charles@curriculumredesign.org
@CurrRedesign #4DEdu
October 21, 2019
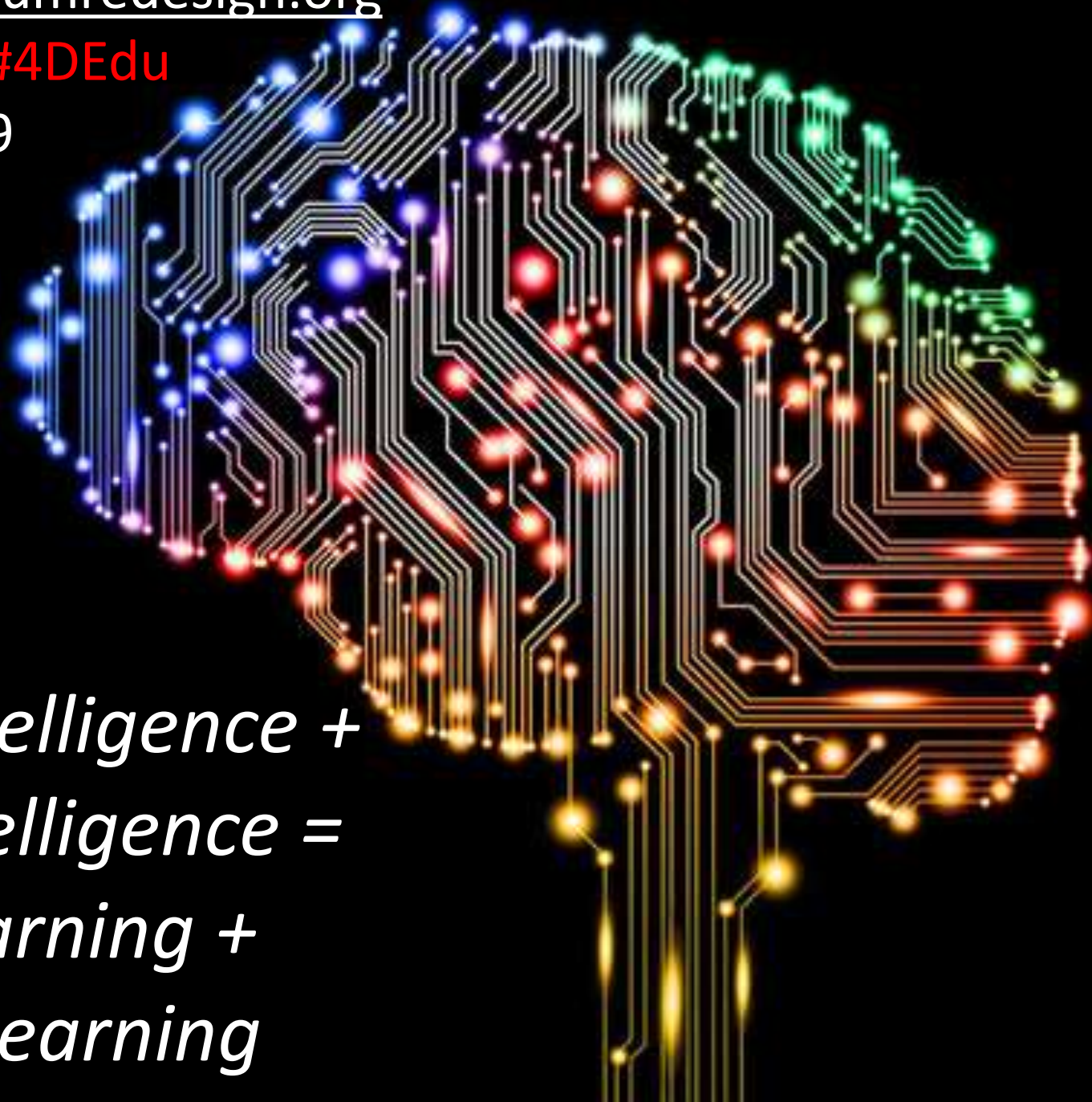
Artificial Intelligence +
Human Intelligence =
Deep Learning +
Deeper Learning

A Classic

Change in Profiles

Substitution:

- Traders: 600 down to… 2
- Computer scientists: +200
- + IT support

Goldman Sachs

"We're headed for a world where you're either going to be able to write algorithms and speak that language or be replaced by algorithms…"

Bridgewater hedge fund billionaire Ray Dalio

Robust Jobs

Policy analysts
Statisticians
Physicists
Economists
Lab managers
Human resource
OH&S advisers
Financial brokers
Solicitors
Technical writers
Actuaries
Detectives
Psychologists
Market researchers
Journalists
School teachers
Programmers
Software engineers
Web developers
DB administrators
Web designers

'The Generators'

'The Artisans'

'The Designers'

'The Informers'

'The Coordinators'

'The Technologists'

'The Carers'

