J-PAL
ABDUL LATIF JAMEEL POVERTY ACTION LAB

Upgrading Education with Technology: Taking Stock and Looking Forward

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A Sea Change in Education Technology (*i*)

- Renaissance in policy applications
  - Enhancing teaching and curricula
  - Facilitating student-educator communication
  - Expanding access to high-quality content
- Unprecedented access
  - Cell phones
  - Computers
  - Email
  - Text messages
  - Social media
  - Scholastic software
  - Online courses

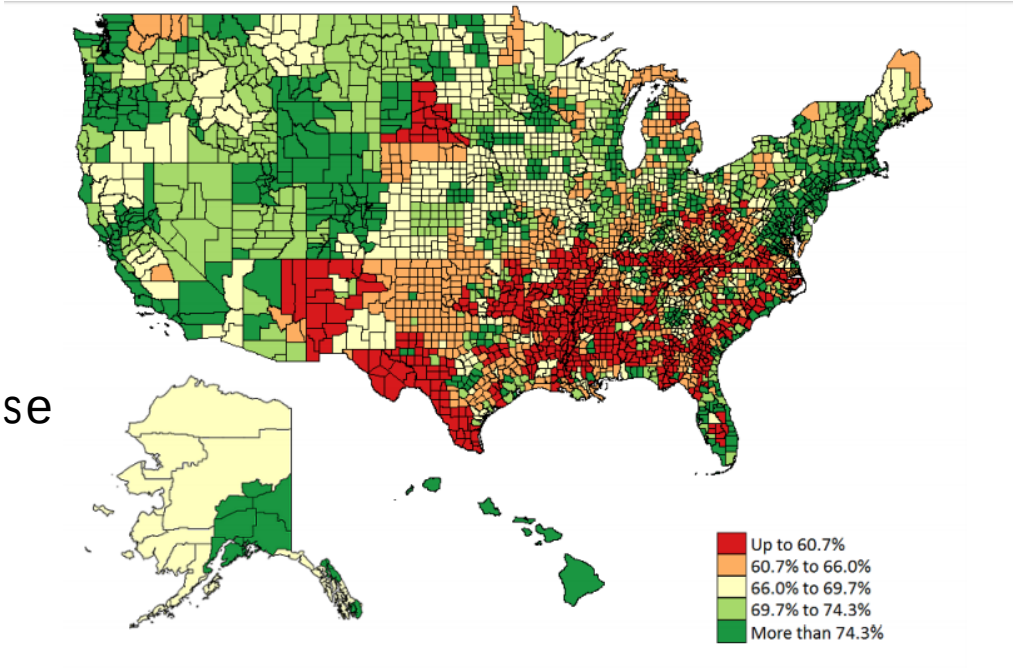
A Sea Change in Education Technology (*ii*)

- Compounding innovations
  - Artificial intelligence
  - Machine learning
  - Big data
- Potential benefits throughout the educational life course
  - Parental involvement
  - Learning and practicing, in and out of the classroom
  - Getting into and succeeding in college
  - Adult education

Education, technology, and inequality

- Enormous disparities in access to quality education
  - Globally
  - Within countries and regions
- When might growing presence of education technology reinforce these disparities?
- How can technology-based interventions improve education for marginalized populations?

Internet Adoption by County (2013)



Source: Council of Economic Advisers

The need for more research

- **Potentially ineffective proliferation of untested programs and approaches**
  - Reliance on software based on educational models that lack evidence
  - Technology-based tools designed without sufficient grounding in the needs of parents, students, and teachers
- **A Need to Understand Mechanisms, context, and generalizability**
  - Rollout and implementation
  - Quality of substitutes (e.g., the quality of instruction that a software module is replacing)
- **Relatively low costs and high potential benefits for Ed-Tech evaluations**
  - Once a platform is established, costs of scale-up frequently approach zero
  - Ed-Tech platforms often support built-in data collection

Literature review objectives

- **Abdul Latif Jameel Poverty Action Lab, North America**
- **Mapping the evidence landscape**
  - What are we most confident about in light of existing rigorous evaluations?
  - What gaps and puzzles remain?
- **Bringing together debates from across the education technology spectrum**
- **Leveraging research insights to guide policy**
  - Which intervention models are most promising for scale-up, and in which contexts are they most likely to succeed?
  - What lessons does the research provide for modifying intervention models and/or adapting them for use in new contexts?

Literature review methodology (i)

- **Identification of starting categories and foundational papers**
  - Access to technology
  - Personalized learning
  - Behavioral interventions
  - Online learning
- **Data-gathering procedures**
  - Keyword searches in Google Scholar
  - Following bibliographies and sources citing already-included articles

Literature review methodology (ii)

- **Inclusion criteria for core studies reviewed**
  - RCTs and RDs
  - Significant technology component

- **Contextual studies**
  - Synthetic reviews and handbook chapters
  - Observational and quasi-experimental analysis
  - Qualitative research and process evaluation

Presentation outline

I. Access to Technology

II. Personalized learning

III. Behavioral interventions

IV. Online learning

Access to technology: Overview

- **15 core papers**
  - 12 RCTs
  - 3 RDs
- Areas of focus
  - Expanding internet coverage (*2*)
  - Giving technology to schools (*3*)
  - Giving computers to students (*9*)
    - Elementary and high school
    - Community college
  - Harmful consequences (*2*)
    - Distractions
    - Antisocial pressures

Access to technology: Evidence (i)

Giving computers to elementary and high school students

- One Laptop Per Child
  - 2.4 million laptops distributed
  - 13 countries
- **Evidence base, 5 studies:**
  - 3rd graders in Beijing migrant schools (1)
  - Elementary students in Peru (2)
    - 1 study on rural schools and one on urban
  - Elementary students in Romania (1)
  - Middle and high school students across 15 schools in California (1)

Access to technology: Evidence (ii)

Giving computers to elementary and high school students

- **Computer proficiency** - Generally **positive impact** on computer skills
  - **0.25 - 0.33 SD increase** in computer skills in China and Romania studies (Mo et al. 2014, Malamud & Pop-Eleches, 2011)
  - Approximate **0.8 SD increase** in XO computer proficiency in urban Peru study (Beuermann et al. 2015)

