Expanding the Mindset

What is engineering?

Narrow Definition

- People
- Problem
- Concept
- Specifications
- Design
- Prototype
- Product
- Market

User-Oriented Design

Design Nature

Modeling Compartment Systems

Fundamentals of Entrepreneurship

Franklin W. Olin College of Engineering

Courtesy of Olin President Richard Miller

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Monday January 16

• 8:00 – 10:00 am: aggregate, breakfast, review questions (amend as needed), discuss how to proceed (all) based on Charles’s proposed template (co-design template and fill it)

• During Lunch: feedback on the CCR timeline and strategy

• All day: small group work and presentations sharing insights (all)
  – Synthesizing the views
  – Answering the questions
  – Asking the next questions and defining the next steps

• End time: 4:00 pm to allow for plane-catching.
CCR Mindset

Logic AND Emotion

head hand heart

Knowledge AND Skills AND Character

Inspired by an inscription used by Charles Voysey, Britain 1896
Leadership lessons from the dancing guy
Key questions to explore

1. What are the consequences of a VUCA world?

2. Are we factoring in technology’s growth sufficiently? Can we reasonably predict significant inflection points in ICT, Biotech, and Energy – and their impact?

3. What are the demands created by 1) and 2) on education systems?

4. Can they adapt fast enough? (if not, what is the hedge? can we harness/blend informal systems?)

What should be the key tenets of a 21st century curriculum?
Ancient Wisdom

Confucius (~551-479 BC):
“I hear and I forget, I see
and I remember, I do
and I understand”

Socrates (~469– 399 BC):
“Education is the kindling
of a flame, not the
filling of a vessel”

Michel de Montaigne
(1533-1592 AD):
“rather a mind shaped
than a head full”
Curriculum has evolved slowly

Greek, Latin

Reading, Writing

Literature

Oratory

Rhetoric

Grammar, Handwriting, Spelling

Music

Art

Philosophy & Ethics

History

Arithmetic

Geometry

Astronomy

Algebra, Trigonometry, Calculus

Biology, Chemistry, Physics

Contemporary Languages incl. 2nd language

Ancient Greece & Rome

Early Christianity & Middle Ages

Renaissance & Enlightenment

Modern Industrial Era

Today

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This is not a new debate

British Grammar School Subjects c. 1800
- Latin
- Greek
- English*
- Reading*
- Writing*
- Arithmetic*

Benjamin Franklin’s Philadelphia Academy Subjects
- French
- German
- Spanish
- Handwriting
- Bookkeeping
- Drawing
- Geometry
- Astronomy
- Geography
- Rhetoric
- Oratory
- Morality
- Natural Philosophy
- History
- Natural History
- Mechanics
- Gardening

* usually optional
More recently

Spencer (1911, UK): The (Seven) Cardinal Principles:

- Health
- Fundamental processes
- Worthy home membership
- Vocational efficiency
- Civic participation
- Worthy use of leisure time
- Ethical behavior

Victorian
More recently (2)

Dewey:
• Experiential education
• Self-directed learning
• Group & social learning
• Inquiry
• Growth & adaptability
• Citizens in society

Pedagogical

Toffler (1970’s):
• Learn how to Choose
• Learn how to Relate
• Learn how to Learn

Meta
Even more recently
Commonality of Concepts

Gardner:
- Disciplined
- Synthesizing
- Creating
- Respectful
- Ethical

Sternberg:
- Practical
- Analytical
- Creative
- Wise

Morin:
- Pertinence in knowledge
- Confronting uncertainties
- Detecting errors
- Understanding each other
- Teaching the human condition
- Ethics for humanity

Psychological
Yet more

Schank: An educated mind can: (paraphrased)

• Generalize reasonably
• Determine connections
• Spot analogies
• Predict outcomes
• Deal with abstraction
• Be self-aware
• Learn from failure
• Recover from failure
• Handle exceptions
• Absorb newness
• Seek explanations
Yet more (2)

Homer-Dixon: Four Conceptual shifts for Prospective Mind

- Systems: From mechanical to complex
- Self: From consumer to problem solver
- Knowledge: From specialized to integrated
- Values: From utilitarian to moral and existential
The OECD’s View

1. The great collaborators and orchestrators
2. The great synthesizers
3. The great explainers
4. The great versatilists
5. The great personalizers
6. The great localizers

7. To which I add: The great innovators

Source: Andreas Schleicher

Skills
## 21st Century Skills Framework

### Core Subjects
- Native Language/Reading
- World Language(s) incl. English
- Arts
- Geography
- History
- Mathematics
- Science
- Government/Civics

### 21st Century Themes
- Global Awareness
- Financial, Economic, Business and Entrepreneurial literacy
- Civic Literacy
- Health Literacy
- Environmental Literacy

Policy
21st Century Skills Framework

Learning & Innovation Skills
• Critical Thinking & Problem Solving
• Creativity & Innovation
• Communication & Collaboration

Information, Media & Technology Skills
• Information Literacy
• Media Literacy
• ICT (Information, Communications & Technology) Literacy

Life & Career Skills
• Flexibility & Adaptability
• Initiative & Self-Direction
• Social & Cross-Cultural Skills
• Productivity & Accountability
• Leadership & Responsibility
Relevance is a choice

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“Numbers and probability provide the basis for statistics, which, together with Logic, constitute the foundation of the Scientific Method”

John Allen Paulos
Example: Ancient Greece
Ratio of Subjects – OECD Average

What should be the ratios?
STEM Education – OECD average

Why so little Technology? (and so much about volcanoes?)
Why is Engineering only a College discipline?
If we need more:

Statistics & Probabilities
   For multiple fields (i.e. business, social sciences)

Art
   For creativity, expression, multimodality

Music
   For memory, brain agility, creativity

*What do we remove?*
What else is needed?

Psychology/Sociology/Anthropology?
Personal Finance/Economics?
Entrepreneurship?
Engineering? Robotics? Programming?
Recreational Maths in lower grades?
Linguistics?
Mythology? Philosophy?
Woodworking? Gardening?
Career management?
Resourcefulness?
Project management?

Etc.
Invariance vs inertia

Today’s task:

1. Document the concerns of the end-users (to be defined) and Pareto them; identify root causes; identify possible mechanisms to address
2. What should be the key tenets of a 21st century curriculum?
3. Devise a documented, global model (completion, ontologic and taxonomic robustness to be iterated upon later)