The Five Dimensions for Attaining Scale: Implications for ELIG Initiatives

Chris Dede
Harvard University
Chris_Dede@harvard.edu
http://isites.harvard.edu/chris_dede
Overview

- A Grand Challenge in Education
- Difficulties in Attaining Scale to Meet this Challenge
- A Framework to Aid Designing for Scale
- Implications for ELIG Initiatives
Today's children can meet future challenges if their schooling and informal learning activities prepare them for adult roles as citizens, employees, managers, parents, volunteers, and entrepreneurs.
# Types of Knowledge/Skills

<table>
<thead>
<tr>
<th>Cognitive Outcomes</th>
<th>Intrapersonal Outcomes</th>
<th>Interpersonal Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive processes and strategies</td>
<td>Intellectual Openness</td>
<td>Teamwork and Collaboration</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Work Ethic and Conscientiousness</td>
<td>Leadership</td>
</tr>
<tr>
<td>Creativity</td>
<td>Positive Core Self-Evaluation</td>
<td>Communication</td>
</tr>
<tr>
<td>Critical Thinking</td>
<td>Metacognition</td>
<td>Responsibility</td>
</tr>
<tr>
<td>Information Literacy</td>
<td>Flexibility</td>
<td>Conflict Resolution</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Initiative</td>
<td></td>
</tr>
<tr>
<td>Innovation</td>
<td>Appreciation of Diversity</td>
<td></td>
</tr>
</tbody>
</table>
3 Contexts for Learning

- Classrooms

- Richly Contextualized Real World Learning
  - Internships, apprenticeships

- Learning Communities (f2f and virtual)
  - Interpretation and transfer
New evidence from many branches of science has significantly added to our understanding of what it means to know, from the neural processes that occur during learning to the influence of culture on what people see and absorb.
4 Dimensions of Design

- **Learner-centered**: preconceptions, needs, preferences, interests.

- **Knowledge/skills-centered**: what is to be taught, why it is taught, and what mastery looks like.

- **Assessment-centered**: diagnostic measures of learners’ thinking and doing that are formative for further instruction and learning.

- **Community-centered**: encouraging a culture of collaborative questioning, respect, and risk taking [a context for the other three]
A Grand Challenge

3 times 4 = 19

for all types of people, of every age, across the world adapted to local context
Overview

- A Grand Challenge in Education
- **Difficulties in Attaining Scale to Meet this Challenge**
- A Framework to Aid Designing for Scale
- Implications for ELIG Initiatives
Scaling Up Products

- Adapting an innovation successful in some local setting to effective usage in a wide range of contexts
  - Fast food as example
- Need not be one-size-fits-all; can be personalized
  - Apps as illustration
- Technology as a lever for scale
  - Can be used to automate or innovate, to make uniform or customized
The Spectrum of Social Media

- **Sharing**
  - Social bookmarking
  - Photo–video-data sharing
  - Social networking
  - Writers’ workshops and fan fiction

- **Thinking**
  - Blogs
  - Podcasts
  - Online discussion forums
  - Twitter

- **Co-Creating**
  - Wikis–collaborative file creation
  - Mashups–collective media creation
  - Collaborative social-change communities
Scaling Up in Education

- In contrast to experiences in other sectors of society, *successfully* scaling up *successful* programs has proved very difficult in education.

- The more complex the innovation and the greater the influence of setting, the more likely a new practice is to fail crossing the “chasm” from its original setting to other sites.

  - Avoiding the “replica trap”: the erroneous strategy of trying to repeat everywhere what worked locally, without considering challenges of size and contextual variations in needs/resources.

    - Problems of magnitude
    - Problems of variation -- not adoption, but adaptation
Types of Problems in Health Care

- **Simple (Straightforward):** building a hospital
- **Complicated:** developing a vaccine
- **Complex:** improving the health of a particular group
  (dynamic, nonlinear, and counter-intuitive, driven by multiple independent factors that interrelate in rapidly shifting ways)

Snowden & Boone, 2007
“Emergent” Models for Investment

- In contrast to “outcome-based” funding centered on clear goals, data-driven strategies, heightened accountability, and rigorous evaluations.

