



UNIVERSITY OF ILLINOIS
COLLEGE OF MEDICINE

Medical Education

Precision Education: Innovations in Learning through AI Analytics Systems in Healthcare and Education

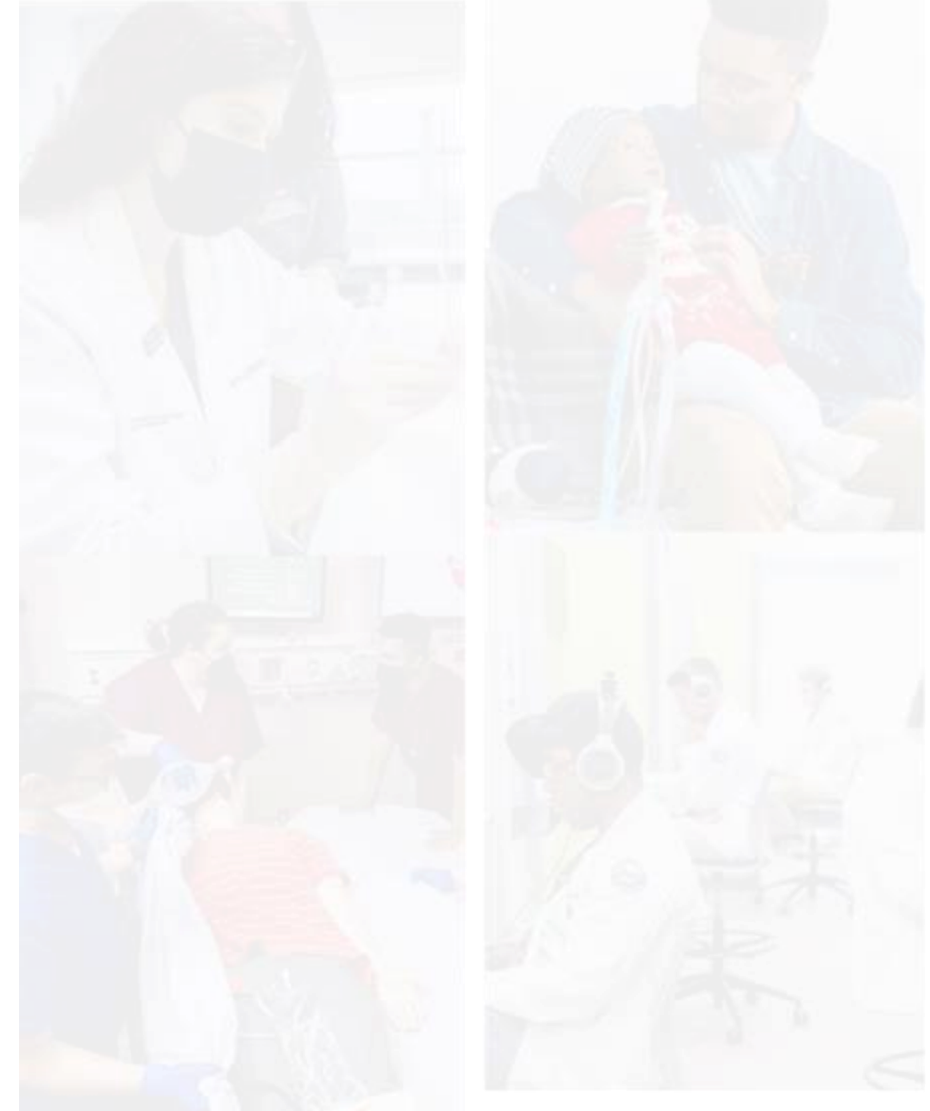
Yoon Soo Park, PhD

Ilene B. Harris Endowed Professor

University of Illinois College of Medicine

Topics for Presentation

1. Precision Education
 - Educational Concepts
2. Precision Education – Healthcare Training
 - Adaptive Virtual Patient
 - Learning Analytics
 - Data Science
3. Precision Education – “High Touch High Tech”
 - Vietnam and Uruguay
4. Summary and Implications



What leads to ↑ learning – 50 Years of Evidence

What leads to
↑ learning



Instruction

Active Learning
Project-Based Learning
Flipped Classroom
Mastery-Based Learning
Small-Group Learning

School factors
Household factors
Socioeconomic factors
Homework
Reducing class size
Instructional approach
Feedback
Curriculum
⋮