General practitioners
Nurses
Podiatrists
Dental technicians
Pharmacists
Veterinarians
Radiographers
Physiotherapists
Tour guides
Beauty therapists
Make-up artists
Community workers
Massage therapists
Cardiac technicians
Childcare workers
Special Ed teachers
Fitness instructors
Psychiatrists
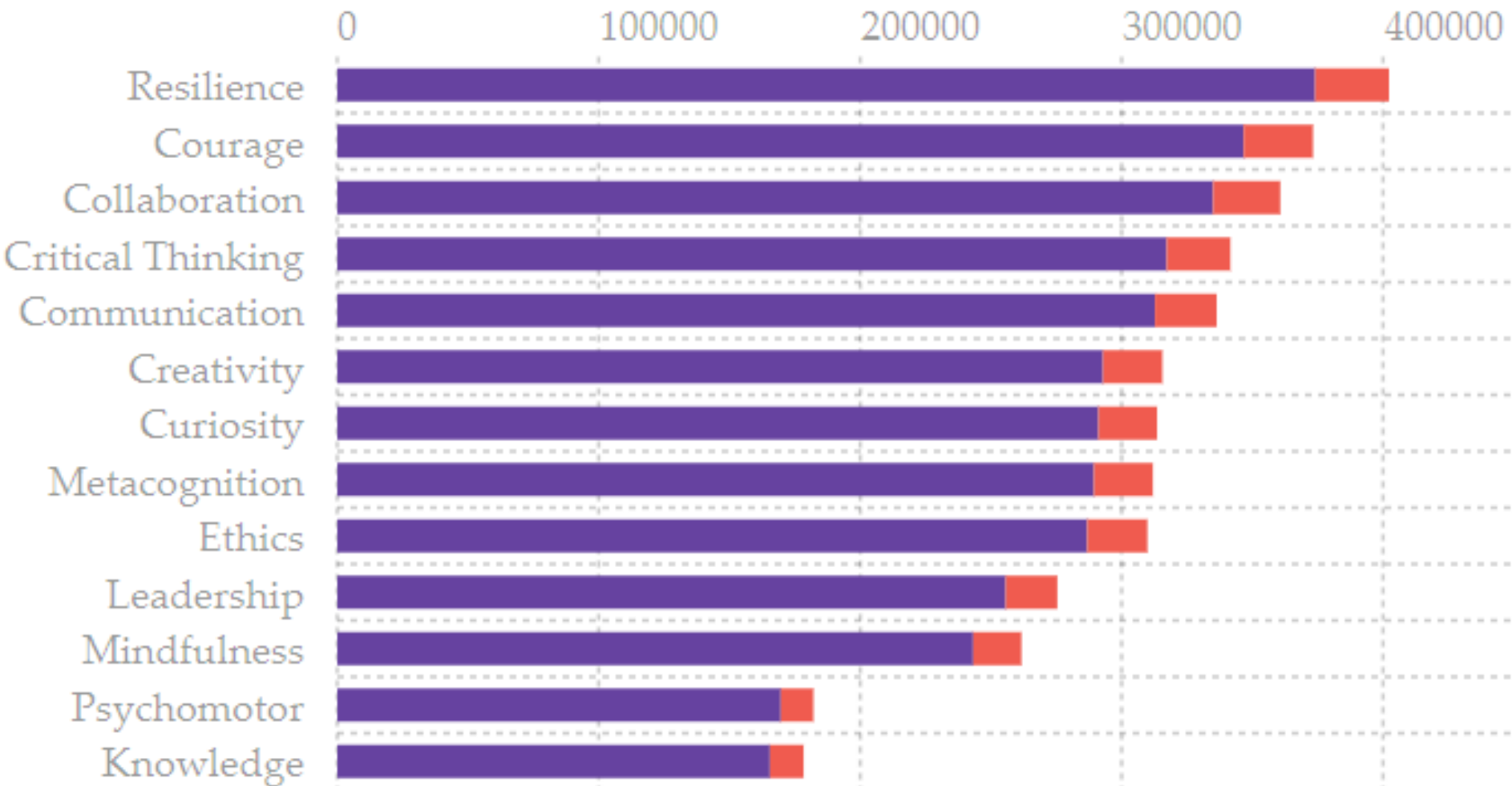Paramedics
Surgeons
Social workers

Emergence of New Jobs

Job	Pay level
App developer	*High*
Driverless car engineer	*High*
Cloud computing specialist	*High*
Big data analyst/data scientist	*High*
Social media manager	Medium
Sustainability manager	Medium
YouTube content creators	Medium
Millennial generational expert	Medium
Drone operators	Medium
Uber driver	Low

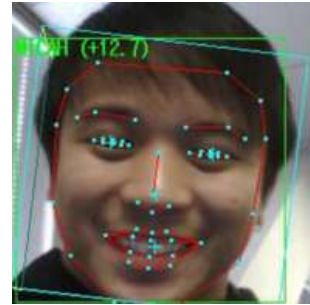Source: World Economic Forum "Future of Jobs"

Occupations needs

Importance-Weighted Demand ▸

	0	100000	200000	300000	400000

Resilience
Courage
Collaboration
Critical Thinking
Communication
Creativity
Curiosity
Metacognition
Ethics
Leadership
Mindfulness
Psychomotor
Knowledge

Source: US O*NET and Bureau of Labor Statistics

The Power of Artificial Intelligence

- Interpretive/Translational:

- Analytical/Synthetic:

- Creative (incrementally):

Reality Check

"and underestimate the effect in the long run."
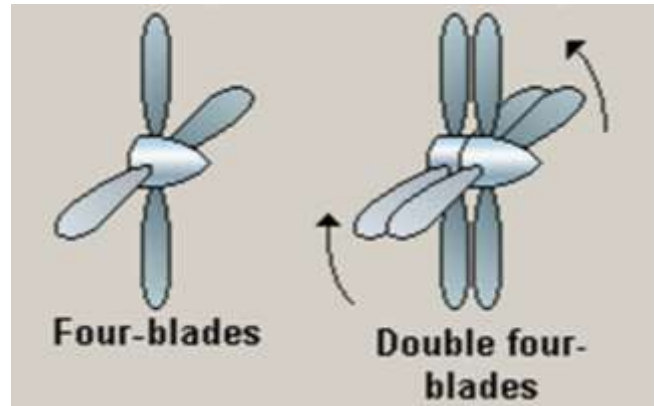
"We tend to overestimate the effect of technology in the short run…

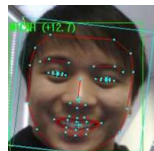Source: Roy Amara, Former President, Institute for the Future

Our Limited Imagination
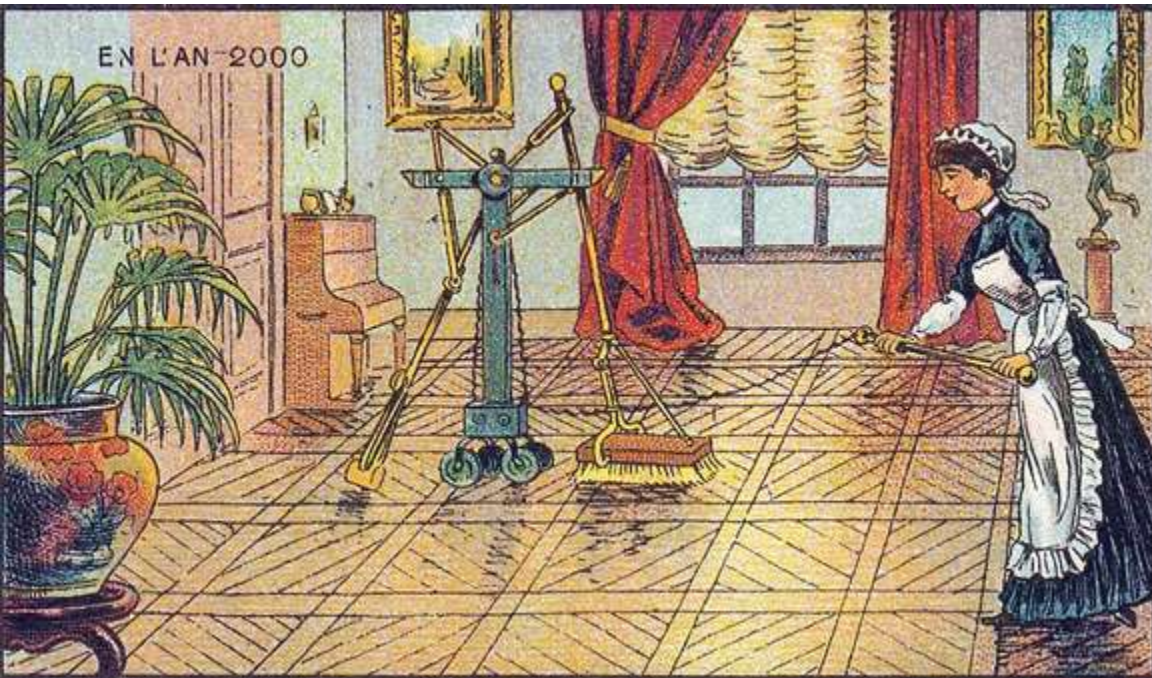
Source: Jean-Marc Côté, 1899