- **Academic outcomes -** Generally **no impact** on with several exceptions:
  - **0.17 SD increase** in math skills estimated in the China study (Mo et al. 2014)

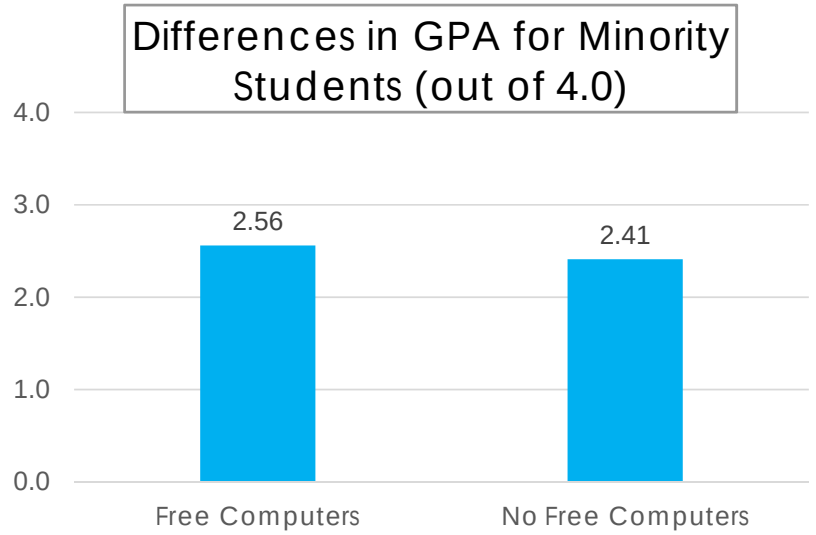
  0.25 - 0.33 SD decrease in grades in the Romania study (Malamud & Pop-Eleches, 2011)

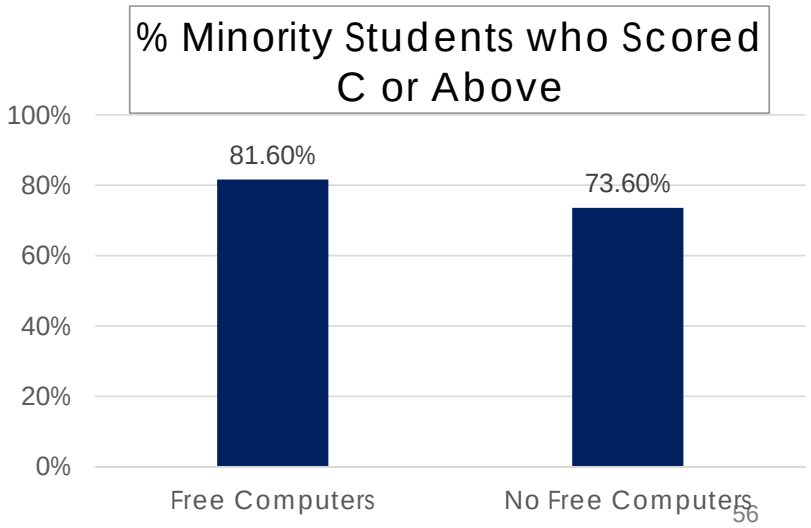
- **Cognitive skills - Mixed findings** depending on context
  - Urban Peru study finds **null impact** (Beuermann et al. 2015)
  - Rural Peru study finds **0.11 SD improvement**, equivalent to ~5 months progress (Cristia et al. 2012)
  - Romania study finds **0.33 SD improvement** (Malamud & Pop-Eleches, 2010)

Access to technology: Evidence (iii)

Giving Computers to Students, Community College

- 4 studies at Butte College in CA (Fairlie, Grunberg, and London)
  - Refurbished laptops for students from *Computers for Classrooms, Inc.*
- **0.14 SD increase** in academic index
- Strongest impact for:
  - Underrepresented minorities, female, low-income, and younger
  - Students with jobs and live farther from campus

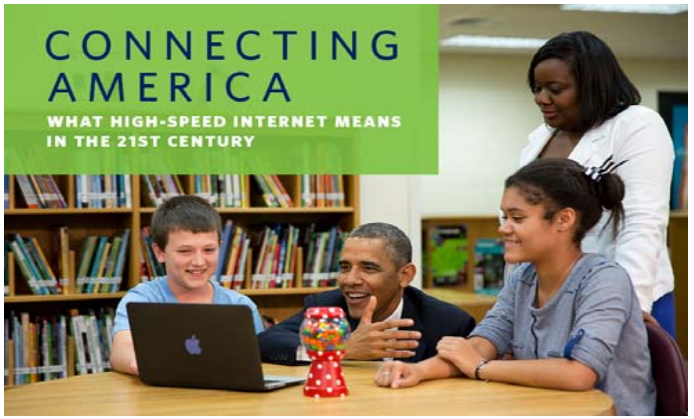




Access to technology: Looking ahead

- Prominent initiatives
  - ConnectED
  - NY Public Libraries

- Future research
  - Identifying the contexts that would benefit most from connectivity
  - Explore more outcomes beyond academic performance
    - Marketable tech skills
    - Access to more resources
    - Social networking
  - Test long-term outcomes of access to technology



I. Access to technology

II. Personalized learning

III. Behavioral interventions

IV. Online learning

Personalized learning: Overview (i)

- **Computer-assisted personalized learning can provide:**
  - Adaptive content better matches each student's level
  - Rapid feedback for students
  - Detailed data for teachers
  - High-quality instruction in low-resource environments
  - Scalability for a pedagogical approach with strong foundation of evidence

Personalized learning: Overview (ii)

- **23 core papers**
  - All RCTs
- Areas of focus
  - Computer-assisted learning (CAL)
    - As substitute for regular class (11)
    - As supplement, held outside regular classes (4)
    - Mix (2)
    - Contrast (1)
    - Comparing adaptive vs. non-adaptive CAL (1)
  - Toolbox of computer-based lessons (3)

