Digital Learning and the Sustainable Innovative Transformation of Education

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The Premise: An opportune moment for Educational Transformation

• Demand
  – Worldwide demand for well-educated workers
    • Rapid development agenda
  – Unaffordable and Unmanageable cost of education
  – Agility needed for rapidly changing knowledge and skills
  – New Generation of Diverse learners
    • Increase in Non-Traditional Learners,

• Supply
  – Technology
  – The Open Movement

• Readiness?
Technology and Open Influence

Technology

- Networks; Devices; Software; Architecture; Processes
  - Mobile Computing
  - Cloud Computing
  - Data Visualization & Analytics
  - Simple Augmented Reality
  - The Semantic Web
  - Game-Based Learning
  - MOOCs?

Open

- Content
- Tools/Applications
  - Finding; Getting; Using
  - Knowledge
- Enabling Resources
  - Legal
  - Policy
  - Community
  - Big Data

Educational Innovation and Transformation
The Boundary-less Difference
Changing the Ecology and Economics of Education

— Alternative models to address enduring problems and new demands of education
  — Alternate ways to learn:
    » Pathways; Customization; Flexibility

— Fresh perspective on resources and relationships
  • Access ^ Cost ^ Quality
  • Individual ^ Institution ^ Knowledge
    – Agency of the Community (Crowd)
    – Disaggregation of educational services
      » Credentialing
TECHNOLOGY IN MIT EDUCATION

- xTutor: 1999
- Internet Labs: 2003
- MIT Shakespeare Project: 1992
- PIVoT: 1999
- Visualizing Cultures: 2002
- TEALsim: 2004
- Project Athena: 1980’s
- MIT Mathlets: 2006
- MIT OpenCourseWare: 2002
- STAR Tools: 2007
- MITx: 2012
Non-profit venture founded by MIT & Harvard

Expand access to quality education

Improve on campus education

Advance research
Why?
MIT’s exertions to reestablish hands-on

Rogers: Learning by Doing

Massively Flipped Classrooms using edX Platform

ESG
Concourse
TEAL

6.01, 2.007
• **Flipped classrooms** – prior to class students view online lectures or readings and answer concept questions, class time used for more interactive learning (14.73r, 18.05r, 8.02r)

• **Online assessment** – students do assessment problems online and get instant feedback (3.091r, 8.02r)

• **On-line instruction modules** (including visualizations, interactive simulations) that students can access on-demand

• **Summer @future** – pilot program to expand academic calendar with 5 blended MIT classes for MIT students during Summer 2014

• **Entrepreneurship Bootcamp** – top MOOC students invited to campus for intensive one-week experience during Summer 2014
3.091x
Introduction to Solid State Chemistry

Reimagining education @MIT: Blended Learning with MITx

- “Treasure chest” of problems (412)
- 277 videos
- 164-page e-text
- No home-works, no exams
- All proctored weekly quizzes
- Learning objectives for each module
- Assessments linked to those learning objectives
Early Results from 3.091

Freshman 5th week flags

<table>
<thead>
<tr>
<th>Year</th>
<th>Freshman 5th week flags</th>
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<tbody>
<tr>
<td>2011</td>
<td>56</td>
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<tr>
<td>2012</td>
<td>29</td>
</tr>
<tr>
<td>2013</td>
<td>3</td>
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</table>
Interactive Simulations: Physics

TEALSim Exploration: Point Charges

This simulation illustrates the field pattern created by two point charges with opposite signs of charge. In this simulation, the position and charge of each particle can be modified in real time, and the field configuration will update itself accordingly. All three field visualization techniques can be applied to show the overall electric field of the two-charge configuration: vector field, field lines, and "grass seeds".

(Please be patient - the simulation may take ~20 seconds to load)

More about this simulation: show
Virtual Game-Like Laboratory
Rich Set of Autograded Exercises

Chemical Equations

H1P2: DECOMPOSITION OF AMMONIUM NITRATE

Solid NH₄NO₃ (ammonium nitrate) decomposes on heating to 400°C, forming N₂O gas and water vapor, H₂O.

(a) Write a balanced chemical equation.

