STEMming the Swell of Absenteeism in Urban Middle Grade Schools: Impacts of a Summer Robotics Program

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Background

- Importance of attendance as indicator of student engagement and predictor of achievement
- Relationship of absenteeism in secondary grades to low motivation
- Two main questions in students' minds about school:
    - "Can I do the task?"
    - "Do I want to do the task?"
- Role of elective activities (like robotics) in building student motivation for school attendance and learning

Research Questions

Compared to a matched sample of students who did not receive summer school:

Did a STEM robotics summer learning program have a positive impact for middle school students on the following year's:

- **attendance rate**
- **math achievement**

Description and Setting of Program

- Development project funded by U.S. Department of Education Investing in Innovation (i3) 2011
- Summer Program implemented in 2012, 2013, 2014 in an urban high poverty district (85% eligible for F/RL, 92% African-American or Hispanic)
- Five week full-day program with 90 minutes math, 90 minutes science/STEM, and 2 hours of robotics per day
- Students build a working robot and compete in a final city-wide tournament

Study Participants

193 rising 6th to 8th grade students participated in Summer 2012

166 were enrolled in grades 6-8 the following year (not retained) with test scores from both 2012 and 2013

- **74% Male**
- **86% F/RL**
- **95% Minority**
- **37% below proficient on previous year's state mathematics test**

Research Design

- Quasi-experimental (random assignment not possible for this district program)
- Comparison group identified through propensity score (nearest remaining neighbor) and Mahalanobis metric matching within each grade level
- Previous year's attendance and mathematics test z-score were prognostic covariates (students with missing data on these and parallel outcome variables excluded from all analyses)

Data Collection

Student data from administrative and program records

Variables (matching and covariates)

- **Student level**

  Male, Eligible for free or reduced lunch, Minority. Spec. Educ., Overage, Changed schools, Suspended,

  Attended Summer School prior year, Prior Math z-score,

  Prior attendance

- **Prior Year Characteristics of Students' Post-Intervention School**

  Enrollment size, %FRL, Charter dummy, Middle School dummy, Middle High School dummy, Avg. Math z-score

  Avg. attendance added as covariate

Analysis Model

Two-Level Fixed Effects Model (covariates assumed homogeneity of treatment effects across sites)

- **Students nested in 8 treatment sites with control students in 9th "no-treatment site"**
- **Level 1 describes the relationship between students' outcomes, student-level characteristics, and their treatment status.**

$$Y_{ij} = \beta_{0j} + \beta_{1j}T_i + \Sigma\beta_{2s}X_{sij} + e_{ij}$$, where

Y_{ij} is an outcome for student i in site j;

T_i is 1 if the student is the treatment group and 0 otherwise;

X_{ij} is a set of S student-level covariates (described above) for student i in site j, measured in the year prior to treatment exposure and centered on the grand mean in the sample; and

e_{ij} is a random error term for student i from site j, assumed to be independently and identically distributed across students within sites

Analysis Model (continued)

