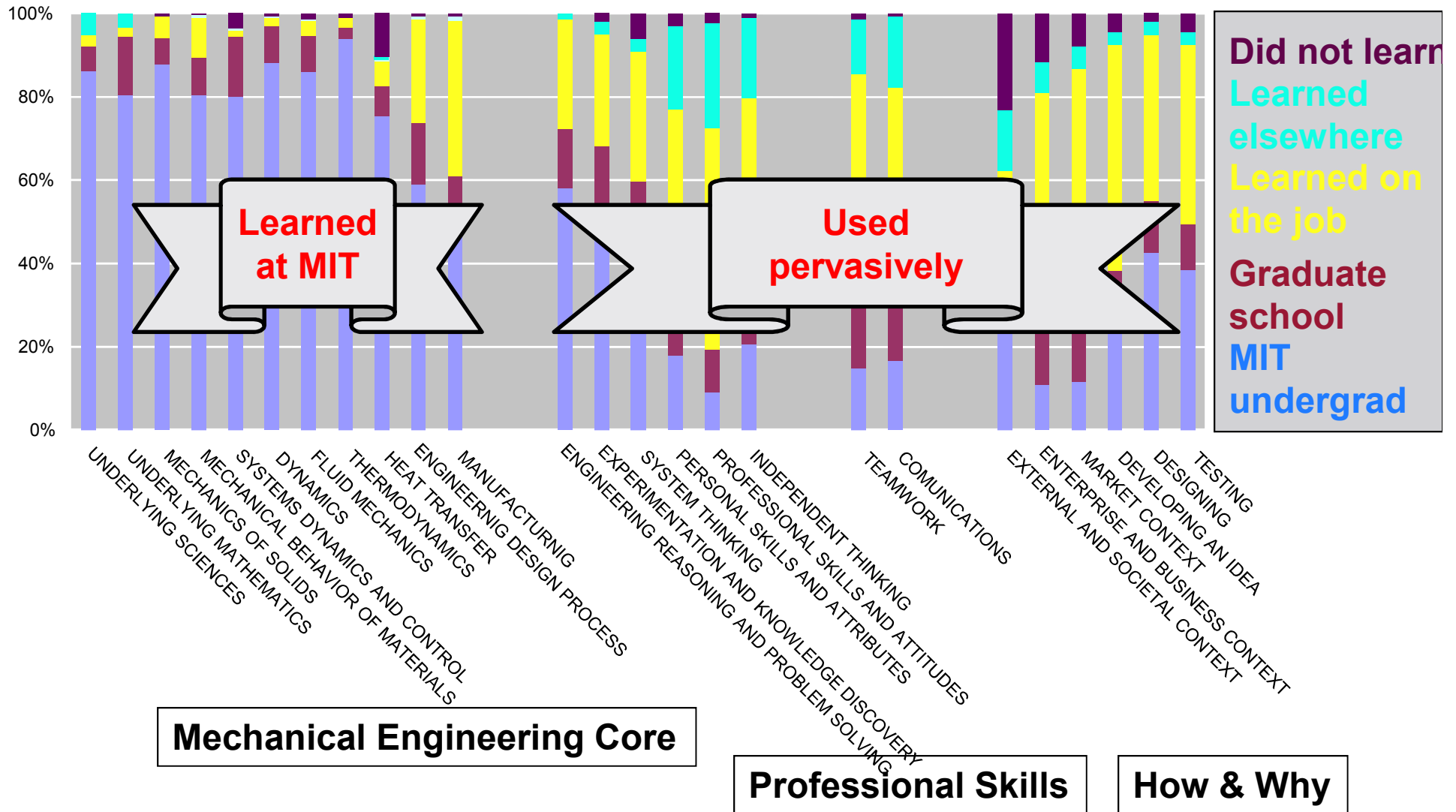


# So Let's Caucus



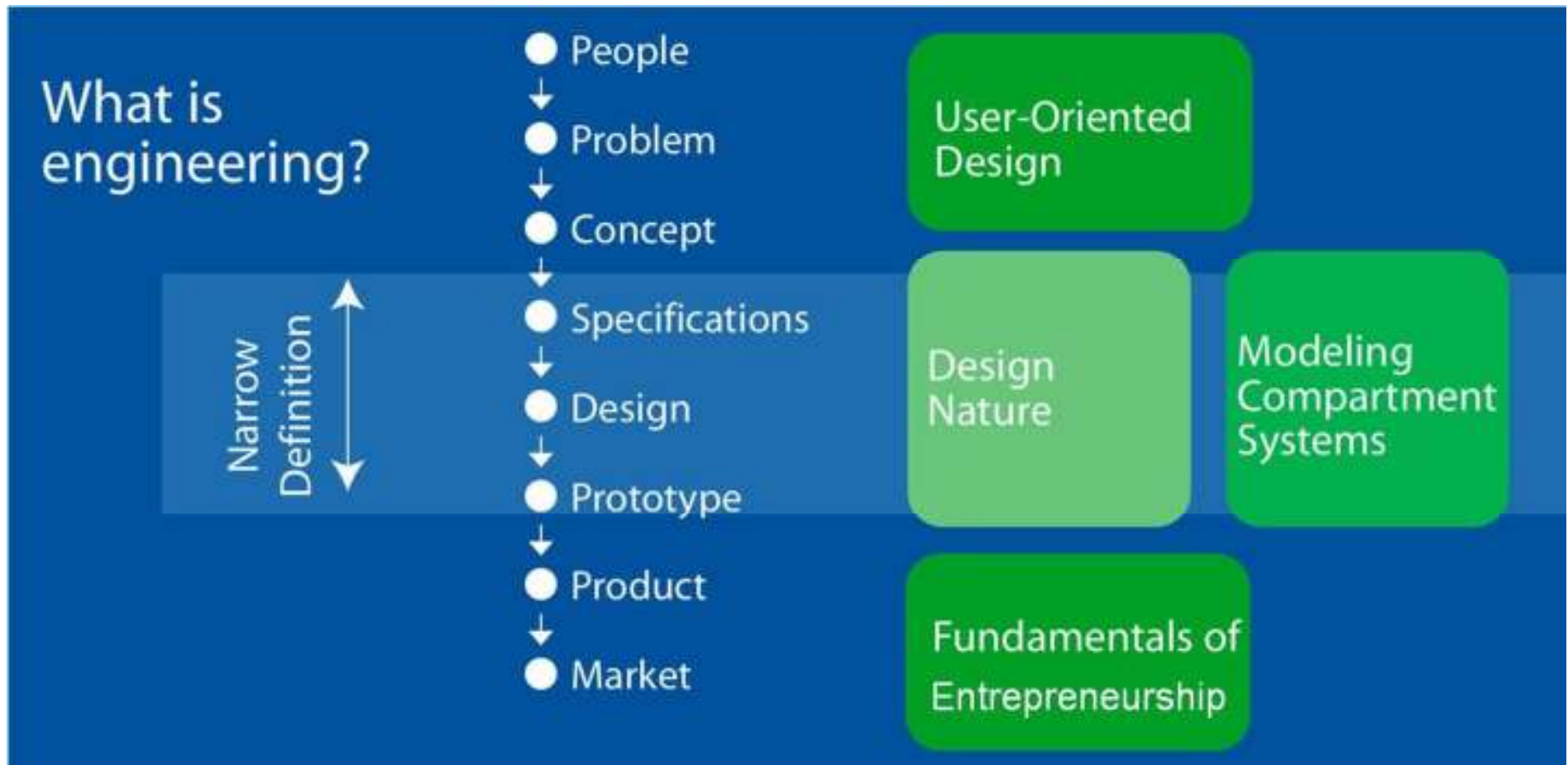
Source: Eriko Horiki

# Mechanical Engineering



Source: Kristen Wolfe June, 2004 S.B. Thesis & Professor Warren Seering. Courtesy Professor Woodie Flowers

