

The Five Dimensions for Attaining Scale: Implications for ELIG Initiatives

Chris Dede

Harvard University

Chris_Dede@harvard.edu

http://isites.harvard.edu/chris_dede

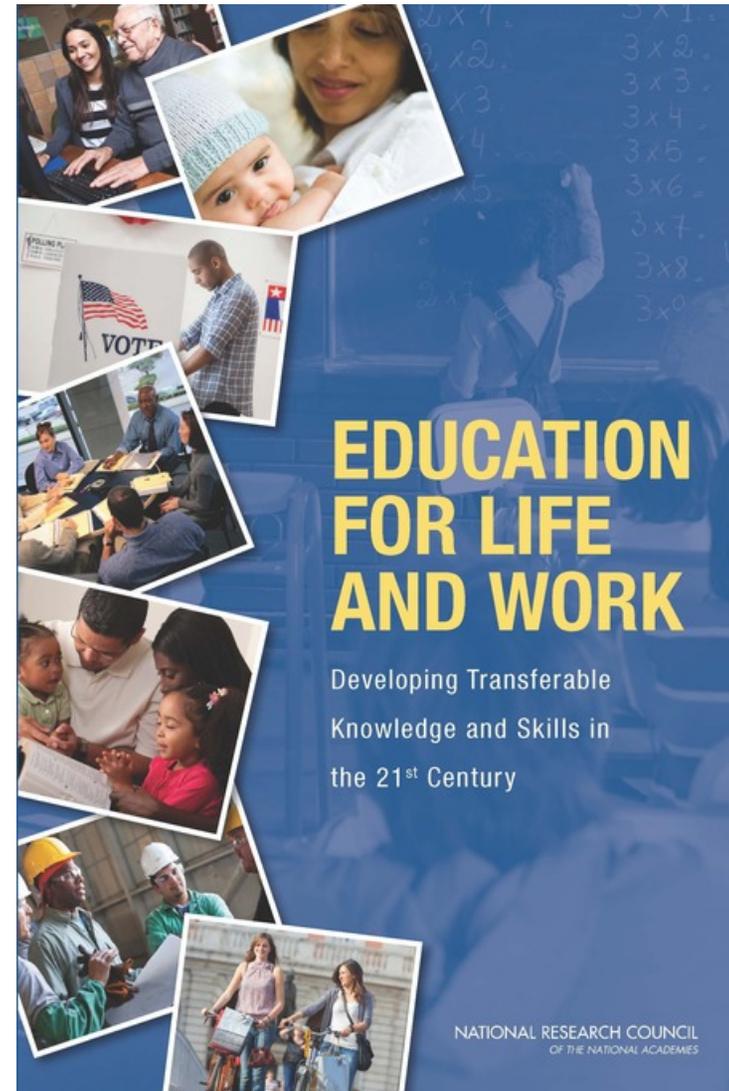


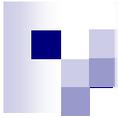
Overview

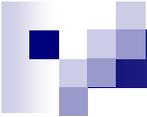
- ***A Grand Challenge in Education***
- Difficulties in Attaining Scale to Meet this Challenge
- A Framework to Aid Designing for Scale
- Implications for ELIG Initiatives

US National Research Council (2012)

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

<i>Cognitive Outcomes</i>	<i>Intrapersonal Outcomes</i>	<i>Interpersonal Outcomes</i>
Cognitive processes and strategies	Intellectual Openness	Teamwork and Collaboration
Knowledge	Work Ethic and Conscientiousness	Leadership
Creativity	Positive Core Self-Evaluation	Communication
Critical Thinking	Metacognition	Responsibility
Information Literacy	Flexibility	Conflict Resolution
Reasoning	Initiative	
Innovation	Appreciation of Diversity	