Level 2: Sites

$\beta_{0j} = \gamma_{00} + u_0$

$\beta_{1J} = \gamma_{10}$

$\beta_{2s} = \gamma_{2S}$ *(and so on for each covariate)*

where

γ_{00} *is the grand mean*

γ_{10} **is the main effect of treatment**

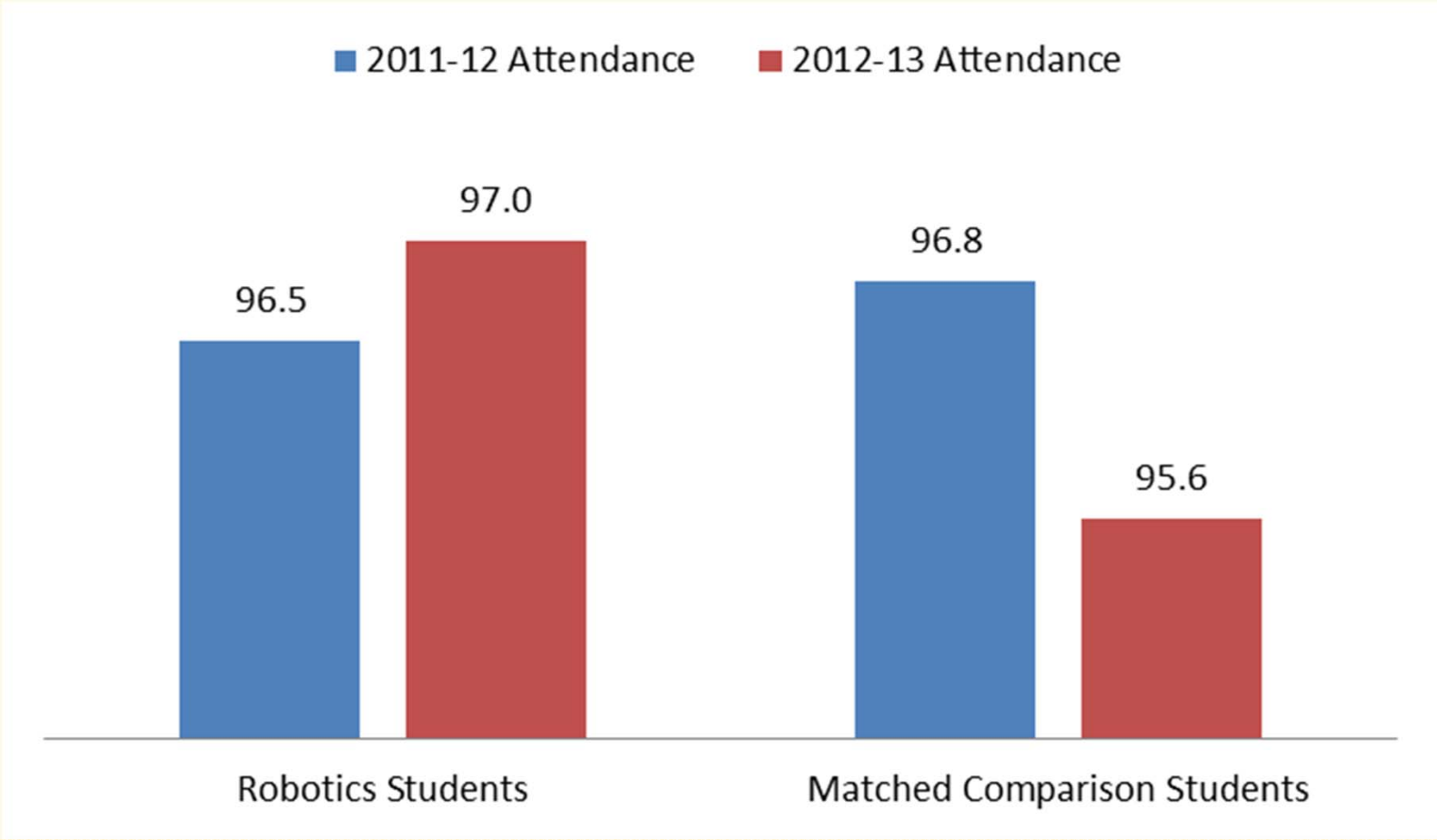
The set of γ_{2S} regression coefficients represent the relationships between students' outcomes and the covariates, with each coefficient assumed to be constant across sites,

U_{0j} J=1,…,J are fixed effects associated with each site effect, and are constrained to have a mean of zero.

Attendance Findings

- Baseline equivalence between the treatment and control group was achieved.
- The adjusted mean attendance rate of the treatment students was 1.4 percentage points higher than control students.
- This impact was both statistically significant ($t(631) = 3.52$, $p = .001$), and large enough to be educationally meaningful, $\Delta = .34$
- Another way of stating the impact is that treatment students attended about 2.5 days more of the 180-day school year on average.

