

The Block Center for Technology and Society Future of Work Initiative

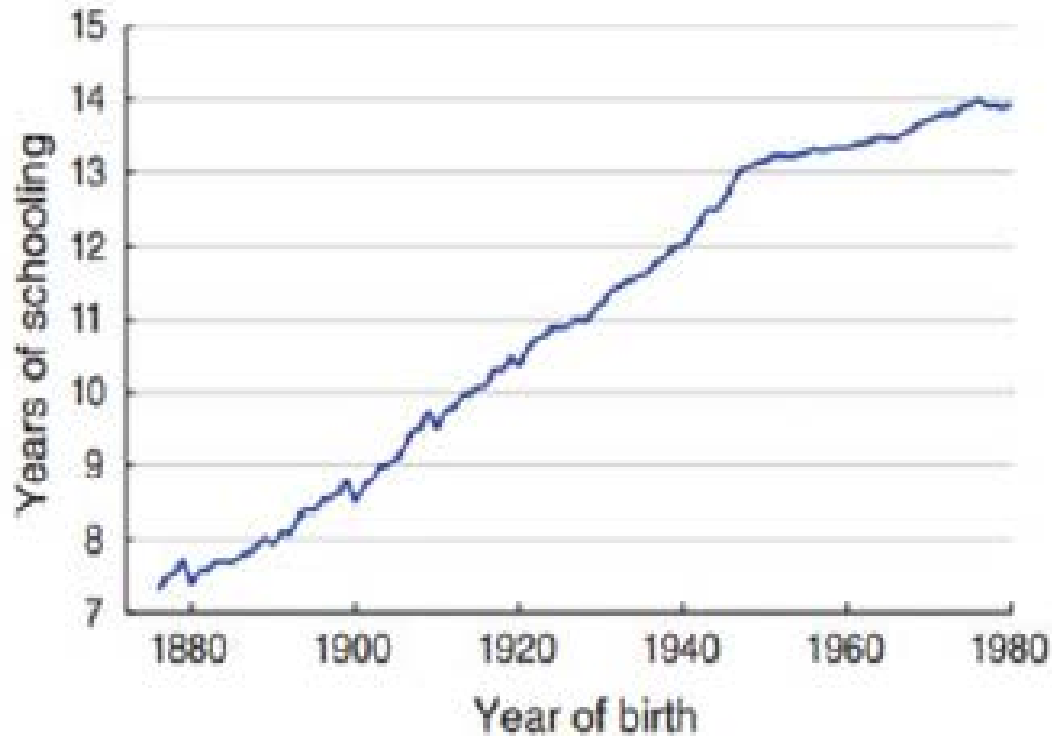
<https://www.cmu.edu/block-center/>



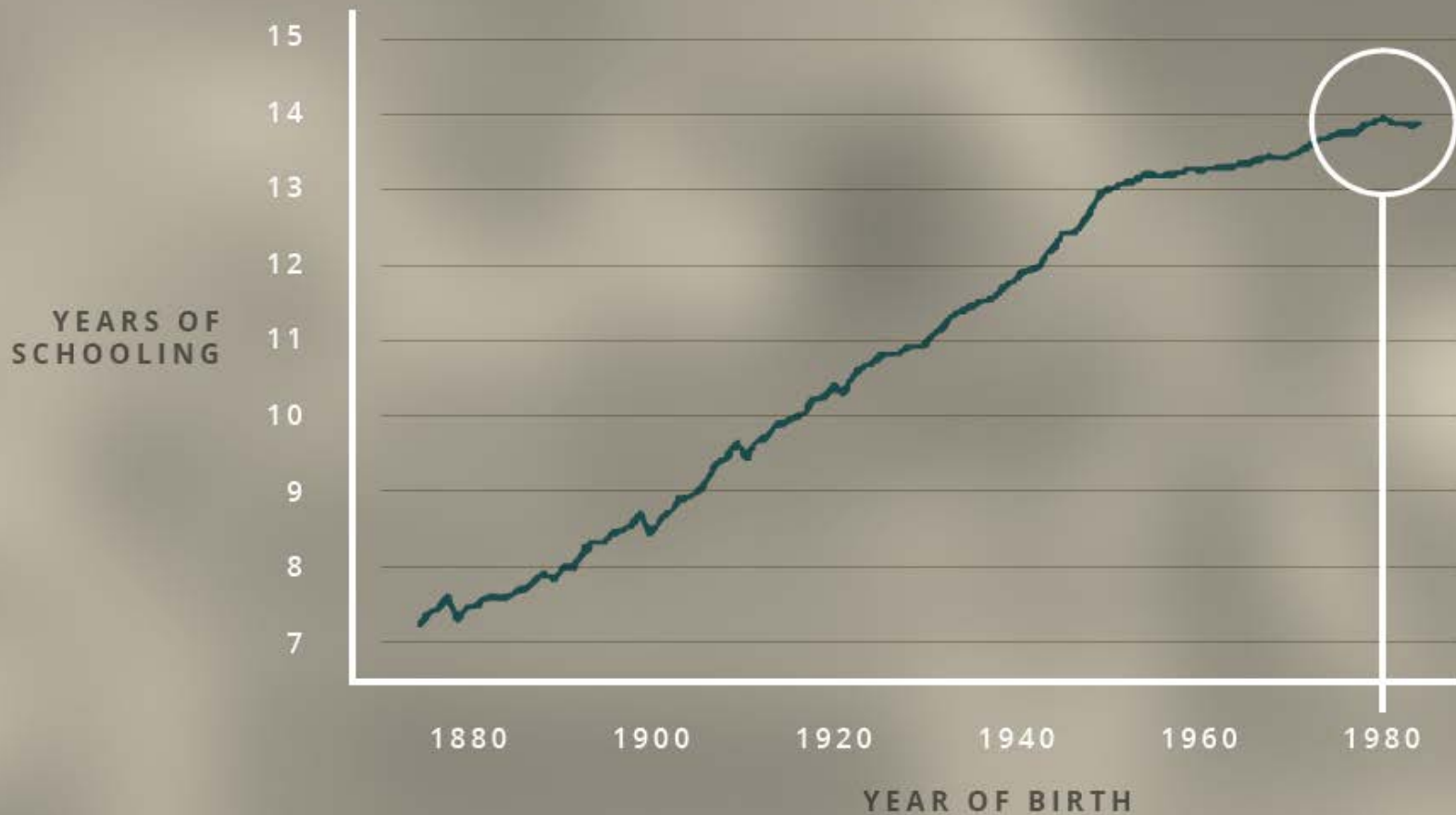