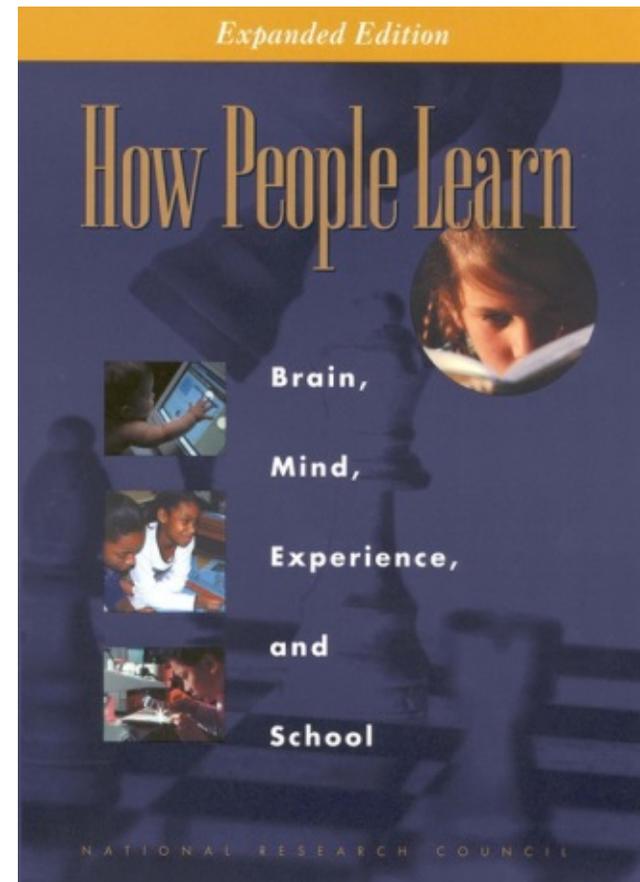


3 Contexts for Learning

- Classrooms
- Richly Contextualized Real World Learning
 - Internships, apprenticeships
- Learning Communities (f2f and virtual)
 - Interpretation and transfer

US National Research Council (2000)

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

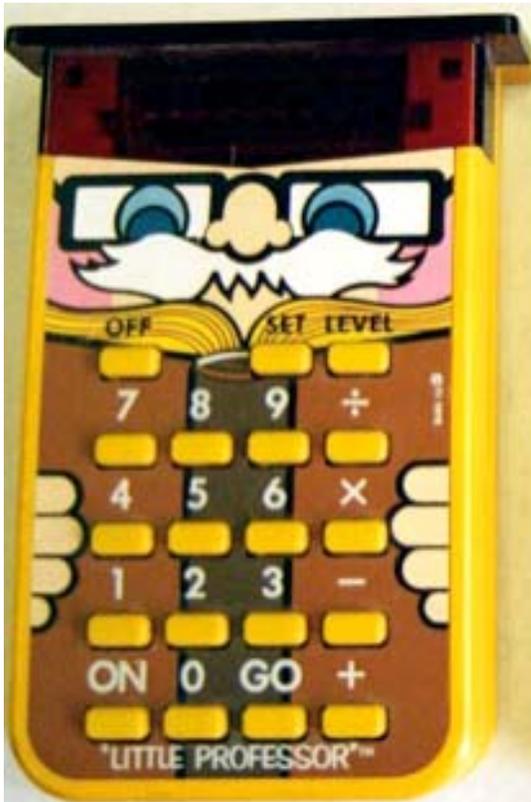
- A Grand Challenge in Education
- ***Difficulties in Attaining Scale to Meet this Challenge***
- A Framework to Aid Designing for Scale
- Implications for ELIG Initiatives



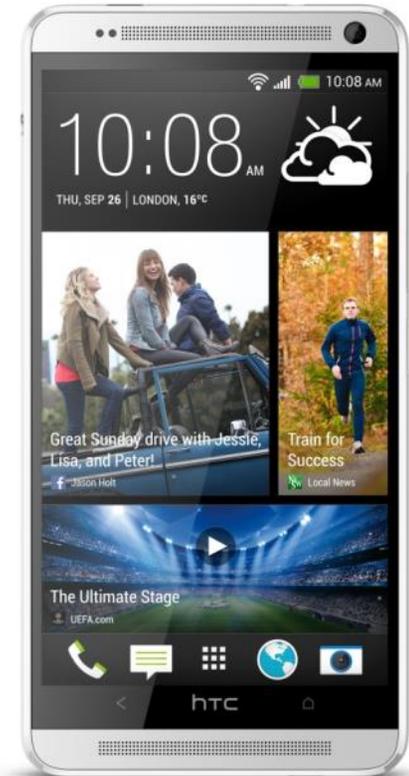
Scaling Up Products

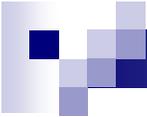
- Adapting an innovation successful in some local setting to effective usage in a wide range of contexts
 - Fast food as example
- Need not be one-size-fits-all; can be personalized
 - Apps as illustration
- Technology as a lever for scale
 - Can be used to automate or innovate, to make uniform or customized

1976



2014





The Spectrum of Social Media

■ *Sharing*

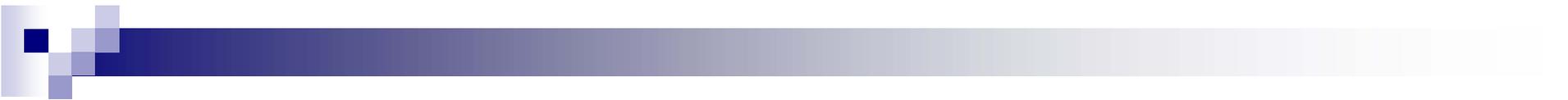
- Social bookmarking
- Photo–video-data sharing
- Social networking
- Writers’ workshops and fan fiction

