Baltimore City Public Schools

Middle School STEM Summer Learning Program

DID THE STEM SUMMER LEARNING PROGRAM HAVE AN IMPACT ON STUDENT ATTENDANCE AND MATH ACHIEVEMENT?

Project Overview

THE PROBLEM: What Challenge Did the Program Try to Address?

To prepare students for science, technology, engineering, and mathematics (STEM) careers, it is essential to keep students engaged academically. To maintain motivation and engagement, middle school students must internalize beliefs of efficacy and belonging. To this end, out-of-school activities can build and reinforce a sense of competence for students. Further, studies suggest that summer enrichment can have a positive impact on students' long-term interests in attending college, studying STEM-fields in college, and pursuing a STEM-related career. Accordingly, the Middle School STEM Summer Learning Program with VEX Robotics[1] was a targeted Baltimore City Public Schools program designed with the goal of increasing student interest in STEM and engagement with school.

THE PROJECT: What Strategies Did the Program Employ?

The i3-funded development[2] grant for the Middle School STEM Summer Learning Program with VEX Robotics, awarded from 2011–2015, was part of a larger Baltimore City summer STEM program. The intervention was designed to expose rising sixth- through eighth-grade students to VEX robotics. The robotics program ran for three years (2012–2014); the intervention was a five-week summer program with half-day instruction in mathematics and science and half-day enrichment activities. The program was open to all middle school students in Baltimore, but targeted students who scored "Basic" on the Maryland School Assessment (MSA) math test. The intervention had the goal of impacting math achievement and student attendance in the following school year. The program was evaluated through a quasi-experimental study, in which students who participated in the program were matched to students who did not participate by attendance, demographic information, and school characteristics. Core program components included the following:

[1] The Baltimore City Public Schools received an i3 development grant supported by the U.S. Department of Education's Investing in Innovation program through Grant Number U411C110047.

[2] Development grants provide funding to support the development or testing of novel or substantially more effective practices that address widely shared education challenges. All i3 grantees are required to conduct rigorous evaluations of their projects. The quality of evidence required to demonstrate a project's effectiveness depends on a project's level of scale or grant type.

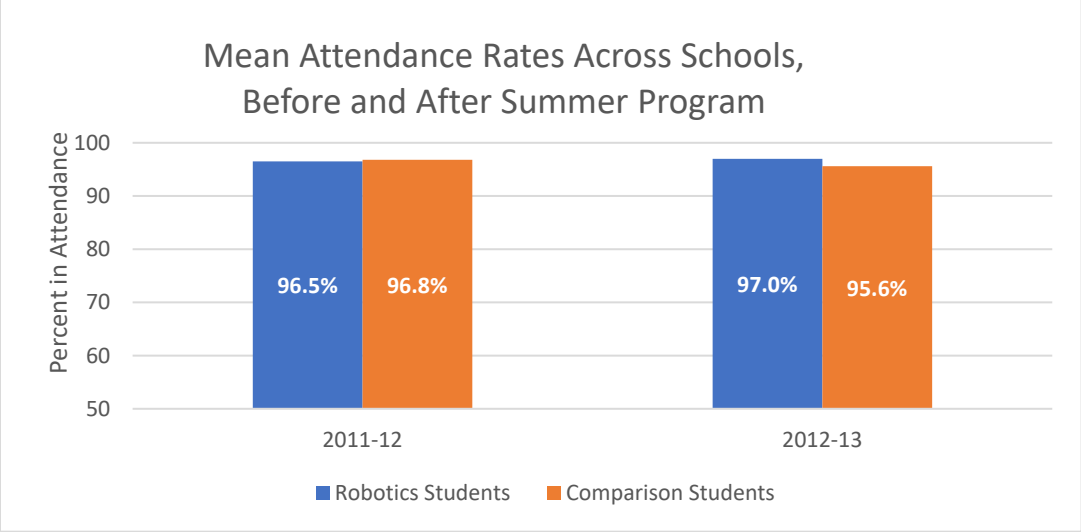
THE STEM SUMMER LEARNING MODEL

- **STEM Instruction.** Half-day math and science instruction during a five-week summer program.
- **Service Delivery Providers.** Teachers performing at a "Satisfactory" level or above were recruited to lead the program; those who were hired attended professional development and training sessions the week prior to the start of the program.
- **Robotics Workshop.** After the half-day STEM instruction, students participated in half-day VEX Robotics program activities during the five-week summer program. The robotics workshop taught students the fundamentals of building robots and provided time for teams to experiment, build their own robots, and participate in competitions

Summary of Results

DID THE STEM SUMMER LEARNING PROGRAM HAVE AN IMPACT ON STUDENT ATTENDANCE AND MATH ACHIEVEMENT?