(b) Calculate the number of grams of H₂O that will form on decomposition of 0.10 mole of ammonium nitrate.
Interactive Auto-graded Problems

Numerical Response

S1E1: NEWTON'S LAW

The next three segments cover review material that 3.091x will rely on over the course of the semester. Check your understanding with each exercises, and see the screencast at the bottom of the page if more information is necessary.

A ball of mass 2.5 kg is pushed along a frictionless surface with a constant force of 15 N applied. Calculate the acceleration of the ball. Express your answers in m/s².

May use randomization, tolerances can be specified
14.73
Challenges of World Poverty
Fall 2013

- MOOC offered Spring 2013
- Campus class uses MOOC to support “flipped classroom” model
- Students watch MOOC videos, and do related exercises and online homework
- Class time used for interactive team-oriented work and presentations
iLab: If you can’t come to the lab... the lab will come to you!
Active Learning Eco-System

- Electric Vehicles
- Molecular Simulations
- Virtual Game-like Laboratory
- Access to telescopes, experts
- Maker Spaces
- iLabs
- Las Cumbres Observatory

The diagram illustrates various components of the Active Learning Eco-System, including electric vehicles, molecular simulations, virtual game-like laboratory, access to telescopes, experts, maker spaces, and iLabs.
FUTURE OF EDUCATION > OPPORTUNITIES

• **New digital tools enhance learning**
  - enhanced student engagement and success in face-to-face and online settings (gaming, simulations, visualizations, toolboxes)

• **Better information for instructors on student performance**
  - learning dashboards that allow instructors to adjust instruction in real-time and continuously improve courses

• **Research data used to improve learning**
  - big data generated by MOOCs used to identify opportunities to improve learning online and on-campus

• **Online “cognitive tutors” offer more effective personalized, adaptive learning based on a new science of learning**
  - addressing varied abilities of students (preparation, capacity, motivation) with alternative pathways based on cognitive science
Institute-wide Task Force on the Future of MIT Education

Task Force Coordinating Group

- Working Group on MIT Education and Facilities for the Future
- Working Group on the Future Global Implications of edX and the Opportunities It Creates
- Working Group on a New Financial Model for Education

Community Engagement

Three Working Groups of Faculty, Students, and Staff
Charge to the Task Force

1. Propose an ecosystem for ongoing research, learning and innovation about the future of education.

2. Recommend a range of possible experiments and pilot projects – on our campus and beyond – that will allow us to explore the future of MIT education.

3. Evaluate the strength and sustainability of MIT’s current financial model and propose alternative approaches.

4. Develop a roadmap to enable this ecosystem and implement these experiments.

Institute-wide Task Force on the Future of MIT Education
Extending MIT’s Educational Impact

• **Recommendation 7:** Extend pedagogical innovation to the world.

• **Recommendation 8:** Support efforts to create a lasting community and knowledge base for MITx learners.

• **Recommendation 9:** Define a K-12 strategy through a special interest group.

• **Recommendation 10:** Create new opportunities for engagement between the MIT community and the world.

• **Recommendation 11:** Move forward to consider the types of certifications that can be supported through MITx and edX, and develop pricing methodologies and revenue-sharing arrangements for agreed-upon certifications.
The future of MIT education looks more global, modular, and flexible.

- **Modularity**
  - Alternate ways to learn: Pathways; Customization
  - Flexibility

- **Blurred Boundaries**
  - Permeability between institutions and sectors (k-12; Community Colleges; Global)

Fly-by-Wire

Scalable differentiated instruction through technology-enabled, competency-based, dynamic scaffolding

• Relate curricular content to student skills and outcomes
  – Modularity and curriculum mapping to create competency-based mappings

• Enable teachers to differentially guide students towards competencies
  – Fly-by-Wire" technology, inspired by aeronautics and control theory

• Deploy these approaches at Scale to meet the needs of many learners cost-effectively.
  – Interoperable online technology architecture
Collaboration

To improve the professional and academic prospects of high school students in underserved communities in India