Feedback

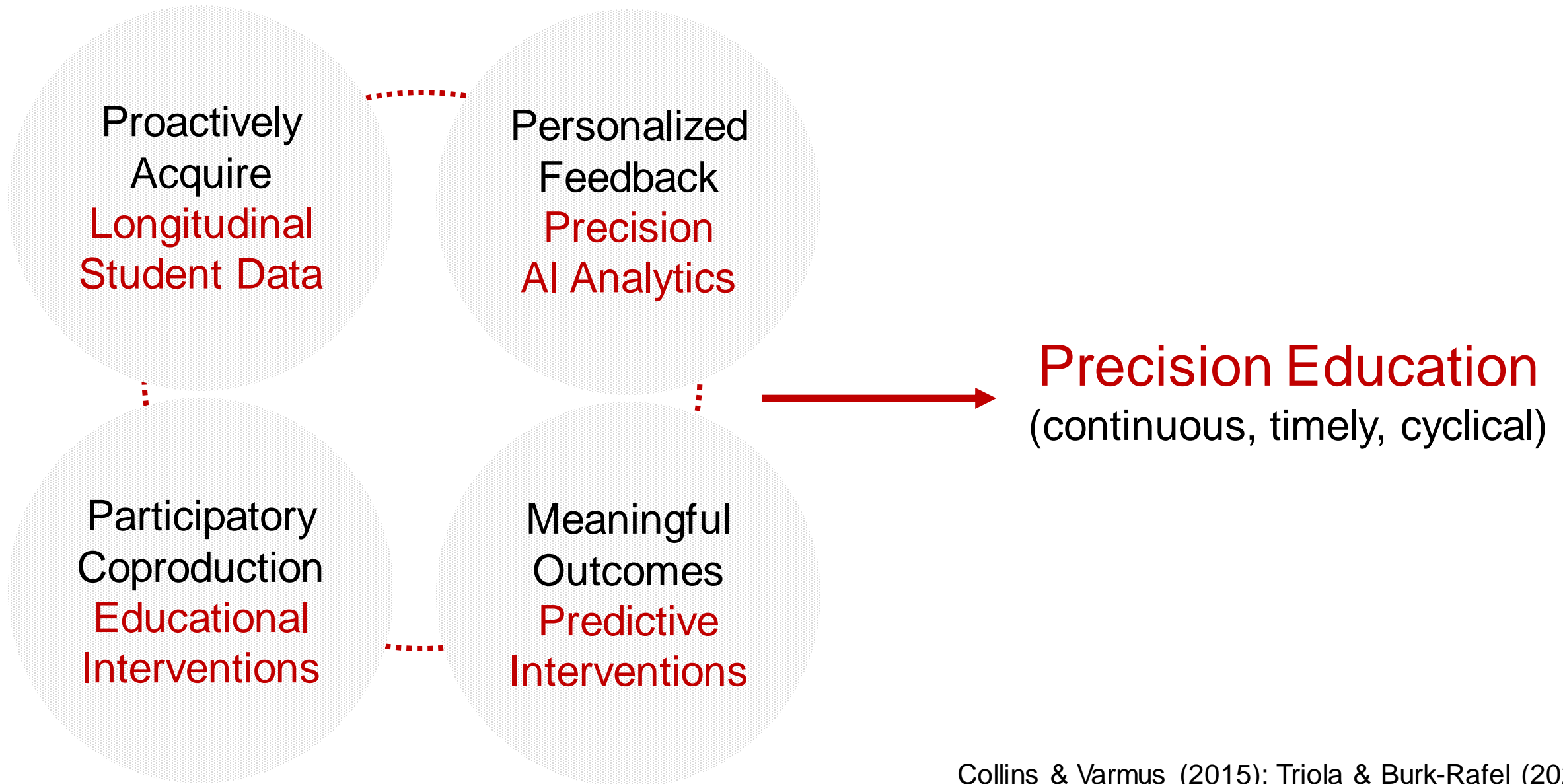
Timing (Immediate)
Personalized
Adaptive
Diagnostic
Actionable