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HeinzCollege

For more than 100 years, America led the world in educating its citizens



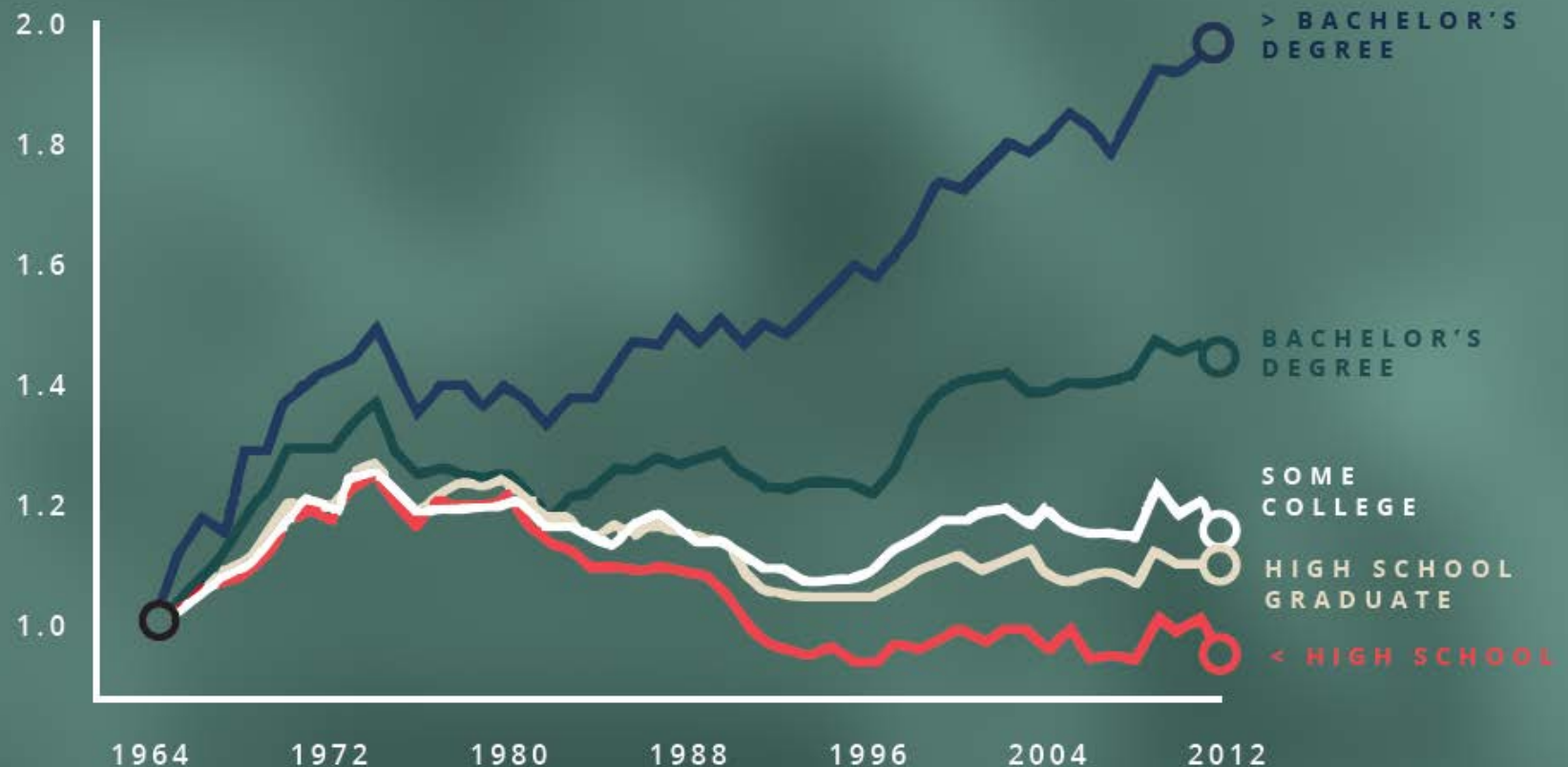
But the supply of skill has grown far more slowly in recent decades