# Expanding the Mindset



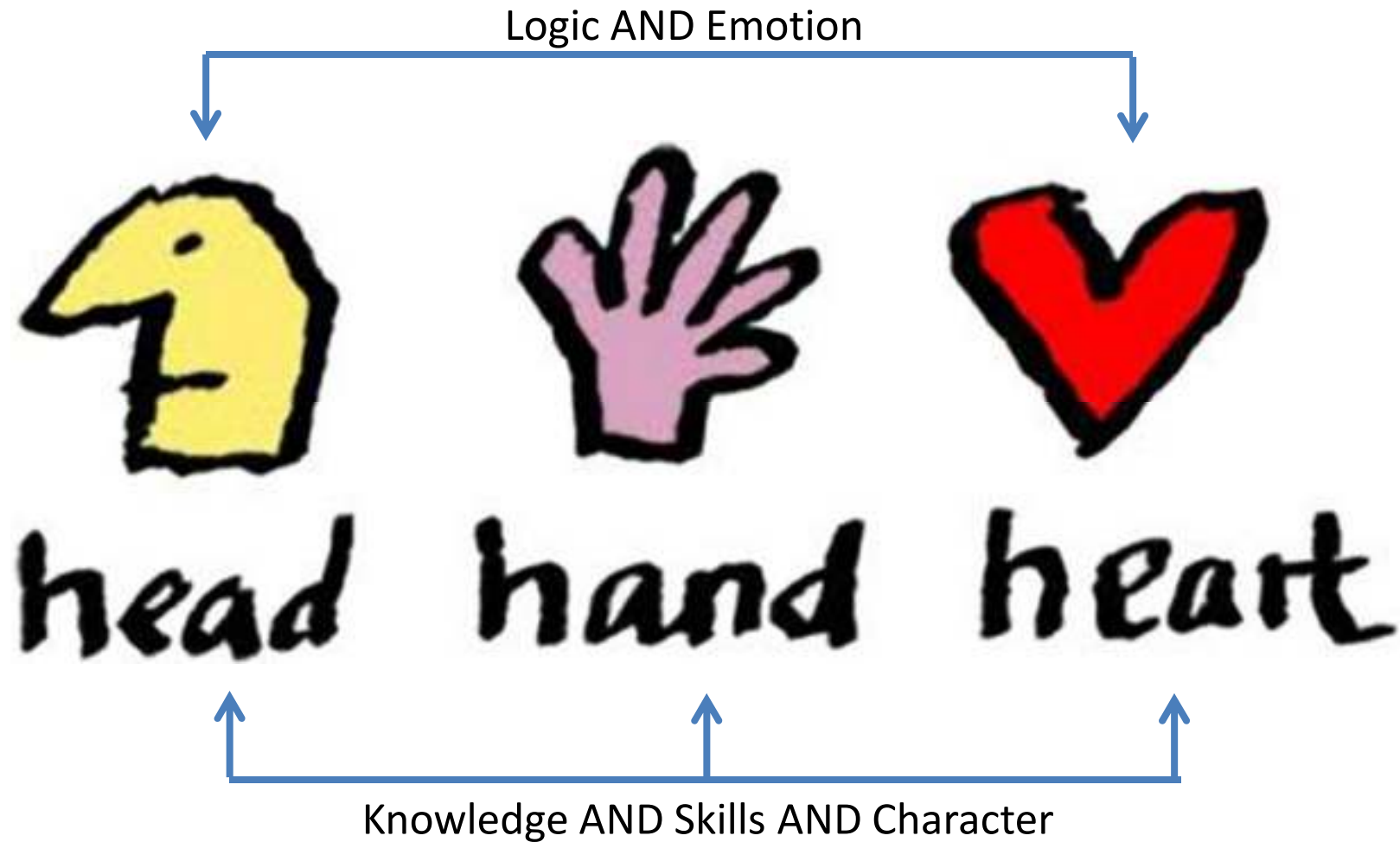
Franklin W. Olin  
College of Engineering