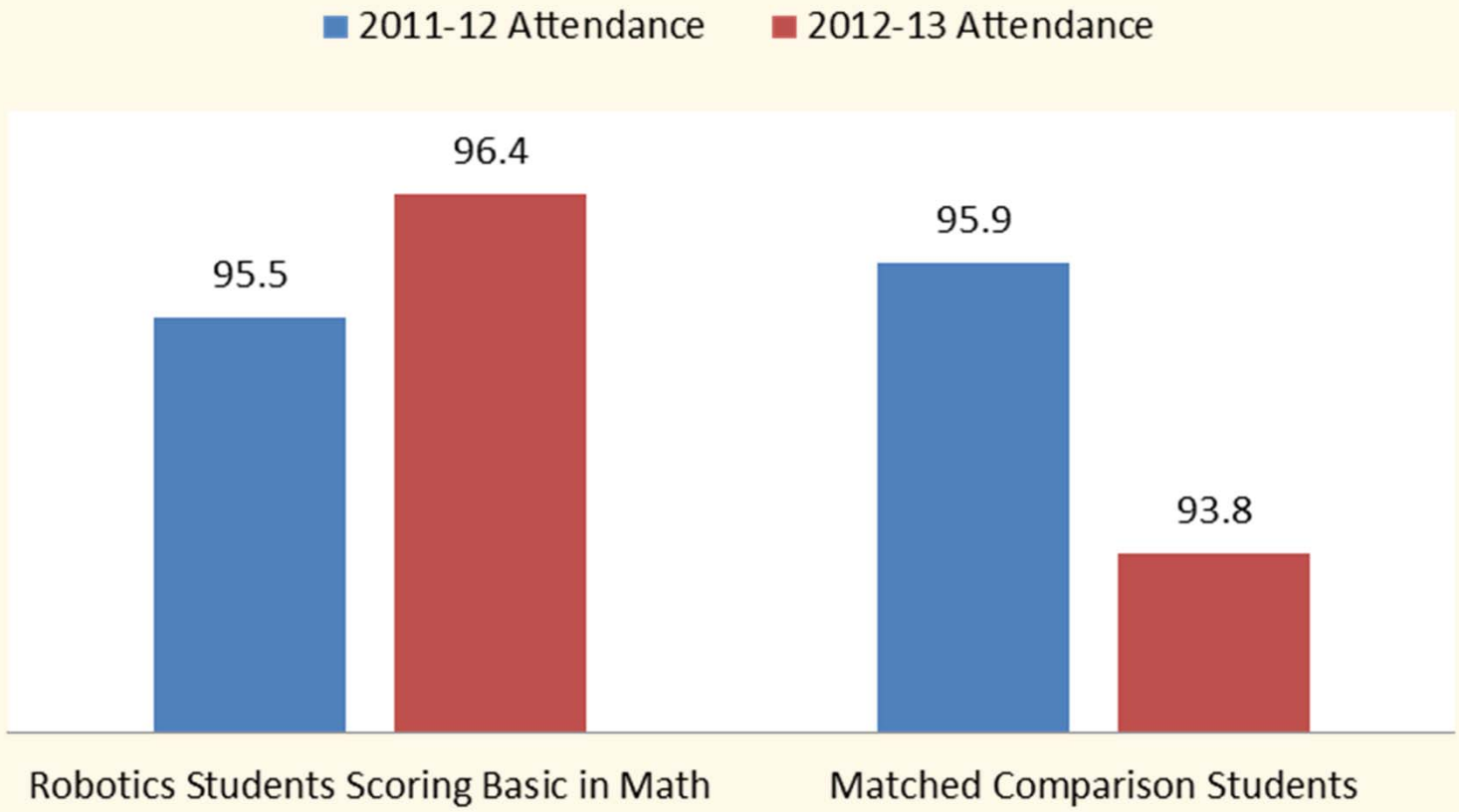
Program Effect on Attendance



Outcomes for Low-Performing Subsample

- Parallel analyses conducted on the subgroup of low-achieving students (60 treatment students who scored Basic on the math pre-test and their 167 matches from the comparison group).
- Baseline equivalence was again achieved.
- Adjusted mean attendance rate of the treatment students in the subsample was 2.6 percentage points higher.
- This impact was both statistically significant ($t(206) = 2.865$, $p. = .005$), and large enough to be educationally meaningful, $\Delta = .33$.
- Another way of stating the impact is that treatment students in the subsample attended, on average, about a week more of school than did the control students in the subsample (i.e., attended 4.7 days more during the course of the 180-day school year.)

Program Effect on Attendance for Low Performing Students



Program Effects on Mathematics Achievement

- Parallel analyses were also conducted with math achievement on the state assessment as the outcome variable.
- The program effect ($\Delta = .07$) on mathematics achievement was not significant, $t(632) = 0.46$, $p = .644$.
- Analyses were also conducted on the subsample of low-performing students described above. There was no significant program effect on math achievement detected for this group of low-performing students ($\Delta = .10$, $t(207) = 1.34$, $p = .183$).
- Data on the district's fall benchmark test in mathematics, administered within two months of the program's completion, were available for a subgroup of treatment students.
- Identical analyses on this more proximal achievement outcome, using a separate matched comparison group of students who had data on that outcome variable, also found no significant program effects on mathematics achievement.

Conclusions

- Limitations must be acknowledged. QED subject to potential unmeasured bias in the self-selection of summer program participants.
- Despite limitations, findings emphasize the importance of investigating the potential impact of out-of –school programs on school-focused engagement.
- Activities outside of the regular school schedule can potentially build developmental competencies -- particularly feelings of confidence, competence, and connection -- that can keep students attached enough to school through attendance to increase their likelihood of success in the middle grades and beyond.
- Finding ways to stir up student interest in pursuing learning activities to maintain even the crudest indicator of engagement, simple school attendance, remains a challenge for most high-poverty secondary schools. High-interest, hands-on activities like robotics may help.

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