Problem
“Integration”
Challenge

Solution
Precision
Education

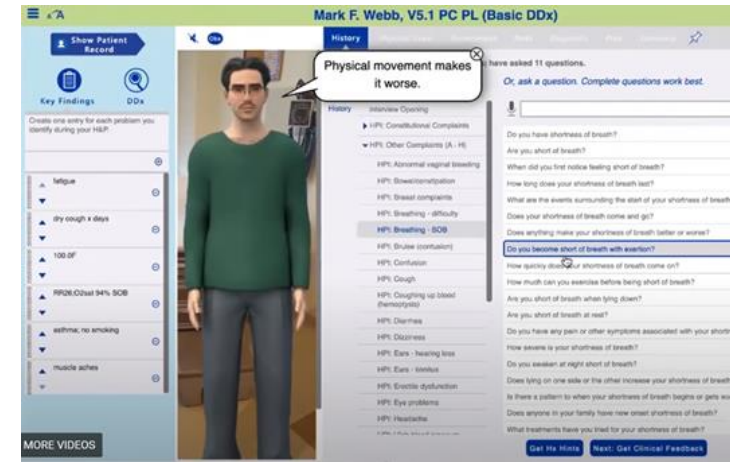
“Precision” Education – Principles



Precision Education – Healthcare Training

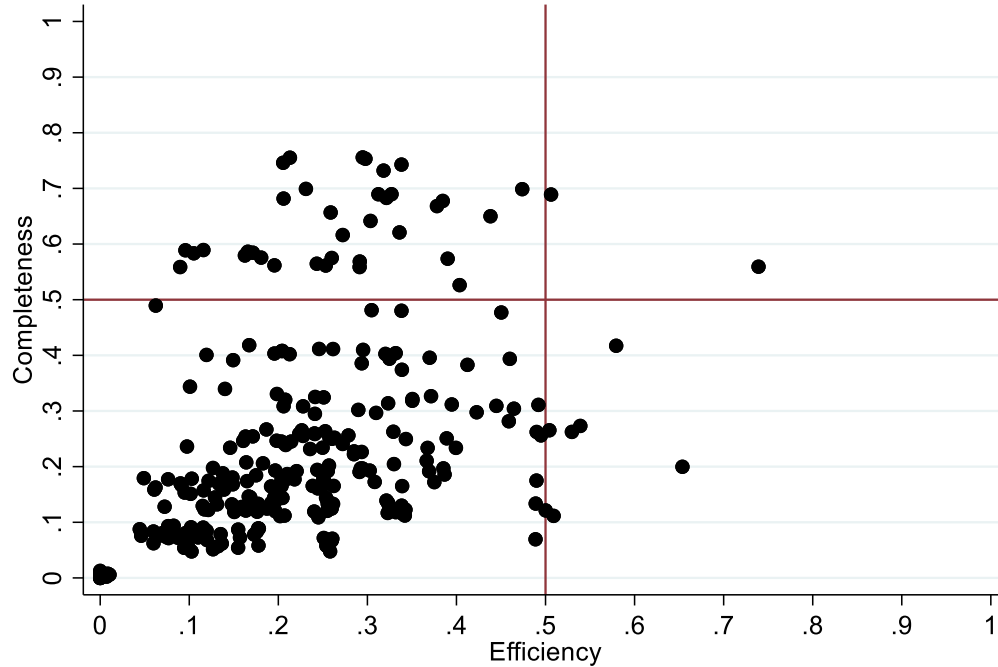


“Adaptive” Virtual Patient → ↑ Clinical Reasoning Skills

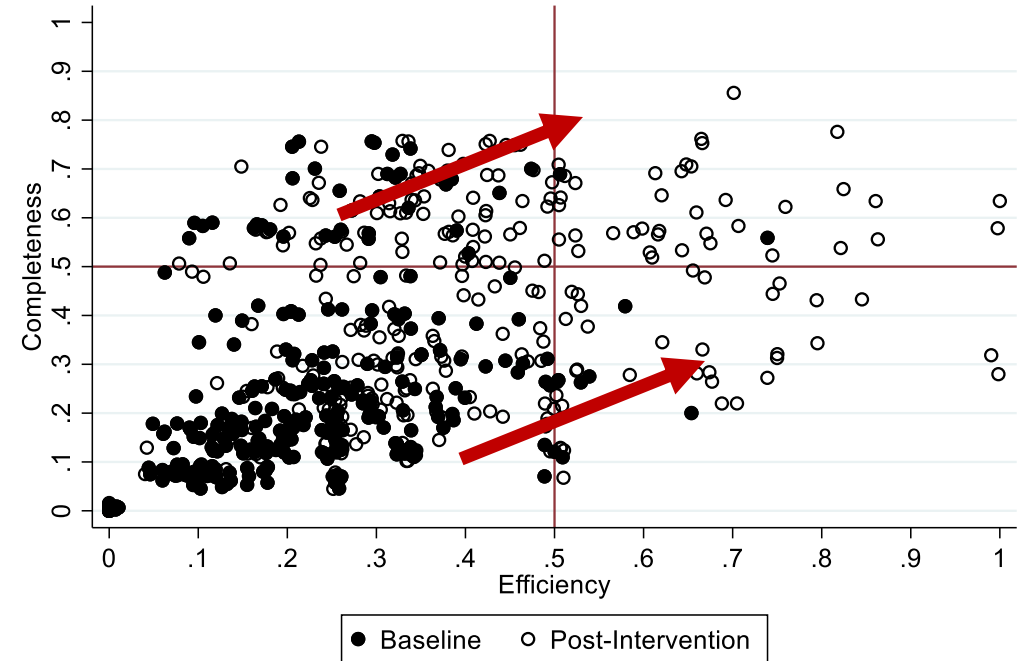


- American Medical Association (AMA) – 2018 to 2019
- Total volunteer participants ($n = 512$; 8 medical schools)

Pre-Intervention: Virtual Patient
Differential Diagnosis



Post-Intervention: Virtual Patient
Differential Diagnosis



Learnings Analytics – Medicine Residency Training

Smartphone



ACADEMIC MEDICINE
Journal of the Association of American Medical Colleges



Synthesizing and Reporting Milestones-Based Learner Analytics Validity Evidence From a Longitudinal Cohort of Internal Medicine Residents

Park, Yoon Soo PhD,; Zar, Fred MD; Tekian, Ara PhD, MHPE

Academic Medicine: August 20, 2019 - Volume Publish Ahead of Print - Issue - p
doi: 10.1097/ACM.0000000000002959