Cognitive Domain and Algorithms

CREATING Synthesizing
EVALUATING
ANALYZING
APPLYING
UNDERSTANDING
REMEMBERING

Source: Bloom/Anderson

Affective Domain and Algorithms

INTERNALIZING
ORGANIZING
VALUING
RESPONDING
RECEIVING
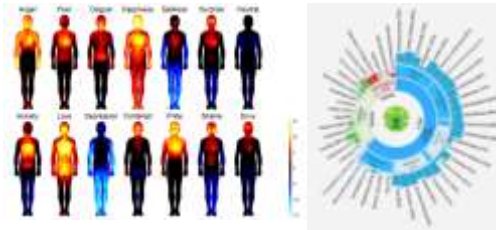
Source: Krathwohl, Bloom, Masia

Psychomotor Domain and Algorithms

ORIGINATION
ADAPTATION
COMPLEX OVERT RESPONSE
MECHANISM
GUIDED RESPONSE
SET
PERCEPTION

Source: Simpson

The Race between Technology and Education

→ Mass *Upskilling*

- What-Curriculum
- How-Teachers
- How-Students

Education

Digital Revolution

→ Mass Schooling

Technology

Industrial Revolution
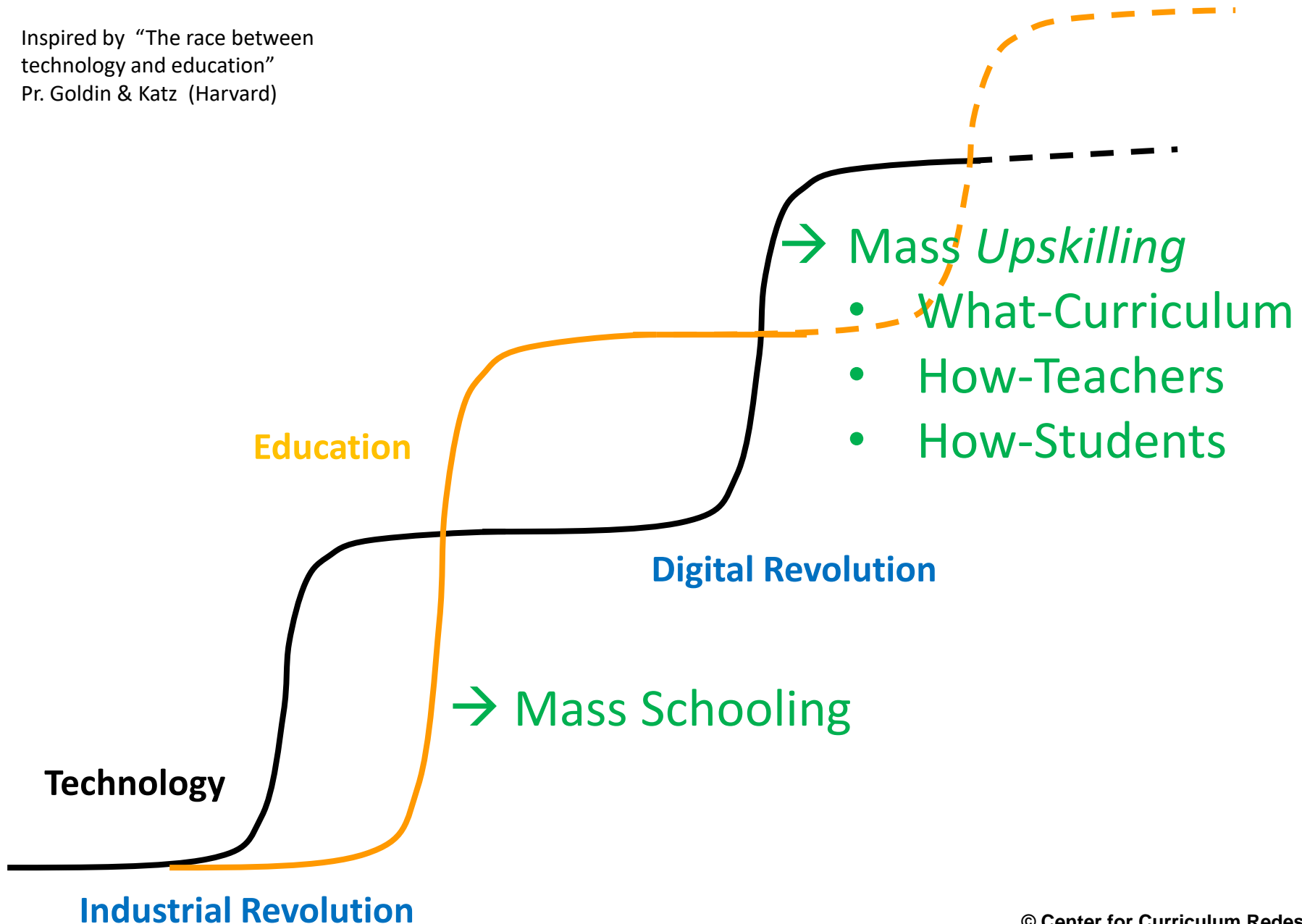
What will we/our children need
to be successful in an A.I. world?