■ *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

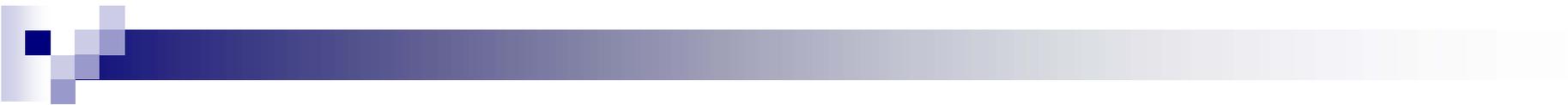
- In contrast to experiences in other sectors of society, *successfully* scaling up successful programs has proved very difficult in education
- The more complex the innovation and the greater the influence of setting, the more likely a new practice is to fail crossing the “chasm” from its original setting 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

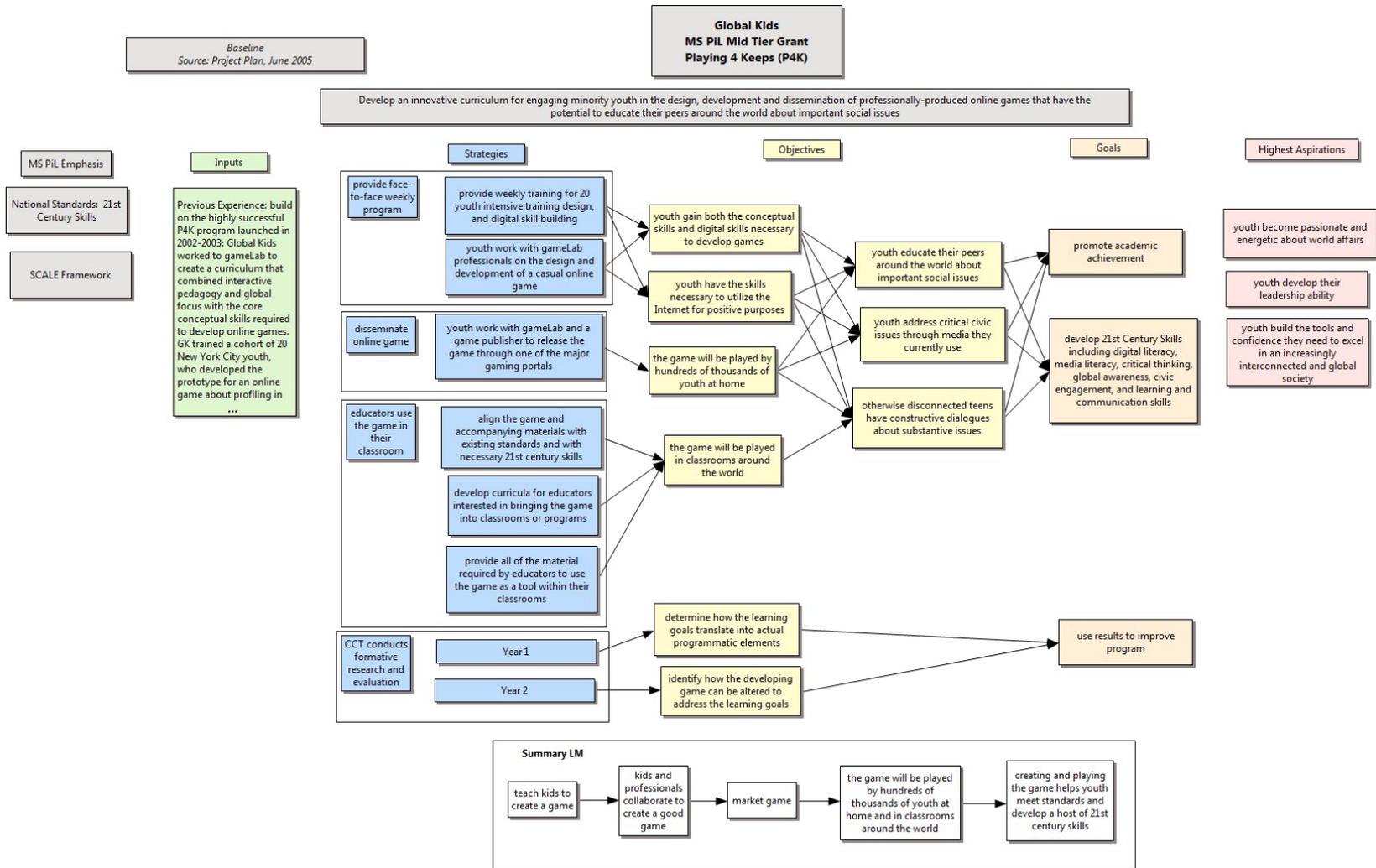
Kania, Kremer, and Russell (2014)