Year 1
Analytics
Score

Analytics Data
OR = 5.82, $p < .001$

Year 2 or 3
Struggling
Learner



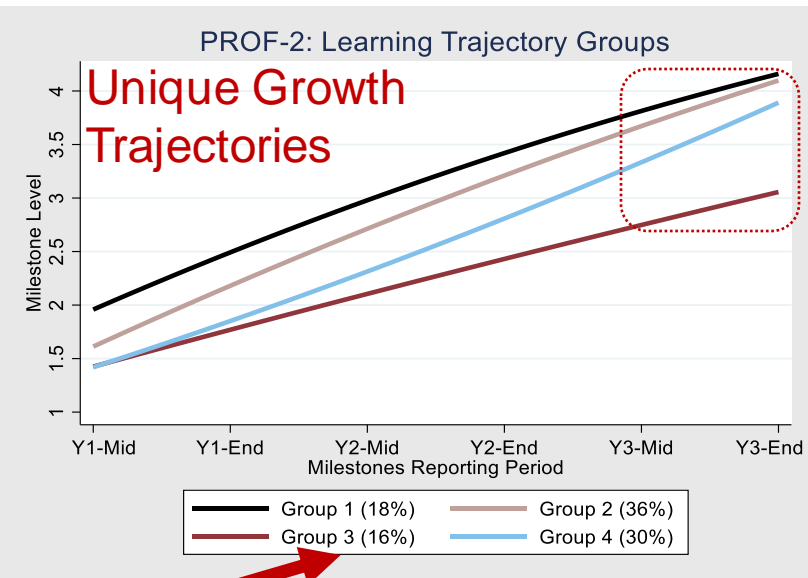
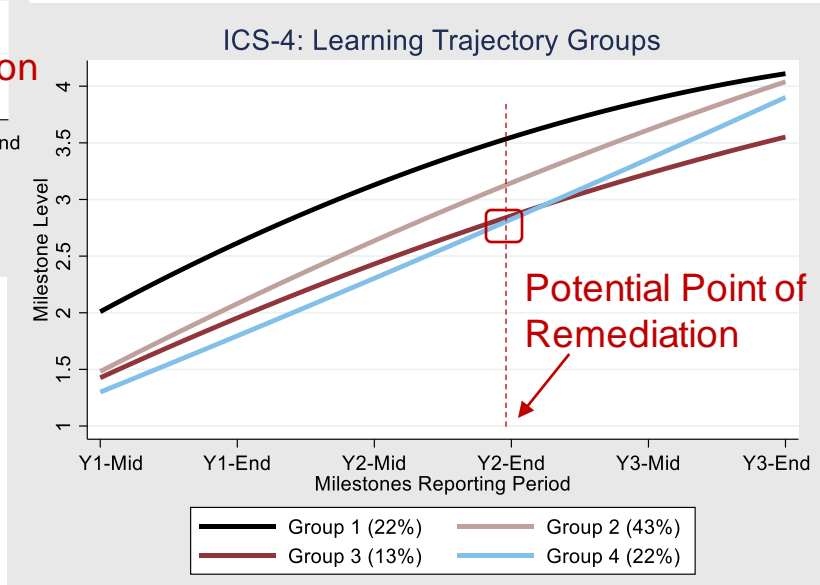
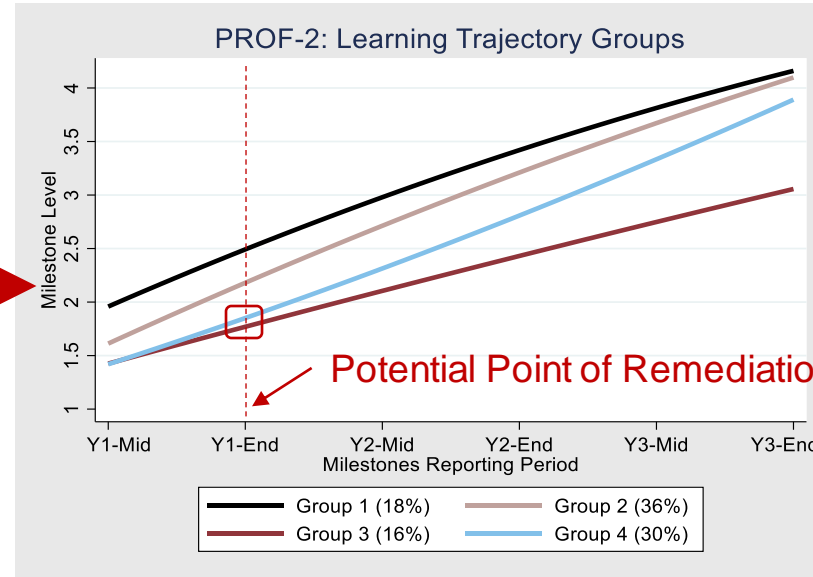
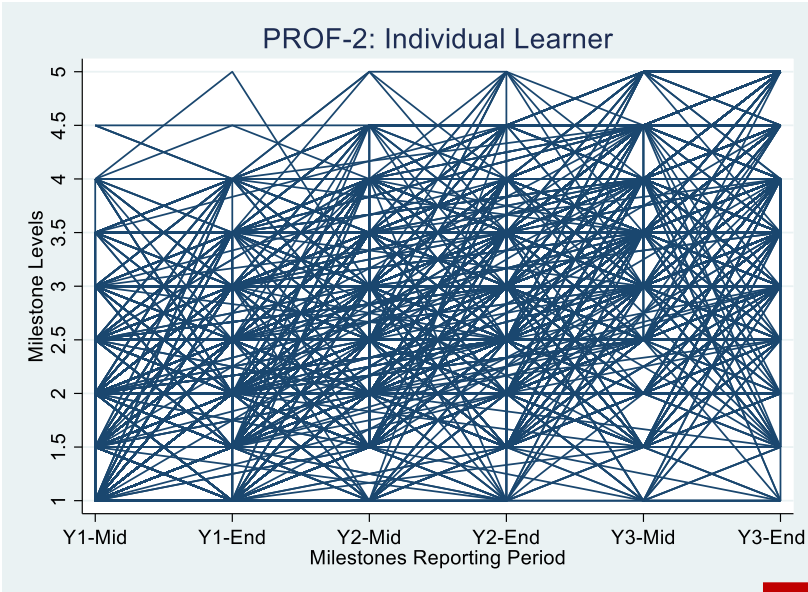
Learning Trajectories – National Data