- My Grand Challenge is emergent in that it specifies a design space and a general goal, but does not prescribe mechanisms for achieving this.

Kania, Kremer, and Russell (2014)
The program logic model is defined as a picture of how your organization does its work – the theory and assumptions underlying the program. A program logic model links outcomes (short- and long-term) with program activities/processes and the theoretical assumptions/principles of the program.
P4K Baseline Logic Model

**Strategies**
- Provide face-to-face weekly program
- Provide weekly training for 20 youth intensive training design, and digital skill building
- Youth work with gamelab professionals on the design and development of a casual online game
- Disseminate online game
- Youth work with gamelab and a game publisher to release the game through one of the major gaming portals
- Education use the game in their classroom
- Align the game and accompanying materials with existing standards and with necessary 21st century skills
- Develop curricula for educators interested in bringing the game into classrooms or programs
- Provide all of the material required by educators to use the game as a tool within their classrooms

**Inputs**
- National Standards: 21st Century Skills
- SCALE Framework
- Previous experience build on the highly successful P4K programs launched in 2012-2013: Global Kids worked with Gamelab to create a curriculum that combined interactive pedagogy and global focus with the core conceptual skills required to develop online games. OK ran a cohort of 20 New York City youth, who developed the prototype for an online game about profiling in _...

**Objectives**
- Youth gain both the conceptual skills and digital skills necessary to develop games
- Youth have the skills necessary to utilize the Internet for positive purposes
- The game will be played by hundreds of thousands of youth at home
- The game will be played in classrooms around the world
- Determine how the learning goals translate into actual programmatic elements
- Identify how the developing game can be altered to address the learning goals

**Outputs**
- Youth educate their peers around the world about important social issues
- Address critical civic issues through media they currently use
- Young disinterested kids have constructive dialogue about substantive issues
- Use results to improve program

**Perspective**
- MSPII/Mid Tier Grant: Playing 4 Keeps (P4K)

**Goals**
- Promote academic achievement
- Develop 21st Century Skills including digital literacy, media literacy, critical thinking, global awareness, civic engagement, and learning and communication skills

**Highest Aspirations**
- Youth become passionate and energetic about world affairs
- Youth develop their leadership ability
- Youth build the tools and confidence they need to excel in an increasingly interconnected and global society
Overview

- A Grand Challenge in Education
- Difficulties in Attaining Scale to Meet this Challenge
- *A Framework to Aid Designing for Scale*
- Implications for ELIG Initiatives
Sources of Leverage for Scaling

- **Depth**: evaluation and research to understand and enhance causes of effectiveness

- **Sustainability**: robust-design to enable adapting to negative shifts in context

- **Spread**: modifying to retain effectiveness while reducing resources and expertise required

- **Shift**: moving beyond “brand” to support users as co-evaluators, co-designers, and co-scalers

- **Evolution**: learning from users’ adaptations about how to rethink the innovation’s model
Exploring the Process of Scaling Up

What are the steps — and traps — in moving from innovation to broad-based adoption and consequential change?