**Scope (3 years):**
- 1,650,000 students;
- 1,100 schools;
- 4,400 teachers;
- 4 states

Incorporating thoughtful pedagogical design & contemporary technology

Will help provide sustainable, quality learning experiences at scale in English, Mathematics, & Science (Physics, Chemistry, Biology)
Goal — Quality at Scale

Quality at Scale

Students
Prepare for active participation in higher learning in vocational programs / employment opportunities

Teachers
Improve teacher education and transform teacher practice

Platform
“Platform” for curricula offering, research and innovation in education
Focus > conceptual understanding and application of foundational concepts through active learning > emphasis will be on “Learning by Doing” [ skills + knowledge + attitude ]
Multiple elements for delivering learning experiences and professional development at scale and for providing support for the learning communities.
CLiX Ecosystem

Tata Trusts

TISS

MIT

Development Partners
- Eklavya, Bhopal
- Centre for Education Innovation and Action Research, TISS, Mumbai
- Homi Bhabha Centre for Science Education, TIFR, Mumbai
- MIT, Cambridge, MA, USA
- National Institute of Advanced Studies, Bengaluru

Implementation Partners

State Governments
- Chhattisgarh
- Mizoram
- Rajasthan
- Telangana

Institutions
- UNICEF, Chhattisgarh
- University of Mizoram
- CEIAR, Jaipur
- SCERT, Telangana
- Eklavya, Bhopal

Field Implementation Teams

Students

Teachers

Parents

Community
CLiX Teams

CORE
- Leadership
- Project Management
- Technology
- Research
- Production

CURRICULUM
- Invitation to CLiX
- English
- Math
- Science
- Values & Life Skills
- TPD

IMPLEMENTATION
- Chhattisgarh
- Mizoram
- Rajasthan
- Telangana
- CEIAR
Value Proposition

- Scale as input not only as outcome
- Indian Language
- Open in / Open out
- Technology Is integral
- Focus on Professional Values and Ethics

Value Proposition
CLIX Impact

- Raise social capital and expand opportunities for participating youth
- Transformation
- Quality at scale
- Global model for world-class engagement
ORACLE
a model for innovation generalization
(Ronald G. Havelock and A. M. Huberman)

Object
Promised Benefit; Value Proposition
Macro; Micro

Resources
Adequate; Appropriate

Authority
Support of Leadership
Levels; Stages; Persistent

Consensus
- All Levels

Linkages
Infrastructure
Physical; Organizational
Launch; Sustainability

Environment
Social; Political; Economic; Readiness
Changing the Ecology and Economics of Education

• Abundance
  • Actionable Access to Resources, Learning Experiences; Communities
  • Alternate ways to learn: Models; Pathways

• Blended Learning; Boundary-less Education

• Customization and Continuous Improvement
  – Learner feedback/Analytics /Open Design
  – Continuous Education
<table>
<thead>
<tr>
<th>Where could we be going</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visible</strong></td>
</tr>
<tr>
<td><strong>Situated</strong></td>
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<tr>
<td><strong>Receiving/Knowing</strong></td>
</tr>
<tr>
<td><strong>Limited Term</strong></td>
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<td><strong>Enrolled Student</strong></td>
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<tr>
<td><strong>Dropouts</strong></td>
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<tr>
<td><strong>DE as 2nd Class</strong></td>
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<td><strong>University</strong></td>
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“The potential of new technologies is presenting higher education with a historic opportunity: the opportunity to better serve society by reinventing what we do and how we do it.”

-MIT President L. Rafael Reif, 2012
Goal — Quality at Scale

Quality at Scale

- **Students**: Prepare for active participation in higher learning in vocational programs / employment opportunities
- **Teachers**: Improve teacher education and transform teacher practice
- **Platform**: “Platform” for curricula offering, research and innovation in education
Collaboration

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- SCERT, Telangana
- Eklavya, Bhopal

Field Implementation Teams

Students  Teachers  Parents  Community
Value Proposition

Scale as input not only as outcome

Indian Language

Open in / Open out

Value Proposition

Technology Is integral

Focus on Professional Values and Ethics
What could success look like

Key Indicators:

