What Should Students Learn in the 21st Century?

Riel Miller
Sense making & making sense – variables, metrics and models

“We are in one of those eras when, with our certainties shattered and our traditional ways of thinking shown to be impotent, everything has to be rebuilt and reinvented. We are in an era when the central question for politics is what model of development, what model of society and civilization, we aspire to live under and bequeath to our children.”

Nicolas Sarkozy, President, France

“In an increasingly performance-oriented society, metrics matter. What we measure affects what we do. If we have the wrong metrics we will strive for the wrong things. In the quest to increase GDP, we may end up with a society in which citizens are worse off.”

Stiglitz, Sen, Fitoussi, Mis-measuring Our Lives
Thinking Deeper Research Paper No.1 - Parts 1 & 2

Thinking Strategically About Education and Technology: Making Learning Happen Today for Tomorrow’s World

Authors: Riel Miller¹, Janet Looney² and Jim Wynn³
Date: December, 2010
Sponsored by: Promethean Education Strategy Group
Thinking Deeper Research Paper No.1 - Part 3
Making it Happen: Formative Assessment and Educational Technologies

Author: Janet Looney
Date: December, 2010
Sponsored by: Promethean Education Strategy Group
Second Round of Thinking Deeper Papers

Learning Productivity: It is time for a breakthrough?
Stefan Bergheim, Riel Miller, Ilkka Tuomi

Assessment Competency: Knowing What You Know and Learning Analytics
Janet Looney, George Siemens
Substitution
Convergence: Catch-up with the leader

[Vivid chart showing the income per person (fixed PPP$) for different countries over time, illustrating the concept of economic convergence.]
Leap-frog: From behind to being ahead

Leap-frog to where?
What is the Question?
Thinking about systemic change

<table>
<thead>
<tr>
<th>Change within the system</th>
<th>Change outside the system</th>
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<td>Inside-in</td>
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<td>Outside-in</td>
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Systemic Emergence

Novelty is not exponential. The challenge is to make sense of novelty – playing with emergence
“It seems inescapable that there are limits to the predictive power of the laws of physics. The world appears to be complex. But the basic laws that govern the regularities of the world must be simple to be discoverable, comprehensible, and effectively applicable…. However, there is no evidence that our universe is so regular. Even the most deterministic classical theories did not claim this. They claimed only to predict future evolution when given initial conditions. Not everything that can be observed can be predicted — only the regularities in those observations are the province of science. The regularities of the universe are limited and therefore there are limits to the predictive power of physics. This kind of limit is therefore not a failure of the scientific enterprise. Limits are inherent to that enterprise, and their demarcation is an important scientific question.”

James B. Hartle, Sources of Predictability, University of California, Santa Barbara, 2008
What is the Future?

... we are now able to include probabilities in the formulation of the basic laws of physics. Once this is done, Newtonian determinism fails, the future is no longer determined by the present.  

Mankind is at a turning point, the beginning of a new rationality in which science is no longer identified with certitude and probability with ignorance. ... science is no longer limited to idealized and simplified situations but reflects the complexity of the real world, a science that views us and our creativity as part of a fundamental trend present at all levels of nature.

What difference does it make?

Why bother?

• It changes what we see.
• It changes what we imagine.
• It changes what we resist.
• It changes what we preserve.
• It changes how we preserve what we want to preserve.
• It changes the conditions of change.
The possible is not in the future it is in the past.

“We must resign ourselves to the inevitable: it is the real which makes itself possible, and not the possible which becomes real. But the truth is that philosophy has never frankly admitted this continuous creation of unforeseeable novelty.”

Henri Bergson, The Creative Mind
Caught in the Probabilistic Stance: Probable, Possible, Plausible, Desirable

Figure 1 – The Cone of Plausibility-Probability

The Future is many not one

Source: Bishop, 2007
Then what?

If we accept this starting point – the future does not exist but can “be” – how do we make it actionable?
What is Futures Literacy?
Futures Literacy is the capacity to tell anticipatory stories using rigorous imagining based on sharing depth of knowledge from across the community.
Futures Literacy is a way of internalizing the constant development of our understanding of the emergent present and of changing anticipatory assumptions.
Futures Literacy is:

Three basic building blocks:

A. Anticipatory systems perspective that encompasses both animate and inanimate anticipation.

B. Three distinct ontological dimensions for imagining the future and the different methods that are related to each.

C. Hybrid Strategic Scenario Method: A learning process that uses collective intelligence – action research processes for reframing and questioning anticipatory assumptions – building the capacity to embrace complexity, spontaneity, improvisation.
Step A: Bugs Bunny Anticipates
Taking an Anticipatory Systems View

\[
S : \text{ object system}
\]

\[
M : \text{ model of } S
\]

\[
E : \text{ effector system}
\]


Slide by A. H. Louie, Mathematical Biologist
Step B: Distinguishing three dimensions of the potential of the present
Contingency futures: a tsunami

THE DAY AFTER TOMORROW
WHERE WILL YOU BE?

