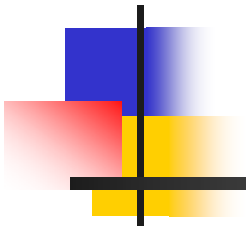


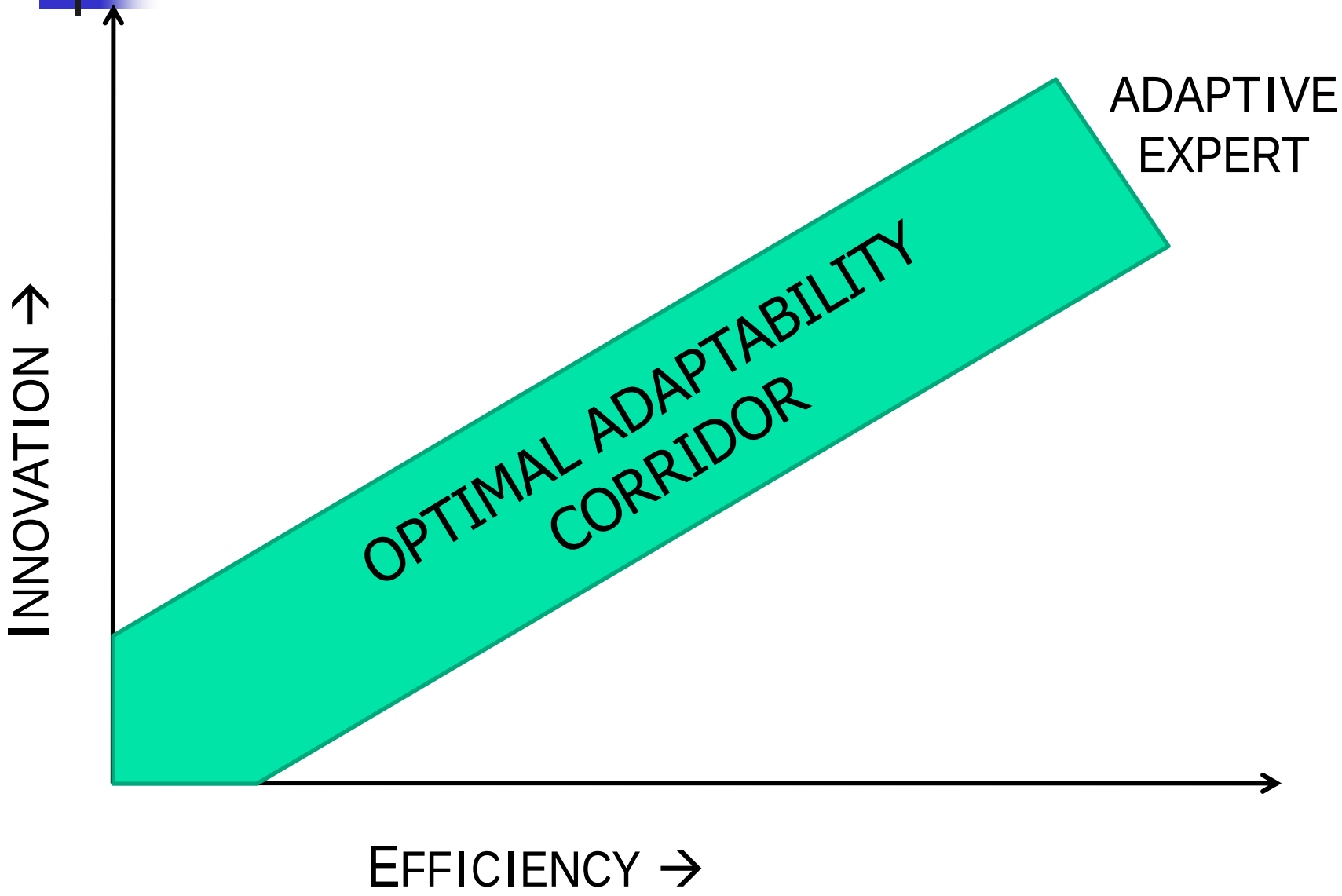
To be Efficient or to Innovate?

