CSCI 1377

Tools for Thought

Learning II
Educational Technology

"I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks."

— Thomas Edison (1922)

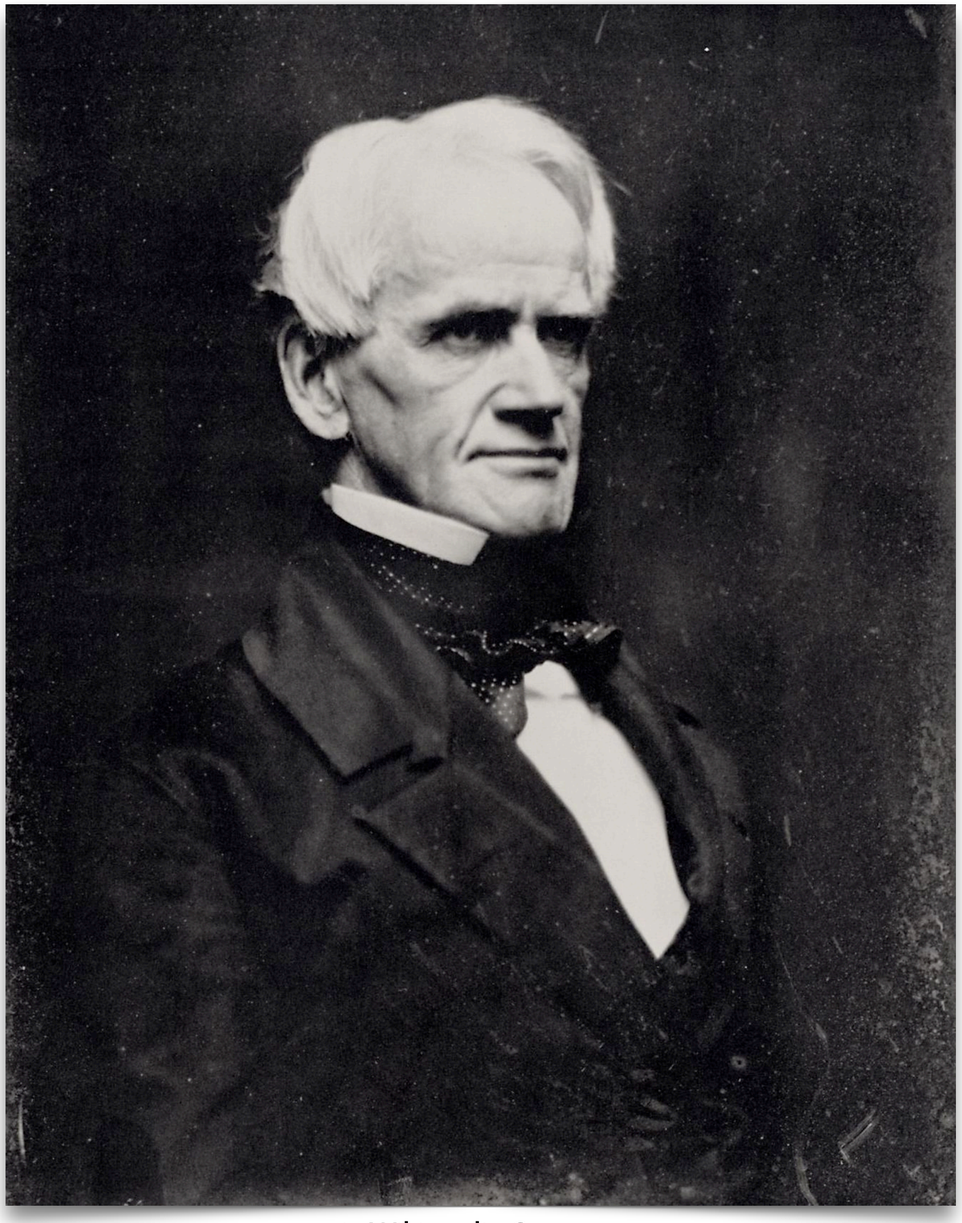
What is the purpose of an education?

Horace Mann (1796 - 1859)

Abolitionist, Brown alum, education reformer, Congressional rep for Massachusetts

Proponent of the Common School movement

Buried in North Burial Ground, only 30mins walk from here!



via Wikimedia Commons

[Mann’s Twelfth Annual Report]