IN THEATERS WORLDWIDE MAY 28, 2004
Contingency futures: winning the lottery
How does the contingency AS function? Simulation
Optimization Futures:
Chess, Farming, Assembly Line

- **Goal**, known in advance & fixed
- **Rules**, given in advance & fixed
- **Resources**, given in advance & fixed
Optimization is Complicated: A Computer Can Do It

May 11th, 1997

Computer won world champion of chess
(Deep Blue)  (Garry Kasparov)

(Reuters = Kyodo News)
Embracing complexity: use the future, imagining the potential of the present
Step C: Rigorous Imagining

Hybrid Strategic Scenario Method: Rich stories as a way to question assumptions
Futures Literacy
Using the future for knowledge creation and capacity building
Hybrid Strategic Scenarios

• Level 1 futures literacy
  – Temporal awareness, values, expectations

• Level 2 futures literacy
  – Rigorous imagining

• Level 3 futures literacy
  – Strategic scenarios
The Industrial Revolution: An Example

Ford
THE UNIVERSAL CAR

Buy It Because
It’s a Better Car

Model T
Touring Car
L.t.d. Ford,
Ontario

$650

Get particulars from Ford Motor Co. of Canada, Ltd. Ford, Ont.
“Because productivity determines how well we live, Americans want to know how they're doing. ... it's a Herculean task to calculate a productivity number that sums up the efforts of 130 million workers, employed in millions of establishments that produce more than $11 trillion in output. The Bureau of Labor Statistics does the best it can in producing quarterly estimates of output per hour, derived largely from surveys of businesses. BLS data show that U.S. productivity has grown steadily over the long haul, with output per hour rising an average 2.3 percent annually since 1870.”

Federal Reserve Bank of Dallas, 2003
Productivity Growth US

• GDP largely measures monetized market production, but what is counted and what is part of a market changes over time. Accounting is a convention. Markets are the quintessential outcome of platforms.

• The point of this second round of Thinking Deeper papers was to pose some new questions about the categories, the meaning of the categories and the way of generating data to make categories work.

• This demands that we open up the questions of purpose and the systems that are related to those purposes.
“The core argument is that a leap in learning productivity throughout society, in schools, universities, workplaces, communities, and families, is possible if we understand and act on two fundamental changes taking place in the world today.

- The first change is the growing importance of what might be called ‘open learning’ for economic, social and governance activities.
- The second is that the methods for understanding and acting on the potential for productivity improvements both within and between open and closed learning systems is improving.”


Riel Miller 2012
All encompassing definitions of learning and learning as value creation

• Learning is any process that enables a change in a person’s capacity to understand themselves and act in the world around them.

• Value is context specific but is rooted in different forms of utility – usefulness in the eye-of-the beholder at a particular moment and place. So ‘tradability’ is not inherent to ‘value creation’ but accounting and signaling do depend on systems for shared sense making – like ownership, markets and money (transparency and trust).

• Learning is a value creating process – hierarchical and heterarchical – externally and internally “valued”.
“The Fundamental Processes of Learning”

Knud Illeris, 2009
Learning as production of knowledge

Source: Etienne Wegner

Riel Miller 2012
Figure 1: Dewey cycle of learning.

1. interruption in routine action
2. problem definition and conceptualization
3. definition of a working hypothesis
4. inference and thought experiment
5. experimental action

idea, concept

problem solving, return to routine
Learning as production and value creation – stock, flow & transactions

Knowledge as a stock of value

Learning as a flow of value creation

Tradable knowledge

Non-tradable knowledge

Riel Miller 2012
Learning in every day life is more intense if, in daily life, more:

- know-how
- know-who
- know-what
- know-why
Average Learning Intensity of Daily Life

Average intensity of know-how

Average intensity of know-what

Average intensity of know-who

Average intensity of know-why (decision making capacity)

Agricultural Society | Industrial Society | Learning Society

Source: Riel Miller, XperidoX Futures Consulting; rielm@yahoo.com

Riel Miller 2012
Compositional Transformation

Share of total wealth creation by source

Agriculture

Social Identity

Craft/Creative

Industrial (goods & services, public & private)

Agricultural Society | Industrial Information | Learning Intensive

Riel Miller 2012
Systemic Economic Transformation: Changes What and How We Produce

- Unique creation dominates
- Organization is fluid and open

“Next stage” of market economy – beyond mass-production and mass-consumption
Creating wealth – changing sources

Beyond the dualism of supply & demand
Industrial Era Logic
Sequential Production
Resource (Re)Allocation
Unique creation

Refinement of taste - choice

Experience and identity

Networked - just-in-time DIY
Clouds of value creation:
Transforming the organizational foundations
Murmuration

Starlings Flying in a Flock
Imagine Clouds of Unique Creation
Flows of Collaboration and Experience
Local and Global, Multiple Dynamic Communities - Heterarchical
Identity & choice