Courtesy of Olin President Richard Miller

## 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



# 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 21<sup>st</sup> century curriculum?

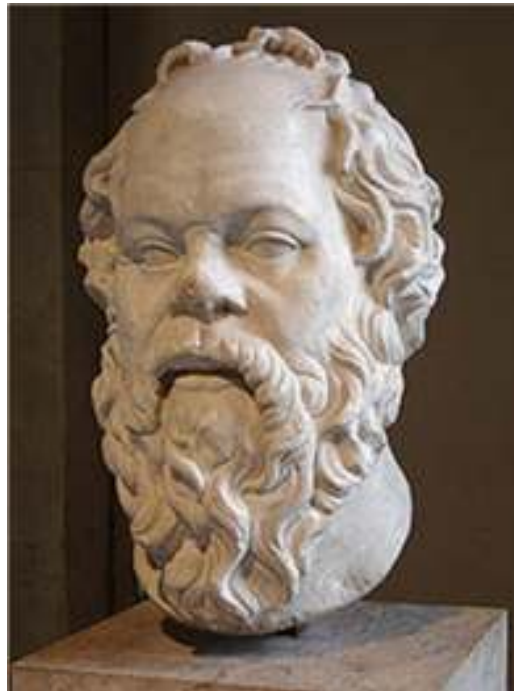


# Ancient Wisdom



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

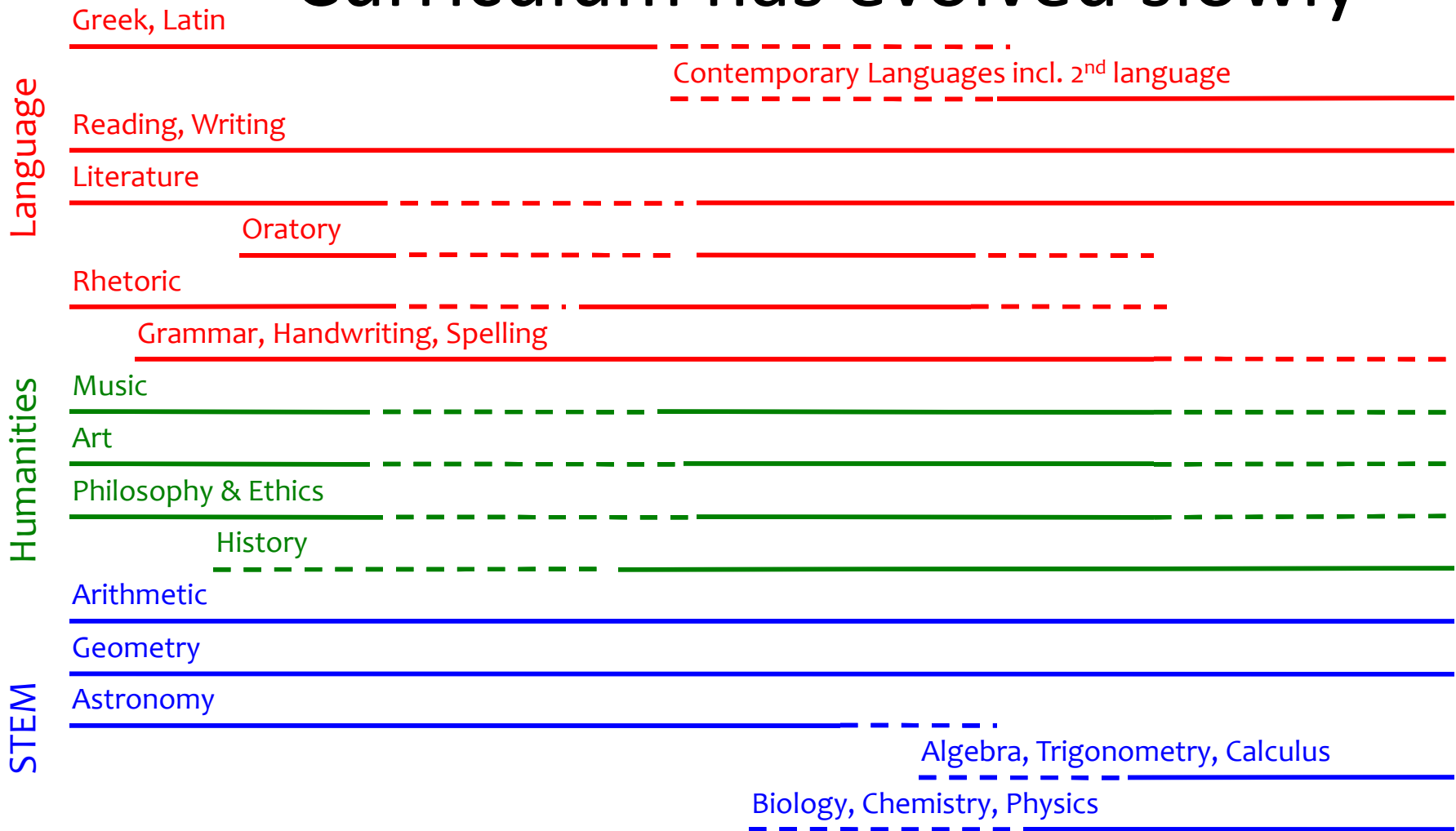
Socrates (~469– 399 BC):  
“Education is the kindling  
of a flame, not the  
filling of a vessel”