Program Logic Models: Kellogg

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

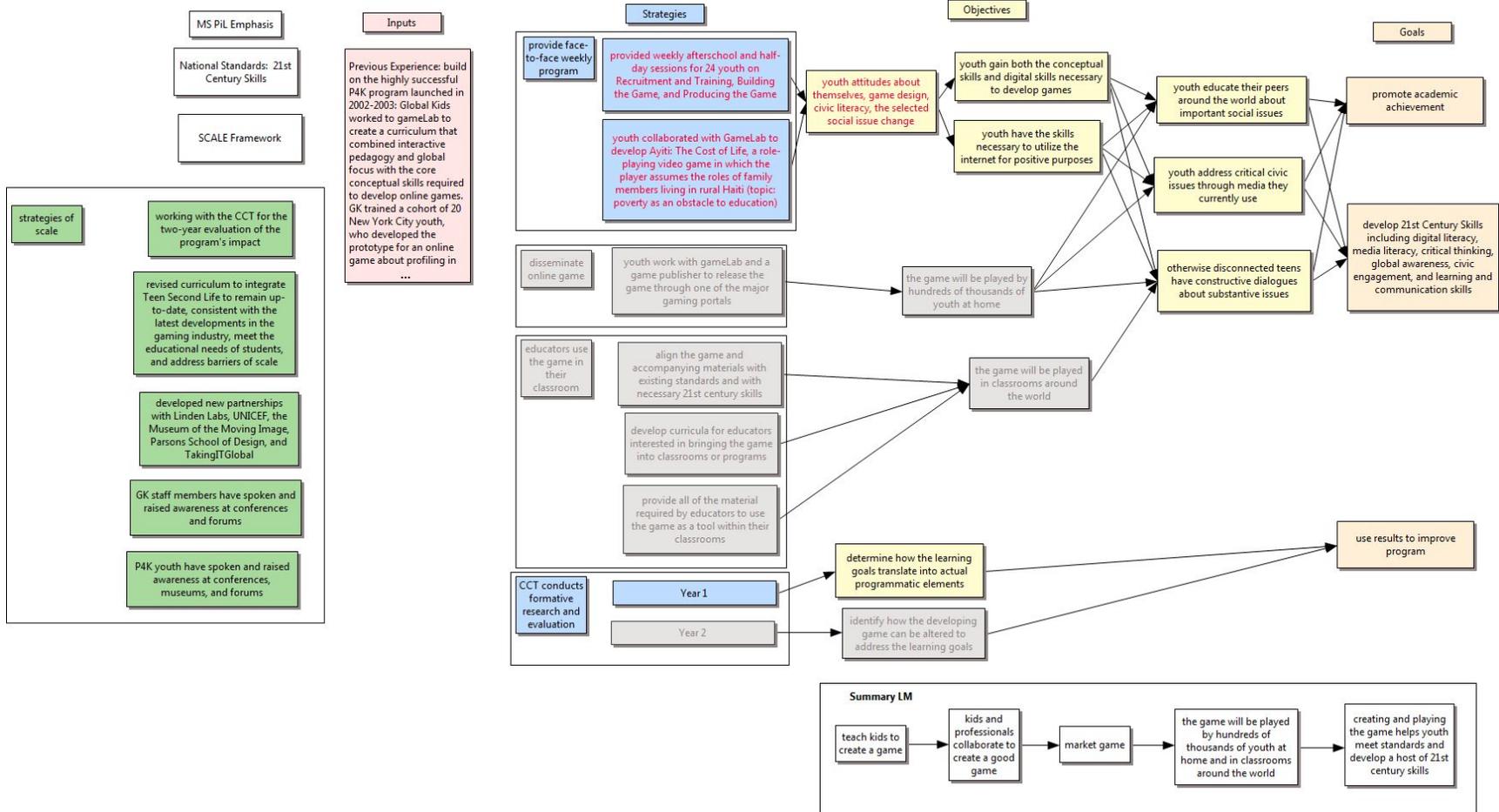


P4K Year One Enacted Logic Model

