Designing and Scaling Highly Effective Interventions that Produce BIG Improvement: Counter-intuitive Lessons from the Higher Order Thinking Skills (HOTS) Project

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Limitations of the Existing Scaling-up and DBIR Research

- No adequate theory or understanding of the conditions under which it is reasonable to expect practitioners to adopt a new approach
- Assumes that design is a process of engineering something from theory

As a result, existing research:

- Overestimates the benefits of interventions and glorifies those with SMALL benefits
- Unfairly blames practitioners when they do not implement such interventions
- Promotes a design approach that is not likely to produce BIG improvements

The Importance of BIG improvement

- In the absence of BIG improvement/benefits there is little incentive/reason for practitioners to adopt a new approach

- Most research on scientifically validated practices use statistical criteria such as statistical significance or an ES of .2 that really indicate small benefits that have no practical importance

- My new book: *Authentic Quantitative Analysis for Education Leadership Decision-Making and EdD Dissertations* (NCPEA Press*) contains alternative statistical criteria for what constitutes benefits that are* BIG enough to warrant that practitioners consider the approach

It is rare to find Projects that Scaled with Consistent BIG Benefits—especially post grade 3

Two examples of successful interventions that scaled with BIG benefits are:

- Statway (Carnegie Foundation)
- Higher Order Thinking Skills (HOTS) Project (yours truly)

Both are examples of Networked Improvement Community (NIC) approach to Design-Based Research (DBR)

Statway

- Problem needing solution: Approximately half the students who enroll at a community college (CC) are placed into a developmental math course sequence which they must pass before they can enroll in CC credit earning courses. Most fail to ever earn any CC credit.

- Intervention: A new developmental math sequence that emphasizes the statistical types of math knowledge (as opposed to high school Algebra) that students need in CC coursework.

- BIG Results: The percentage of students earning community college math credits increased from 15% after two years of developmental math to 50% after only a single year of Statway developmental math.

HOTS

- Problem Needing Solution: The academic performance of at-risk students drops after the third grade which leads to a rewidening of achievement gaps by the 8^{th} grade
- Approach: Replace all content-based/remedial supplemental services for Title I and Learning Disabled (LD) students with intensive general thinking development activities via a Socratic learning environment wherein students verbalize increasingly sophisticated ideas
- Implementation: Over 30 years HOTS has been implemented in approximately 2600 schools in 49 states and served close to ½ million Title 1 and LD students
- BIG Results: Three times the growth in reading comprehension and twice the growth in math on standardized and state tests without extra “help” in those content areas

  - Approximately15% of HOTS Title I students made honor roll within the first year.
  - Major increases in student verbalization
  - These gains showed up across all cultures and school settings

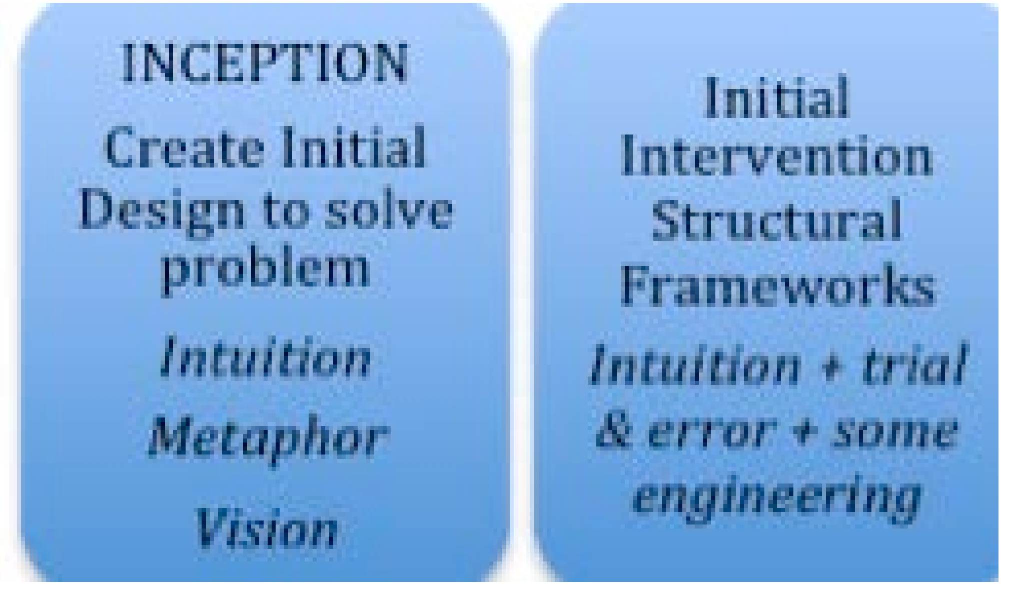
The Initial Design Process Used BY HOTS and Statway

My research on the similarities in the design process used by both interventions found that:

- The initial design process for interventions that can produce scalable BIG benefits is a two-stage process.
- Neither design emerged from the application of academic theory or research evidence.