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



# Curriculum has evolved slowly



**Ancient  
Greece &  
Rome**

**Early  
Christianity &  
Middle Ages**

**Renaissance &  
Enlightenment**

**Modern  
Industrial  
Era**

**Today**

# 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	Rhetoric
German	Oratory
Spanish	Morality
Handwriting	Natural Philosophy
Bookkeeping	History
Drawing	Natural History
Geometry	Mechanics
Astronomy	Gardening
Geography	

\* 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

Task



# 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

Systems  
dynamics

# 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



Source: Andreas Schleicher

**Skills**

7. *To which I add:* The great **innovators**

# 21<sup>st</sup> Century Skills Framework

## Core Subjects

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

## 21<sup>st</sup> Century Themes

- Global Awareness
- Financial, Economic, Business and Entrepreneurial literacy
- Civic Literacy
- Health Literacy
- Environmental Literacy

**Policy**

# 21<sup>st</sup> Century Skills Framework

## Learning & Innovation Skills

- Critical Thinking & Problem Solving
- Creativity & Innovation
- Communication & Collaboration

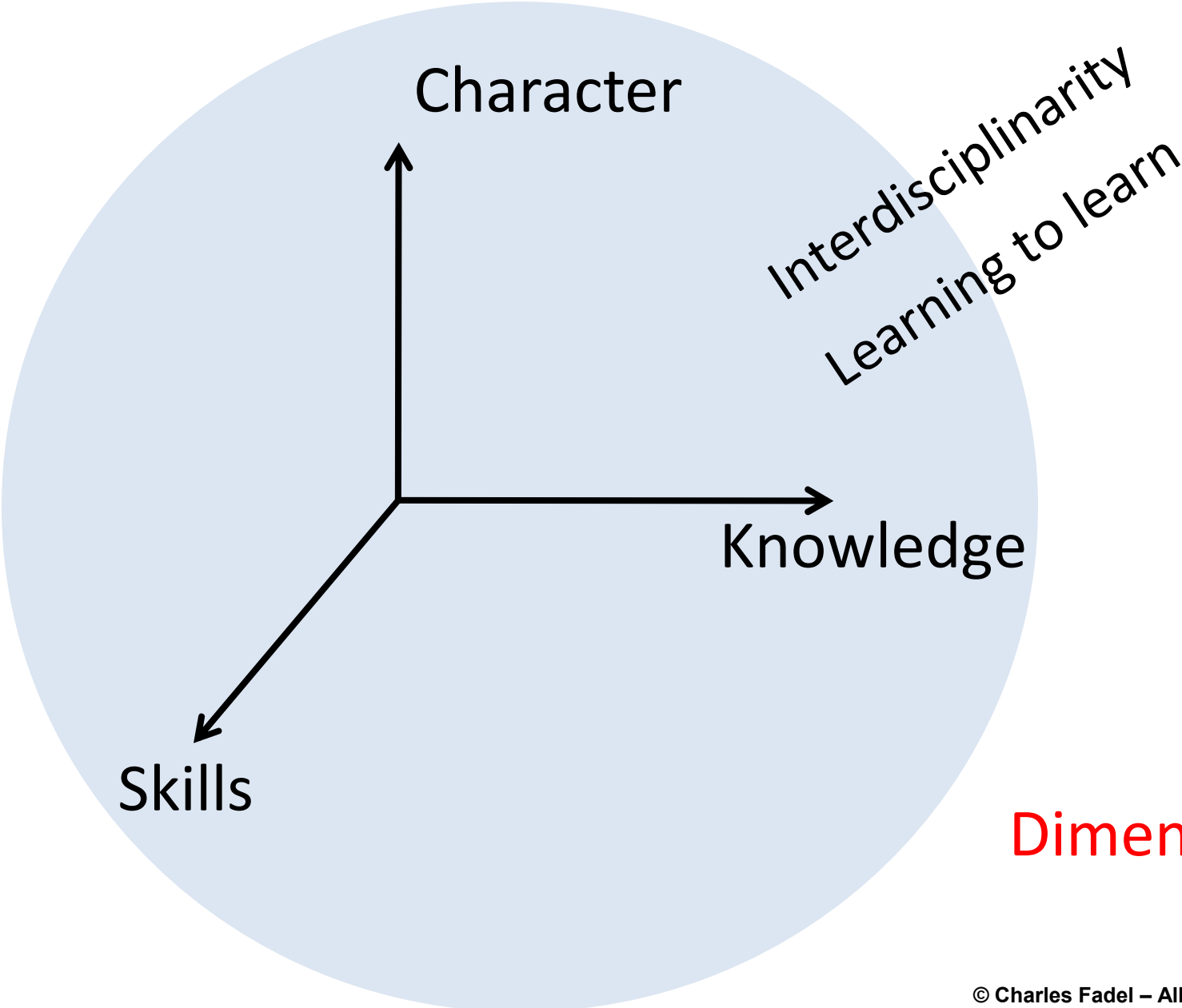
## Information, Media & Technology Skills

