Overview of Pedagogy, Learning & Technology in the 21st Century

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Even Geniuses Work Hard
Carol S. Dweck (1999, 2007)

Teachers who strive to design challenging, meaningful learning tasks may find that their students respond differently depending on the students’ assumptions about intelligence. Students with a growing mindset may tackle such work with learning tasks that require them to stretch or take risks.

To prepare students to benefit from meaningful work, therefore, teachers need to create a growth-mindset culture in the classroom.
Fixed Mind-set  
Intelligence is static

Growth Mind-set  
Intelligence can be developed

As a result, they may plateau early and achieve less than their full potential.

All this confirms a deterministic view of the world.

As a result, they reach ever-higher levels of achievement.

All this gives them a greater sense of free will.

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CHALLENGES
- Leads to a desire to look smart and therefore a tendency to...
  - avoid challenges

Growth Mind-set
- Leads to a desire to learn and therefore a tendency to...
  - embrace challenges

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OBSTACLES
- ...give up easily

Growth Mind-set
- ...persist in the face of setbacks

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EFFORT
- ...see effort as fruitless or worse

Growth Mind-set
- ...see effort as the path to mastery

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CRITICISM
- ...ignore useful negative feedback

Growth Mind-set
- ...learn from criticism

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SUCCESS OF OTHERS
- ...feel threatened by the success of others

Growth Mind-set
- ...find lessons and inspiration in the success of others

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GRAPHIC BY NIGEL HOLMES
SeKng
  DirecGons
  ?

Improving
  the
  InstrucGonal
  Programing?

Developing
  the
  OrganizaGon?

Securing
  Accountabilty?
There are four characteristics that such a culture must have:

1. diversity of expertise among its members, who are valued for their contributions and given support to develop
2. a shared objective of continually advancing the collective knowledge and skills
3. an emphasis on learning how to learn
4. mechanisms for sharing what is learned. If a learning community is presented with a problem, then the learning community can bring its collective knowledge to bear on the problem. It is not necessary that each member assimilate everything that the community knows, but each should know who within the community has relevant expertise to address any problem.
CYCLE 1

Observe

Action

Reflect

Plan

CYCLE 2

Observe

Action

Reflect

Revised Plan
What is Knowledge Building (KB) Discourse?

- Another key component of the inquiry process is Knowledge Building Discourse, a *communal activity in which learners come together to pose questions, posit theories, and to revisit, negotiate, and refine ideas.*

- Knowledge Building Discourse “serves to identify shared problems and gaps in understanding and to advance understanding *beyond the level of most knowledgeable individual*.” (Scardamalia, 2012, p.12).
Governments and International Organizations Everywhere Calling for Innovation

The Organization for Economic Co-operation and Development (OECD) has started referring to contemporary societies as “innovation-driven.”

...new ideas are essential to the development of human capital and are key engines of economic growth, drivers of market productivity, and sources of cohesion for all nations... 
(G8summit, 2006)
Innovation is not just about new ways to make money

Innovation is needed for economic progress, but...

• The need for new knowledge, new solutions, extends well beyond the economic sphere and is needed to deal with urgent and increasingly complex problems of health, environment, resources, crime, corruption, and oppression (Homer-Dixon 2000, 2006).

• One of the most pressing needs is for knowledge of how to deal with complexity itself.
How Can Schools Increase People’s Ability to Create Knowledge?

- A mid-20th century answer: Develop skills, personal characteristics, habits of mind, and attitudes conducive to knowledge creation.

- There are no tested or even very plausible ways of achieving these objectives.

- The Knowledge Building alternative: Learn to create knowledge by actually doing it.

- This requires finding ways to support novices in carrying out knowledge creation.
Knowledge Building

- can be described as a capacity for “productive work that advances the frontiers of knowledge as these are perceived by the community” (Bereiter & Scardamalia, 2003).
Knowledge Building

12 Foundational Principles

- Collective cognitive responsibility
- Epistemic agency
- Real ideas, authentic problems
- Democratizing knowledge
- Symmetrical knowledge advancement
- Improvable ideas
- Idea diversity
- Rise-above
- Pervasive Knowledge Building
- Knowledge Building Discourse
- Constructive use of authoritative sources
- Concurrent, transformative and embedded assessments

6 central themes

- Knowledge advancement as community rather than individual achievement
- Knowledge advancement as idea improvement rather than acceptance or rejection of ideas
- Knowledge of in contrast to knowledge about
- Discourse as collaborative problem solving rather than argumentation
- Constructive use of authoritative sources
- Knowledge as emergent

Fullan’s 6 C’s

- Communication
- Collaboration
- Critical Thinking
- Creativity
- Citizenship
- Character Education

Partnership for 21st Century Skills Framework
Knowledge building represents an attempt to refashion education in a fundamental way, so that it becomes a coherent effort to initiate students into a knowledge creating culture. Accordingly, it involves students not only developing knowledge building competencies but also students coming to see themselves and their work as part of the civilization-wide effort to advance knowledge frontiers.
Education in its largest sense means initiating students into the world-wide knowledge-creating culture.