That is the Assessment

PER Seminar

Monday, October 26, 2009

Schwartz, Bransford & Sears (2005)



Goal For Today

Get your thoughts and ideas on how this framework can inform assessment of problem solving within the context of introductory undergraduate math and science courses.

You were asked to read Schwartz's article.
If you've not read it, please see handout for relevant quotes from Schwartz's article.

EFFICIENCY

- “rapidly retrieve and accurately apply appropriate knowledge and skills to solve a problem”
- “includes a high degree of consistency (lack of variability) that maximizes success and minimizes failure”
- “the best way to be efficient is to practice tasks and gain experiences with important classes and components of problems so that they become “routine” and easy to solve later.”
- “best way to ensure (efficiency) transfer is to “teach for it” so that the problems people encounter on a test or in an everyday environment can be solved with high frequency because they are quite close to what has been learned previously”
- “Appropriate kinds of practice help people turn non-routine, difficult-to-solve problems into routine problems that can be solved quickly and easily.”

INNOVATION

- “People who are optimally adaptive can rearrange their environments and their thinking to handle new types of problems or information. Innovation and adaptability “favor the prepared mind.”
- “that people need to acquire the kinds of well-organized, fluently accessible sets of skills and knowledge that are represented on the efficiency dimension”
- “innovation often requires a movement *away from* what is momentarily most efficient for the individual.”
- “the processes of innovation (and the insights that precede it) as involving “the sudden cessation of stupidity”. The stupidity comes from one’s initial framing of problems—framings that contain assumptions that “put people in a box,” or more technically, constrained the problem spaces within which they work.”

INNOVATION

- “...many people have difficulty questioning the first thoughts that come to mind and hence are less likely than others to experience the ‘sense of disequilibrium’ that provides an impetus for questioning current assumptions and “letting go” when necessary.”
- “Overcoming the ‘pull’ of efficient access to current knowledge and assumptions is not an easy task, and an overemphasis on efficiency can be damaging in the long run.”
- “...innovation is often preceded by a sense of disequilibrium that signals that certain processes or ways of thinking (e.g., previously learned routines) are not quite working properly. At other times, new ideas may simply emerge from interactions with tools and people without a prior sense that something was wrong or needed to be fixed.”

Balancing Efficiency & Innovation

- "...training dedicated to high efficiency can restrict transfer to highly similar situations. On the other hand, opportunities to engage in general, content-free skills of critical thinking or problem solving appear to provide a set of flexible 'weak methods' that are too inefficient for the large problem spaces found in many real-world tasks.
- "it will not work to give students a set of efficiency oriented, content-filled tasks that follow the horizontal axis... and a separate set of strategy-training tasks that fall along the vertical axis."
- "Innovative interactions are different from interactions dedicated to efficiency, where one repeats a behavior to tune speed and accuracy. Innovative interactions involve reaching beyond the immediately known."

Assessing Efficiency & Innovation

- What *elements* of a problem in introductory college math or science assess efficiency?
- What *elements* of a problem in introductory college math or science assess innovation?

Talk to your neighbor and write down your thoughts on each of the above.
Time left is show below

Time is Up!

Sharing Ideas

- Put up the paper on which you wrote down your ideas.
- Walk around the room to take a look at ideas that others have written down on their sheets of paper.

Discuss your ideas with others
Time left is shown below

Time is Up!

Listing Criteria

- List *criteria* that you would use to decide the extent to which a problem assesses efficiency.
- List *criteria* that you would use to decide the extent to which a problem assesses innovation.

Based on your discussions, work with your neighbor to write down your list of criteria on each of the above.
Time left is shown below.

Time is Up!

Based on your criteria...

- Design a problem in introductory college math or science that attempts to balance efficiency and innovation.
  - Articulate assumptions about the problem solver e.g. prior knowledge, material covered, familiarity with problem etc.
- Use the criteria you listed to rate extend to which the problem you designed assesses...
  - Efficiency
  - Innovation

Work with your neighbor
Time left is shown below.

Time is Up!