1. Student
   - Enhanced proficiency in communicative English
   - Improved conceptual skills
   - Increased STEM interest and ability
   - Widened career access and choices

2. Teacher
   - Integrated IT in curriculum and teaching
   - Improved subject knowledge

3. Systemic
   - Demonstrated proof of concept of technology enabled education in high schools
ORACLE
a model for innovation generalization
(Ronald G. Havelock and A. M. Huberman)

Object
Promised Benefit; Value Proposition
Macro; Micro

Resources
Adequate; Appropriate

Authority
Support of Leadership
Levels; Stages; Persistent

Consensus
- All Levels

Linkages
Infrastructure
Physical; Organizational
Launch; Sustainability

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Social; Political; Economic; Readiness
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Physical; Organizational
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Environment
Social; Political; Economic; Readiness
Implementation

Before school

During School Hours:
accessed by grades 8, 9, 11

After School

School Science Lab

Learning Lab

- 1:1 or 1:2 devices / user ratio
- Instructor/facilitator support
Why?

- More modularity
- “Choose your own adventure” courses
- More hands-on, active learning time in MIT classrooms/elsewhere
- More research apprenticeship
- More field experiences
- More internships/travel
- More interactive assessments and real-time feedback

☞ More Magic Time
CLIx Pilot States

RAJASTHAN

- 300 Schools
- 1,200 Teachers
- 45,000 Students

MIZORAM

- 200 Schools
- 800 Teachers
- 30,000 Students

TELANGANA

- 300 Schools
- 1,200 Teachers
- 45,000 Students

CHHATTISGARH

- 300 Schools
- 1,200 Teachers
- 45,000 Students
Technology and Open Influence

Technology

- Networks; Devices; Software; Architecture; Processes
  - Mobile Computing
  - Cloud Computing
  - Data Visualization & Analytics
  - Simple Augmented Reality
  - The Semantic Web
  - Game-Based Learning

Open

- Content
- Tools/Applications
  - Finding; Getting; Using
  - Knowledge
- Enabling Resources
  - Legal
  - Policy
  - Community

Educational Innovation and Transformation
Concept-Based Learning & Modularity

Chemistry

John Essigmann

Bridge challenging concepts between courses with similar concepts

MechE

Ken Kamrin & Pedro Reis

Modularize mechanics and materials into discrete learning experiences

Aero-Astro

Wilcox, Darmofal, Radovitzky, Wang

Transform 16.20 & 16.90 to modular, active learning experiences, and enable self-paced completion of the courses
15.390x Entrepreneurship 101: Who is Your Customer?
- 6-week MOOC offered Spring 2014 to 50K enrollees
- 47 top MOOC students from around the world invited to the MIT campus for Global Entrepreneurship Bootcamp in Summer 2014, for an intensive weeklong team-based action learning experience
New types of blended education combine the best of online and on-campus learning

Improved efficiencies in teaching and learning without reduction in quality

Online courses allow 3rd year students to spend a semester or more away from campus, doing work in the field

First year coursework done online before students arrive at MIT, reducing tuition costs and increasing throughput

MOOCs help us identify and recruit talented students who otherwise would not have found their way to MIT

REINVENTING EDUCATION @MIT > IS THIS THE FUTURE?
FUTURE OF EDUCATION > A NEW SCIENCE OF LEARNING

“Cognitive tutors” based on neuroscience and cognitive psychology will enhance learning

- Advances in neuroscience and cognitive science provide insight into how digital technologies can be used to enhance Attention, Memory, Motivation, Thinking

- Online “cognitive tutors” based on this new science of learning can offer personalized, adaptive learning
  - Addressing varied abilities of students (preparation, capacity, motivation) with alternative pathways
15.390x Entrepreneurship 101: Who is Your Customer?
- 6-week MOOC offered Spring 2014 to 50K enrollees
- 47 top MOOC students from around the world invited to the MIT campus for Global Entrepreneurship Bootcamp in Summer 2014, for an intensive weeklong team-based action learning experience
Neurodiversity, Digital Learning, and Individualized Education

John Gabrieli
Department of Brain & Cognitive Sciences
Institute for Medical Engineering & Sciences
McGovern Institute for Brain Research
MIT
Individualized Education: Neuroimaging Predicts Who Responds to What Form of Education

- what poor reader will or will not make major progress in reading over the next 2.5 years?