<table>
<thead>
<tr>
<th>Dimensions of Scale</th>
<th>Depth</th>
<th>Sustainability</th>
<th>Spread</th>
<th>Shift</th>
<th>Evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taking an educational innovation completely to scale involves five dimensions that reflect different aspects of making an intervention effective in one setting useful across a wide spectrum of contexts.</td>
<td>Getting to scale produces deep and consequential changes in practice. Requires evaluation and research to understand and enhance the impact of effectiveness.</td>
<td>Sustaining scaled growth means maintaining these changes in practice over substantial periods of time. Requires robust design to enable adapting to negative shifts in context.</td>
<td>Scaling up is achieved by diffusion of the innovation to large numbers of users. Requires modifications to retain effectiveness while reducing the resources and expertise required.</td>
<td>Ownership of the innovation is assumed by users, who deepen and sustain the innovation via adaptation. Requires moving beyond &quot;brand&quot; to support users as co-evaluators, co-designers, and co-sellers.</td>
<td>The innovation as revised by its adapters is influential in reshaping the thinking of its designers. Requires learning from users' adaptations about how to rethink the innovation's model.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sources of Leverage</th>
<th>Evaluation and Research</th>
<th>Robust Design</th>
<th>Reducing Resources and Expertise</th>
<th>Moving Beyond Brand</th>
<th>Rethinking the Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each dimension provides leverage for the scaling process by revealing the intervention to increase its power, durability, applicability, and flexibility.</td>
<td>What are the sources of the innovation's effectiveness? What conditions does each source depend on for success? How sensitive is each source to these conditions? How consistent is the innovation with the current political and cultural context of educational improvement?</td>
<td>How can the innovation be modified so that it functions in various types of inchoate environments? How typical is each condition for success in the target population of users? How can developers support varied users while evolving toward conditions for success that enable full effectiveness?</td>
<td>How much is the overall power of the innovation affected by reducing its cost or the knowledge required to implement it? How much power is retained in a light version that requires fewer resources or less expertise of its users? How can developers support light users to achieve full effectiveness?</td>
<td>How can developers support users going beyond what the original developers have accomplished? How can developers build users' capacity as co-evaluators, co-designers, and co-sellers? How can users form a &quot;community of practice&quot; that helps answer questions about scale?</td>
<td>How can developers unlearn their initial beliefs, values, and assumptions about the innovation and generate willingness to start the innovation process over again? How can they value the unique and discontinuous evolution? How can developers form a &quot;community of collaborative re-design&quot; with other innovators?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traps to Avoid</th>
<th>Trap of Perfection</th>
<th>Trap of Mutation</th>
<th>Trap of Optimality</th>
<th>Trap of Origination</th>
<th>Trap of Unlearning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evolving along each dimension requires the developers of the innovation to overcome traps that have both cognitive and effective aspects.</td>
<td>Developers should not seek an unattainable goal of perfection at the cost of diverting resources from other dimensions of scale. (This goal should not be the enemy of the good.)</td>
<td>Developers should ensure that the ways they modify the innovation to adapt to various inchoate contexts do not undermine its core conditions for success.</td>
<td>Developers should realize a somewhat less powerful innovation that reaches much greater numbers of users is a step forward.</td>
<td>Developers should not attempt to control the original innovation in ways that stifle adoption and further innovation by users.</td>
<td>Developers' unwillingness to take a fresh look can prevent genuine evolution.</td>
</tr>
</tbody>
</table>
Immersive Interfaces for Learning and Assessment

- **Full Immersion in Virtual Reality**
  Sensory immersion via head-mounted display or CAVE

- **Multi-User Virtual Environments**
  2-1/2D immersion in virtual contexts with computer-based agents, digital objects, and avatars of participants

- **Ubiquitous Computing**
  Mobile wireless devices for “augmented reality” that mixes the real and virtual worlds
Depth Dimension of Scale

- How effective is the innovation?
- What are the sources of the innovation’s effectiveness?
  - On what conditions for success does each source depend?
  - How sensitive is each source to attenuation or absence of a particular condition for success?

Trap of Perfection
Illustrative Depth in River City

- Design-based Research
  - Iterative cycles of theory-design-implementation-reconception

- Contrasting Theories of Learning
  - Guided Social Constructivism
  - Expert Mentoring
  - Legitimate Peripheral Participation
  - Best of the Best

- Guidance System
Sustainability Dimension of Scale

- How can the innovation be modified so that it functions in various types of inhospitable conditions?
  - How typical is each condition for success in my target population of users?
  - How can I support “hybrid” users in evolving towards conditions for success that enable full effectiveness?

*Trap of Mutation – Don’t Want to Lose Depth*
Illustrative **Sustainability in River City**

- **Increasing Engagement**
  - Access to Special Powers based on Performance
  - Use of Intrinsic rather than Extrinsic Motivation

- **Embedding Formative Assessments**
  - Newspaper reporter Kent Brock
  - Potential for Individualized Interventions based on Diverse Learning Styles
Spread Dimension of Scale

- How can I modify the innovation to retain effectiveness while reducing resources and expertise required?
- How much is the overall power of the innovation affected by reducing its cost or the knowledge required to implement?
  - How much power is retained in a “light” version of the innovation that requires fewer resources or less expertise of its users?
  - How can I support “light” users to evolve towards sufficient resources and expertise to achieve full effectiveness?