21st Century → Versatility

Renaissance Humans Needed

Breadth of Knowledge

Depth of Expertise

4-D Framework

Modernized Disciplines
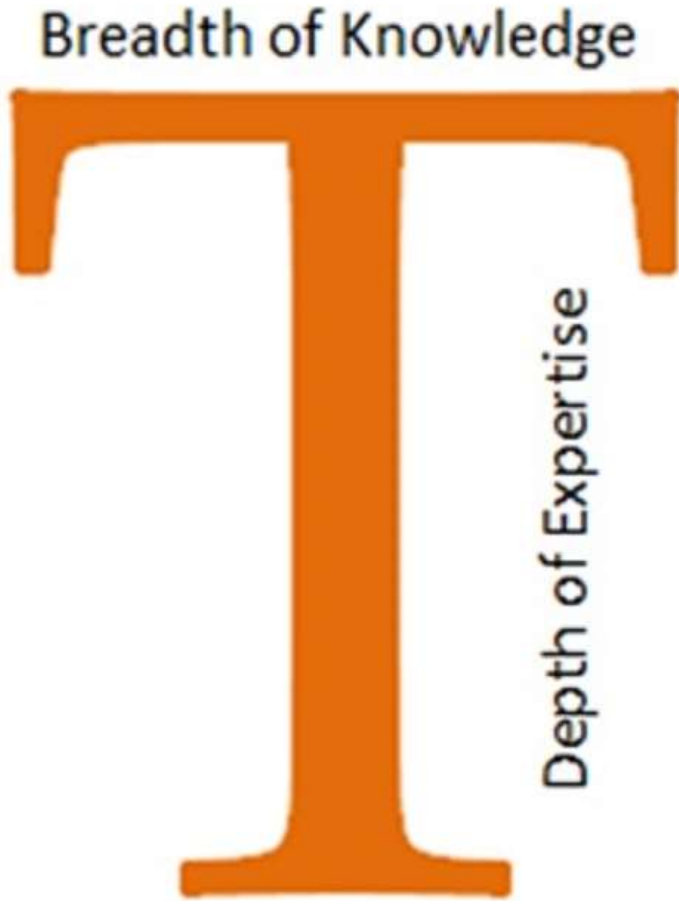Interdisciplinarity