Source: Goldin and Katz, 2008

A growing imbalance between skill supply and skill demand has exacerbated income inequality

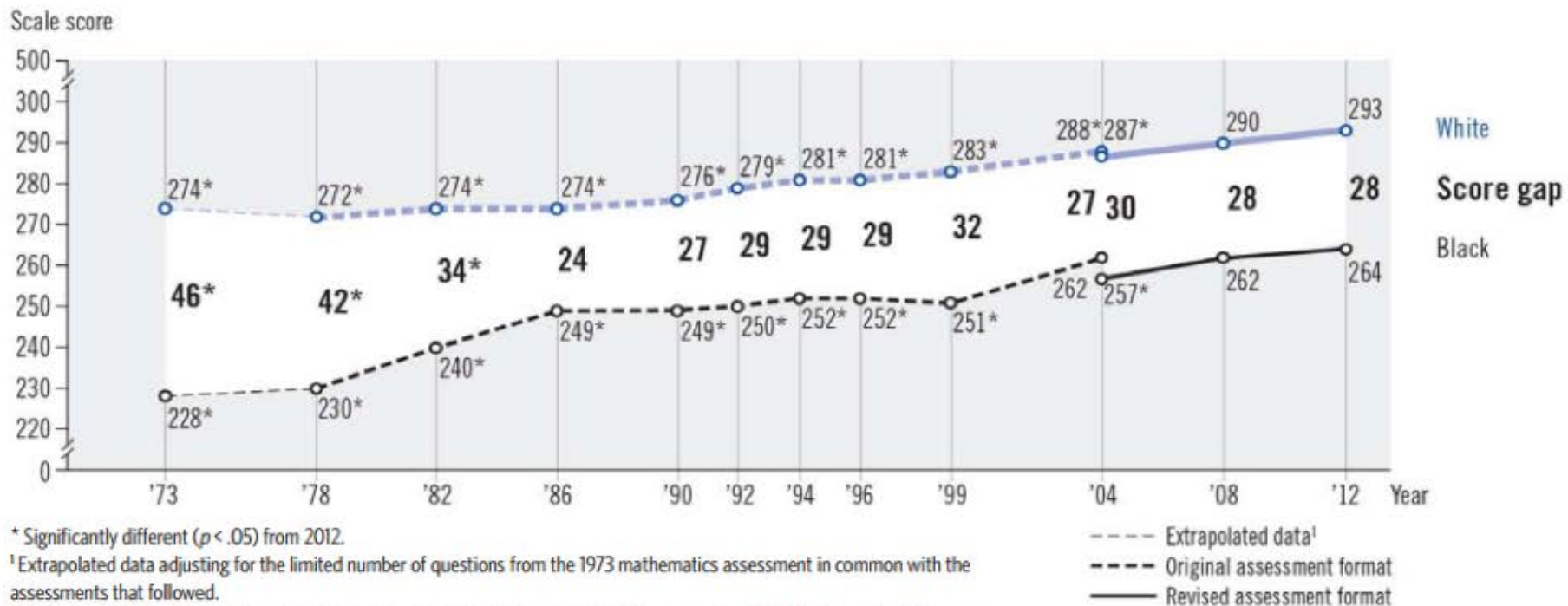