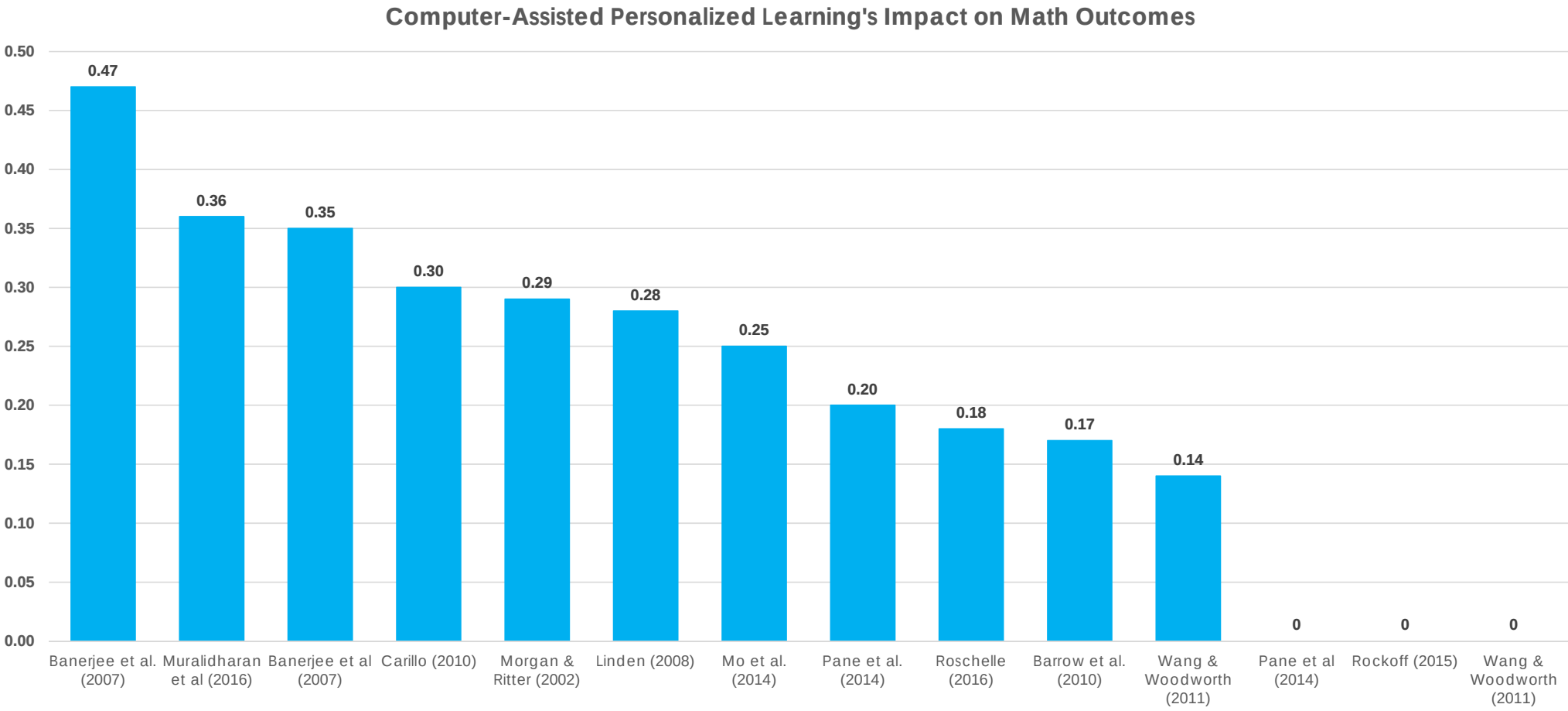
- Subject areas
  - Math (12)
  - Language (5)
  - Multiple subjects (6)

- Location
  - Canada (1)
  - China (1)
  - Ecuador (1)
  - India (3)
  - Netherlands (1)
  - USA (16)

Personalized learning: Evidence (i)

- **Promising evidence of effectiveness on learning**
  - Computer-assisted personalized learning leads to consistently positive impacts especially when used as a complement
  - One study finds a **0.57 SD decrease** when the program is used as a substitute, but a **0.28 SD increase** when used as a complement (Linden 2008)
- **Math interventions seem especially successful**
  - 11 studies showing positive effect and only 2 studies showing no effects
- **Evidence for language is more mixed**
  - 4 studies showing positive effect and 4 studies showing no effects

Personalized learning: Evidence (ii)



Personalized learning: Evidence (iii)

MINDSPARK

Setting: New Delhi, India

Features

- After-school program for 90 minutes a day
- 45 minute per day was with computer assisted learning adapts to learning levels

Impact

- **0.36 SD increase** in math
- **0.22 SD increase** in Hindi

ASSISTments™

Setting: 7th grade in Maine

Features

- Immediate feedback on homework
- Organizes practice problems for students based on principles such as spaced practice and mastery learning

Impact

- **0.18 SD increase** in math

Personalized learning: Looking forward

- New personalized learning programs
  - ALEKS
  - Summit Basecamp
  - AltSchool
- Future research
  - Disentangle causal mechanisms
  - Identify optimal blends of personalized vs. traditional class time
  - Better understand when personalized learning helps students at the top vs. the bottom

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Behavioral interventions: Overview (i)

- Technology and "nudge" interventions
  - Reminders
  - Bits of actionable information
  - Priming
  - Encouragement
- Behavioral economics and education research are overcoming barriers associated with:
  - Time inconsistency
  - Limited cognitive capacity
  - Status quo bias
  - Negative emotions

Behavioral interventions: Overview (ii)

- 39 core papers
  - All RCTs
- Areas of focus
  - Engaging parental participation in early childhood education (5)
  - Improving school-parent information flows (10)
  - Transitioning to and succeeding in college (14)
  - Mindset interventions (5)
  - Text message-based adult education (3)
  - Incentivizing greater student effort (2)

Behavioral interventions: Evidence (i)