- 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

# CCR Framework



# Relevance is a choice

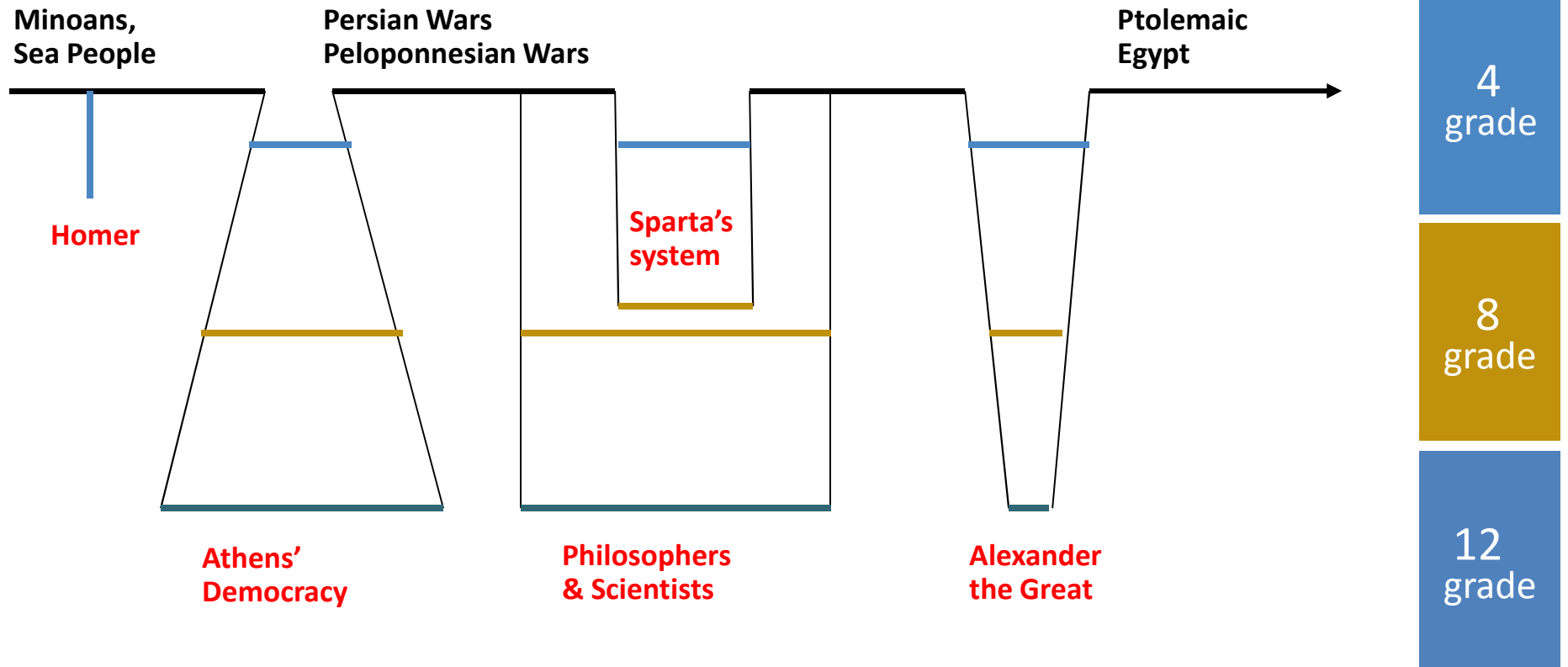
Discipline (below)	Algebra	Applied Maths	Calculus	Discrete Mathematics	Foundations	Geometry	Numbers & Operations	Statistics & Probability	Topology & Recreational
X represents significant usage in	Matrices, Operations, Vectors etc	Complex systems, Control, Game theory, etc	Analysis, Transforms, Polynomials, etc	Automata, Graphs, Computational maths etc	Sets, Logic etc	Curves, Dimensions, Transformations, Trigonometry, etc	Arithmetic operations, Fractions, Sequences, etc	Distributions, Analysis, Estimation, etc	Knots, Figures, Folding, Spaces, etc
Anthropology							X	X	
Architecture		X				X	X	X	X
Art/Design						X	X		X
Biology (genetics, zoology, etc)	X	X	X	X		X	X	X	X
Business	X	X	X	X			X	X	
Civil engineering	X	X	X	X		X	X	X	X
Computer science	X	X	X	X	X	X	X	X	X
Economics	X	X	X	X		X	X	X	X
Electrical engineering	X	X	X	X		X	X	X	
Geology/Geography	X		X				X	X	
History							X	X	
Law							X	X	
Linguistics		X					X	X	
Mechanical engineering	X	X	X	X		X	X	X	X
Medicine/Pharmacy		X					X	X	
Music			X				X		
Neuroscience	X	X	X	X		X	X	X	
Philosophy					X		X	X	
Physics	X	X	X	X	X	X	X	X	X
Psychology	X	X	X	X			X	X	
Sociology							X	X	