JAMA Network | **Open**

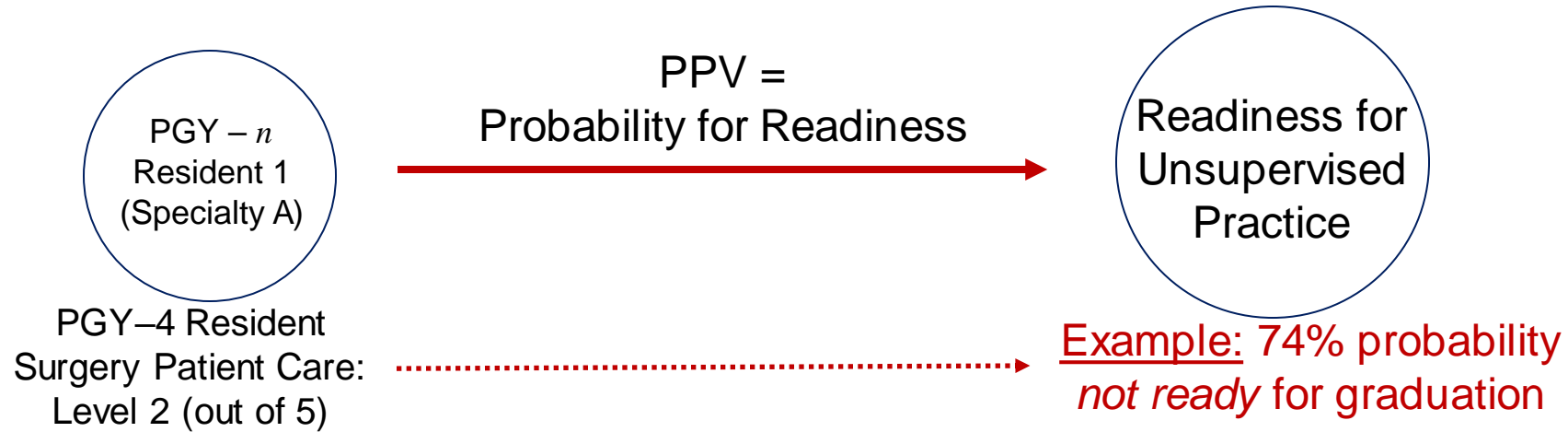
Original Investigation | Medical Education

Longitudinal Reliability of Milestones-Based Learning Trajectories in Family Medicine Residents

Yoon Soo Park, PhD; Stanley J. Hamstra, PhD; Kenji Yamazaki, PhD; Eric Holmboe, MD



Predictive Probability Values (PPV)



ORIGINAL REPORTS
Predicting Performance at Graduation From Early ACGME Milestone Ratings: Longitudinal Learning Analytics in Professionalism and Communication in Vascular Surgery

Brigitte K. Smith MD, MHPE, FACS, FSVS^{*}, Ara Tekian PhD, MHPE[‡], Eric Holmboe MD, MACP, FRCP[†], Erica L. Mitchell MD, MEd, SE, FACS, DFSVS[‡], Yoon Soo Park PhD[‡], Stanley J. Hamstra PhD[‡]

Annals of Vascular Surgery

CLINICAL RESEARCH | VOLUME 76, P463-471, OCTOBER 01, 2021

Using Learning Analytics to Examine Achievement of Graduation Targets for Systems-Based Practice and Practice-Based Learning and Improvement: A National Cohort of Vascular Surgery Fellows

Brigitte K. Smith^{*}, Abigail Luman^{*}, Kenji Yamazaki^{*}, Eric Holmboe^{*}, Erica L. Mitchell^{*}, Yoon Soo Park^{*} • Show all authors

Published: April 24, 2021 • DOI: <https://doi.org/10.1016/j.avsg.2021.03.046> • Check for updates



ORIGINAL ARTICLE: PDF ONLY
The Use of Learning Analytics to Enable Detection of Underperforming Trainees
An Analysis of National Vascular Surgery Trainee ACGME Milestones Assessment Data

Smith, Brigitte K. MD, MHPE, FACS, FSVS^{*}; Yamazaki, Kenji PhD[‡]; Tekian, Ara PhD, MHPE[‡]; Holmboe, Eric MD, MACP, FRCP[†]; Hamstra, Stanley J. PhD[‡]; Mitchell, Erica L. MD, Med, SE, FACS, DFSVS[‡]; Park, Yoon Soo PhD[‡]

Teaching and Learning in Medicine
An International Journal
Volume 33, 2021 - Issue 3

Validation
Milestone Learning Trajectories of Residents at Five Anesthesiology Residency Programs