- what dyscalculic child will benefit from a math program?

Better than conventional educational measures
Learning Science and Online Learning

Supported by the National Science Foundation, US

Symposium to share perspectives and Expertise:

• To understand the influence of Learning Science Research including DBER on Online Learning

• To explore how Online Learning can inform the agenda for Learning Science Research

Goals

– Inform the agenda for future educational research

– Inform digital/online learning activities at our institutions To design better learning experiences

– Influence development policy, practice and scholarship
**Learning Sciences & Online Learning Recommendations**

* Research and practice: collaborative, iterative, and data-driven

- Integrating practice-based evidence (Bryk) with evidence-based practice
- Supporting learners in creating coherent learning progressions as technology creates increasingly disaggregated systems over the course of their lifetimes
- Developing or collect the battery of assessments to develop a profile in cognitive and non-cognitive skills
- Building bridges between 21st century skills real world learning opportunities
- Integrating mentoring, learning engineering and lifelong learning
MIT Online Education Policy Initiative

Supported by the Carnegie Corporation, NY, US

• **To explore** teaching pedagogy and efficacy, institutional business models, and global educational engagement strategies and **to present** a cohesive report on these issues that can be used by policymakers and leaders in education.

• **To engage** in the public discourse surrounding online education and **to encourage** productive discussion

• **To influence** policy and policymakers to create a welcoming environment for educational innovation
Integrated Science of Learning

• Cognitive Science and Learning Research
• Discipline Based Education Research
• Social Sciences Perspectives on Education
• Education Technology
• Other Contributing Disciplines
Strategic Education Initiatives

• SEI configures and manages education projects driven by MIT’s (and ODL’s) strategic priorities and mission.

• SEI works with national and international partners to advance the field of digital learning.
  – Universities, foundations and trusts, non-governmental organizations and countries

• SEI focuses on solutions and not just products
Inspiration
- Scratch
- First Robotics
- MIT K12 Videos
- Edgerton Center

Informal
- Edgerton Camps
- Splash
- Spark
- MITES

Formal
- AP courses

Pedagogy & Tools
- Hands-on learning
- Projects
- STEM-focus
- Entrepreneurship

Educator Prof. Dev
- Scheller Teacher Training Program
- More coming
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“The future of MIT education looks more global, modular, and flexible.”

The Economics of a Flipped Campus

• At MIT level schools, we shoot for 10:1 student/faculty ratios
• Professors spend 4-5 hours per week in intensive lecturing or recitations per class
• Professors spend another 2-4 hours in office hours etc.
• At a flipped university, the ratio can easily be 40:1
• Professors spend 15-20 hours/week in contact with the students but in a fluid environment
• Net faculty-student interaction actually goes up, not down
How does Strategic Education Initiatives do its work?

- **SEI configures and manages education projects** driven by MIT’s (and ODL’s) strategic priorities and mission.

- **SEI works with national and international partners** to advance the field of digital learning.
  - Universities, foundations and trusts, non-governmental organizations and countries

- **SEI focuses on solutions** and not just products
2. The Interacting Subfields of Education

• Many fields of research develop “outside-in” first and “inside-out” second
  – e.g., zoology and botany started as observational sciences
  – breakthroughs of the 20th century → understanding of biochemistry, molecular biology, DNA and gene expression
  – enabling a ground-up understanding of biological systems
  – many other examples (e.g., thermodynamics ↔ statistical mechanics)
The Premise: An opportune moment for Educational Transformation

• Demand
  – Worldwide demand for well-educated workers
    • Rapid development agenda
  – Unaffordable and Unmanageable cost of education
  – Agility needed for rapidly changing knowledge and skills
  – New Generation of Diverse learners
    • Increase in Non-Traditional Learners,

• Supply
  – Technology
  – The Open Movement

• Readiness?
Outside-In and Inside-Out Views of Education

- Education has largely been studied “outside-in” and may be on the verge of an “inside-out” view.