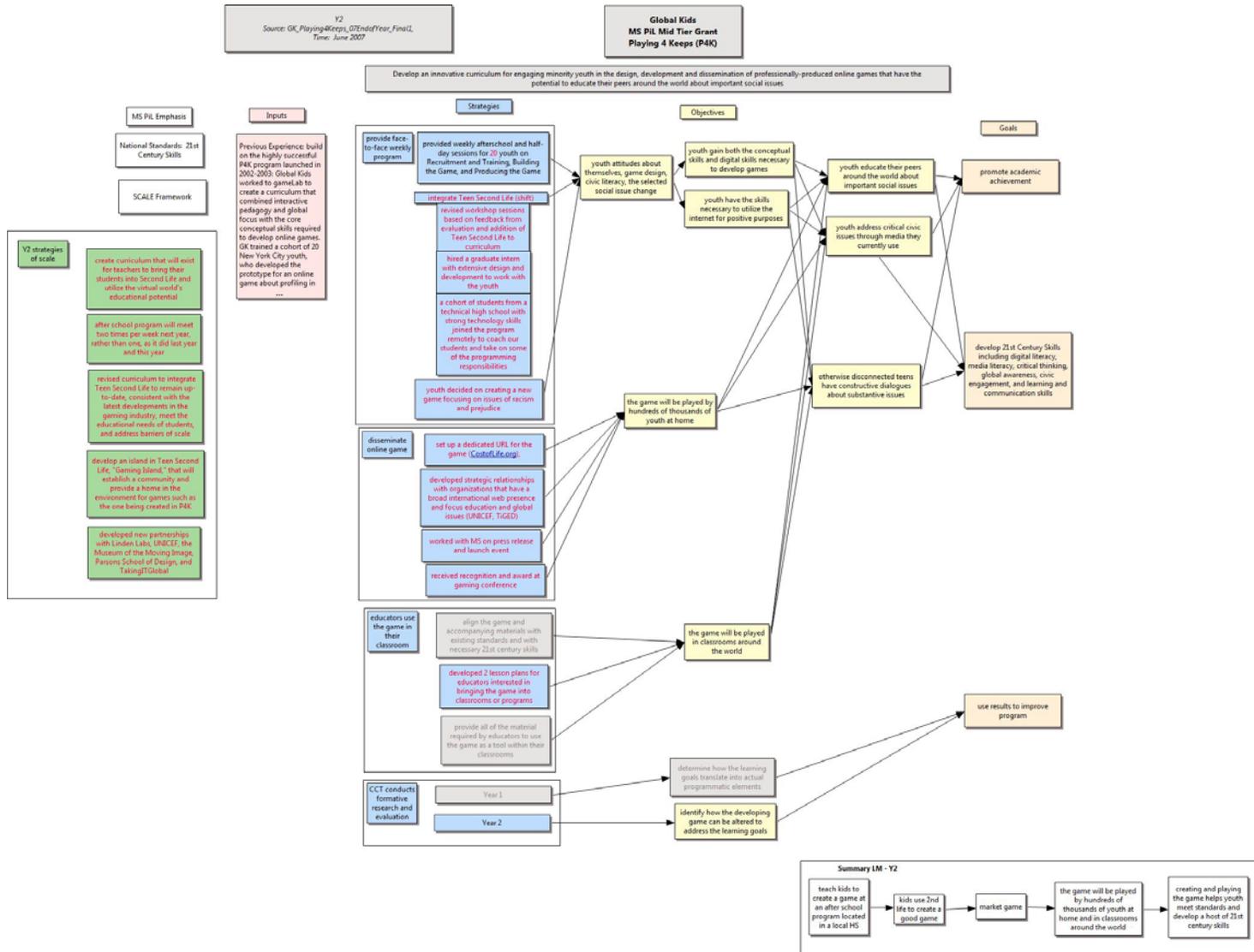
Y1
Source: GK_MS_P4K_June06_FinalNarrative,
GK_MS_P4K_June06_EvalSummary
Time: June 2006

Global Kids
MS PiL Mid Tier Grant
Playing 4 Keeps (P4K)