Pedro Tanaka^{*}, Yoon Soo Park^{*}, Jay Roby, Kyle Ahn^{*}, Clinton Kakazu, Ankeet Udani & Alex Macario ...show less
Pages 304-313 | Published online: 17 Dec 2020

Download citation • <https://doi.org/10.1080/10401334.2020.1842210> • Check for updates



Milestones Research and Reports:

<https://www.acgme.org/what-we-do/accreditation/milestones/rese>

Table 2: Milestones 1.0 to 2.0 Table

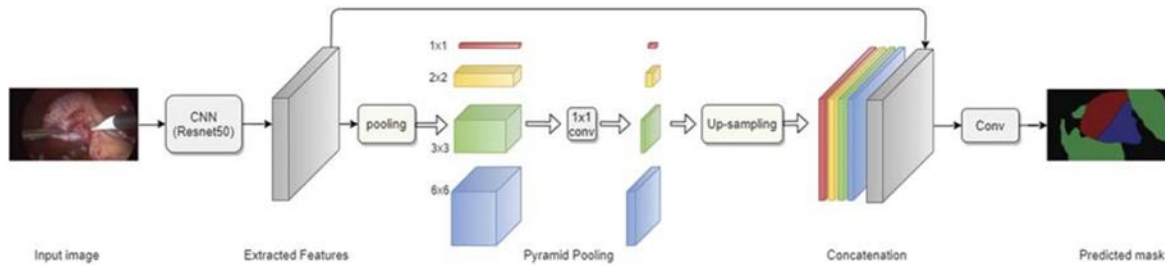
The example is from the Family Medicine Milestones, Subcompetency 3: Health promotion and wellness.

Subcompetency	Threshold	Yr1, Mid-Year	Yr1, Year-End	Yr2, Mid-Year	Yr3, Mid-Year
PC03	≤ Lev 5.0				
	≤ Lev 4.5				
	≤ Lev 4.0				17.1
	≤ Lev 3.5		16.7	17.4	20.2
	≤ Lev 3.0		17.0	20.4	46.7
	≤ Lev 2.5	16.9	18.5	27.3	49.7
	≤ Lev 2.0	-17.7	-21.9	35.9	38.7
	≤ Lev 1.5	20.3	29.2	41.4	24.0
≤ Lev 1.0	24.0	35.7	44.3	11.1	

AI Analytics – Video and Images

Intraoperative Guidance







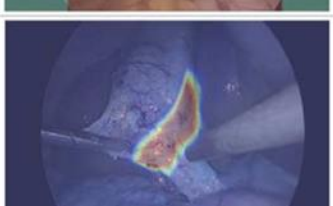
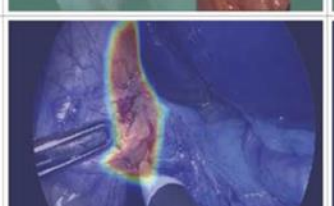

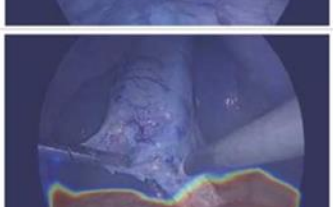


Data and Model Building using Deep Convolutional Neural Network



Precision Education → AI Analytics

- Dermatology
- Pathology
- Radiology

Model Predictions for Training

	Example 1	Example 2	Example 3
Original Frame			
Model Prediction			
Model Prediction (Heat Map): Go Zone			
Model Prediction (Heat Map): No-Go Zone			

Figures from Madani et al., *Annals of Surgery* (2022)

Precision Education – “High Touch High Tech” in Mathematics Vietnam and Uruguay

Vietnam – 7th Grade Mathematics

Pre-Class “High Tech”



In-Class “High Touch”



Control

- 3 schools
- 14 teachers
- 832 students

Treatment

- 4 schools
- 8 teachers
- 531 students

Pre-test

(August 2019 –
October 2019)



Post-test

(December 2019 –
January 2020)

Impact of “High Touch High Tech”

Mathematics Performance: ↑ **.44** (≈ 2 years of learning)

Teacher Self-Efficacy: ↑ **.24**

Baseline
(Pre-test)