The Middle School STEM Summer Learning Program with VEX Robotics yielded positive impacts on student attendance but did not have an impact on student achievement in math.



- **ATTENDANCE.** The evaluation found a statistically significant effect for attendance in the 2012–13 school year following the 2012 summer program (the first year of the study). Students in the program group attended about 2.5 more days of school than the comparison group. In the second year of the study, the intervention group also had slightly, but not significantly, better attendance, attending school at a rate 0.6 percentage points higher than comparison group students.
- **Math Achievement**. In Year 1, students were given both the district mathematics benchmark test in the fall and the MSA test in the spring. In Year 2, the MSA test was given in the spring. Program students did not demonstrate significantly higher math achievement scores than comparison students in either year.

Please see Appendices B and C for information about the evaluation's design and the quality of the evidence, respectively.

SECONDARY FINDINGS

The evaluators noted that the intervention boosted the attendance of low-achieving students. However, the program did not appear to have significant effects on student STEM aspirations or teacher effectiveness.

- **LOW-PERFORMING STUDENTS.** Low-performing students had a statistically significant improvement in attendance after the 2012 summer program; they attended an average 4.7 more days of school than the comparison group.
- **STUDENT ASPIRATIONS.** Short surveys were given to students at the beginning and end of the summer program to see if there was a change in students' aspirations for attending college, studying math and science in college, and pursuing a STEM career. The study found no statistically significant impacts in either program year, though sample sizes were too small to detect any program effects.
- **TEACHER EFFECTIVENESS.** The professional development (PD) component of the program aimed to increase teacher effectiveness beyond the summer program and into regular classrooms. Differences in instructional effectiveness scores before and after the intervention were not statistically significant.
- **LONG-TERM EFFECT.** In the 2013–2014 school year, over a year after their participation in the program, 2012 summer program attendees had higher attendance rates than comparison students as a whole (by 1.5 percentage points) as well as among low-achieving students (by 2.4 percentage points). However, neither effect was statistically significant.

Please see Appendices B and C for information about the evaluation's design and the quality of the evidence, respectively.

OTHER CONSIDERATIONS

The Middle School STEM Summer Learning Program with VEX Robotics study noted a variety of takeaways. These are highlighted below.

- **THE POTENTIAL TO INCREASE STUDENT MOTIVATION AND ENGAGEMENT.** The positive effects of the robotics program indicate that summer programming could be an avenue for keeping students engaged in school. Both in-school and out-of-school instructional time can be utilized to foster secondary student motivation and engagement with school culture, academic studies, and peers.
- **INCENTIVIZING ATTENDANCE.** Attendance is a common challenge of summer programming, and more conversation around incentivizing attendance and engaging students in the programs is needed. Summer programming can be a way to address learning gaps, but low rates of attendance can be disruptive.
- **RECRUITMENT OF LOW-PERFORMING STUDENTS TO ENRICHMENT.** The VEX Robotics summer program fell short of its goal to recruit low-performing math students, whom program leaders hoped would benefit from the program. Mailers were sent to students' homes, and packets were given to schools to promote the program with the targeted students. Additional conversation is needed at the district level about how to increase the likelihood that students who need additional instruction will receive it.

For More Information

Evaluation Reports

Final Evaluation Report (2015) (PDF) (Baltimore Education Research Consortium, July 2015)[3]

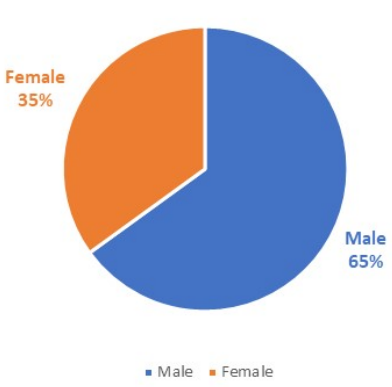
[3] The information and data for this report was collected at publication date from the most recent report as of 01/23/2020: Baltimore Education Research Consortium (2015). *The Baltimore City Schools Middle School STEM Summer Program with VEX Robotics*. Retrieved from http://baltimore-berc.org/wp-content/uploads/2015/07/i3STEMReportJuly2015.pdf