- Three of the many fields of study that can impact education, yet they have evolved into mostly independent silos.

  - Education Research
  - Cognitive Psychology
  - Neuroscience
Outside-In and Inside-Out Views of Education

• Education research and educator preparation has largely been outside-in in its approach

• Cognitive science (the merger of cognitive psychology and neuroscience) provides an inside-out model

• Integration of these two models would be powerful

• A broader merger would involve all the other fields listed in Figure 1, and would grow dynamically as more connections and couplings emerge
3. Background: Advances in Topics Related to Education

3.1 Key Fronts in Education

3.2 Cognitive Science and Learning Research

3.3 Discipline Based Education Research

3.4 Social Sciences Perspectives on Education

3.5 Education Technology

3.6 Other Contributing Disciplines
3.2 Cognitive Science and Learning Research

The study of learning inside-out, that is, from the neuroscience and cognitive psychology perspective, has progressed greatly since the times of Ebbinghaus and his research on how memories fade after learning

- Mind wandering
- Retrieval practice / testing effect
- Spaced learning and retrieval
- Interleaved practice
- Cognitive load theory
- Learning states and curiosity
- ...

3.3 Discipline-Based Education Research

There is a long history of research into learning within specific disciplines. With roots primarily in the natural sciences, these efforts focused on effective teaching of core concepts by experts in the field.

- Origins in physics: Millikan; Feynman; Force Concept Inventory
- Recent work: Mazur on active learning; Belcher et al. on Technology-Enabled Active Learning
- NRC-commissioned DBER Report: experts in the discipline bring a new level of nuance to the discussion
3.4 Social Sciences Perspectives on Education

Social scientists have explored utilization of learning media and impact of education for many years. Recent efforts have often focused on drawing attention to underserved audiences.

• How do students actually use online learning media?

• What sorts of students are best/worst served by online environments (see e.g., Digital Divide)?

• What are the broader social impacts of online learning and education as a whole?

• New direction – how can social science research contribute to design of learning environments?
3.5 Education Technology

• Radio, television in the early-mid 20\textsuperscript{th} century; video over the internet in the 1990s (YouTube)
• Programming environments and authoring systems, simulations and games
• Open Education Resources movement, OpenCourseWare, Khan Academy
• MOOCs, cMOOCs, xMOOCs; Coursera, Udacity, edX
• Blending online and in-person learning: MITx on campus
• Learning Management Systems
• Simulations and virtual reality
• Teaching machines; cognitive tutors
3.6 Other Contributing Disciplines

• Motivation and rewards in learning

• Health and nutrition

• Architecture and learning space design
5.1 Towards an Integrated Science of Learning

• The richness of research results across disciplines – education research, DBER, social science, cognitive science, and others not discussed here – points to a pressing need, and an opportunity, for a new integrated science of learning (ISOL)

• Not a new idea: we simply make a larger case that goes beyond the merger of cognitive science and education research, building on emerging convergence between outside-in and inside-out approaches to learning research from across disciplines

• A promising opportunity to create a new field of enquiry that cuts across all these disciplines – and new emerging ones – so that we can begin to form an increasingly comprehensive and dynamic understanding of education

• We recommend ISOL here in the context of higher education; it may have equal relevancy in PK12 education and in continuing education of adults
The Open Emerging Ecosystem for Learning

– Generative
  • 4Rs: Reuse; Remix, Revise, Redistribute
    – Permitted by Technology, Legally and Policy

– Boundary-less
  • Access, Development and Use not limited by domain/community/technology/Policy
    – Bidirectional
    – Distributed locus of control
    – Individual to social learning

– New Structural Relationships
  • Access – Cost - Quality
  • Individual – Institution – Knowledge
    – Agency of the Community (Crowd)
    – Co-creation of Learning Opportunities
    – Disaggregation of educational services
      » Credentialing; Distributed over time and place
CLIx Phase 1 - Scope

• In 2015-2017:
  3 States,
  1,000 schools,
  150,000 students,
  2,700 teachers

• Mathematics, English, Science & Values

• Ecosystem of Partners including State Governments, led by MIT and TISS
Constructionism 3.0

Neil Gershenfeld

Digital Fabrication,
Fabrication for all!