This is neither cultural transmission nor importing of a foreign culture. It is more like cultural nurturance.

Culturally Sensitive Innovation
Increase societal capacity for the creation of new knowledge, new solutions, and needed advances.

**Developing citizens who:**

- are socialized into a world-wide knowledge-creating culture
- develop multiple ways of contributing to innovation
- are well grounded in science and humanities and appreciate their role in a progressive society
- are intellectually engaged in their own educational development
- thrive on complexity and idea diversity

**Knowledge Creation**

**Knowledge Building**
<table>
<thead>
<tr>
<th>Shallow Constructivism</th>
<th>Deep Constructivism</th>
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<tbody>
<tr>
<td><strong>Collaborative Learning --&gt; Community Knowledge</strong></td>
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<tr>
<td>COLLABORATIVE LEARNING</td>
<td>COMMUNITY KNOWLEDGE, COLLECTIVE RESPONSIBILITY</td>
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<tr>
<td><strong>Differential Participation --&gt; Equitable Participation in Knowledge Work</strong></td>
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<tr>
<td>INDIVIDUAL DIFFERENCES</td>
<td>DEMOCRATIZING KNOWLEDGE</td>
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<tr>
<td><strong>Authenticity: Teacher --&gt; Student Point of View</strong></td>
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<tr>
<td>MEANINGFUL ACTIVITIES</td>
<td>REAL IDEAS, AUTHENTIC PROBLEMS</td>
</tr>
<tr>
<td><strong>Canonical Knowledge --&gt; New Knowledge</strong></td>
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<tr>
<td>CURRICULUM</td>
<td>IDEA DIVERSITY</td>
</tr>
<tr>
<td><strong>Belief Mode/Right-Wrong --&gt; Design Mode/Continual Improvement</strong></td>
<td></td>
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<tr>
<td>INQUIRY: QUESTION-ANSWER</td>
<td>IMPROVABLE IDEAS</td>
</tr>
<tr>
<td><strong>Comprehending/Finding Answers --&gt; Advancing the State of Knowledge</strong></td>
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<tr>
<td>UNDERSTANDING GIVEN INFORMATION</td>
<td>CONSTRUCTIVE USES OF AUTHORITATIVES SOURCES</td>
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### Knowledge Building Discourse

- **Self-Regulation/Student Choice --> Taking Charge at the Highest Level**
  - **STUDENT INPUT/CHOICE**
  - **EPISTEMIC AGENCY**

- **Truth --> Ever-Advancing Understanding**
  - **DISCIPLINED DISCOURSE**
  - **KNOWLEDGE BUILDING DISCOURSE**

- **Best Practice --> Beyond Best Practice**
  - **CONSENSUS**
  - **RISE ABOVE**

- **Guided Discovery --> Knowledge Creation**
  - **HIGHER-ORDER THINKING**
  - **PERVASIVE KNOWLEDGE BUILDING**

- **Externally Defined Benchmarks --> Self Organization**
  - **STANDARDS**
  - **CONCURRENT, EMBEDDED AND TRANSFORMATIVE ASSESSMENT**

- **Local Community --> Global Community**
  - **HIGH-PERFORMING CLASSES**
  - **SYMMETRIC KNOWLEDGE ADVANCEMENT**

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*Distinguishing Knowledge Building from Learning: Accessible at:
http://ikit.org/fulltext/AnnBrownOct10.06.pdf*

Beyond Inquiry: Education for Innovation

With most inquiry approaches, responsibility for idea improvement remains with the teacher or curriculum or educational technology designer.
Knowledge Building: What is Different?

CASE STUDY: Exploring light

Knowledge Building using Knowledge Forum

Inquiry-Based Learning using Web-Based Inquiry for Science (WISE) platform
The Web-based Inquiry Science Environment (WISE): An Introduction
Two Effective Models of Science Education: WISE Compared to Knowledge Building

- WISE (Web-Based Inquiry Science Environment) project provides well-designed examples.
- From the WISE homepage: “WISE is a simple yet powerful learning environment where students examine real world evidence and analyze current scientific controversies.”
- Some WISE projects engage students in developing and improving their own explanations of natural phenomena, but others center on debate and do not involve students’ own ideas.
A WISE Inquiry Project on Light

- Two hypotheses about light are presented:
  - Light goes on forever until it is absorbed
  - Light dies out as it gets farther from the source