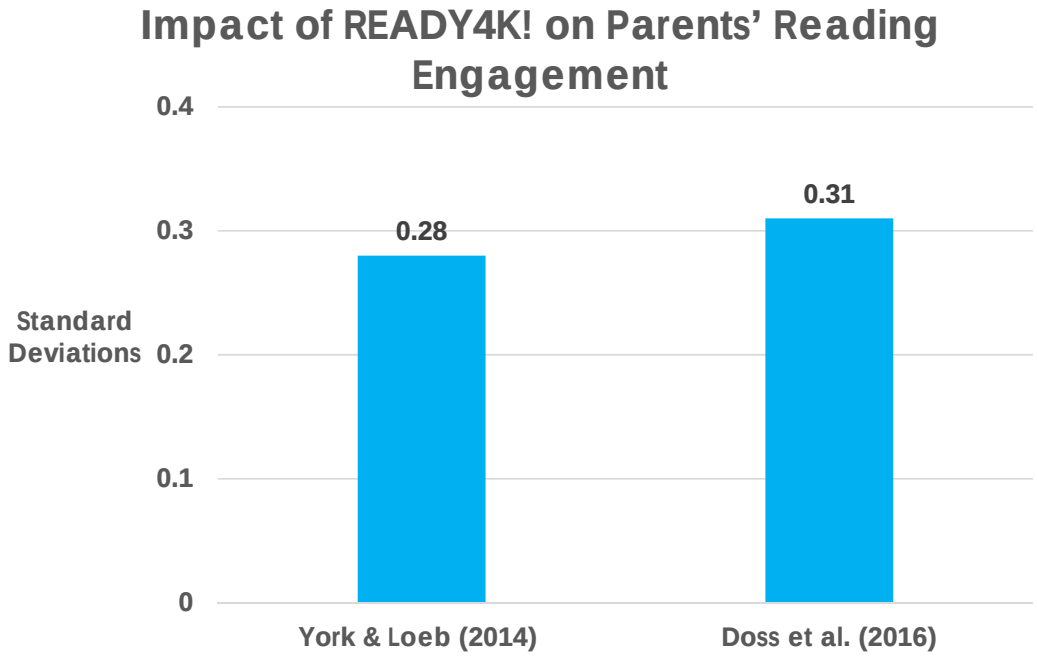
Engaging parents—Practicing skills with young children

- Evidence base (5 studies)
- Outcomes of interest
  - Time spent engaged in learning activities with children
  - Literacy skills development
- Findings
  - Text messages interventions to parents have been successful at increasing their engagement with young children around basic skills practice
    - Early childhood literacy activities (Doss et al. 2016; Hurwitz et al. 2015; Mayer et al. 2015; York & Loeb, 2014)
    - Summer learning loss reduction (Kraft & Monti-Nussbaum, 2017)

Behavioral interventions: Evidence (ii)

READY4K!—York & Loeb (2014); Doss et al. (2016)

- Text messages sent to parents of preschoolers (York & Loeb, 2014) and Kindergartners (Doss et al. 2016)
- 3 texts weekly, covering
  - "Facts"
  - "Tips"
  - "Growth"
- E.g."Bath time is great for teaching your child important skills for K. Start by asking: What are the things we need for bath time?"



Behavioral interventions: Evidence (iii)

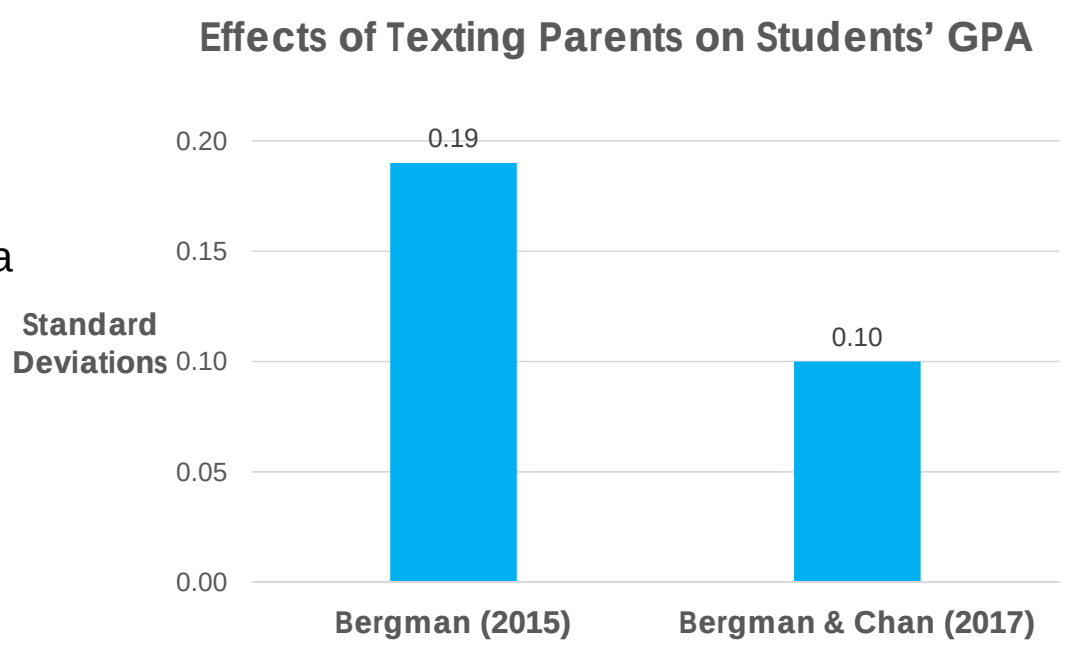
Improving information flows to parents

- Evidence base (9 studies)
- Outcomes of interest
  - Academic achievement
  - Attendance
  - Behavior
- Findings
  - Text messages to parents with updates on the above can improve these outcomes
    - All but one study (Balu et al. 2016) showed **positive impacts** on at least one key outcome
  - Two basic approaches have been evaluated, and both have shown promise:
    - Large-scale, automated texting (Balu et al. 2016; Bergman 2015; Bergman and Chan 2017; Bergman & Rogers, 2016)
    - Personalized messages written by teachers (Kraft & Dougherty, 2013; Kraft & Rogers, 2015)