Fab Labs
digital bits <=> physical atoms
A Fab Education

Fab Lab Barcelona

Fab Academy

MC2STEM
High School
Fab Lab
Heightened Interest + Urgency for Educational Research

• Key Fronts in Education

• Cognitive Science and Learning Research

• Discipline Based Education Research

• Social Sciences Perspectives on Education

• Education Technology

• Other Contributing Disciplines
Cognitive Science and Learning Research

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• Mind wandering
• Retrieval practice / testing effect
• Spaced learning and retrieval
• Interleaved practice
• Cognitive load theory
• Learning states and curiosity
• ...

Assessment Banks and Recommenders

• **Scaling Problem**: Managing, sharing or supporting re-use of assessment items; Effectively mapping them to learning objectives

• **Digital Learning Assessment Bank**
  – A global federation of assessment tools for online assessments
  – A secure and interoperable Federated Assessment Service to create and update assessment offerings and perform assessment authorizing, reporting, learning objectives mapping and analytics

• **Recommenders**
  – Identification and selection of assessments from the digital learning assessment bank for use by course authors.
  
  • **Big Data capability can allow us to study the effectiveness of assessments drawn from these assessments banks for different learning outcomes/ in different**
Competency and Skill based Learning

Problem: Mapping between educational courses/programs and job skills.

– Modeling educational goals related to course and programs

**Learning objective cataloging systems (services to manage and map data on educational goals)**

  - Interoperability

**Semantic analysis.**

– Starting with knowledge models, developed by domain experts, auto-generate learning outcomes from available data
Strategic Scaffolding

• Create automatic support and scaffolding strategies for a wide variety of “Network learners”
  – Help understand conditions under which successful learning occurs for diverse learners/contexts
    • interaction among students, pedagogy, curricular material, support networks (Community)
    • Help seeking behavior (Community)
    • Dynamic/Increasingly Complex
Recommendations: Curricula & Assessment

• Deep focus on [improving student learning in] remedial mathematics in all settings

• *Develop or collect the battery of assessments to develop a profile in cognitive and non-cognitive skills*

• Broad student mentoring and counseling
  – Improving counseling and advising including academics, success coaching and someone that can help beyond school to give a broad view
Recommendations: Research Agenda

How to implement: Proposal(s) / project(s) in each of these areas

• Integrating mentoring, learning engineering and lifelong learning
  – New models for supporting learners and the learning experiences they participate in over the course of their lifetimes

• **Building bridges between 21st century skills and internships / real world learning opportunities**

• Creating and evolving portfolios and analytics

• Creating personal dashboard to evolve with and remind students
Symposium Goals

• Share perspectives and collectively address the synergistic opportunities from learning sciences and online learning perspectives
  – To design better learning experiences
  – To inform the agenda for future educational research

• Outcomes
  – Inform digital/online learning activities at our institutions
  – Influence development policy, practice and scholarship
Current Pain Points/Opportunity Areas for Big Data in Education

• **Distributed, Embedded Assessment**
  – Repositories and Recommenders

• **Competency and Skill based Learning**
  – Mapping between educational courses/programs and job skills

• **Strategic Scaffolding**
  – Automatic support and scaffolding strategies for a wide variety of “Network learners”
Laying a Foundation for the Future

• **Recommendation 1:**

  • Establish an Initiative for Educational Innovation to build on the momentum of the Task Force, enable bold experimentation, and realize the future the Task Force has imagined for education on campus and beyond.
Transforming Pedagogy

• **Recommendation 2:** Catalyze ongoing research, learning, and innovation about the future of MIT residential education.

• **Recommendation 3:** Build on the success of freshman learning communities and consider future expansions of the cohort-based freshman community model.

• **Recommendation 4:** Use online and blended learning to strengthen the teaching of communications.

• **Recommendation 5:** Create an Undergraduate Service Opportunities Program.

• **Recommendation 6:** Explore online and blended learning models to improve graduate curriculum accessibility.