Tenets of Mann's goals for public schooling

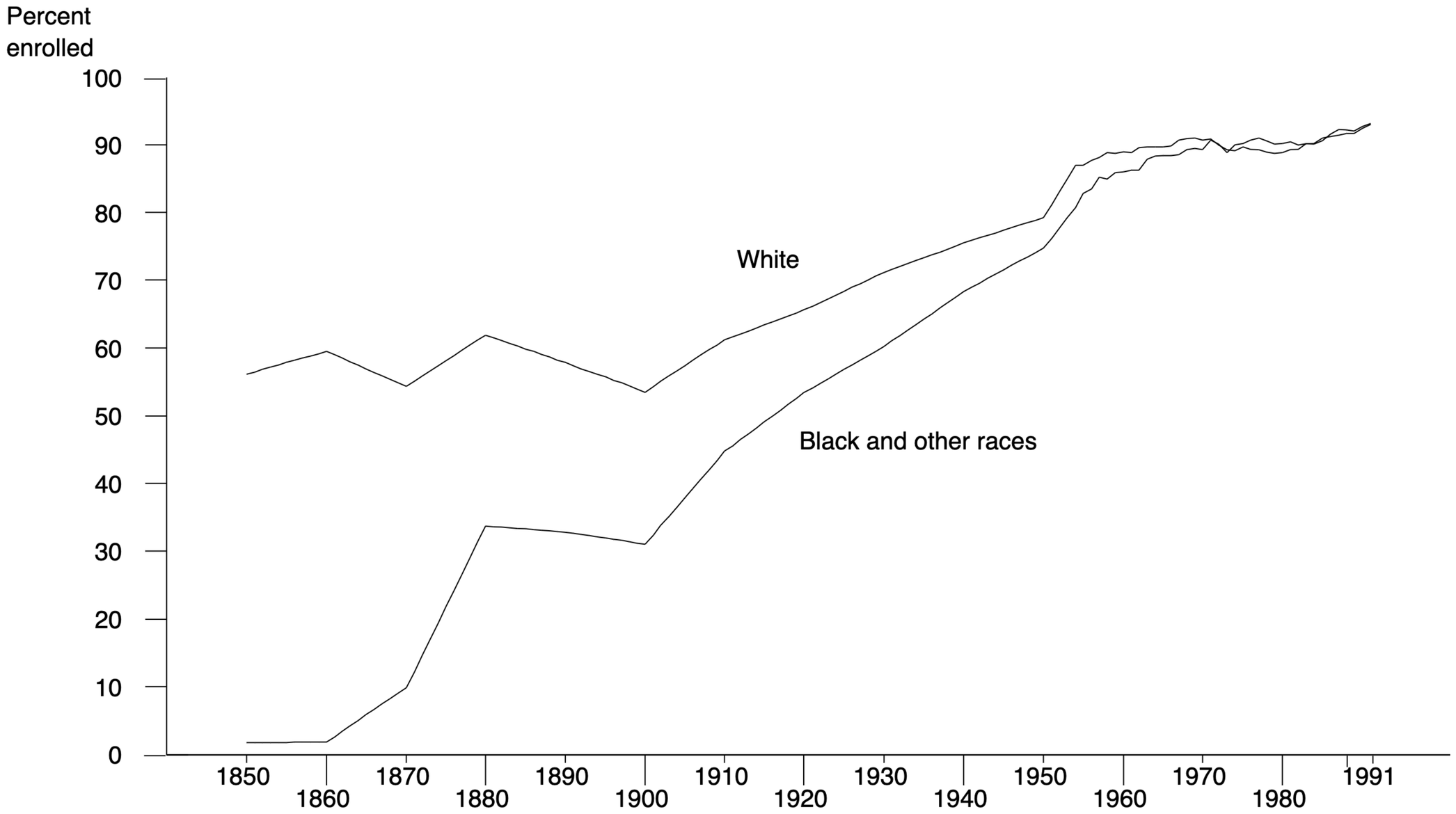
- Physical education: improving the health of the public
  - e.g. human anatomy, hydro engineering, temperance

- Intellectual education: "removing poverty and securing abundance"
  - Education is "a thousand times more lucrative than fraud; and adds a thousand fold more to a nation's resources than the most successful conquests"
  - Education as a social equalizer vs. unfettered capitalism or feudalism

- Political education: improving good governance
  - "elector and elected [...] tend to the same level [...] legislators are a mirror reflecting the moral countenance of their constituents"

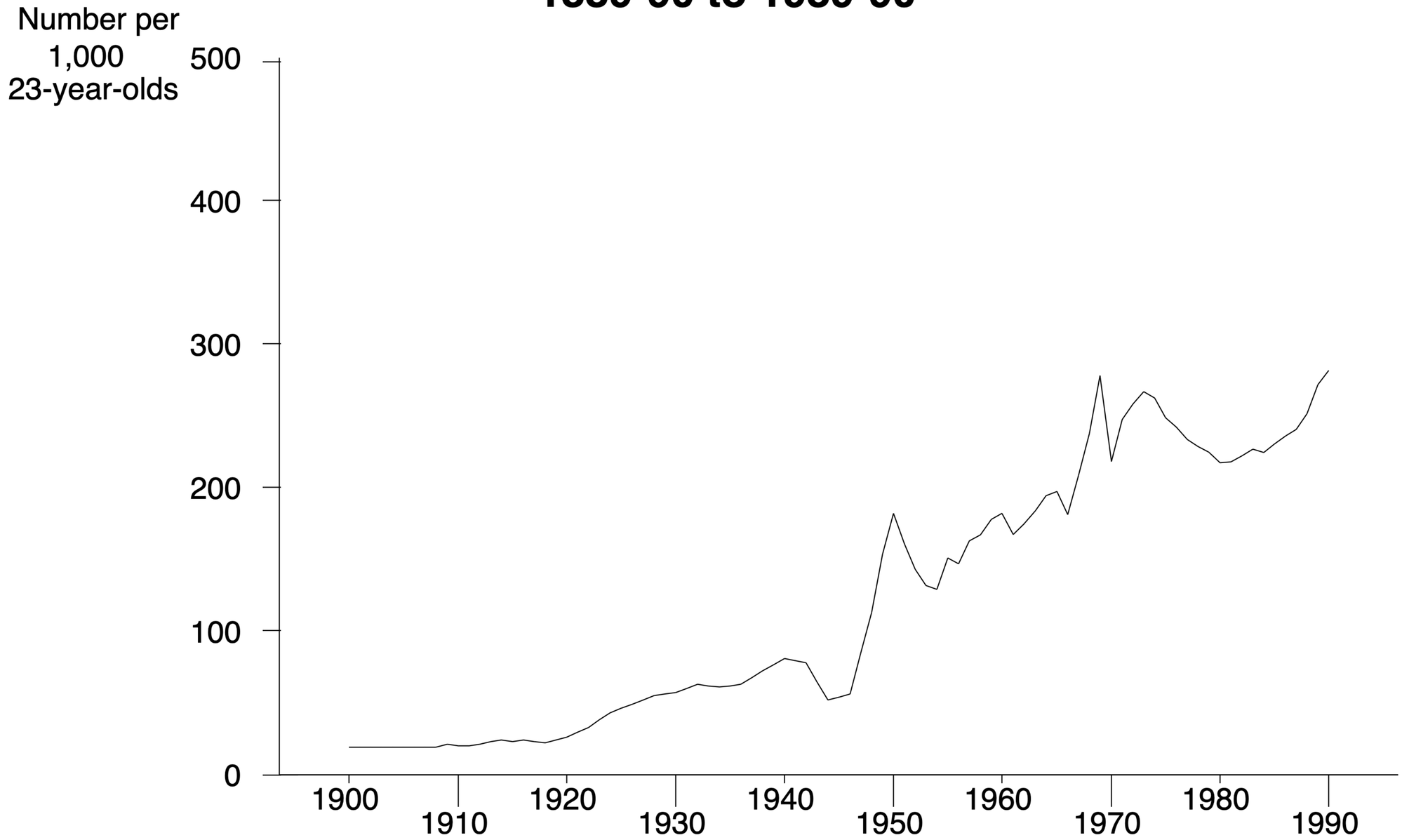
Horace Mann. "Twelfth Annual Report to the Secretary of the Massachusetts State Board of Education" 1848