Behavioral interventions: Evidence (iv)

Texting middle/high schoolers' parents—Bergman (2015); Bergman & Chan (2017)

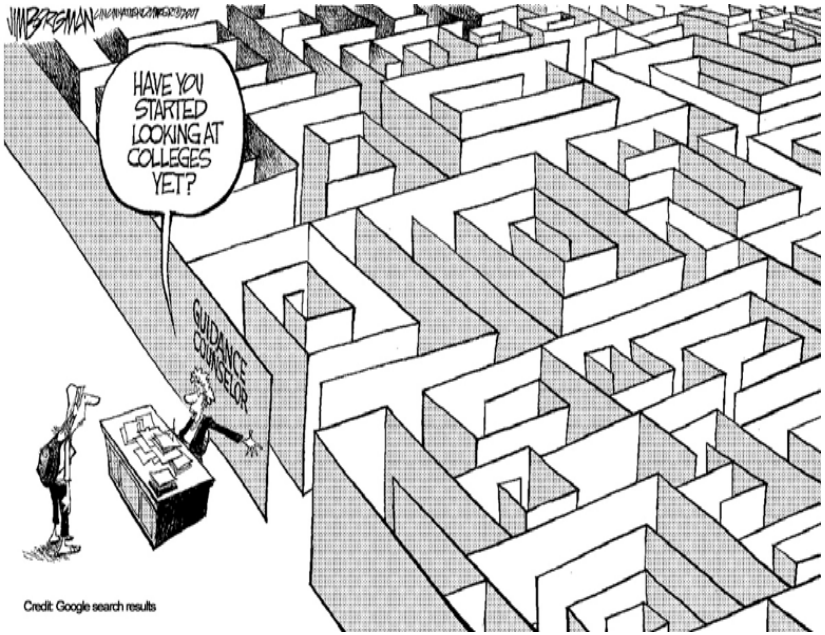
- Bergman (2015)
  - One public school, California
  - Text messages, emails, and/or phone calls
- Bergman & Chan (2017)
  - 22 public schools, West Virginia
  - Text messages only
- What explains the difference in effect size?
  - Population?
  - Scale?
  - Involvement of multiple communication channels?



Behavioral interventions: Evidence (v)

Transitioning to college

- Evidence base (13 studies)
- Outcomes of interest
  - Applying to and getting into college
  - Applying for/receiving financial aid
  - Enrollment/other administrative tasks
  - Academic success
- Findings
  - Text message nudges can improve college enrollment and financial aid filing (Castleman & Page, 2015; 2016A; 2016B; Page & Castleman, 2016)
  - Some studies suggest that more intensive assistance (Bettinger et al.) yields strong effects, and at least one information-only intervention showed no impact

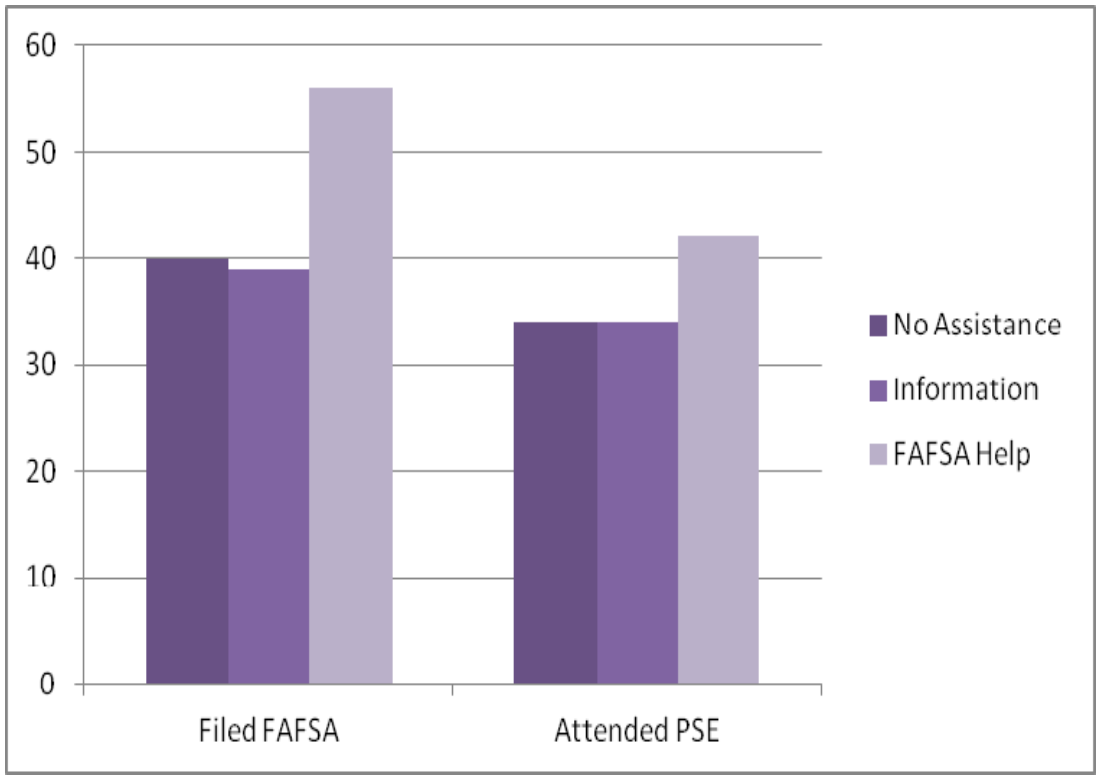


Behavioral interventions: Evidence (vi)

H&R Block and the FAFSA Experiment—Bettinger et al. (2012)