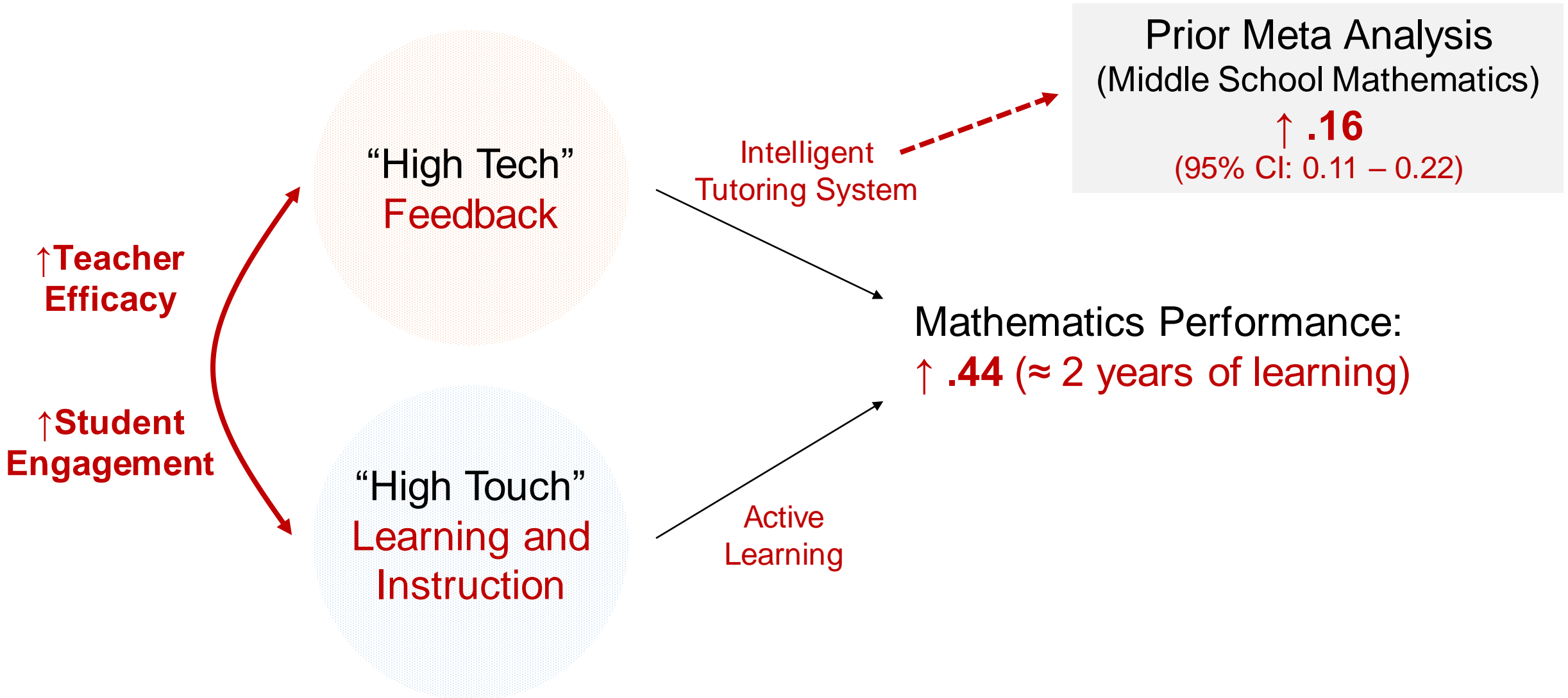


Follow-up
(Post-test)

↑ Impact for **lower-performing students**
Bottom 25%: ↑ **.85**

↑ Impact if **student has positive attitude**

Impact of “High Touch High Tech” in Vietnam



Uruguay – 5th Grade Mathematics



Control

- 28 schools
- 39 teachers
- 711 students

Treatment

Soft

(No Observation)

- 51 schools
- 74 teachers
- 1,233 students

Hard

(Observation,
Feedback)

- 29 schools
- 42 teachers
- 765 students

Pre-test (Baseline)

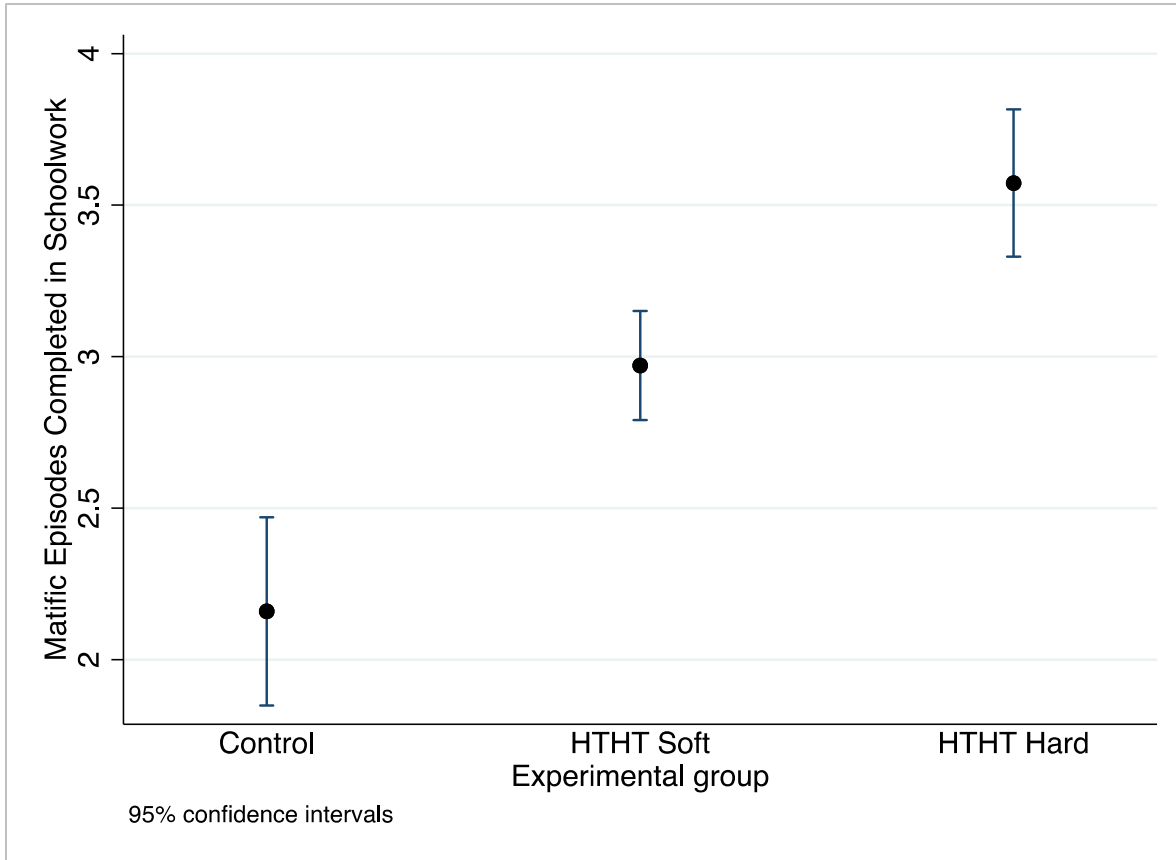
Post-test (Endline)