- Many different kinds of evidence--visual, verbal, and qualitative--are presented

- It is up to the students to evaluate the evidence in order to decide between hypotheses.
Bicyclists at Night

Rider wearing white is more visible than rider wearing black
Searchlight Photo

Showing high light intensity at source, becoming less as it goes farther away.
Galaxies in the Young Universe
Ordinary camera on left, Hubble photo on right, enlargement in corner
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
<tr>
<td>1</td>
<td>Light intensity measured at increasing distances from light source.</td>
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<tr>
<td>2</td>
<td>Light source is flashlight with and without a mirrored reflector.</td>
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<td>7</td>
<td>Intensity</td>
<td>Intensity</td>
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<tr>
<td>8</td>
<td>Distance</td>
<td>No Reflector</td>
<td>With Reflector</td>
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<td>9</td>
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<td>410.3</td>
<td>531.4</td>
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<td>347.1</td>
<td>550.0</td>
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<tr>
<td>12</td>
<td>10.0</td>
<td>227.4</td>
<td>359.1</td>
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<td>15.0</td>
<td>146.1</td>
<td>239.1</td>
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<td>14</td>
<td>20.0</td>
<td>111.6</td>
<td>180.4</td>
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<tr>
<td>15</td>
<td>25.0</td>
<td>87.1</td>
<td>158.0</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>30.0</td>
<td>69.7</td>
<td>124.4</td>
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</table>
Flashlight Intensity Over Distance
(with and without mirrored reflector)
Debating Two Hypotheses About Light

Student Activities

- Students examine each piece of evidence with regard to relevance, methods, and credibility of the source.

- Sort evidence into 3 categories: supporting “Light Goes on Forever,” supporting “Light Dies Out,” and “irrelevant.”

- Debate. Teams select the strongest evidence supporting their hypothesis, and also select counter-evidence for which they prepare replies.
Debating Two Hypotheses About Light: A Critique

- Students draw their own conclusions from evidence.
- They process much interesting scientific information.
- But fundamental questions are glossed over:

  - What is light?
  - How do we see?
  - What happens to light when it is absorbed?
  - What causes light?
The Most Serious Weakness of Project-Based Inquiry:
No Insight into How Scientific Ideas, Hypotheses, and Theories are Created

- How did anyone get the idea that “Light goes on forever”?
- Could any evidence actually prove that light goes on forever unless it is absorbed?
- Then why do most scientists believe it?
- Answer: They don’t believe it as an isolated hypothesis. They have confidence in a theory that implies light goes on forever unless it is absorbed.
Science Learning through Knowledge Building

Example from a Grade 4 Knowledge Building Classroom

Part of a long, student-directed inquiry into questions about light
Knowledge Forum (KF) provides a community workspace to support *Community Knowledge, Collective Responsibility*
Knowledge Forum Interface

- Note
- View
- Picture
- Movie
- Sound
- Paint
- Attach
- Promising Idea
- Analytic Toolkit

Related Views
- Local Community
- Extended Community
- World Community

New Note - pz

- Gr 2 Set
  - My theory
  - I need to understand
  - Important information + source
- We need an experiment to
- The evidence shows that
- This theory could be improved by
- A useful analogy
- A promising idea
- Our improved theory

Add

Annotate
Close
Successful knowledge-building discourse depends on authentic problems—things the students actually wonder about.

- What is light? It’s not animal or vegetable or mineral, so what is it?
- Can light bend?
- How does light travel?
- What are rainbows made out of?
Research Results: Span Basics + 21st Century Competencies

- Standardized test scores in reading comprehension, vocabulary, and spelling
- Ability to read difficult texts
- Quality of questions and comments
- Depth of explanation
- Graphical literacy
- Conceptual change
- Math problem solving
- Portfolio commentaries
- Collaborative processes
- Inquiry processes
- Results beyond grade-level expectations
- Emergence of new competencies
How does light travel?
What makes a rainbow?
Continually “Rising-Above”

Enabled through enactment and nurturance of a Knowledge Creating Culture
Early primary Knowledge Building teachers discuss their practice

- Zoey Donahue – Grade 1 teacher at the Dr. Eric Jackman Institute for Child Studies (EJICS) at the University of Toronto

- Carol Stephenson – Senior Kindergarten teacher at the Dr. Eric Jackman Institute for Child Studies

- FULL VIDEO AVAILABLE AT:
  http://ikit.org/kb_resources/?p=1093
Next Steps: Innovation, Idea Improvement, “Rise Above”

• Producing new ideas is easy (at least for children); improving ideas is hard. **We need to make the process more intellectually engaging over longer spans of time and for a broader range of students**