- H&R block program offers clients with college-age kids free FAFSA filing

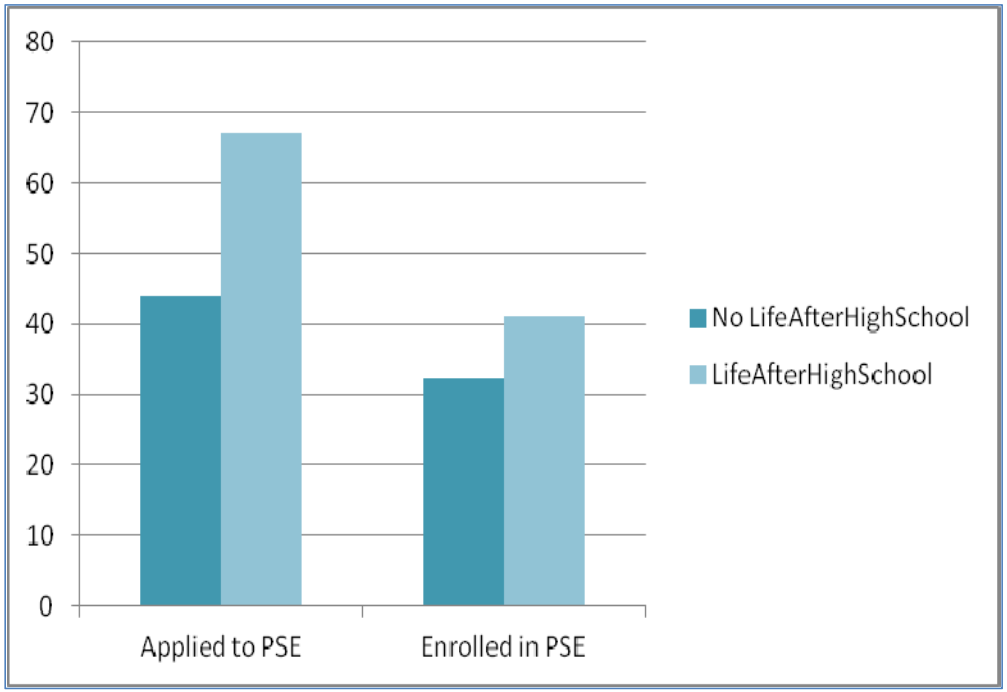
- Tax entry system is linked to FAFSA for automatic population of fields, so that FAFSA can be generated within minutes after tax interview completion



Behavioral interventions: Evidence (vii)

LifeAfterHighSchool—Oreopoulous & Ford (2016)

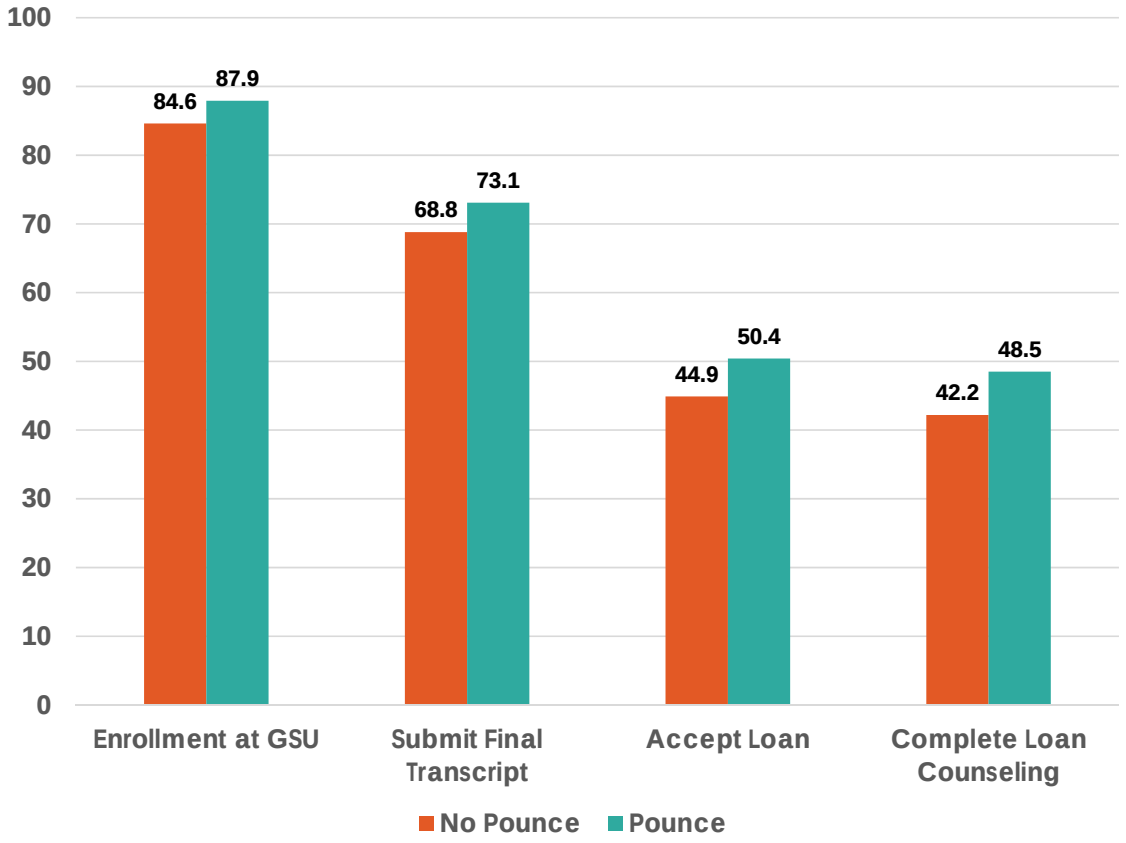
- High schools selected based on low transition rates to college
- 12th graders attend 3 workshops (60-70 mins each) during class time
  - Choose programs of interest and try budget calculator
  - Begin financial aid application, email parent to complete
  - Apply for college or university programs at no cost



Behavioral interventions: Evidence (viii)

Artificial intelligence and the transition to college—Page & Gehlbach (2017)