April 2022 to October 2022

Impact of “High Touch High Tech”

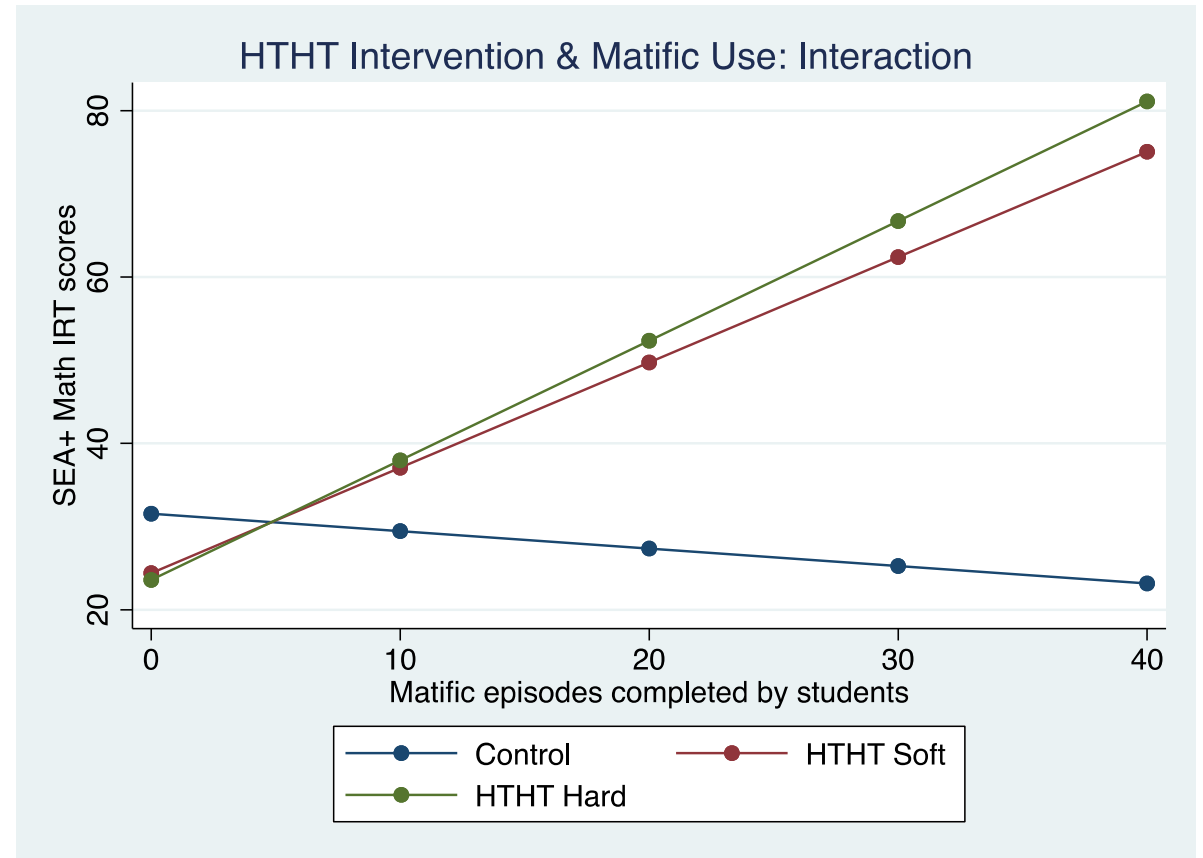
School Work Completion

→ Technology
(Matic) (Matic)



Learning Gains

→ Mathematics Performance
(SEA+ Assessment)



Figures courtesy of Dr. Janice HJ Kim

Digital Transformation → Precision Education

- Digital Transformation → new opportunities for learning
- Precision Education
 - Data and Technology → personalize education, ↑ efficiency, ↑ outcomes
 - Empirical evidence from Healthcare and Education

Proactively
Acquire
Longitudinal
Student Data

Personalized
Feedback
Precision
AI Analytics

Participatory
Coproductio
Educational
Interventions

Meaningful
Outcomes
Predictive
Interventions

Questions:
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