In the interim, mass education became a reality



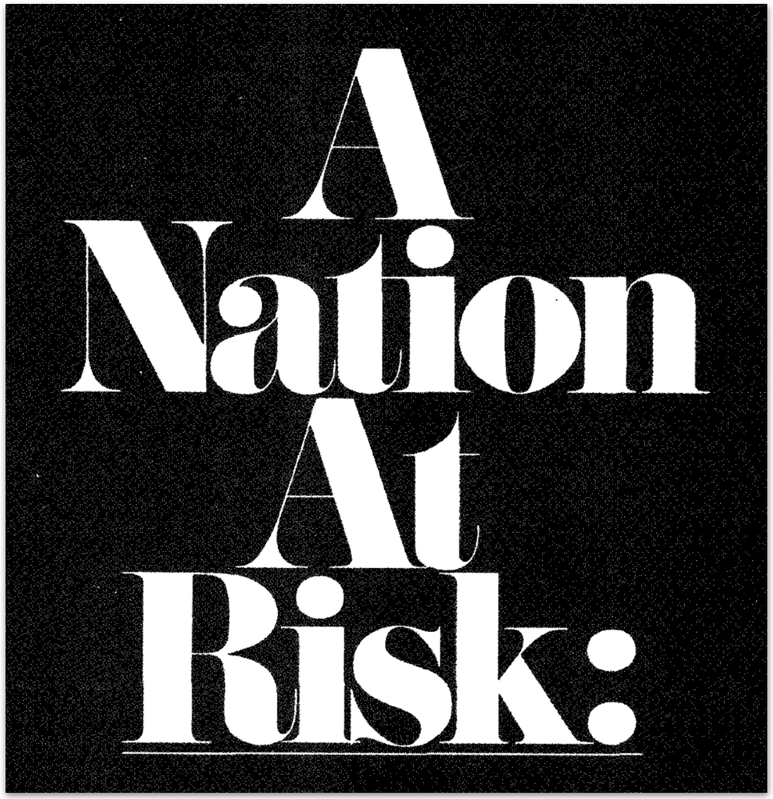
Ed. Thomas Snyder. 120 Years of American Education: A Statistical Portrait. 1993

Figure 17.--Bachelor's degrees per 1,000 23-year-olds: 1889-90 to 1989-90



Ed. Thomas Snyder. 120 Years of American Education: A Statistical Portrait. 1993

In the 1970s and on, the US feared stagnation



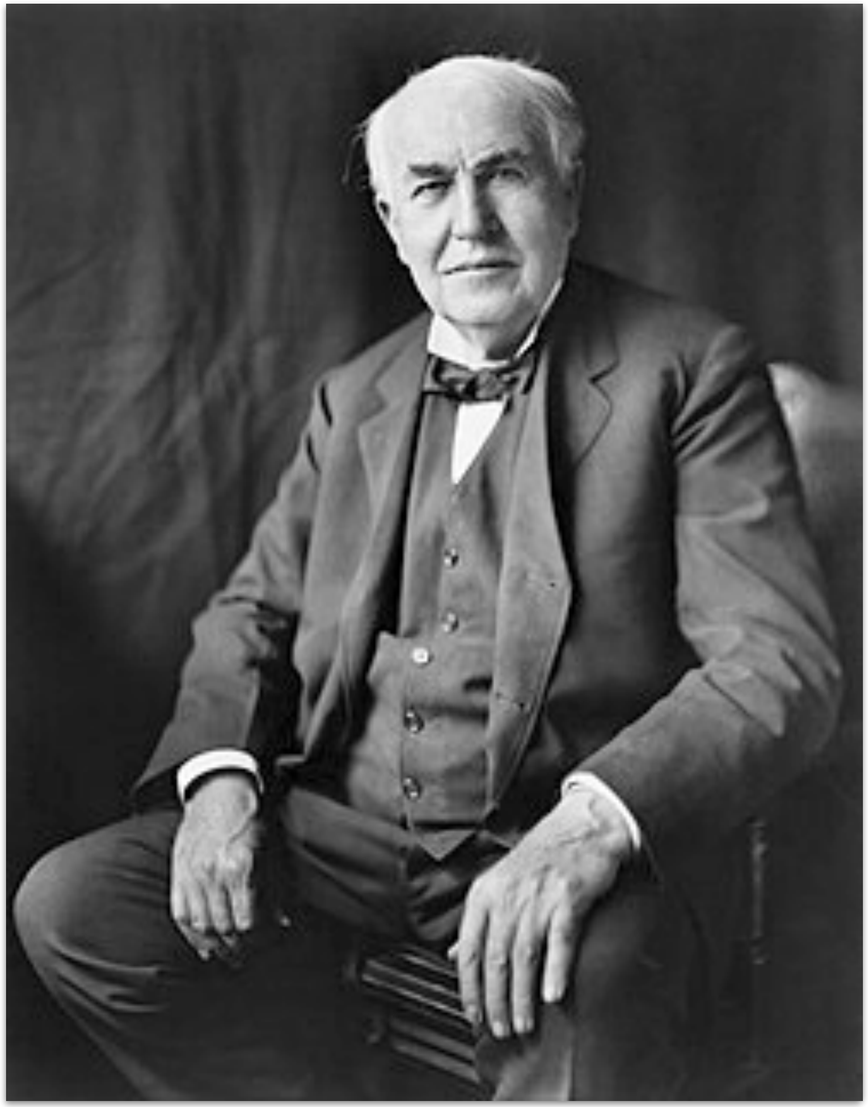
(1983)

"Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world. [...] The time is long past when America's destiny was assured simply by an abundance of natural resources and inexhaustible human enthusiasm, and by our relative isolation from the malignant problems of older civilizations. The world is indeed one global village. We live among determined, well-educated, and strongly motivated competitors. We compete with them for international standing and markets, not only with products but also with the ideas of our laboratories and neighborhood workshops. America's position in the world may once have been reasonably secure with only a few exceptionally well-trained men and women. It is no longer."