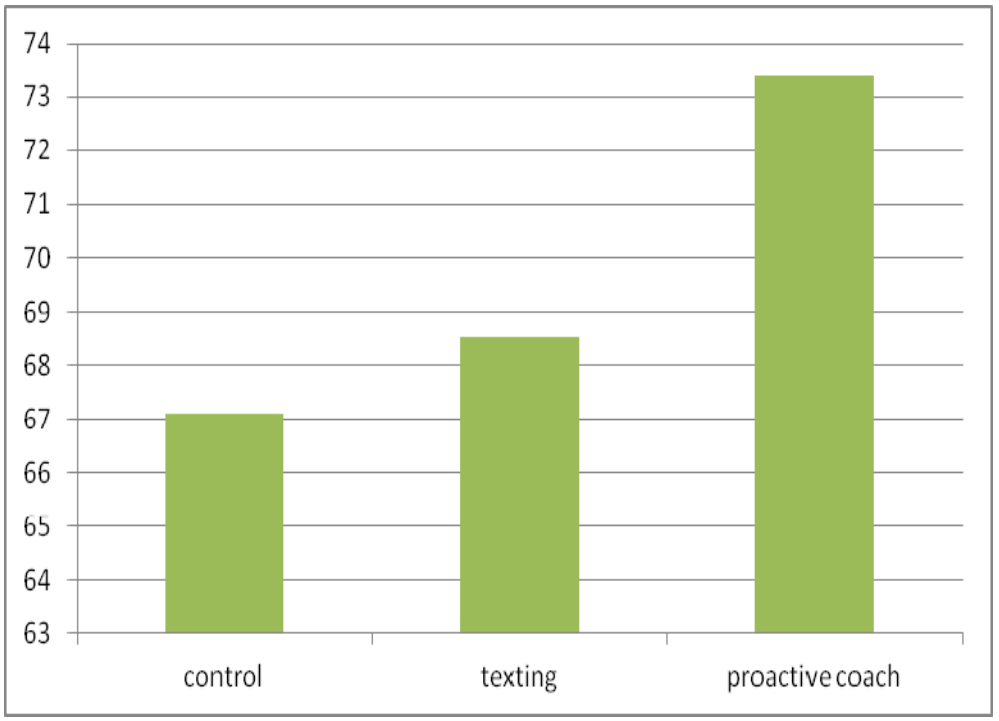
- Designed and implemented at AdmitHub for Georgia State University
- Text students about topics like financial aid, enrollment forms, registration, and deposits
- Computer helps interpret response to messages
- 88% of students send at least one message
- Computer handled 90%+ of messages



Behavioral interventions: Evidence (ix)

How Far Can Technology Go? — Oreopoulos & Petronijevic (2017)

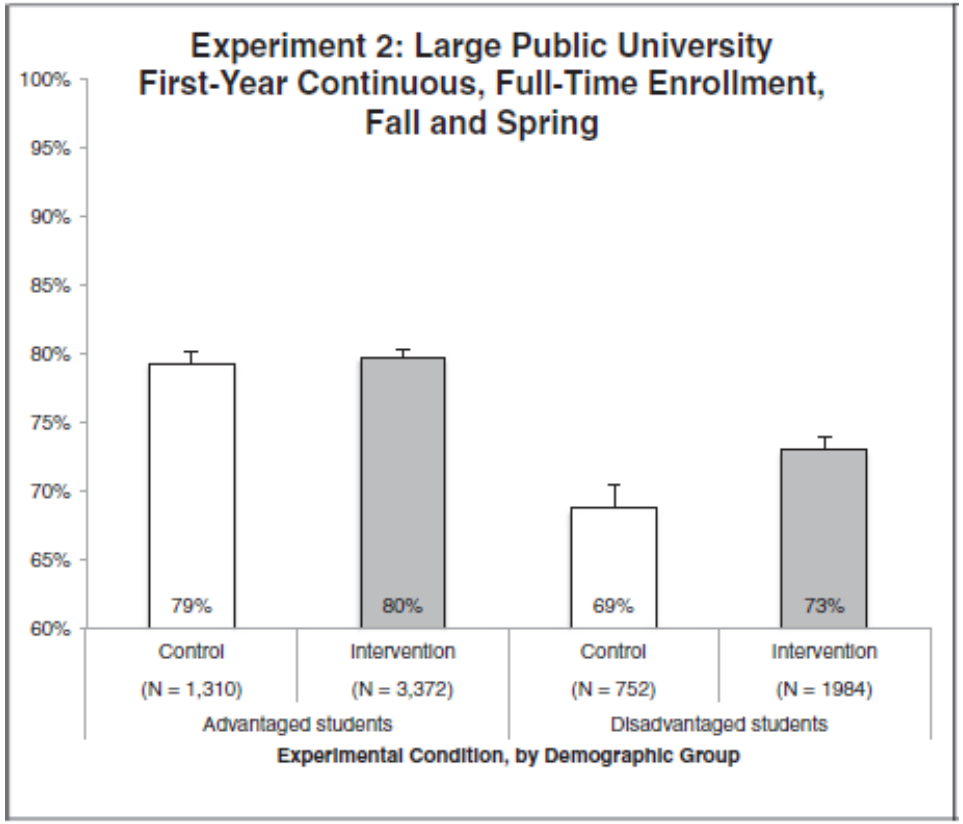
- Online exercise to think about future goals and strategies for this year's academic success
- Electronic college coach providing tips, advice, motivation, and personal support for one year:
- **0.1 SD increase** in year grades, but much higher effect from personalization



Behavioral interventions: Evidence (x)

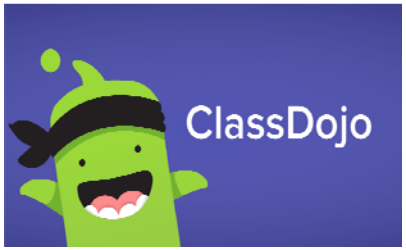
Mindset interventions— e.g. Yeager et al. (2016)

- 5 tech-based online RCTs
- Encourage students to see their situation in different perspective
- Setbacks, feeling out of place, lack of motivation normal, but how one approaches these matters
- Opportunity for frequent experiments to learn what works
- Initial large scale results find small short-term effects on disadvantaged sub-groups



