Bootstrap
+ computing creatively thriving mathematically

"I program my own videogames": An Evaluation of Bootstrap

McClanahan | Associates

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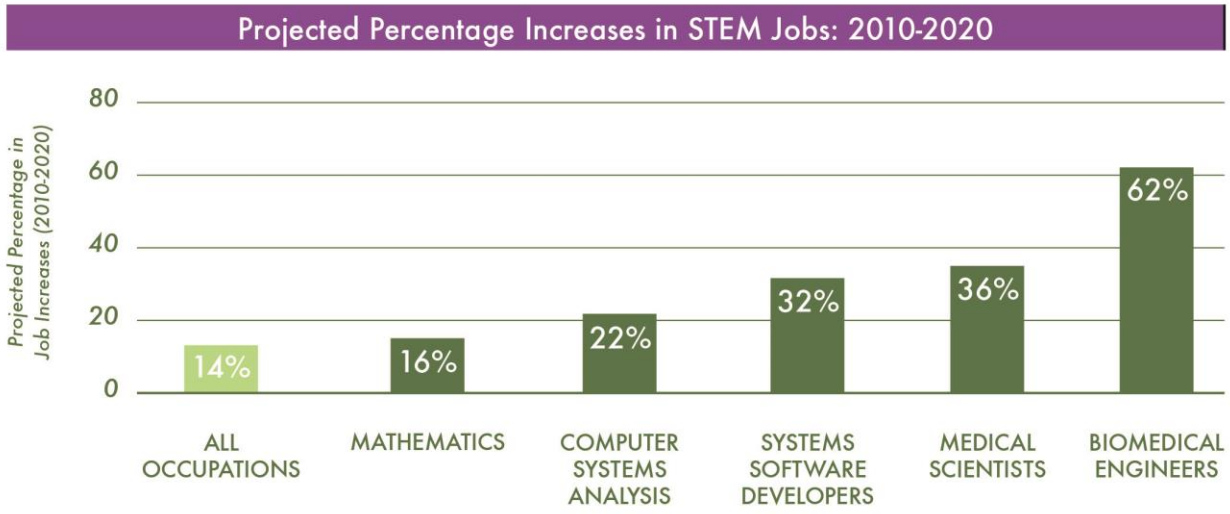
INTRODUCTION

Today, too few students in the United States are prepared for or pursuing careers in science, technology, engineering and math (STEM) fields, despite growing demand for these skills in the labor market. As a country, we have recognized this challenge, and the past decade has seen an increasing focus on preparing students for careers in these areas. Despite these efforts to better prepare youth and maintain or grow their interest in science, computing, and math, there remains a shortage of STEM-qualified graduates. According to a 2014 study of 1.8 million high school students who are preparing for college, only about 16 percent had an interest in, and the skills to pursue, a STEM career.[1] Students in the U.S. are performing below their international peers in science and math,[2] and even with an emphasis on boosting the representation of minorities and women in STEM careers, research shows that the STEM workforce today is no more diverse than it was fourteen years ago.[3]



Source: http://www.ed.gov/stem

Finding a way to get students in middle and high school (particularly underrepresented minorities and girls) excited about and interested in mathematics, computing, and science is paramount, and may be the key to keeping STEM careers on their radar as they prepare to enter college and the workforce. One such program that is geared to doing just that is Bootstrap. Bootstrap is a curricular module that teaches algebraic and geometric concepts through computer programming, integrating math and computing education to enable access to and success in both subjects for all students in grades 6 to 12.