CHANGE IN REAL WAGE LEVELS FOR MALE U.S. WORKERS



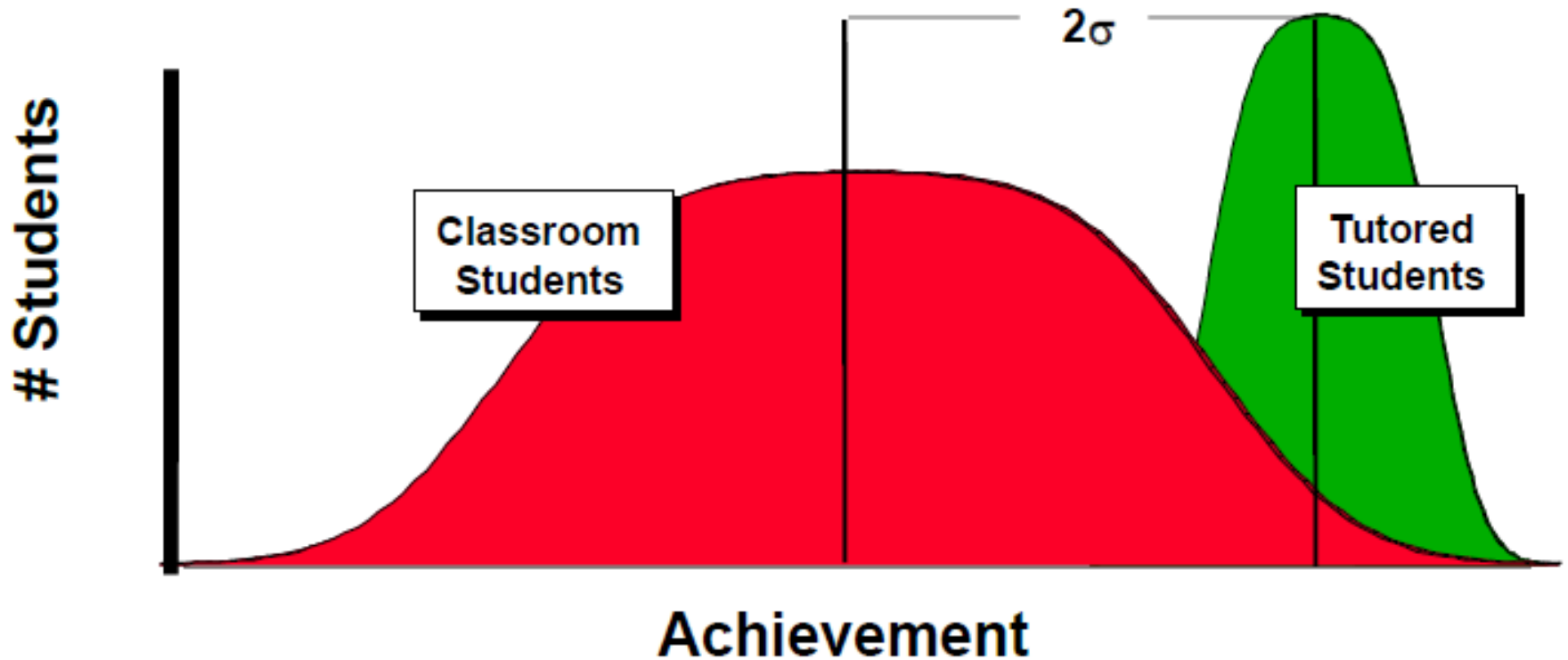
These broad trends hit disadvantaged groups especially hard...