*Trap of Scaling the Project, Not the Model*
Knowledge Diffusion (Rogers)

- Compatibility
- Simplicity
- Trialability
- Observability
- Opinion leadership

Not Proof of Effectiveness
Illustrative Spread in River City

- The River City Dashboard
  - Tools for Teacher Management
- Automated Email Reports
  - Details on Student Behaviors and Interactions
  - Potential Development of Visualizations (SGER)
  - Potential for Sophisticated Formative Assessment
- Aid for Inexperienced or Unprepared Teachers
  - Videoclips for Student Induction
  - Quick-Briefing Lesson Plans
  - Professional Development Webinars
Shift Dimension of Scale

- How can I move beyond “brand” to support users as co-evaluators, co-designers, and co-scalers?
- How can I support users going beyond what the originators have accomplished?
  - How can I build users’ capacity as co-evaluators? As co-designers? As co-scalers?
  - How can users form a “community of practice” that helps answer questions about scale?

Trap of Origination
Illustrative Shift in River City

- Approving Adaptations
  - Special Education
  - Teacher-to-Teacher Curricular Help
- Teachers as Co-Designers
  - Changes to the Online Lab Notebook
- Teachers as Co-Evaluators
  - Insights from Automated Email Reports
  - Accounts of Unanticipated Student Behavior
  - Waterfall
  - Bug Catcher
Evolution Dimension of Scale

- How can I unlearn my beliefs, values, and assumptions about the innovation?
  - How willing am I to start the innovation process over again?
  - How can I “make the familiar strange” to facilitate reconceptualization and discontinuous evolution?
  - How can I form a “community of reflective redesign” with other innovators?

Trap of Unlearning
Illustrative Evolution in River City

- Shift in Professional Development Strategy
  - Delivery Method
  - Emphasis
  - Level of Detail
  - Train-the-Trainer Sessions

- New Study on Virtual Ecosystems and Complex Causality
Institutional change leading to improved student outcomes maintained over substantial time.

Many users who make changes.

Many users spread the change.

Revisions reshape original design.

Depth, evolution, sustainability, shift, spread.
Overview

- A Grand Challenge in Education
- Difficulties in Attaining Scale to Meet this Challenge
- A Framework to Aid Designing for Scale
- Implications for ELIG Initiatives
Planning for Scale

What are your goals in scaling up your model? To whom do you hope to scale? Describe what “scale success” would look like.

What actions might you take to DEEPEN the power of your model?

What actions might you take to make your model SUSTAINABLE?

What actions might you take to SPREAD your model?

What actions might you take to facilitate SHIFT and EVOLUTION of your model?

Where are you strongest on these dimensions? Weakest?
Advances in technology and in knowledge about expertise, learning, and assessment have the potential to reshape the many forms of education and training past matriculation from high school.
Massive: Reduced Cost with Large Group of Learners

- Reduced instructional presence
  - Adaptive materials *limited* to certain types of subjects and instructional goals
- Sufficient social reinforcement to aid retention
- Sufficient peer contribution to increase mastery
- Sufficient situated learning to inculcate expertise
Module 1: Pond Ecosystem
Modeled after Black’s Nook Pond in Cambridge, MA

http://ecomuve.gse.harvard.edu
Augmenting Real World Ecosystems

http://ecomobile.gse.harvard.edu
Common Challenges/Concerns

- Tension between fidelity and necessary adaptation
- Impact of adaptations and diverse contexts on learner outcomes
- Effectively using formative data to intervene/correct course
- Facilitating transfer of “ownership” of the innovation & sustaining momentum/growth
Scale is a Difficult Problem

- What scales is not an innovation, but a model of an innovation
  - Similar to, but different from a franchise
- Scaling to each site requires adaptation to local context and culture
  - “Tower of Babel” as a symptom of deeper confusion
Organic Scaling “like a Weed”