Knowledge

Mindfulness
Curiosity
Courage
Resilience
Ethics
Leadership

Creativity
Critical thinking
Communication
Collaboration

21st Century Education

Skills

Character

Psychomotor

Growth Mindset
Metacognition

Meta-Learning

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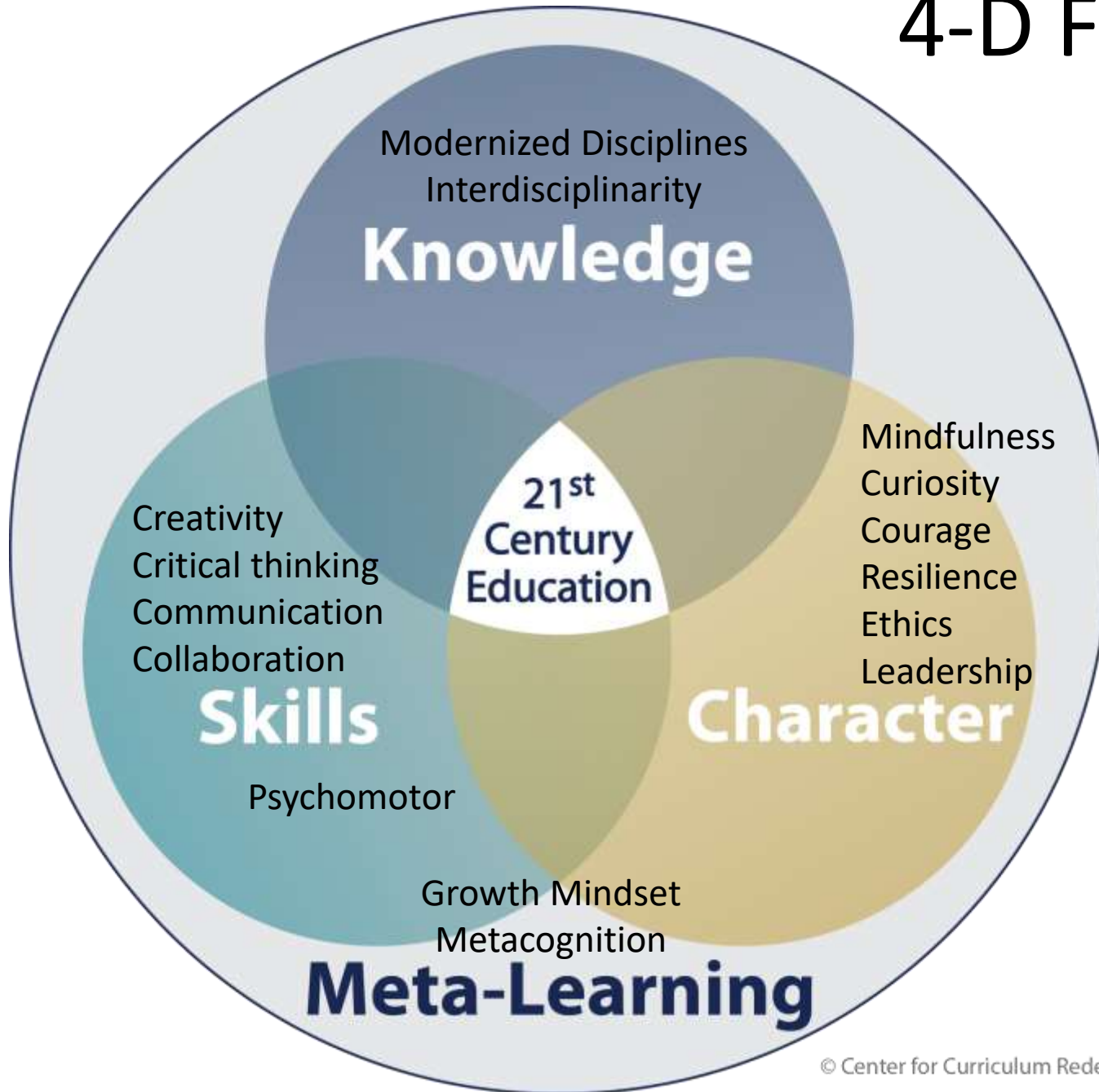
Flipping the Curriculum
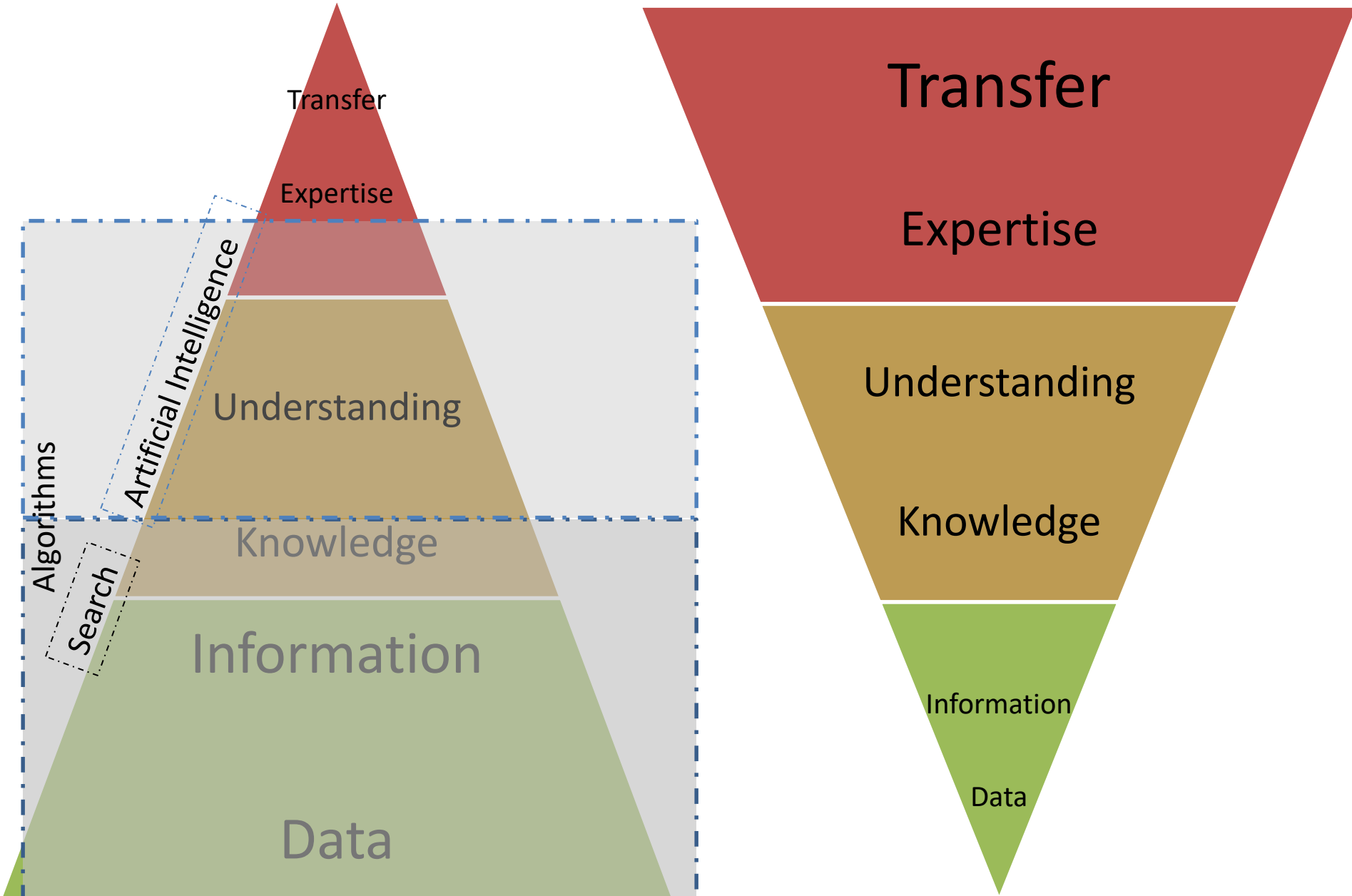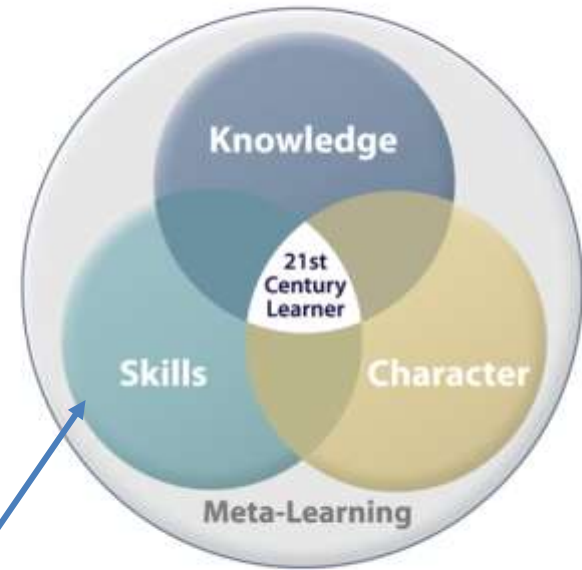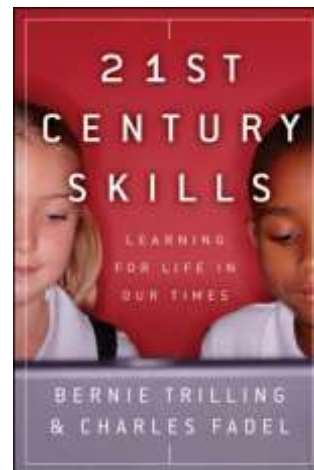
Essential Content vs Chronology
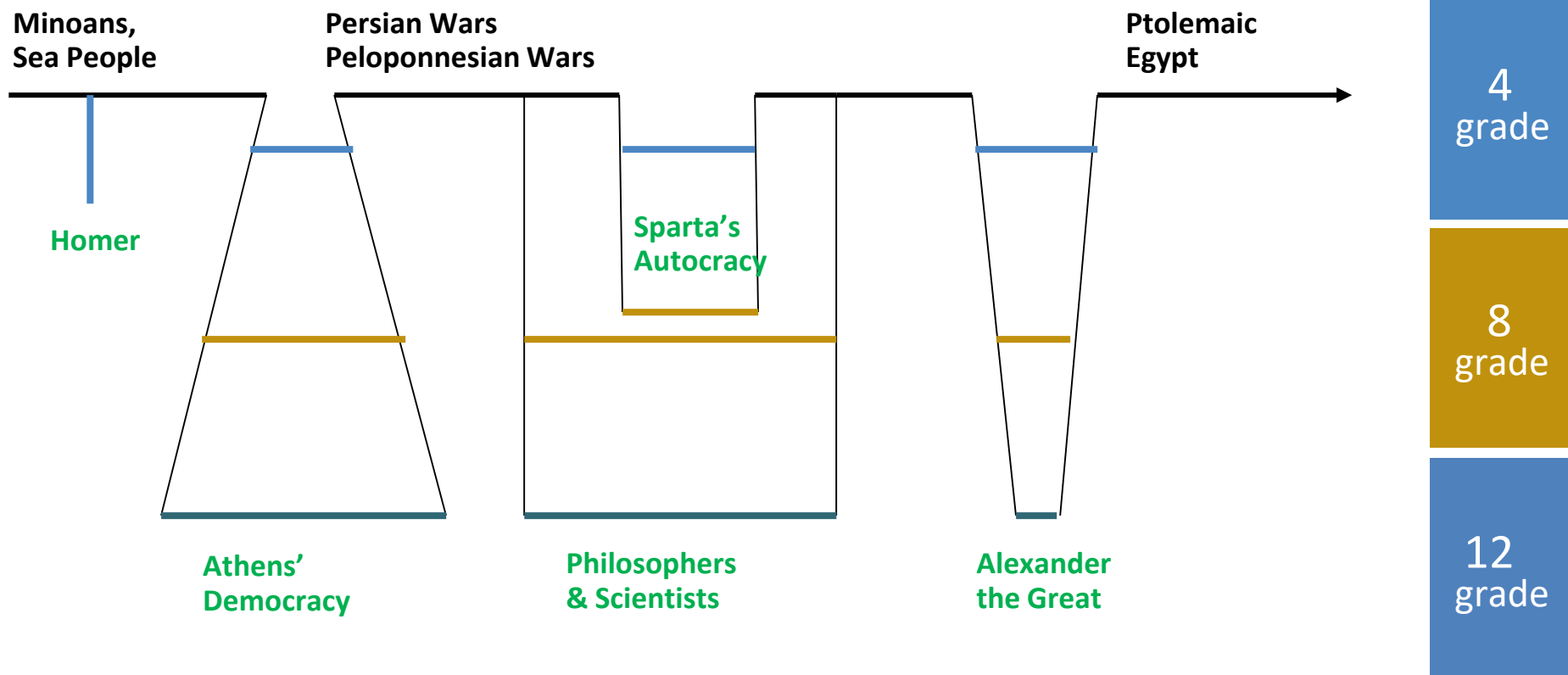
Example: Ancient Greece