Since 2006, Bootstrap's training, curricula, pedagogy, and software have been designed with teachers in mind—reflecting a core belief in the value of human teachers. Bootstrap trains teachers to implement its curricula in math and computer science classes, as well as in out-of-school programs,[4] offering in-person teacher training and comprehensive lesson plans and student activities on its website. Taught by Bootstrap "master" teachers, Bootstrap's two-day teacher training workshops cover one of Bootstrap's

[1] Alphonse, Lylah. "Interest vs. Intent: The New STEM Gap." *U.S. News and World Report*. 5 Feb. 2014 Web. 15 Dec. 2015.
[2] Layton, Lyndsey. "U.S. Students Lay Around Average on International Science, Math and Reading Test." *The Washington Post*. 3 Dec. 2013 Web. 10 Oct. 2014.
[3] Bidwell, Allie. "STEM Workforce No More Diverse Than 14 Years Ago." *U.S. New and World Report.* 24 Feb. 2015 Web 20 Dec 2015.
[4] This study focused on in-school implementation only.

curriculum and provide hands-on opportunities for teachers to participate in Bootstrap activities. Participating teachers can also qualify for professional development credits. Along with its standard materials, Bootstrap provides additional resources for teachers, including YouTube videos and online discussion groups. With the exception of the in-person trainings, all Bootstrap resources (including the curricula) are provided free of charge.

BOOTSTRAP: A SNAPSHOT

Bootstrap offers two curricula, both of which are geared toward students in middle and high school, and are aligned with the Common Core standards for algebra.

BOOTSTRAP:1 uses applied mathematical concepts and programming to help students create a videogame. The curriculum includes nine lesson plans along with supplemental materials and a student workbook. Students create a simple, three-character game involving a player, a target, and a danger. They design what each character looks like and use algebraic concepts to detect collisions, handle keystrokes, and determine how the characters move and interact.

BOOTSTRAP:2 is more advanced and takes students deeper into mathematical concepts by building events and data structures on top of the foundations laid by Bootstrap:1, and allows students to build far more sophisticated programs. Students learn how the world-based event loop that drives their Bootstrap:1 game works, and use it to create animations using simple datatypes for their "world." They then learn about data structures and design a "world" structure for a sophisticated game of their own.

Every year, more than 300 teachers learn how to use Bootstrap to teach their students algebra, geometry, and computer programming. This year, Bootstrap expects to train 400 teachers, and is focused on growing over the next several years. Since its founding in 2006, Bootstrap has likely reached 12,000 to 13,000 students and aims to serve over 300,000 students by 2022.

As a growing data-driven program, Bootstrap set out to better understand the strengths and weaknesses of its model and implementation to determine if the program was achieving its goals, and to illuminate where the program should be tweaked to better meet teachers' and students' needs. McClanahan Associates (MAI), in partnership with Bootstrap, conducted an eighteen-month evaluation of the Bootstrap program to achieve these goals and answer two primary research questions:

- *What are the experiences of teachers who implement Bootstrap?*
- *Do students who participate in Bootstrap achieve gains in algebra?*

Data for the evaluation was gathered systematically from both teachers and students in the form of a teacher survey and student algebra assessment. Over 300 teachers attempted to complete the Bootstrap survey at some point during the evaluation, and ninety-six were eligible for inclusion in the study and completed the survey, and 378 students who participated in the Bootstrap program provided algebra assessment data (representing twelve different Bootstrap teachers).[5]

[5] Although the sample of teachers who submitted student assessment data is a unique sample of teachers who were motivated to provide assessment data to Bootstrap, their backgrounds (when it came to gender, type of school in which they teach, grade level of school in which they teach, degree type, and the number of years they have been teaching) *were* similar to the teachers who did not provide student assessment data. The two samples differed only when it came to age and having a connection to a Bootstrap partnership organization.

Overall, the study found that teachers in varying settings (including those in middle and high schools, in low income schools and schools that serve high percentages of underserved minority students, and private, magnet, selective enrollment and public schools alike) and with different backgrounds (including those whose primary teaching assignment is math or computer science) are successfully implementing Bootstrap, and that students who participate are achieving meaningful gains in targeted algebra skills.

