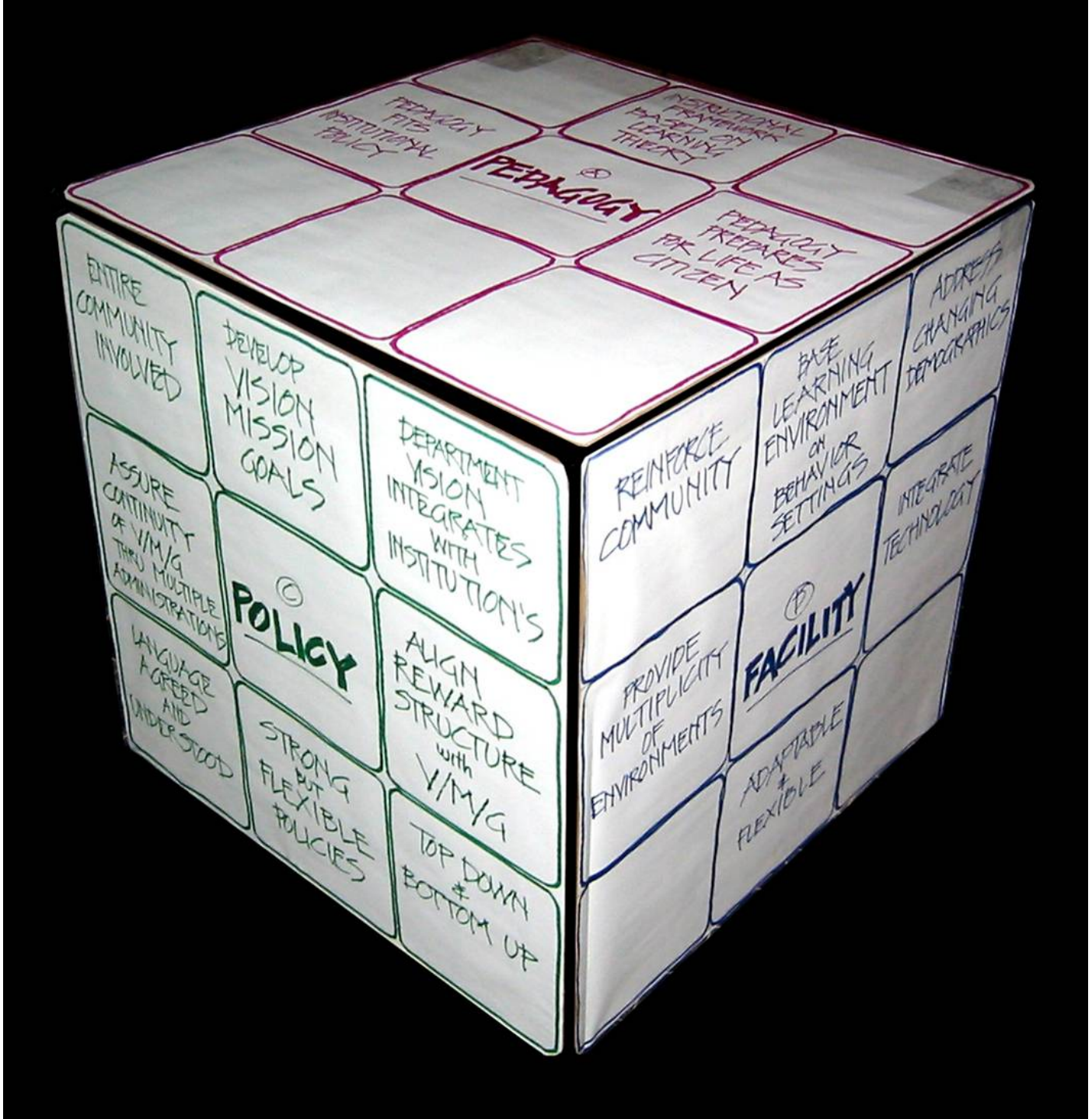
What learners are to become:

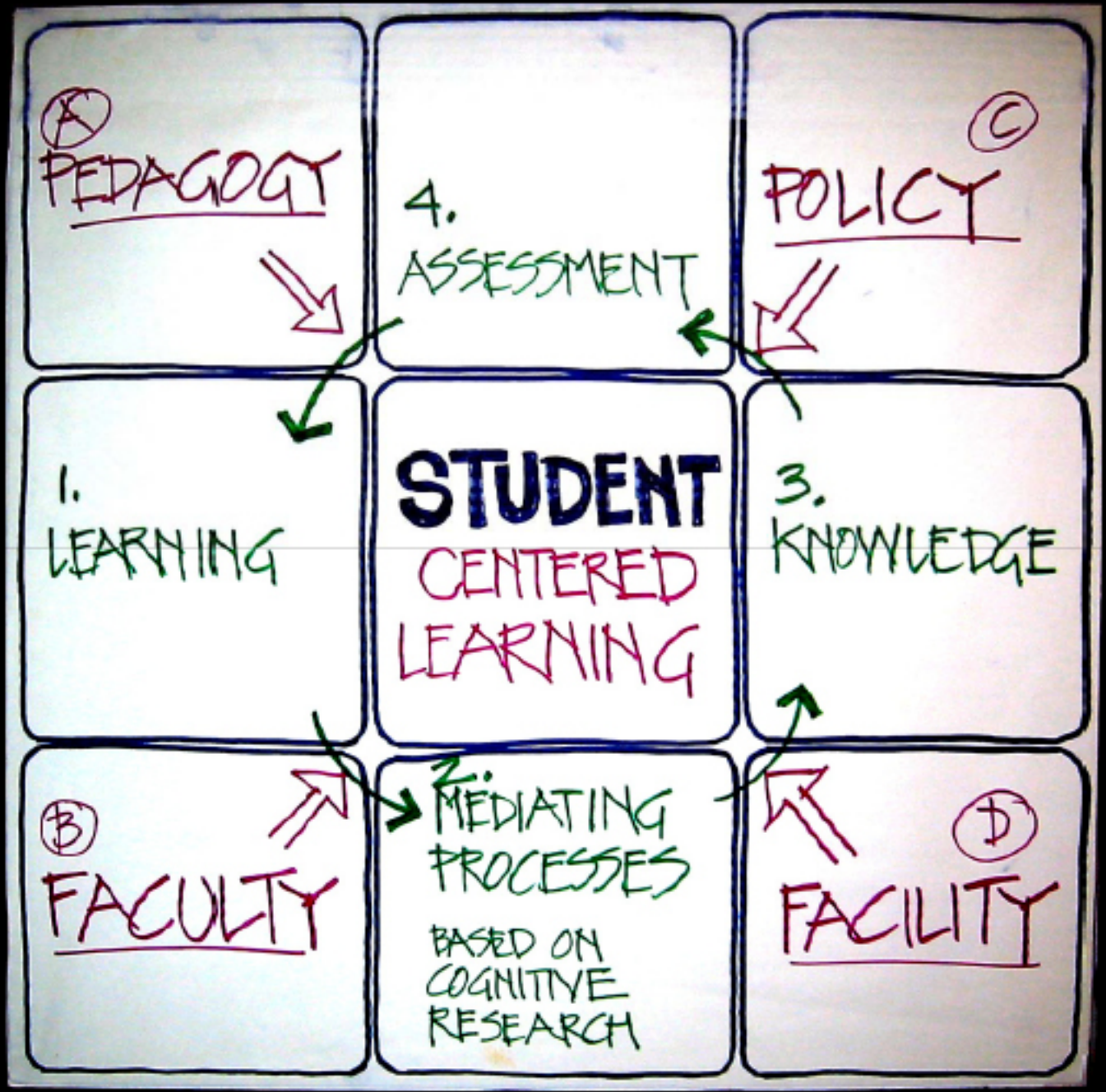
- Agents of their own learning
- Able to see themselves as becoming socialized into a particular community of practice, gaining a sense of self-efficacy
- Able to address routine and non-routine problems within that community of practice








PEDAGOGY FITS INSTITUTIONAL POLICY
INSTRUCTIONAL FRAMEWORK BASED ON LEARNING THEORY
PEDAGOGY
PEDAGOGY PREPARES FOR LIFE AS CITIZEN
ENTIRE COMMUNITY INVOLVED
DEVELOP VISION MISSION GOALS
DEPARTMENT VISION INTEGRATES WITH INSTITUTION'S
ASSURE CONTINUITY OF V/M/G THRU MULTIPLE ADMINISTRATIONS
POLICY
LANGUAGE AGREED AND UNDERSTOOD
STRONG BUT FLEXIBLE POLICIES
ALIGN REWARD STRUCTURE WITH V/M/G
TOP DOWN & BOTTOM UP
REINFORCE COMMUNITY
BASE LEARNING ENVIRONMENT ON BEHAVIOR SETTINGS
ADDRESS CHANGING DEMOGRAPHICS
INTEGRATE TECHNOLOGY
PROVIDE MULTIPLICITY OF ENVIRONMENTS
FACILITY
ADAPTABLE & FLEXIBLE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