• “Rise-above” requires creation of a new, higher order knowledge object. **We need to make advances—as well as plateaus and dead ends—more evident to all**

• Significant innovation requires **sustained** creative work with ideas. **We need greater support for pervasive knowledge building**
Making Connections Across Communities

Rise Above and Connectedness Across Multi-Level Knowledge Building Communities
Reach Every Student

Our Goals:

✓ High levels of student achievement

✓ Reduced gaps in student achievement

✓ Increased public confidence in education
<table>
<thead>
<tr>
<th>Improvement Journey</th>
<th>Poor to Fair</th>
<th>Fair to Good</th>
<th>Good to Great</th>
<th>Great to Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theme</strong></td>
<td>Achieving the basics of literacy and numeracy</td>
<td>Getting the foundations in place</td>
<td>Shaping the professional</td>
<td>Improving through peers and innovation</td>
</tr>
</tbody>
</table>
| **Intervention cluster** | - Providing motivation and scaffolding for low skill teachers  
  - Scripted teaching materials  
  - Coaching on curriculum  
  - Instructional time on task  
  - School visits by center  
  - Incentives for high performance | - Data and accountability foundation  
  - Transparency to schools and/or public on school performance  
  - School Inspections and Inspection Institutions | - Raising calibre of entering teachers and principals  
  - Recruiting programs  
  - Pre-service training  
  - Certification requirements | - Cultivating peer-led learning for teachers and principals  
  - Collaborative practice  
  - Decentralizing pedagogical rights to schools and teachers  
  - Rotation and secondment programs |
|                     | - Getting all schools to a minimum quality level  
  - Outcome targets  
  - Additional support for low performing schools  
  - School Infrastructure Improvement  
  - Provision of textbooks | - Financial and organizational foundation  
  - Optimization of school and teacher volumes  
  - Decentralizing financial and administrative rights  
  - Increasing funding  
  - Funding allocation model  
  - Organizational redesign | - Raising calibre of existing teachers and principals  
  - In-service training programs  
  - Coaching on practice  
  - Career tracks  
  - Teacher and community forums | - Creating additional support mechanisms for professionals |
|                     | - Getting Students in seats  
  - Expand school seats  
  - Fulfill students’ basic needs to raise attendance | - Pedagogical foundation  
  - School model/streaming  
  - Language of instruction | - School-based decision-making  
  - Self-evaluation  
  - Independent and specialized schools | - Release professionals from admin burden by providing additional administrative staff |
|                     | - System-sponsored experimentation/innovation across schools  
  - Providing additional funding for innovation  
  - Sharing innovation from front-line to all schools | | | |

Establish Knowledge Building Discourse as a New Norm

This requires connected knowledge building communities—policy makers, teachers, students...all taking responsibility for educational breakthroughs
Establish Knowledge Building Discourse as a New Norm

- **PARTNERSHIPS FOR EXTENDING THE POSSIBLE IN EDUCATION**
  - Networking of innovators at all levels
    - Technology to support sustained creative work with ideas and to provide a scalable, cross-sector architecture to "rise above" isolated fragments and cluster to powerful ideas
  - Professional learning and certification
    - Teachers and students taking knowledge building and learning with engagement and understanding to new heights

- **HUBS OF INNOVATION**
  - Advanced knowledge building technology
    - World-wide quantitative and qualitative data banks for sharing practices, products, and results and enabling a research-intensive enterprise data guideline for thesis research
  - Embedded assessments usable by students as well as teachers
    - Instant individual and group feedback to boost knowledge building and learning
  - Knowledge building data exchange and research-based demonstrations of advances
    - Coherent framework and inclusive design for media and resources to support knowledge building

- **COMPREHENSIVE, SUSTAINABLE SOLUTIONS**
  - Open and free resources for an idea-centered curriculum
    - Courses, workshops, and mentoring—on site and online: we succeed when all succeed
Culture of Collaborative Inquiry

“Inside out” learning – looking deeply into the instructional core, developing theories of action to guide our work

Evidence-based - student work as a source of information about effective strategies for teaching, leading and learning

Collaborative and Competency-based – professionals working together to uncover, articulate, develop and share current best thinking

Deeper implementation - based on thoughtful analysis of evidence from practice and achievement indicators

Adaptive work – building our collective professional capacity (knowledge and practice) to reach every student
School/Classroom Leadership

Task Predicts Performance

Features of effective learning tasks:
• They require and instil deep thinking.
• They immerse the student in disciplinary inquiry.
• They are connected to the world outside the classroom.
• They have intellectual rigour.
• They involve substantive conversation.

References:

• Bereiter, Carl (1994) 'Implications of postmodernism for science, or, science as progressive discourse', Educational Psychologist, 29: 1, 3 — 12