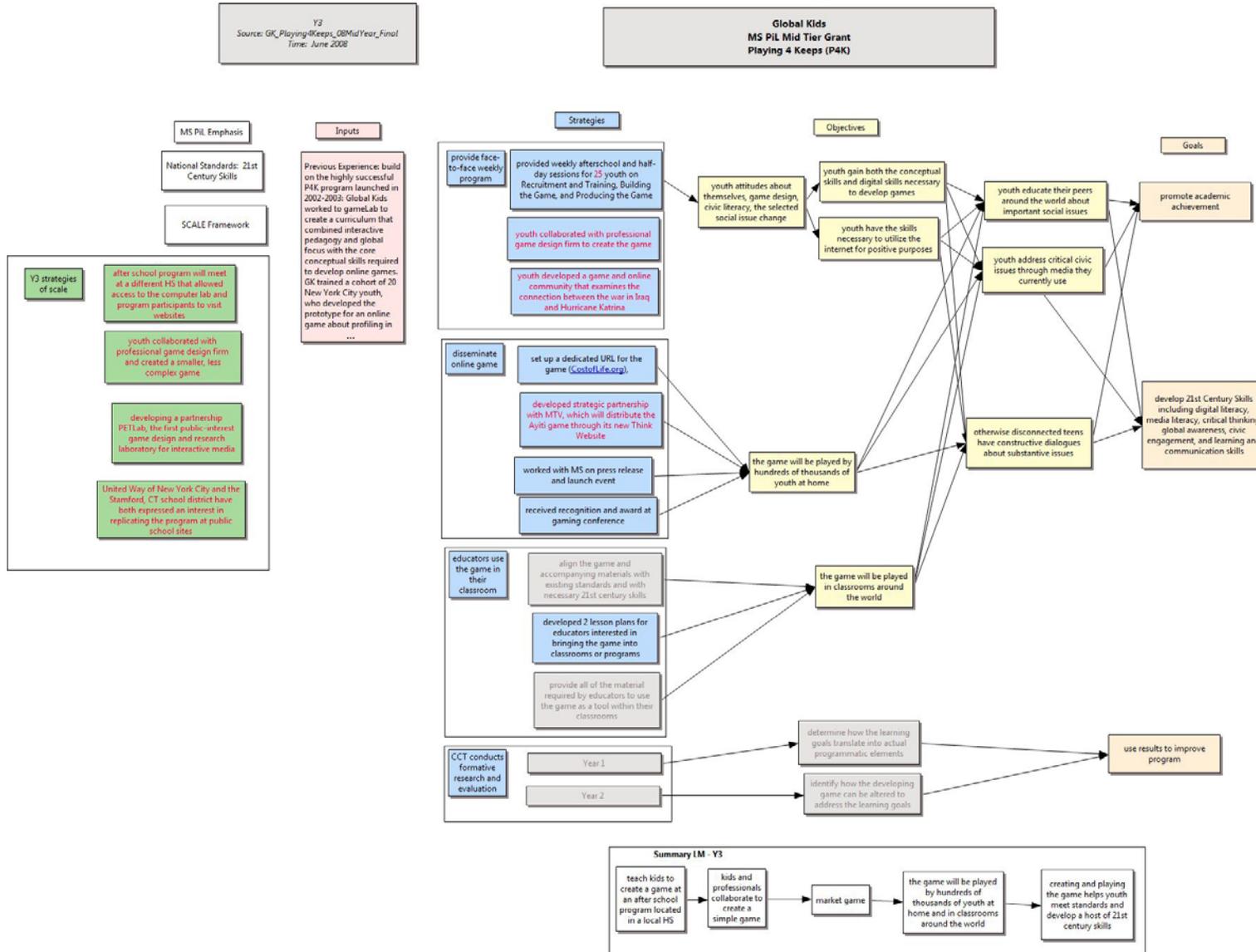
Develop an innovative curriculum for engaging minority youth in the design, development and dissemination of professionally-produced online games that have the potential to educate their peers around the world about important social issues



P4K Year Two Logic Model



P4K Year Three Logic Model





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**

You have a proven innovation you want to scale...



Exploring the Process of Scaling Up

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



<p>Dimensions of Scale 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.</p>	<p>Depth Getting to scale produces deep and consequential changes in practice. Requires evaluation and research to understand and enhance the causes of effectiveness.</p>	<p>Sustainability 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.</p>	<p>Spread 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.</p>	<p>Shift Ownership of the innovation is assumed by users, who deepen and sustain the innovation via adaptation. Requires moving beyond "brand" to support users as co-evaluators, co-designers, and co-scalers.</p>	<p>Evolution 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.</p>
<p>Sources of Leverage Each dimension provides leverage for the scaling process by evolving the intervention to increase its power, durability, applicability, and flexibility.</p>	<p>Evaluation and Research 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?</p>	<p>Robust Design How can the innovation be modified so that it functions in various types of inhospitable conditions? 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?</p>	<p>Reducing Resources and Expertise 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?</p>	<p>Moving Beyond Brand How can developers support users going beyond what the originators have accomplished? How can developers build users' capacity as co-evaluators, co-designers, and co-scalers? How can users form a "community of practice" that helps answer questions about scale?</p>	<p>Rethinking the Model 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 developers facilitate reconceptualization and discontinuous evolution? How can developers form a "community of reflective redesign" with other innovators?</p>
<p>Traps to Avoid Evolving along each dimension requires the developers of the innovation to overcome traps that have both cognitive and affective aspects.</p>	<p>Trap of Perfection Developers should not seek an unattainable goal of perfection at the cost of deflecting resources from other dimensions of scale. (The great should not be the enemy of the good.)</p>	<p>Trap of Mutation Developers should ensure that the ways they modify the innovation to adapt to various inhospitable contexts do not undercut its core conditions for success.</p>	<p>Trap of Optimality Developers should realize a somewhat less powerful innovation that reaches much greater numbers of users is a step forward.</p>	<p>Trap of Origination Developers should not attempt to control the original innovation in ways that deter adaptation and further innovation by users.</p>	<p>Trap of Unlearning Developers' unwillingness to take a fresh look can prevent genuine evolution.</p>