Knowledge That Matters

Essential Content

Discipline → Core Concept, Core Concept, ….

Branch — Branch → Core Concept, ….

Subject — Subject → Core Concept, ….

Topic — Topic

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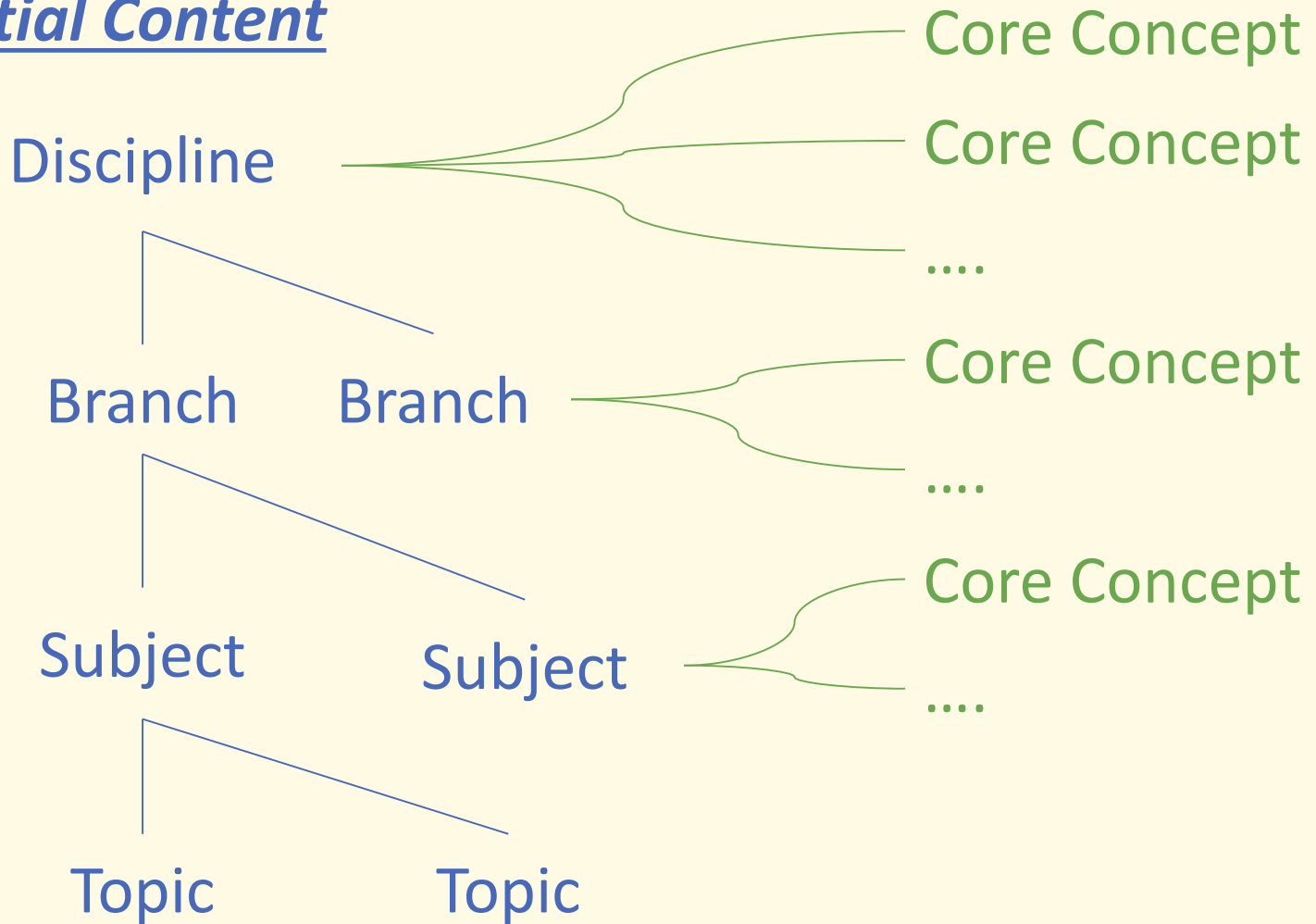
Core Concepts of Mathematics for a 21st (

Mathematizing

Translating and interpreting the world around us into mathematica
us to use the tools of mathematics to ask and answ

1. **Abstraction**: To understand a situation/the world mathematically,
   objects and relationships that express the qualities we are interest
   mathematically , we replace a given aspect of it with mathematica
2. **Variables:** Variables are used to expre
   solutions during mathematical compu
   variable may represent a potentially i
3. **Making Assumptions**: To begin to ask
   decisions about the constraints of the
   due to the nature of the question, the

Core Concepts of Arithmetic for a 21st

Mathematizing

1. **Counting**[1]: Assigning numbers in order to discrete[2] things: one-
   things stays constant as long as the things being counted aren't

   a. **Starting somewhere that isn't 1:** (counting on) It is not
      starting from 1 like a poem. See additive comparison bel

   b. **Counting without counting everything:** It is possible a
      an understanding of a number without counting. (e.g. cor
      matching 1-1 and seeing how much is left over)