Heterogeneous/small Scale of social affiliation/identity Homogeneous /large

Learning Intensive Society

Less choice Decisions - what, where, when, with whom, how More choice

Beyond individual vs collective: banal creativity

Riel Miller 2012
Governance: capacity to make decisions

Capacity for reframing and sense making: spontaneity

Riel Miller 2012
Imagining the Scale of Change: Frame a Picture

- **Wealth, rules, governance, values**
  - Physical/financial vs human capital
  - Simple vs complex property rights
  - Ex-ante vs real-time allocation of power
  - Shared values as basis for transaction trust (Universal Declaration of Human Rights)

- **Quality of life**
  - Mass production vs production for self/community
  - Life organized for work vs work organized for life
  - Hierarchy vs autonomy
  - Imposed identity vs self-generated identity
  - Sen’s definition of “freedom”
21st Century Transitions: Synergy Conditions and the Policy Challenge

- Ease of use
- Range of uses
- Technological dynamism
- Task unpredictability & predictability
- Economic dynamism
- Autonomy
- Extent of choices
- Social dynamism
- Transparency & access to information
- Dynamic governance
- Experimentation & reflection

Heterogeneity & smaller scale of affiliation

— Mass-era — Learning society
Expanding the number of university graduates does not increase wealth nor lead to "greater competitive" advantage.

**Systemic Change**

(changes in the conditions of change)

**Challenge**

Anticipatory Assumptions:

A. The preponderant source of wealth is no longer industrial (tangible or intangible).

B. The primary source of productivity increases is learning by doing, i.e. experience that allows for refinement of taste (self-knowledge).

C. Unique creation is local, ideas are global and tangibles are cheap.
Experimentalism not administration

Decision making in the face of complexity, learning by doing, self-organising systems, evolutionary emergence are all processes that entail “error”, administration in both public and private sectors punishes error
The wealthiest societies have the highest average age

The productivity of unique creation and the quality of decision making capacity both increase, with experience and better information – this is the wisdom economy – the know why society.
Education and Economic Growth:
From the 19th to the 21st Century

Executive Summary
The research summarized in this article shows that schooling is necessary for industrial
development. The form of schooling that emerged in the 19th century generates specific

cognitive, behavioral and social knowledge that are critical ingredients for the way industrial
societies organize:

- production and consumption
- daily life in cities and nations
- the size and fitness of the population for work
- the creation and use of knowledge.

Therefore, it is documented that:

- Schooling is a necessary but not sufficient condition for the spectacular feats of industrial
development in the 20th century.
- The intricacy of the relationship between schooling and the industrial form of economic
growth is confirmed by the technical economics literature.
- Economists have demonstrated that both individuals and societies gain from the investments
made in schooling.
Industrial society requires:

- most people speak and read a common language (labor market, transaction space);
- the majority of people are punctual (on-time) and respect authority (obedient) – “factory”;
- people find it routine to cooperate with strangers at work and in their local community – urban;
- adults can participate in the labor force without putting their children at risk and children do not compete with their parents in the labor market.
Functions of the industrial school

- **Custody**: keeping pupils safe and secure (99.9%)
- **Behavioural rules**: instilling punctuality, obedience, respect for hierarchy (95%)
- **Cognitive development**: literacy, numeracy, test scores (?)
- **Socialisation**: internalisation of specific values towards civic life (?)
- **Screening and sorting**: reproduces (legitimately) socio-economic differences (95%)
Decline of the school, ascendance of learning

- The role of the industrial era school is no longer constructive, it is destructive of an emergent post-industrial society, it is time to unbundle its functions of custody, behaviour, cognitive development, socialization, social screening

- The new institutions of a learning society are emergent, but the collective enabling choices (platforms) have yet to be made – it will require a struggle to develop new systems of trust, transparency, transactions.
Discovering emergent conditions for change – the collective ‘platforms’

• Banking: Life-logging (a record of what you have done that demonstrates competences, including learning from failure and third party assessments) is owned and controlled by each person. Everyone has their own “cyber-citizen” of planet earth life-log as a basic right (supplied in different ways in different places but assured as a public good for everyone). This is the record of what they know based on what they have done – it goes into their “knowbank”.

• Currency (assessment-evaluation): Open and “folksonomic” sense-making communities are facilitated by search tools that provide trustworthy (not only advertising funded) meaning equivalences to specific skills, knowledge, relationships. Such ‘analytical’ tools enable an improvement of the data, learning to evaluate, this makes it relatively inexpensive to question and redefine the equivalences and relationships that give meaning to what people know.
Transformation

“Society is now at a stage in history in which one pulse is ending and another beginning. The immense destruction that a new pulse signals is both frightening and creative. It raises fundamental questions about transformation. The only way to approach such a period, in which uncertainty is very large and one cannot predict what the future holds, is not to predict, but to experiment and act inventively and exuberantly via diverse adventures in living.”

C.S. “Buzz” Hollings, “Coping with Transformational Change”, Options, IIASA, Summer 2010
How we anticipate matters it changes the present.

Thank you
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