Technology has a long history at promising educational reform

"Books will soon be obsolete in the public schools. Scholars will be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed inside of ten years."

— Thomas Edison (1913)



via Wikimedia Commons

Starting in the 90s, computers became the future

1. “Modern computers and learning devices will be accessible to every student.
2. Classrooms will be connected to one another and to the outside world.
3. Educational software will be an integral part of the curriculum—and as engaging as the best video game.
4. Teachers will be ready to use and teach with technology.”

— Clinton administration, 1996

Ed tech has since taken many forms

1994 Bulletin Board Systems 11

1995 The Web 15

1996 Computer-Mediated Communication 21

1997 Constructivism 27

1998 Wikis 37

1999 E-Learning 43

2000 Learning Objects 49

2001 E-Learning Standards 57

2002 The Learning Management System 63

2003 Blogs 69

2004 Open Educational Resources 77

2005 Video 85

2006 Web 2.0 91

2007 Second Life and Virtual Worlds 97

2008 E-Portfolios 101

2009 Twitter and Social Media 107

2010 Connectivism 115

2011 Personal Learning Environments 123

2012 Massive Open Online Courses 129

2013 Open Textbooks 137

2014 Learning Analytics 143

2015 Digital Badges 151

2016 The Return of Artificial Intelligence 155

2017 Blockchain 161

2018 Ed Tech's Dystopian Turn 169

Martin Weller. *25 Years of Ed Tech.* 2020

1980s-2000s: hardware outpaced adoption

- Computers were quickly adopted across American schools
  - 1981: 125 students per computer → 1991: 18 → 2001: 5

- Computers were used for one-off exercises and logistics
  - "As for enhanced efficiency in learning and teaching, there have been no advances over the last decade that can be confidently attributed to broader access to computers."
  - "Teachers at all levels of schooling have used the new technology basically to continue what they have always done: communicate with parents and administrators, prepare syllabi and lectures, record grades, assign research papers."

- My experience: used computers primarily for word processing
  - Teachers would sometimes roll in the computer cart for one-off activities

Larry Cuban. *Oversold and Underused: Computers in the Classroom.* 2003

via SMART Technologies

Interactive whiteboards gained significant traction in the early 2000s

- Boards blanketed the US and UK, costing $3-5k a piece
  - Often funded by federal dollars under No Child Left Behind and later policies
- Minimal training provided to teachers in its use
- Research shows no impact on educational outcomes

IWBs were not warmly received by all teachers

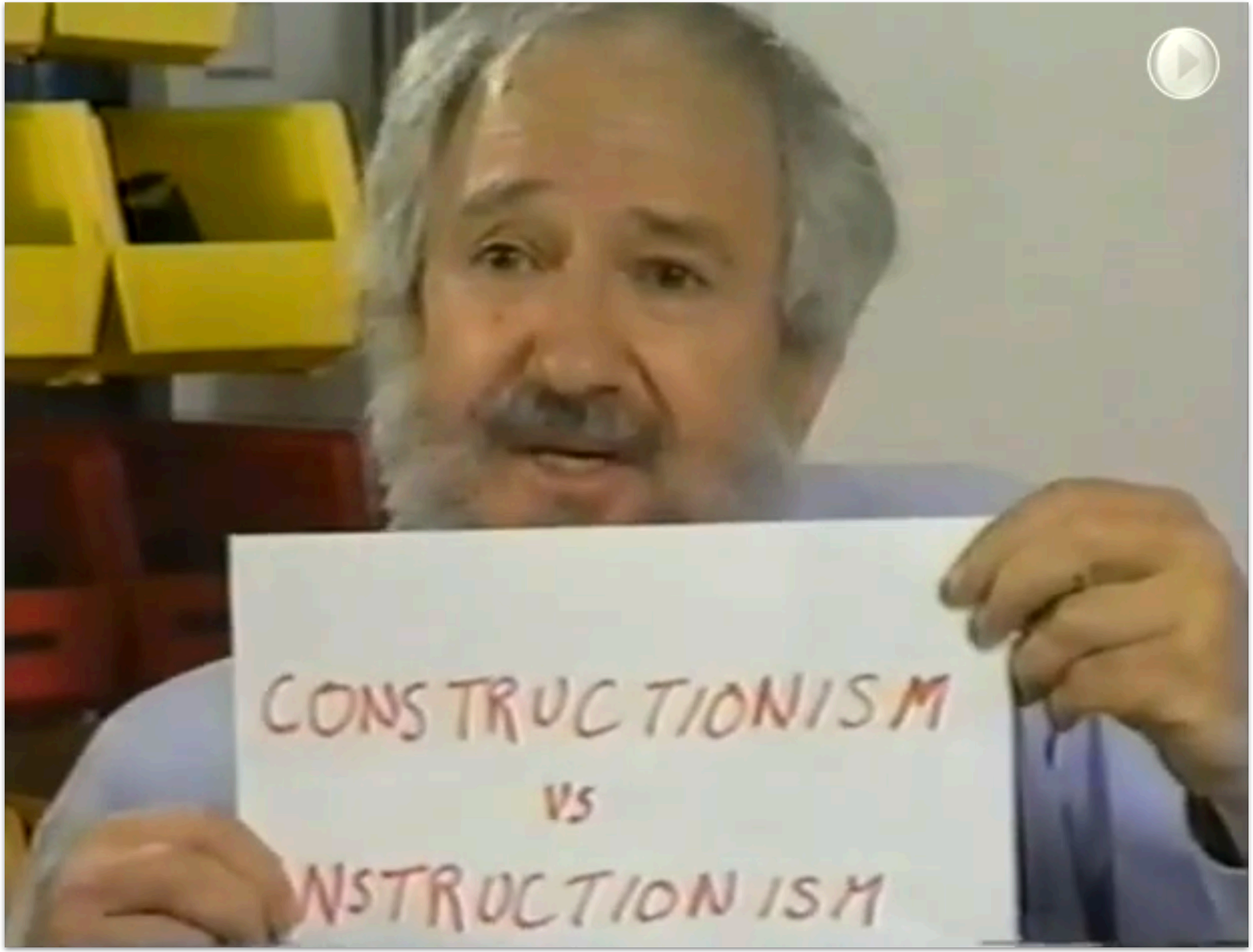
> "Most of the time, interactive whiteboard programs are, in fact, nothing more than vain attempts to buy change. Rarely paired with a clear vision of the classrooms we'd like to see, a set of tangible objectives that can be measured, or any systematic attempts to evaluate outcomes, these high-priced contraptions are sad examples of the careless decision-making and waste that are crippling some of our schools and systems."
>
> — Bill Ferriter, "Why I Hate Interactive Whiteboards" (2010)