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Figure 25. Trend in NAEP mathematics average scores and score gaps for White and Black 13-year-old students



Foundational research on the impact of personalized learning suggests the possibility of revolutionary advances in education



(Bloom, 1984)

The inspiring lessons of Jon Guryan's research in Chicago...



Prof. Jonathan Guryan
Northwestern University



- Jon's team conducted a large-scale RCT in some of Chicago's most challenged school districts.
- Underperforming male students were provided with intensive 1-on-2 tutoring every day for an academic year, using a program developed by SAGA Innovations.
- The learning gains were large enough to narrow the achievement gap by one-third after just one year.
- The high human resource costs of this program put it beyond the bounds of political feasibility for the districts that need it most.

What if we used AI to accelerate math learning by personalizing math instruction?

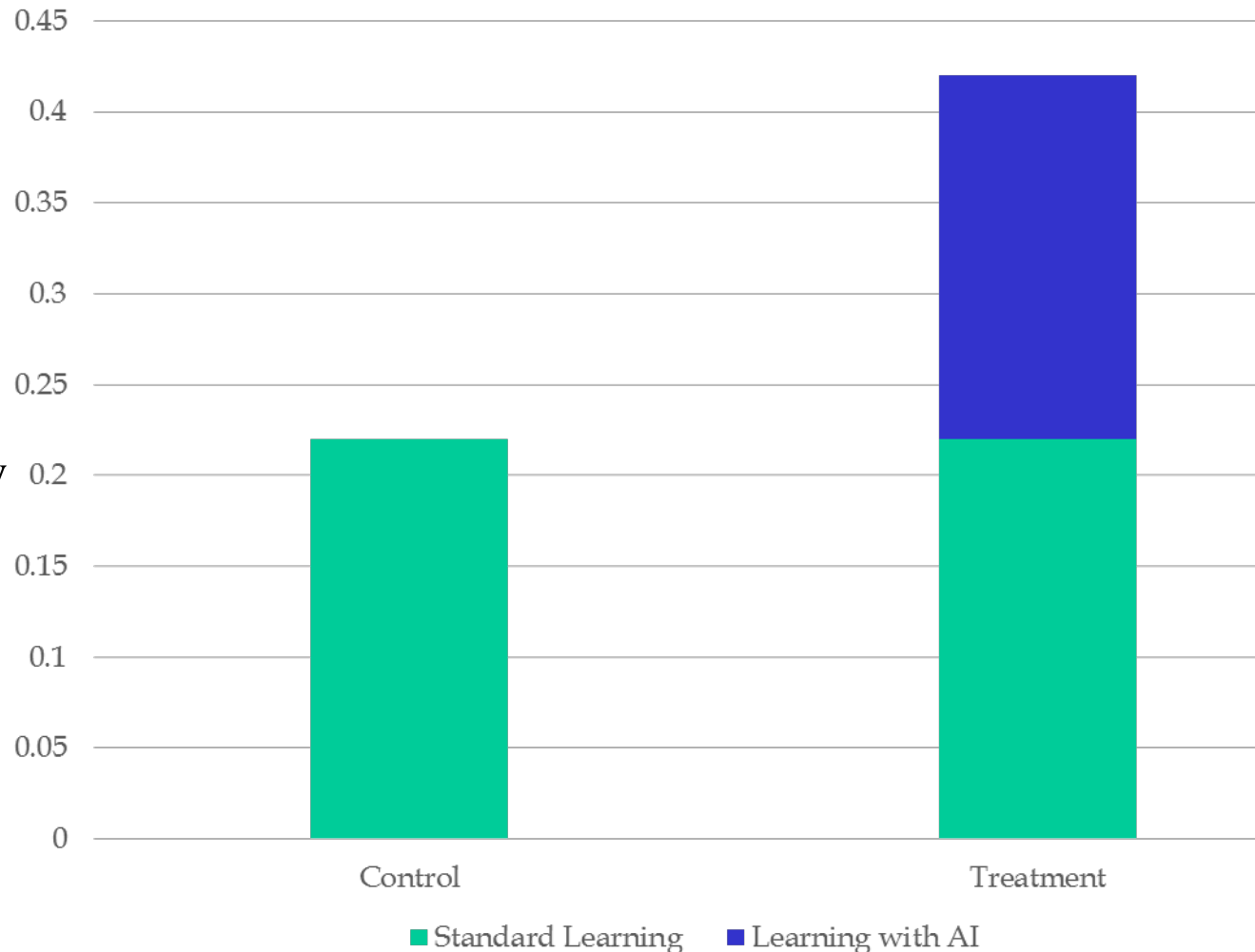
AI systems double the rate of math learning



Prof. Ken Koedinger

Carnegie Mellon University

**CARNEGIE
LEARNING**
LONG + LIVE + MATH



Our plan: run parallel randomized control trials in Pittsburgh and Chicago...