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

John Allen Paulos

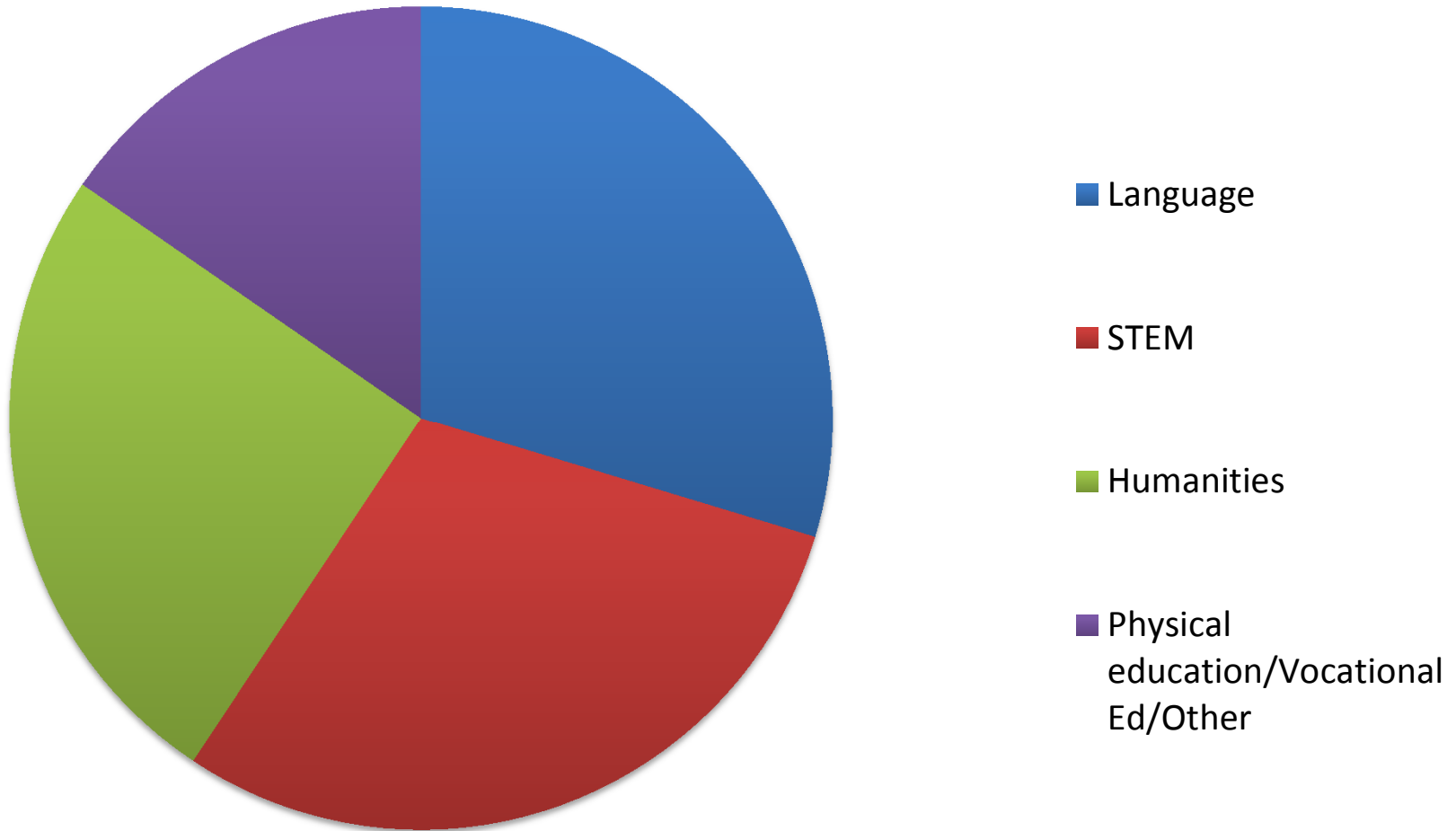


# Impact vs Context