How can we restructure the whole experience around the technology?

Seymour Papert
(1928 - 2016)

Inventor of the Logo turtle and language

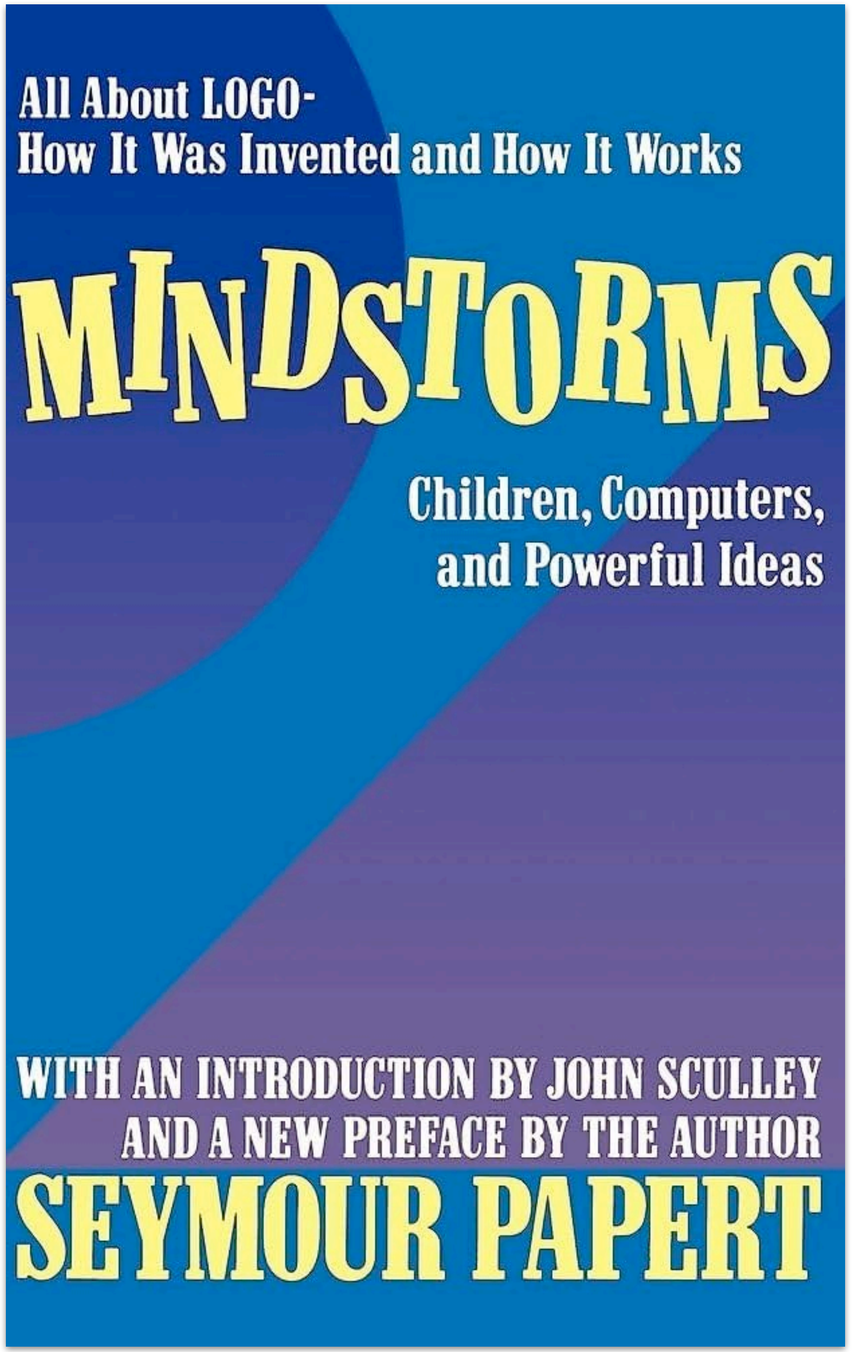
Leader of the constructionist movement



youtu.be/7cUxutkuJdE

“In this book I discuss ways in which the computer presence could contribute to mental processes not only instrumentally but in more essential, conceptual ways, influencing how people think even when they are far removed from physical contact with a computer. It is about an end to the culture that makes science and technology alien to the vast majority of people. […]

The idea of "talking mathematics" to a computer can be generalized to a view of learning mathematics in "Mathland"; that is to say, in a context which is to learning mathematics what living in France is to learning French.”