Indeed…HOTS was designed around general thinking development because I was ignorant of the fact that research has consistently found that it does not work (as compared to thinking in content)…As a result, HOTS is the only intervention ever designed to provide intensive general thinking development to at-risk students

Two Initial Design States



There is almost nothing written about the intuitive, aesthetic, metaphorical nature of the INCEPTION stage of design for educational interventions

Yet, the INCEPTION design stage drives all subsequent design, research, and development activities, and is what makes BIG improvements possible

INCEPTION Metaphors Used to Design HOTS

(Resultant Decisions)

Metaphor 1—Convert Title I to the methods used to teach bright rich kids *(Socratic environment)*

Metaphor 2—Dinnertable Conversation *(Do <u>not</u> link HOTS activities to classroom content)*

Metaphor 3—Computer games as family life experiences *(Use computer activities as a basis for metacognitive conversation)*

Metaphor 4—Brain as a muscle *(Maximize linkage ideas across computer contexts)*

Metaphor 5—Teacher training modeled on how actors learn in the theater *(Learning from the context of practice)*

Other HOTS—Statway Design similarities

- No one had any idea of whether the interventions would actually work. Once the initial design approach was established the philosophy was "let's try it out and see if it works"
- A very different approach was used, and a key element in designing such an approach was to find something that would engage the students
- BIG improvement results right from the beginning
- All the aspects of the intervention, e.g., curriculum and training, needed to have very clear and detailed specification
- As the project scaled-up new adaptations became necessary and possible;
- It was only after the design was in operation that research on student learning was brought to bear on solving problems or for enhancing the effects of the intervention

Examples of other successful interventions based on intuitive design and alternative forms of scientific discovery

- Obstetrics
- Bagless vacuum cleaner
- Kahn Academy

Key Design Characteristics of Successful DBR NICs

- If the initial intuitions/metaphors are off base the intervention will not scale with BIG benefits regardless of how much traditional research/theory is used

- You cannot know if the initial intuitions/metaphors are off base. The best predictor that an intervention will produce BIG improvements is that it uses a very different approach than previously tried

- The traditional research design of laboratory research, e.g., randomized control trials, are useless for improving the intervention

- If and when the intervention is successful, it will result in new and very different knowledge

New Knowledge

Statway

Smart community college students struggle with mathematics because they suffer from “Conceptual Atrophy”, i.e., their willingness to bring reason to bear on mathematical problems lies dormant, and how to overcome this problem.

HOTS

After the third grade at-risk students’ main impediment is that “they do not understand what it means to understand”—though they have the intellectual potential to do so. In the absence of a sense of understanding students cannot benefit from quality content instruction to their full intellectual potential.

A sense of understanding is developed through intensive general thinking development Socratic conversation with the critical element being students’ active, spontaneous verbalizing of increasingly sophisticated ideas for 30 minutes a day for 1 ½ years.

HOTS New Knowledge (continued…)

Another way of thinking about what a sense of understanding is to think of it as *cognitive mindfulness*

Knowing that intensive general thinking development can develop a sense of understanding in at-risk students-post grade 3…

- provides a powerful way to accelerate their academic success,
- provides an explanation for why the progressive reforms of past decades such as NCTM (and the Common Core) that always focus solely on thinking-in-content do not reduce achievement gaps

The use of iterative quick learning pilots and scaling resulted in very precise knowledge as to how to orchestrate and integrate the various elements of HOTS and determine how much intervention it takes to develop a sense of understanding. *(Precision is a desired characteristic of scientific theory.)*

Implications of the Intuitive Nature of Design for Practitioners

- When faced with a seemingly intractable problem and there is no clear research that demonstrates BIG practical potential—become a designer.
- Assemble a design team and trust your instincts to design and develop a new and very different approach.
- This can end up working far better than anything researchers might recommend. (Of course there is no guarantee that it will work at all.)

Sources of Info on the Intuitive Nature of Successful Intervention Design and Alternative Idiosyncratic Modes of Scientific Discovery

- Gawand, A. *Better*. The development of obstetrics ability to save at-risk babies through iterative clinical trials of intuitive ideas.
- Science Friday (2014). Downloaded from http://sciencefriday.com/segment/01/24/2014/james-dysonfailures-are-interesting.html, 10/12/14. Talks about how Dyson combined intuition, happenstance, aesthetic design, and engineering to invent the bagless vacuum cleaner.
- Firestein, S*. Ignorance: How It Drives Science*. (2012). Talks about how science progresses from understanding what we do not know (as opposed to pretending that we know how to design an intervention or engineer it from theory.)
- Holmes, J*. Nonsense: The Power of Not Knowing*. (2015). Talks about how to turn uncertainty into positives.