FINDING #1: Students of Committed Bootstrap Teachers Experience Growth in Their Knowledge of Key Algebraic Concepts

A core finding of this evaluation is that students experience growth in their knowledge of the key algebraic concepts[6] taught through the Bootstrap curriculum. While the number of teachers who provided student assessment data was small (twelve teachers in total; see appendix), overall student assessments showed that students made significant improvements in their knowledge of algebra between the pre- and post-assessments. Table 1 presents the number of correct responses overall and on each section of the pre- and post-assessments, together with the results from a test that showed whether students exhibited statistically significant improvement in algebraic knowledge after participating in the Bootstrap curriculum. For the overall assessments, as well as each subsection, results provide evidence of substantial gains in algebraic knowledge. This study was not designed to assess whether these gains among participating students could be attributed to Bootstrap; however, additional analyses revealed that gains were as robust among middle school students, who were less likely to be simultaneously enrolled in an algebra course, as they were among high school students.

Table 1: Correct Responses on Student Pre- and Post-Assessments

Assessment Item	Number Correct on Pre-Assessment	Number Correct on Post-Assessment	Significance Level of Student Improvement on Paired T-Test
Overall (of 39 problems)	10.1	18.3	***
Composition (of 8 problems)	3.9	5.7	***
Matching (of 4 problems)	2.3	2.9	***
Word Problems (of 27 problems)	4.1	9.7	***
Word Problems – Part C Only (of 9 problems)	2.1	4.3	***

** p<.01, *** p<.001

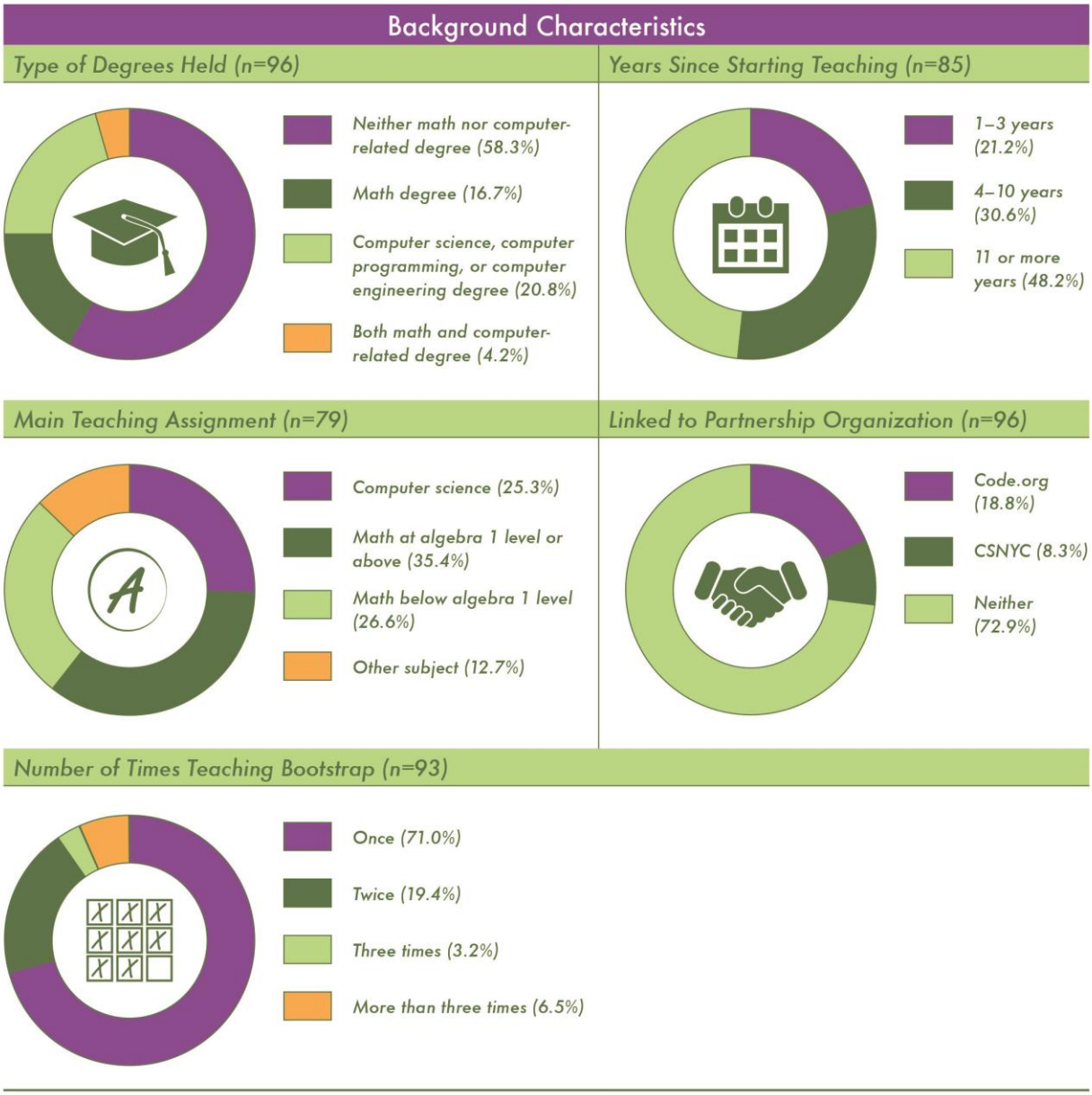
FINDING #2: Bootstrap Teachers Are Diverse