Introduce Modern Disciplines

Entrepreneurship
Tech & Engineering
Social Sciences
Wellness
and more…

Embed Themes

Environmental Literacy

Global Literacy

Information Literacy

Civic Literacy

Digital Literacy

Systems Thinking

Design Thinking

Computational Thinking

Matrix between Knowledge & other Dimensions

© 2014 Center for Curriculum Redesign – All Rights Reserved		Skills				Character						Meta-Learning	
		Creativity	Critical thinking	Communication	Collaboration	Mindfulness	Curiosity	Courage	Resilience	Ethics	Leadership	Growth	Metacognition
Themes - embedded throughout — Global literacy / Environmental Literacy / Etc.	**Traditional Knowledge (Interdisciplinary)**												
	Mathematics												
	Science												
	Language												
	Etc.												
	Modern Knowledge (Interdisciplinary)												
	Robotics												
	Entrepreneurship												
	Wellness												
	Etc.												

Competencies are expressed through Knowledge domain

Some Competencies will need out-of-school development

Deliberately, comprehensively, systematically, demonstrably

So…

What do we remove ?

→ Deep re-examination of every single discipline's branches, topics, items…

…while fighting biases, groupthink, politics, etc.

Relevance is a choice

© Charles Fadel Occupation (below)	Algebra	Applied Maths	Calculus	Discrete Mathematics	Foundations	Geometry	Numbers & Operations	Statistics & Probability	Topology & Recreational
Taxonomy & Ontology: Wolfram Research →	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
Agriculture						X	X	X	
Architecture		X				X	X	X	X
Astronomy/Cosmology	X	X	X	X		X	X	X	X
Biology, Botany, Zoology		X		X			X	X	
Biotechnology, Genetics	X	X	X	X		X	X	X	X
Business		X					X	X	
Cinematography/Photography						X	X		X
Civil engineering	X	X	X	X		X	X	X	X
Communication		X					X	X	
Computer science	X	X	X	X	X	X	X	X	X
Craftsmanship						X	X		X
Dance						X	X		X
Design						X	X		X
Drawing						X	X		X
Economics & Finance	X	X	X	X		X	X	X	
Education	X	X	X			X	X	X	
Electrical engineering	X	X	X	X		X	X	X	
Environmental science	X	X	X	X		X	X	X	
Ethics							X		
Geography/Geology	X	X	X	X		X	X	X	X
Health							X	X	
History/Archeology	X	X		X			X	X	
Journalism	X	X					X	X	
Languages/Linguistics	X	X		X			X	X	
Law		X					X	X	
Materials Science/Nanotechnology	X	X	X	X		X	X	X	X
Mechanical engineering, Robotics	X	X	X	X		X	X	X	X
Medicine/Pharmacy/Veterinary		X					X	X	
Music	X						X	X	
Painting						X	X		
Philosophy		X			X		X	X	
Physics	X	X	X	X	X	X	X	X	X
Poetry/Prose							X		
Psychology/Sociology/Anthropology	X	X		X			X	X	
Sculpture						X	X		X
Sewing/Knitting/Tapestry						X	X		X
Spirituality/Religions							X		
Theater/Acting							X		X

HOW – Personalized Learning

Unique development of each student

Levels of Personalization

Level	Example of Choices Offered	Technology
Macro	Disciplines (within STEM, humanities, Arts)	Tracking
Meso	Project (swimming vs flying robot)	Tracking
Micro	Grouped pathways (e.g. whole word vs phonetic language acquisition)	Tracking
Nano	Individualized pathways: • "Flat" - multiple possibilities • Adaptive multiple possibilities	• Tracking • Threaded → A.I. that self-learns about Learner

Adaptive Learning's Promises

Source: Area9 Lyceum

A traditional e-learning course took45 minutes to complete

By using adaptive learning, this was reduced by up to 50%.

TIME IN HOURS
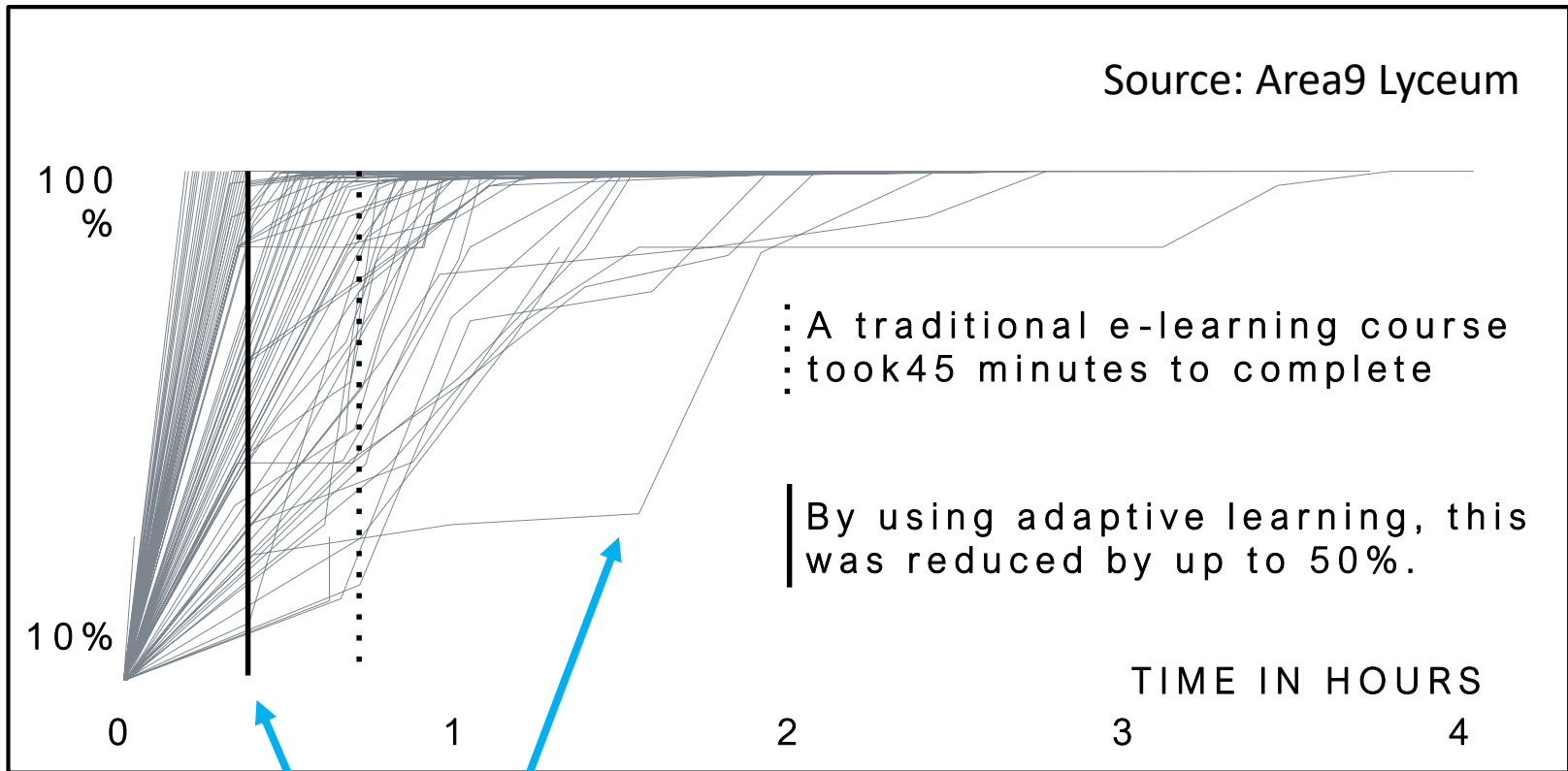
- Self-pacing
- Learning time reduction