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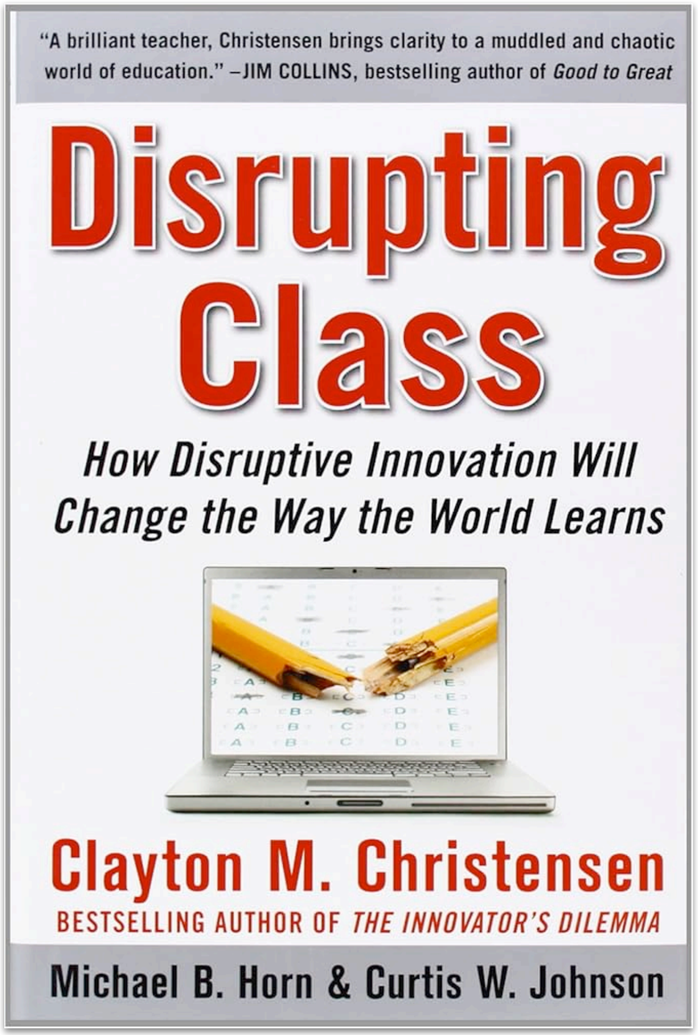
Papert's dream was hard to replicate without him

Through the 1970s and early 1980s, a group of researchers at Edinburgh University ran classroom experiments with Logo. They found that when they worked directly with a small number of students, they came away with positive stories like Papert's. [...]

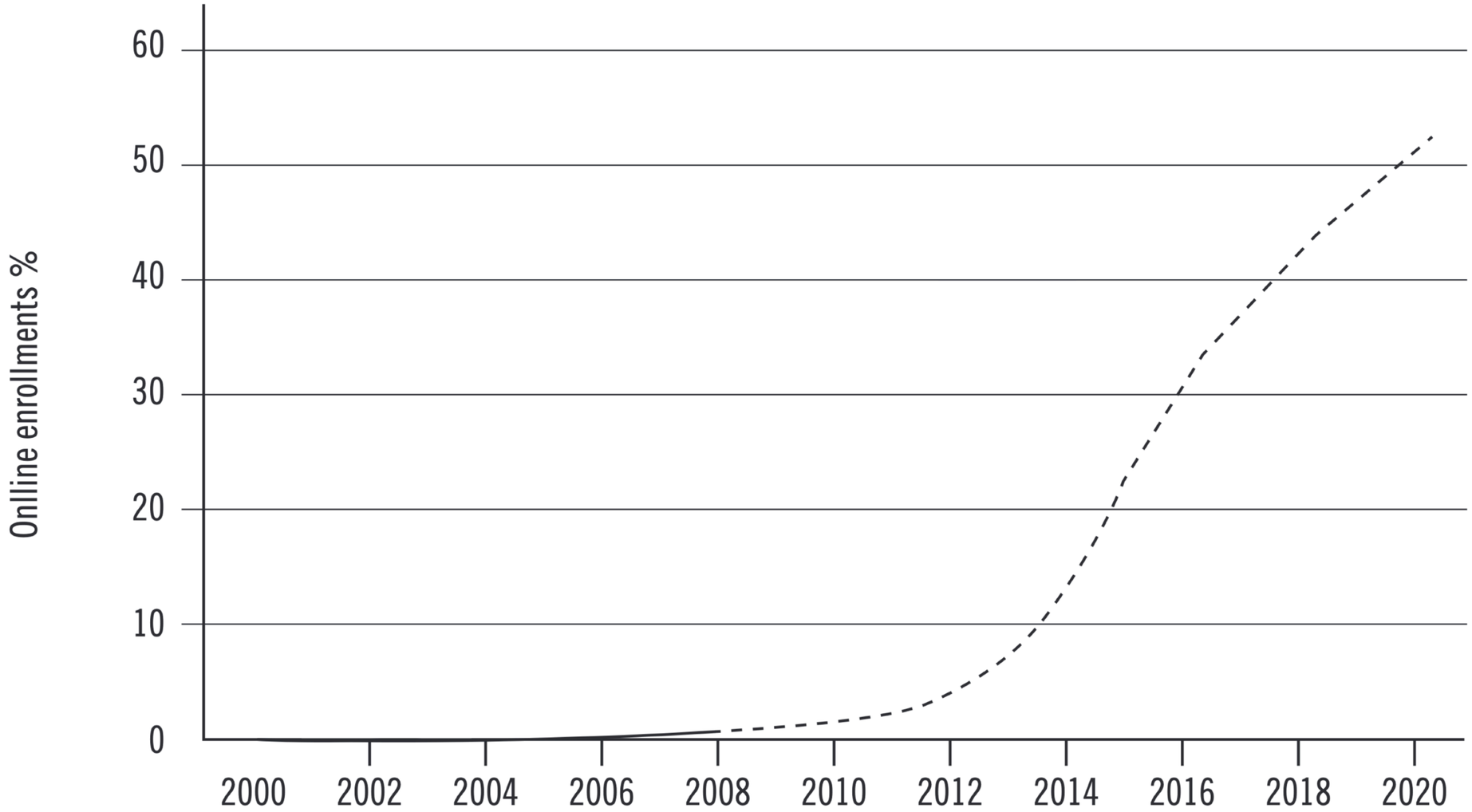
However, Tim O'Shea, one of the researchers in Edinburgh, found that these positive results disappeared if the researchers themselves were not present and actively helping children learn. Once the researcher was gone and a teacher took over, in other words, there were no measurable positive outcomes from using Logo over other kinds of learning. "Even imparting the simpler constructs of Logo in more conventional settings turned out to be very demanding," O'Shea concluded. Moreover, he reported, his group and others had been unable to find any consistent evidence of "skill transfer and other general cognitive benefits" that Logo promised, a finding corroborated by other Logo researchers.