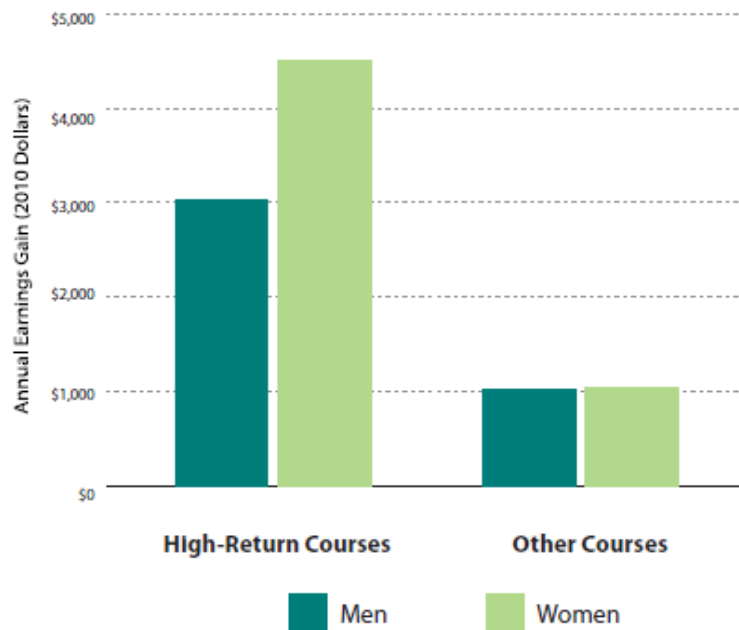
CHICAGO.IL



PITTSBURGH.PA

The biggest benefits from community college education go to those who pursue technical degrees – which often require a significant amount of math!

FIGURE 3
Earnings Gains of Workers in Technical vs. Other Fields



Source: Jacobson et al. (2005b, Table 3, p. 407).

Notes: The figure reports the estimated effects of one year of community college schooling for men and women over 35. Average age of the female sample is 43.6 years; average age of the male sample is 43.1 years (see Jacobson et al. 2005b, Table 1, p. 401). We converted impacts to 2010 dollars using the CPI. We arrive at the per year figures by multiplying the impact per credit per quarter by four times forty-five credits, which is the annual number of credits earned by a regular full-time for-credit student in Washington State.

Math skills deficits are a barrier to success in community colleges and vocational training centers

- Colleges of all kinds find as many as 60% of entering freshman unprepared for college work, most often in mathematics.
- When students are assigned to remedial classes, the pass rate is low (only 38%, according to one study).
- The City University of New York found that the graduation rate for freshman required to take remedial courses was only one quarter that of students who faced no such requirement.
- Mathematics remediation may be the single biggest barrier to increasing graduation rates and this barrier falls especially heavily on members of historically underrepresented groups (Attewell et al., 2006).

We will partner with CCAC to deploy our technology in a community college setting...



- CCAC serves more than 40,000 students (including part-time and noncredit students) annually across 9 campuses and training centers.
- It offers 160 programs of study, and annually awards nearly 2,000 associates' degrees per year to its graduates, as well as over 600 additional certificates and diplomas.
- But many incoming students struggle with serious math skill deficits.