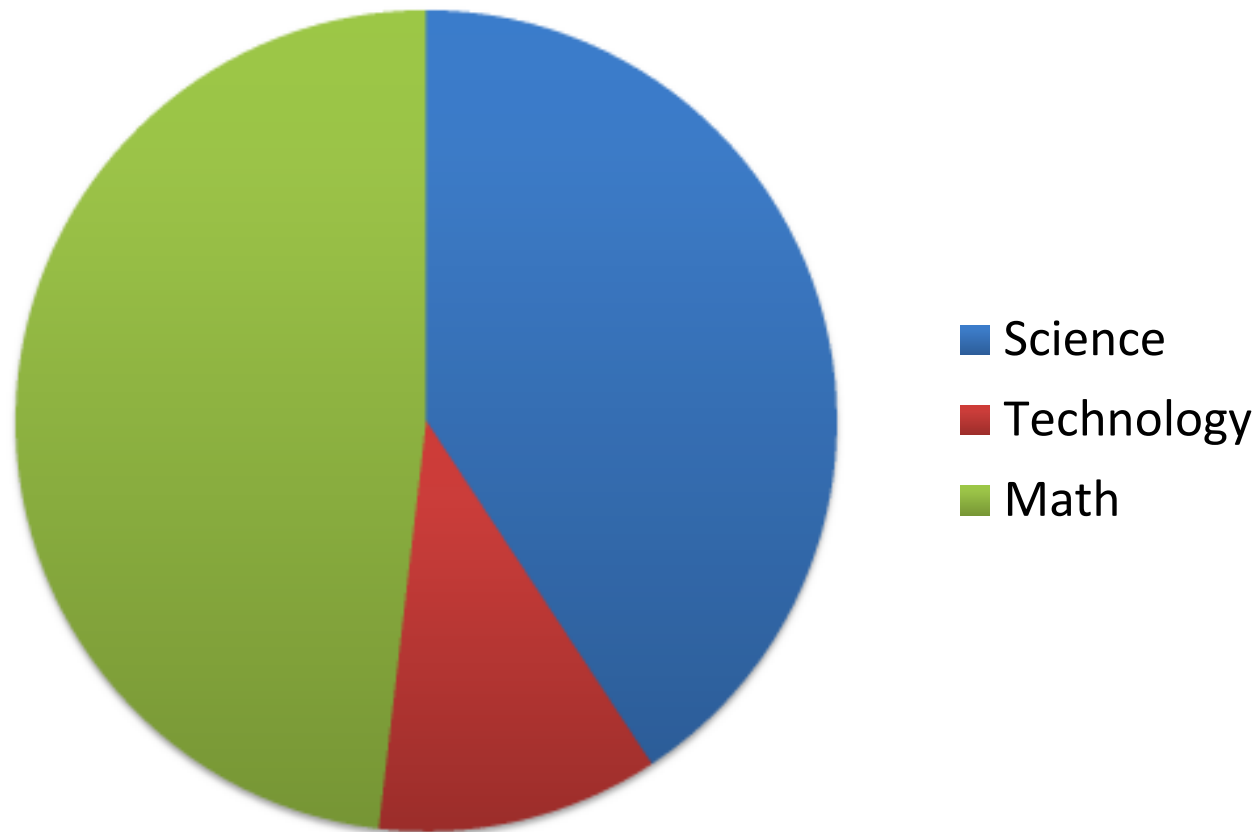
Example: Ancient Greece

# 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 robuststness to be iterated upon later)