Morgan Ames. "Hackers, Computers, and Cooperation: A Critical History of Logo and Constructionist Learning" 2018

So what if we replicated our best instructors?



HBS profs argued in 2008 that an online course takeoff was imminent



Christensen et al. *Disrupting Class* (2008)

youtu.be/nTFEUsudhfs

2012: The year of the Massive Open Online Course

The New York Times

Opinion

Revolution Hits the Universities

By Thomas L. Friedman

Jan. 26, 2013

The New York Times

VIRTUAL U.

College of Future Could Be Come One, Come All

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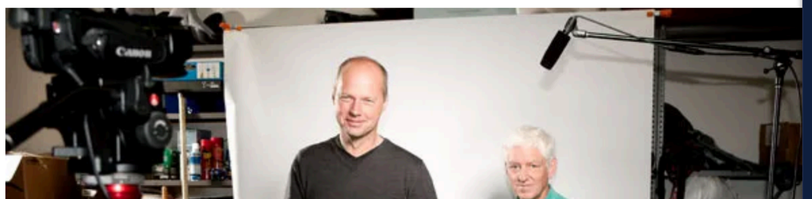
STEVEN LECKART SCIENCE MAR 20, 2012 9:34 PM

The Stanford Education Experiment Could Ch Higher Learning Forever

Wired correspondent Steven Leckart and 160,000 others around globe sign on when two professors let the public take their AI cou online for free.



MIT Technology Review

UNCATEGORIZED

The Crisis in Higher Educatio

Online versions of college courses are attracting hun of students, millions of dollars in funding, and accolad administrators. Is this a fad, or is higher education abo overhaul it needs?

By Nicholas Carr

September 27, 2012

The Atlantic

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BUSINESS

The Big Idea That Can Revolutionize Higher Education: 'MOOC'

Massive open online courses combine the best of college -- exceptional instruction -- with the best of technology -- online interactive learning

By Laura McKenna

MAY 11, 2012 SHARE SAVE

Massive open online courses combine the best of college -- exceptional instruction -- with the best of technology -- online interactive learning. Is this the future of efficient, effective education?

The New York Times

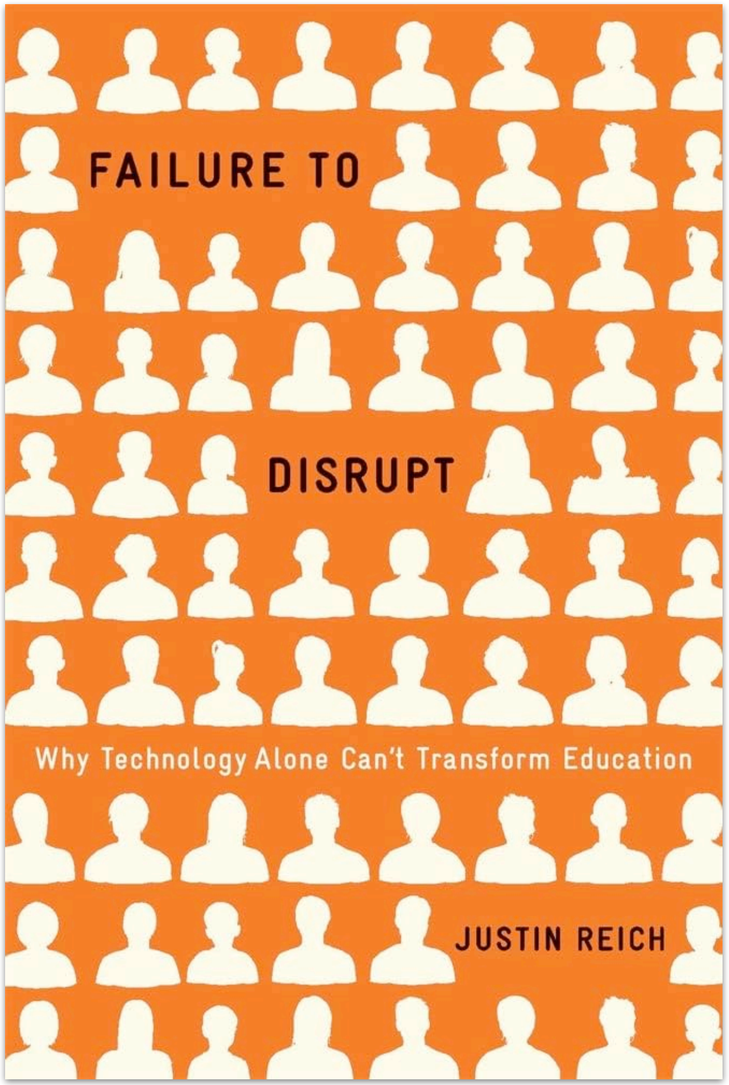
After Setbacks, Online Courses Are Rethought (2013)

Completion rates: “[...] only about half of those who registered for a course ever viewed a lecture, and only about 4 percent completed the courses.”

As a university replacement: “80 percent of those taking the university’s MOOCs had already earned a degree of some kind.”

On mentored MOOCs: “pilot classes [...] did worse than those who took the classes on campus. In the algebra class, fewer than a quarter of the students — and only 12 percent of the high school students — earned a passing grade.”