Appendix A: Students Served by the Project[4]

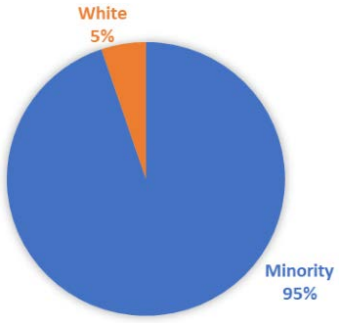
GRADE(S)

PK	K	1	2	3	4	5	6	7	8	9	10	11	12

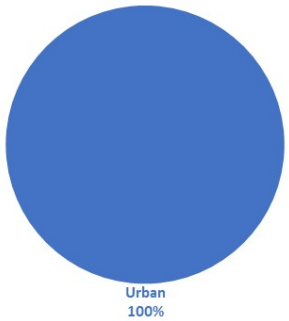
GENDER



RACE/ETHNICITY



COMMUNITY



HIGH-NEED STUDENTS[i]

Free/Reduced-Price Lunch	English Learners	Students with Disabilities
87.5%	N/A	25.6%

[4]These data reflect the entire student population served by the intervention, not just the evaluation sample used in the impact study.

Appendix B: Impact Evaluation Methodology[5]

RESEARCH DESIGN:

Design:	Quasi-Experimental Design
Approach:	▪ District administrative data were used to construct matched comparison groups for program students in 2012 and 2013 through a combination of Mahalanobis and propensity score matching. Students who participated in the summer program and did not have missing data from the following year were selected for the treatment group. All matching was conducted using nearest-remaining-neighbor matching. Program impact analyses on attendance and math were conducted using hierarchical linear modeling.
Study Length:	Two years: 2012–2014

DATA COLLECTION AND ANALYSIS

Study Setting:	BCPS summer robotics program across various sites in Baltimore
Final Sample Sizes:	▪ *Intervention (2012):* 166 rising 6th–8th graders ▪ *Comparison (2012):* 166 rising 6th–8th graders ▪ *Intervention (2013):* 358 rising 6th–8th graders ▪ *Comparison (2013):* 358 rising 6th–8th graders
Intervention Group Characteristics[6]	▪ *Intervention (2012):* • Male: 73.8% • Free/Reduced Price Lunch: 85.6% • Minority: 95.4% • Special education status 22.2% ▪ *Intervention (2013)* • Male: 59.1% • Free/Reduced Price Lunch: 87.8% • Minority: 94.8% ▪ Special education status 20.1%
Comparison Group Characteristics	▪ Not reported
Data Sources:	▪ Standardized math test scores ▪ Attendance records
Key Measures:	▪ Math achievement – Maryland School Assessment (MSA) and district mathematics benchmark ▪ Attendance – district attendance data

[5] These data reflect only the evaluation sample in the impact study, not the entire population served.
[6] Figures include program students who had missing outcome data and were excluded from final analyses.

Appendix C: Quality of the Evidence

WHAT WORKS CLEARINGHOUSE REVIEW[7]

STUDY	RATING
Not reviewed as of 01/23/2020	N/A

EVIDENCE FOR ESSA REVIEW[8]

STUDY	RATING
Not reviewed as of 01/23/2020	N/A

NATIONAL CENTER ON INTENSIVE INTERVENTIONS REVIEW[9]

STUDY	RATING
Not reviewed as of 01/23/2020	N/A

[7] https://ies.ed.gov/ncee/wwc/FWW
[8] https://www.evidenceforessa.org/
[9] https://intensiveintervention.org/

*The **Investing in Innovation Fund (i3)**, established under section 14007 of the American Recovery and Reinvestment Act of 2009, is a federal discretionary grant program at the U.S. Department of Education within the Office of Innovation and Improvement. i3 grants help schools and local education agencies work in partnership with the private sector and the philanthropic community to develop and expand innovative practices that improve student achievement or student growth, close achievement gaps, decrease dropout rates, increase high school graduation rates, and/or increase college enrollment and completion rates for high-need students.*

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[i] "High-need student" refers to a student at risk of academic failure or otherwise in need of special assistance and support, such as students who are living in poverty, attend high-minority schools, are far below grade level, who have left school before receiving a regular high school diploma, at risk of not graduating with a diploma on time, who are homeless, in foster care, have been incarcerated, have disabilities, or who are English learners. For more information see: Applications for New Awards; Investing in Innovation Fund-Development Grants, 81 FR 24070 (April 25, 2016).