Behavioral interventions: Looking forward

- Promising initiatives
  - Class Dojo
  - iPASS
  - Dell Scholars



DELL SCHOLARS PROGRAM
MICHAEL & SUSAN DELL FOUNDATION

- Future research
  - How to better customize text messages to encourage parental participation
  - Finding optimal personalization amounts for text messaging-based school-parent communication interventions
  - Finding the right balance between intensive and light-touch application assistance
  - Identifying the most effective mindsets, as well as when and where they work best

I. Access to technology

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Online learning: Overview (i)

- Approaches
  - Conventional distance courses
    - Middle and high school
    - College
  - MOOCs (Massive Open Online Courses)
- Potential benefits
  - Equitable access
  - Cost reduction
  - Scalability
- Potential drawbacks
  - Rapport with instructors
  - Social networks

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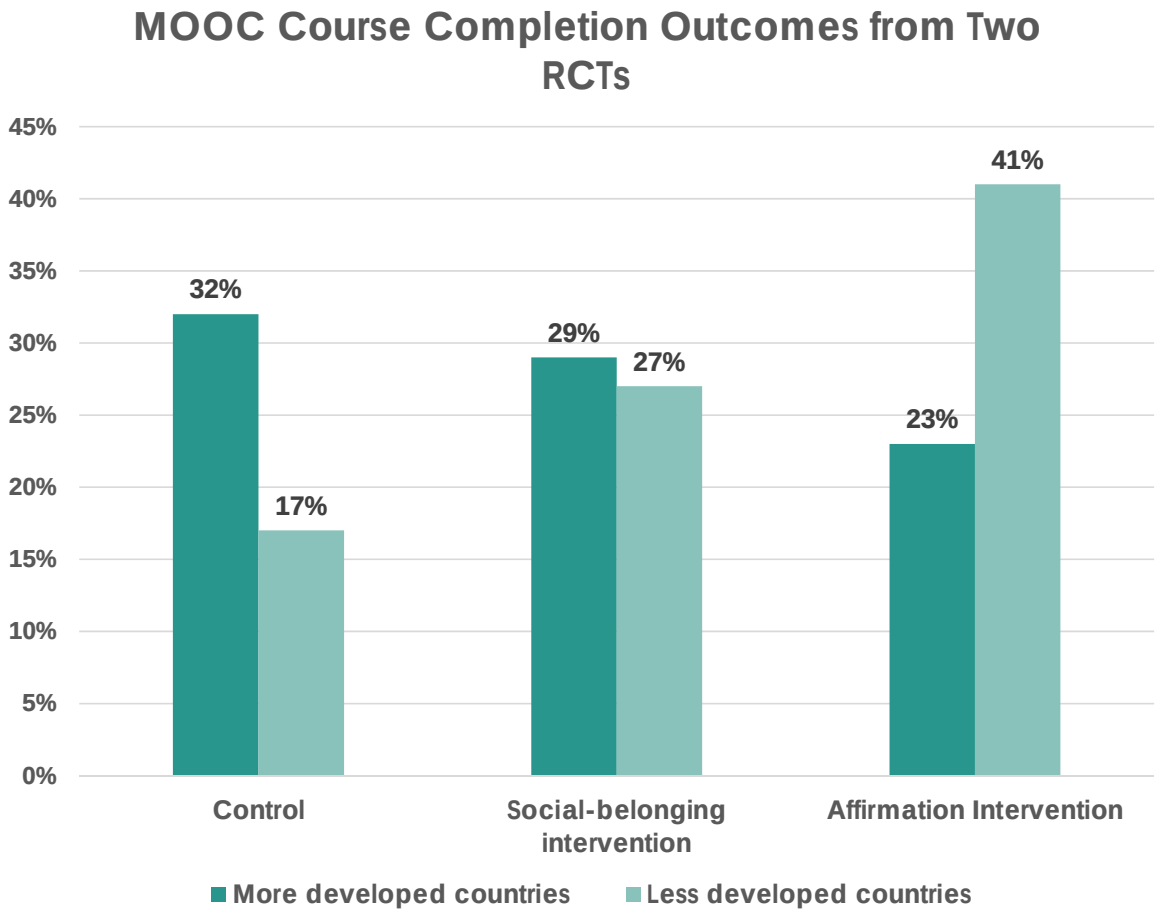
Online learning: Evidence (i)

Online and blended college courses

- Findings
  - Offering online degree option increases enrollment by slightly more than **20 percentage points** (Goodman et al. 2016)
  - In-person vs. blended vs. online only college courses
    - In-person > Online only
      - Individuals in online only courses do **significantly worse** than those studying in-person courses (Alpert et al. 2016)
    - Blended and in-person learning are equally effective
      - There are **no significant differences** in achievement between in-person courses and blended learning courses (Alpert et al. 2016, Joyce et al. 2015, Bowen et al. 2014)

Online learning: Evidence (iv)

- Potential of MOOCs to reach disadvantaged populations
- **15 percentage point gap** in course completion rates between more developed and less developed countries
- Social-belonging intervention left no significant gap between more developed and less developed countries
- Affirmation intervention increased completion for less-developed countries from **17% to 41%**



Source: Kizilcec et al. (2017)

Online learning: Looking ahead

- Prominent initiatives
  - Independent learning modules
    - Khan Academy
    - BrainPop
  - Certifications
    - NanoDegrees
    - MicroMasters
- Future research
  - Establish indicators beyond completion rates to chart the potential impacts of MOOCs
  - Find ways to encourage MOOC usage among non-elite populations
  - Explore online learning outcomes against lower-quality benchmark
  - Test how online courses work for classes in different subject areas
  - Cost-effectiveness of online learning relative to alternatives

Conclusions (*ii*)

Huge potential for incorporating technology into education

Caution is warranted, healthy to be skeptical

Computer Assisted Learning shows most promise so far for generating largest impact

Computers for disadvantaged students also seems worthwhile

Plenty or room to test more nudging to students

Cost needs to be taken into account

Evidence from wide range of countries and contexts

Let's get to work!

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Thank you

For follow-up questions, please email:

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