Major Types of Student-facing AI in Edu

Intelligent Tutoring Systems

(Adaptive *Sequenced* tasks)

Dialog-Based Tutoring Systems

(Adaptive *Socratic* conversations)

Exploratory Learning Environments

(Guided *Self-directed* constructivism)
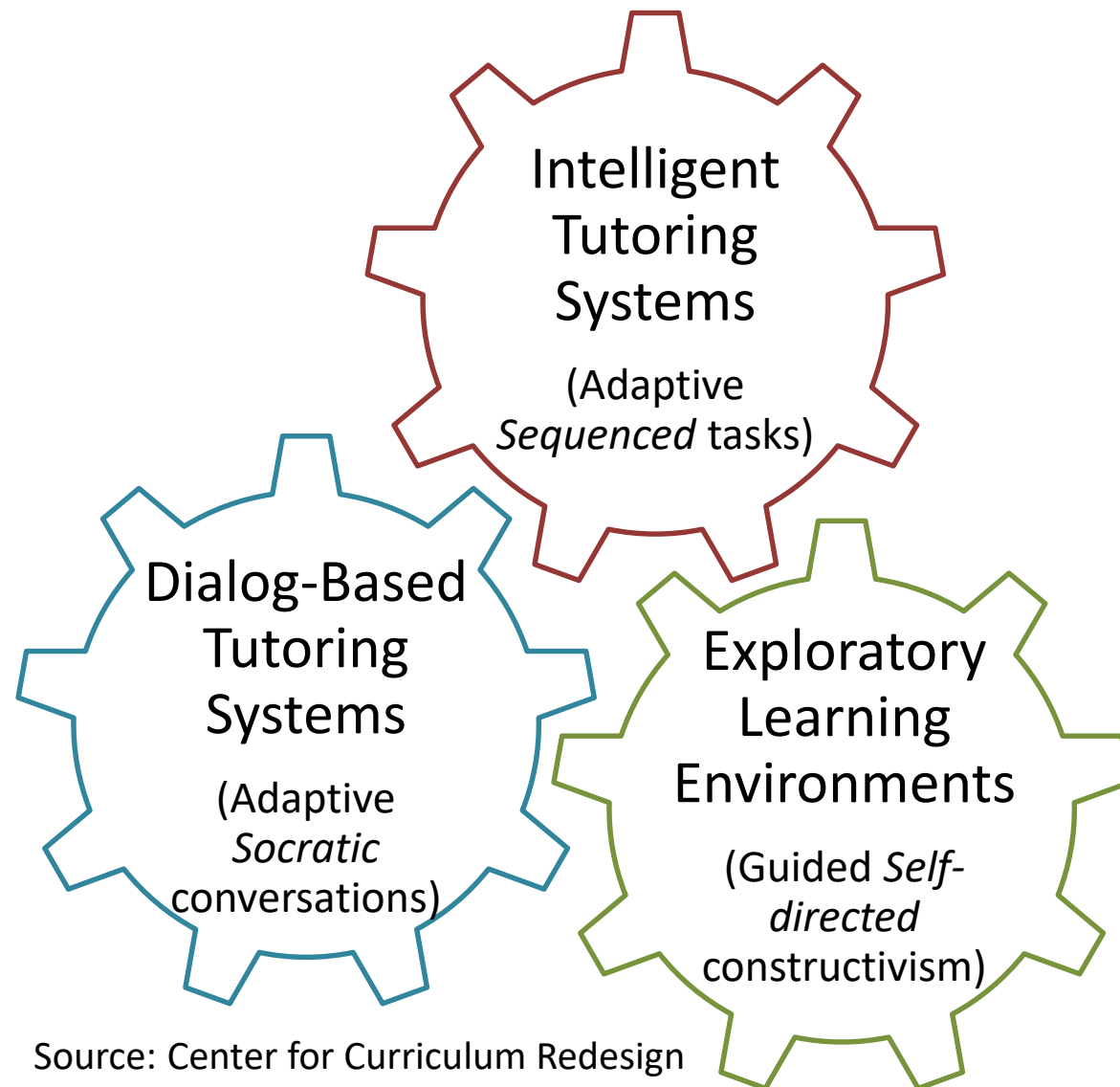
Potential applications within major classes, as well as standalone:

- Automatic essay feedback
- Language learning
- Chatbots
- AR/VR
- Learning network orchestrators
- Collaborative learning
- Student forum monitoring
- Continuous assessments
- AI learning companions

Source: Center for Curriculum Redesign

"This brilliantly reflective and forward-looking book helps the education community in navigating the storm... a daring intellectual undertaking!

—Dirk Vandamme,
OECD

"An invaluable resource for those concerned with the future of education."

—**Tony Wagner**, best-selling author
"*Global Achievement Gap*" & "*Creating Innovators*"

"A must-read for anyone seeking to go beyond the hype of AI towards appropriate, precise, and empowering uses of these tools for learning."

—Maria Langworthy,
Microsoft

WAYNE HOLMES, MAYA BIALIK, CHARLES FADEL

ARTIFICIAL INTELLIGENCE IN EDUCATION

Promises and Implications for Teaching & Learning

**Download:
http://bit.ly/AIED-BOOK**

Learning WITH the Machines

Deep Learning (A.I.) +

"Deeper Learning" (H.I.)

= Augmented Intelligence

Thank You!

"*What* should students learn for the 21ˢᵗ century?"

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