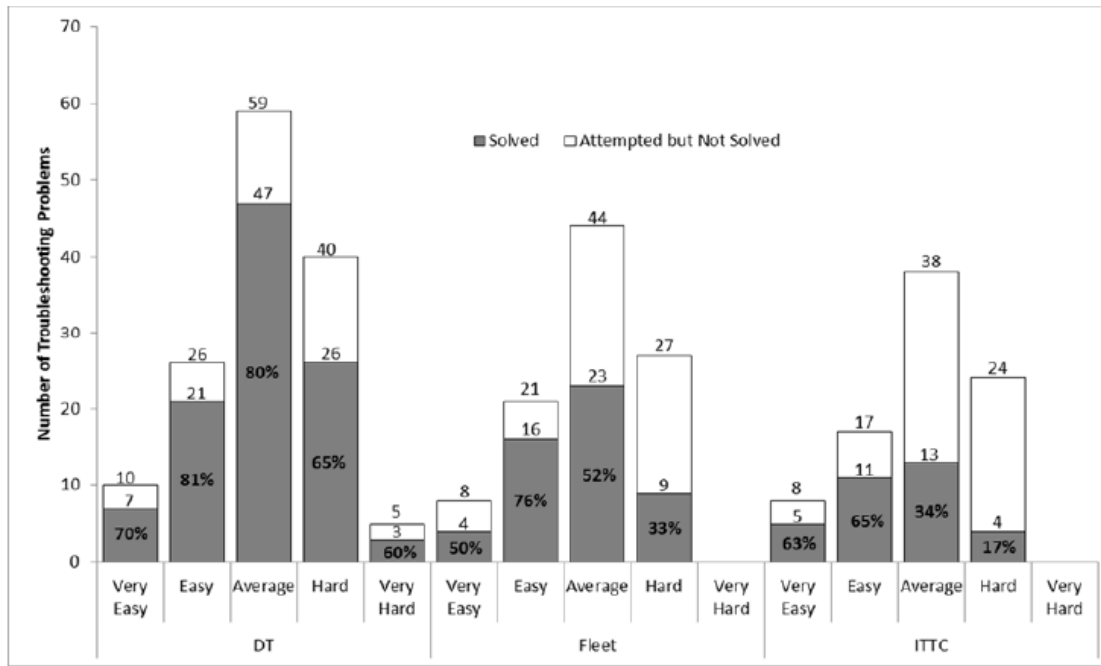
We will also partner with Pittsburgh's Manchester Bidwell Corporation to deploy this technology in a vocational training setting...



Bill Strickland, Founder



Cognitive tutors can also be used to provide more job-specific skills



DT = Digital Tutor

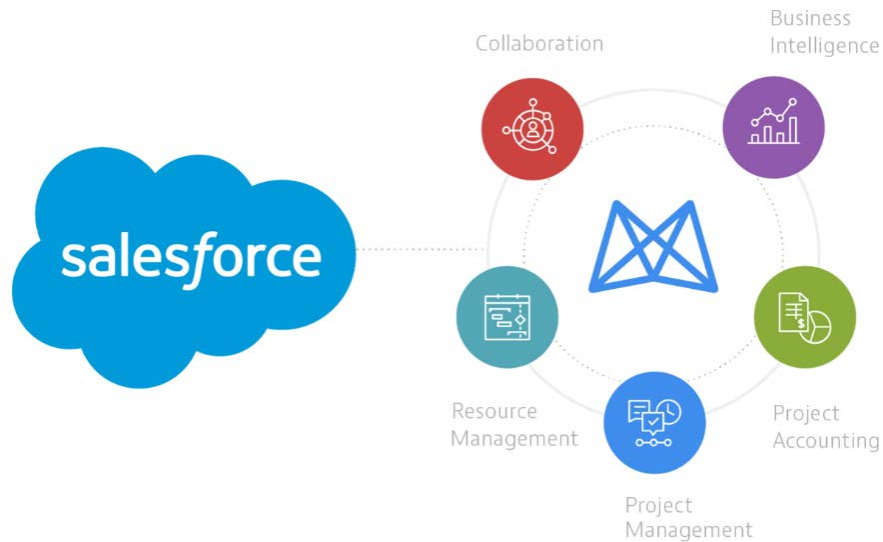
ITTC = Information Technology Training Continuum

Figure 6. Troubleshooting Problems Attempted and Solved by Difficulty Level



Accelerating Development of Expertise: A Digital Tutor for Navy Technical Training

We will develop cognitive tutors that can prepare students for entry-level jobs in the digital economy



New learning technologies and advances in learning science open up the possibilities for a major breakthrough in learning outcomes

- We can accelerate math learning in the K-12 grades.
- We can provide much more effective remediation of math skill gaps in community colleges and vocational training centers.
- We can create new learning models that accelerate job-specific skill formation, providing a new pathway for disadvantaged adults to take advantage of emerging opportunities in the digital economy.
- Getting there will take time and a significant investment in research.

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