Source: Christopher Dede, Harvard University Graduate School of Education; Cynthia Coburn, "Rethinking Scale: Moving Beyond Numbers to Deep and Lasting Change," *Educational Researcher* (2008).

Illustration by Patrick Corrigan



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

River City Interface

The screenshot displays the River City MUVE interface, which is a virtual environment for learning. The interface is divided into several key areas:

- 1. View and Action Space:** This area is located at the top of the interface, containing navigation and control icons such as a home button, directional arrows, and a chat icon. It also includes a menu bar with options like 'File', 'View', 'Options', 'Chat', 'Login', 'Avatar', and 'Visibility'.
- 2. Virtual Space:** This is the central 3D environment where users interact. It shows a character named 'Jody' in a green dress standing in a virtual town square with buildings and trees.
- 3. Chat Window:** Located at the bottom left, this window displays text from other users, including instructions like 'the residents at this point. Remember to be observant of your surroundings. Write down the changes you observe and keep track of the information.'
- 4. Student Workspace:** This area is on the right side of the interface, featuring a 'Web' browser window with tabs for 'GUIDE', 'NOTEBOOK', 'MAP/TOOLS', and 'HELP'. It contains a 'Welcome to River City' message and a list of training stages: 1. Scientist-in-Training, 2. Junior Scientist, 3. Assistant Scientist, and 4. Scientist. A 'Next Page' button with a green arrow is also present.

The bottom status bar provides technical information: 'Download complete', 'Done', '0.0 K/sec', '33.4 frames/sec', '9:15:45 PM Mon Sep 17, 2007 VRT', '120 meters', '20.0 meters', and '0.0 m/s'.



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



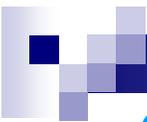
Illustrative Sustainability in River City

■ 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

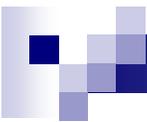
- How can I modify the innovation to retain effectiveness while reducing resources and expertise required?
- How much is the overall power of the innovation affected by reducing its cost or the knowledge required to implement?
 - How much power is retained in a “light” version of the innovation that 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)

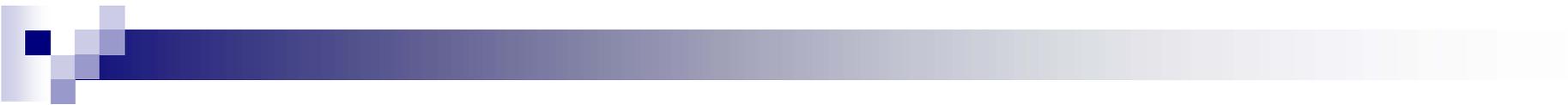
- Compatibility
- Simplicity
- Trialability
- Observability
- Opinion leadership

Not Proof of Effectiveness



Illustrative Spread in River City

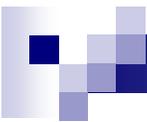
- **The River City Dashboard**
 - Tools for Teacher Management
- **Automated Email Reports**
 - Details on Student Behaviors and Interactions
 - Potential Development of Visualizations (SGER)
 - Potential for Sophisticated Formative Assessment
- **Aid for Inexperienced or Unprepared Teachers**
 - Videoclips 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