Justin Reich's theses on the limits of MOOCs



- Innovative MOOC techniques (esp. peer learning) put aside in favor of familiar "instructionist" approach
- Learning gains accrued to high-performing students, not those who needed help the most
- Auto-grading is a too simplistic form of evaluation to give useful feedback

MOOC businesses have not been successful

Udemy Inc

NASDAQ: UDMY

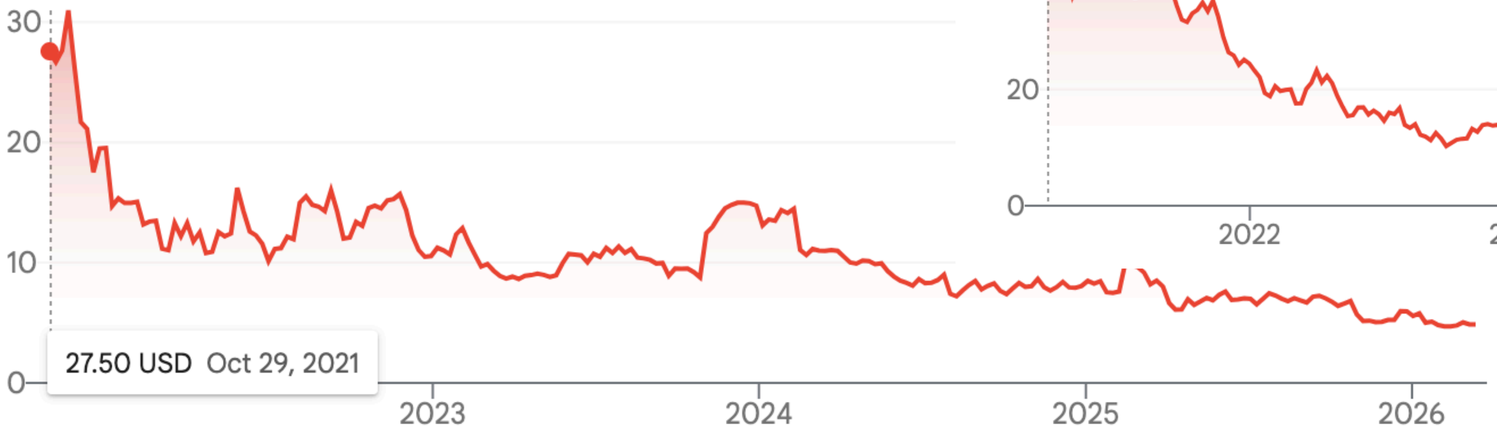
4.86 USD

-22.64 (-82.33%) all time

Closed: Mar 9, 4:03 PM EDT • Disclaimer

After hours 4.86 0.00 (0.00%)

1D | 5D | 1M | 6M | YTD



Coursera Inc

NYSE: COUR

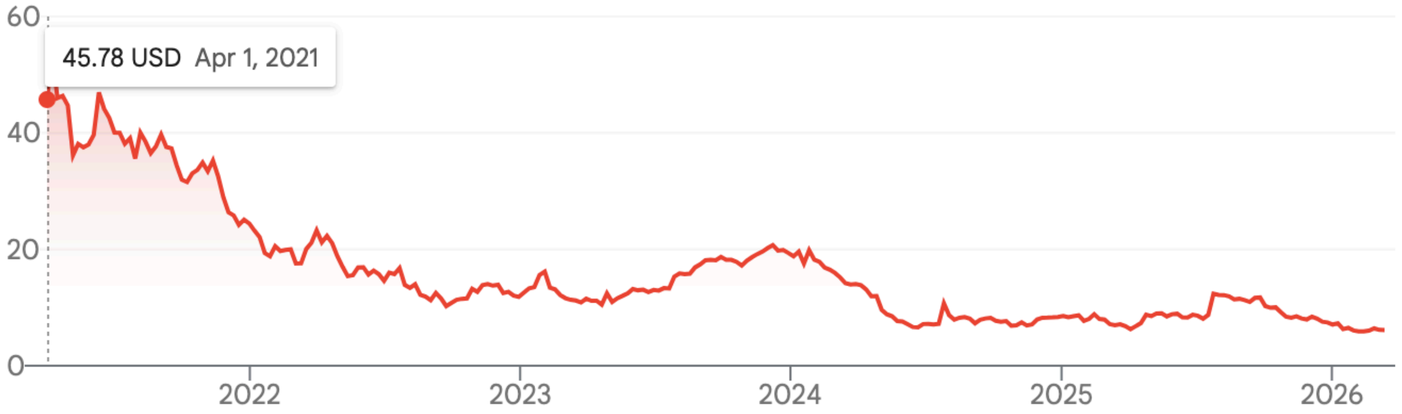
6.15 USD

-39.63 (-86.57%) all time

Closed: Mar 9, 4:03 PM EDT • Disclaimer

After hours 6.15 0.00 (0.00%)

1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max



Recent KA study shows marginal gains on math

- Study: analyze Khan Academy usage of 200,000 students benchmarked against standardized math scores
  - See paper for statistical controls

- On average, students use KA about 10min/week, receiving +0.031SD benefits $\approx$ 0.27 "RIT points"
  - Students generally gain 3-6 RIT points per year under standard math education

- Upper quartile students at 30min/week receive +0.241SD benefits $\approx$ 2.1 RIT points
  - Students who were already high-performing benefit more!

Eames et al. "Computer-assisted learning in the real world: How Khan Academy influences student math learning" 2026

youtu.be/P6FORpg0KVo

Recap

- What is the purpose of an education?
  - To improve society's health, equity, and governance?
  - To improve the US GDP and compete economically with other countries?
  - To keep kids occupied while parents go to work?
- What is the goal of putting computers into education?
  - Fears of low test scores, and a sense that technology is the future
  - Leads to purchases of desktops, smart boards, tablets, etc. with no clear purpose
  - Engaging students vs. teaching students?1
- What are the big ideas in ed tech?
  - Multimedia: students will find videos, interactibles, etc. more engaging
  - MOOCs: the "best" instructors can share their content with everyone
  - Tutors: personalize education to each student based on needs