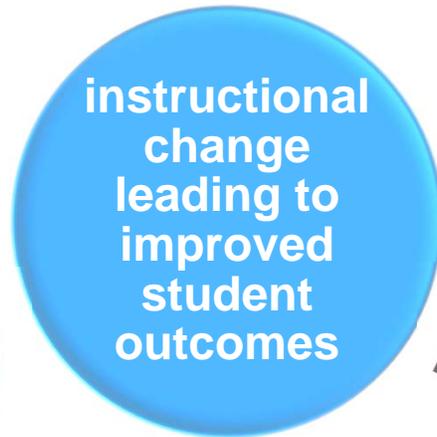


Illustrative Evolution in River City

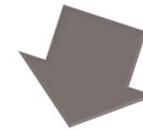
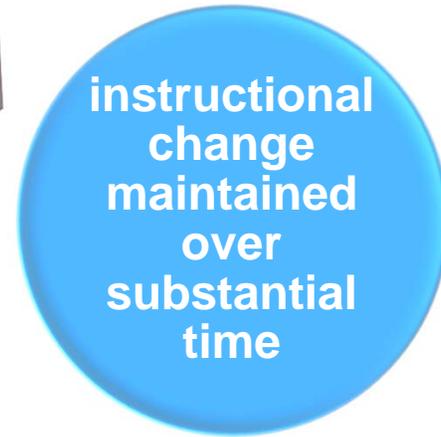
- Shift in Professional Development Strategy
 - Delivery Method
 - Emphasis
 - Level of Detail
 - Train-the-Trainer Sessions
- New Study on Virtual Ecosystems and Complex Causality

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?

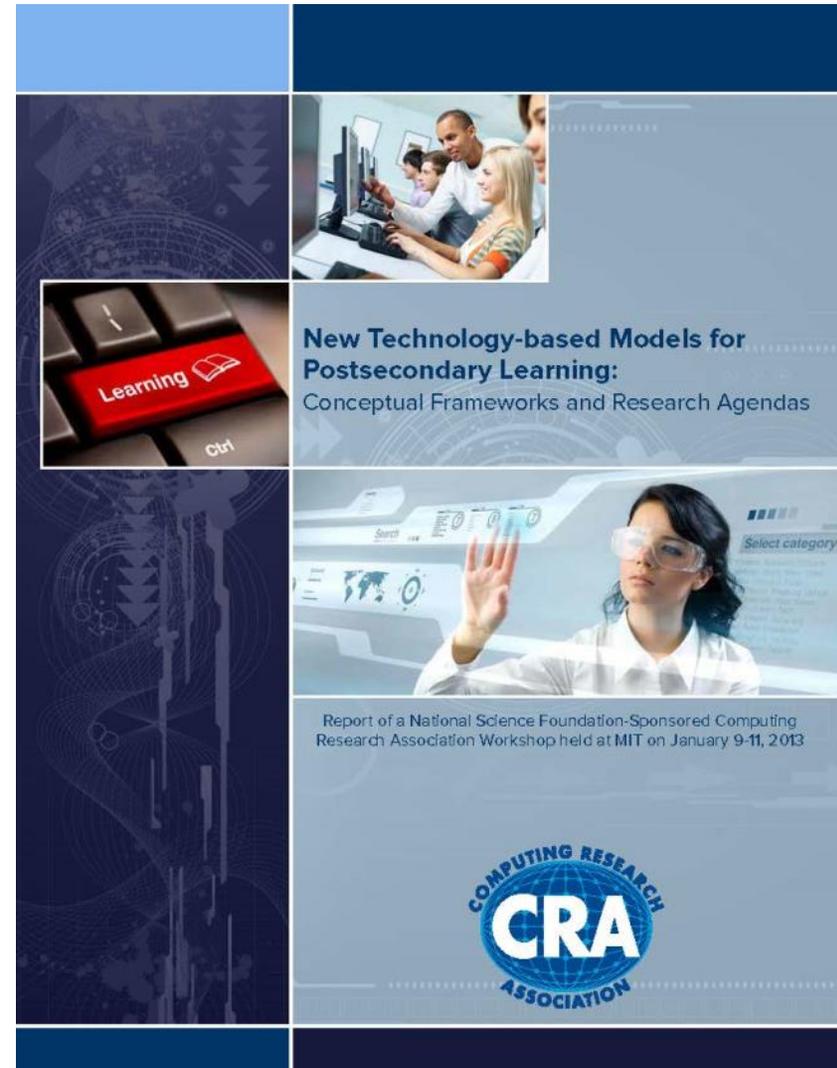
What actions might you take to SPREAD your model?

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

Where are you strongest on these dimensions? Weakest?

National Science Foundation (2013)

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.



New Technology-based Models for Postsecondary Learning:
Conceptual Frameworks and Research Agendas

Report of a National Science Foundation-Sponsored Computing Research Association Workshop held at MIT on January 9-11, 2013

**COMPUTING RESEARCH
CRA
ASSOCIATION**



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>



(Conner Flynn)

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”