Bootstrap teachers who completed the survey were made up of men (42 percent) and women (58 percent) of varying ages (most teachers were between the ages of nineteen and twenty-nine, but a third were between forty and forty-nine years old; the remainder were aged fifty and older). The majority of participating teachers teach in public (three-quarters) middle and high schools (44 percent high school, 49 percent middle school); the remaining one-quarter teach in private schools.

[6] The specific algebraic concepts are function composition, matching representations of functions, and word problems.

The teachers' educational backgrounds were also diverse. Surprisingly, the majority (58 percent) held a bachelor's (BA/BS) or master's (MA/MS) degree in a subject *other* than math, computer science, or computer programming. However, most of the teachers responded that their primary teaching assignment was either math (at a level of algebra one or above) or computer science. With respect to teaching experience, one in five teachers had three or fewer years of experience, and slightly less than half (48 percent) had 11 or more years of experience. Just over a quarter of teachers came to Bootstrap through one of Bootstrap's strategic partnerships with Code.org or CSNYC. Finally, many teachers were not new to Bootstrap—at the time of the survey, just under a third had taught Bootstrap previously.

Table 2: Background of Bootstrap Teachers



FINDING #3: Committed Teachers With Different Educational Backgrounds and in Different School Settings Can Successfully Teach Bootstrap

Students made achievement gains between the pre- and post-assessments irrespective of the substantive educational background of their Bootstrap teacher, demonstrating that that it is not necessary to have a math or a computer degree to successfully teach the Bootstrap curriculum.[7] Despite the variation in their educational backgrounds, all but one of the teachers who provided student assessment data noted a primary teaching assignment of either math or computer science. Again, students whose teachers specialized in various disciplines all experienced gains in their math skills, suggesting that it is possible to implement Bootstrap in a variety of classes.[8] Strong gains were documented where the main teaching assignment was math at a level below algebra one, supporting the argument that that accrued gains may be attributable to the Bootstrap curriculum and not to other math that is being taught concurrently.

Table 3: Growth in Student Assessment Performance by Teacher Background

Teacher/Teaching Characteristic	Teachers	Number of Assessed Students	Average Change in Number Correct on Assessment From Pre-Assessment to Post-Assessment (*max=39*)
Educational Background			
MATH DEGREE	1	12	3.8+
COMPUTER DEGREE	3	105	4.1***
NEITHER MATH NOR COMPUTER DEGREE	8	261	10.0***
Main Teaching Assignment			
COMPUTER SCIENCE	4	104	9.8***
MATH AT ALGEBRA 1	3	140	6.3***
MATH BELOW ALGEBRA 1	4	129	9.0***
OTHER	1	5	5.0+

*+ p<.10, *** p<.001*

Bootstrap can be implemented successfully by committed teachers across a wide variety of school environments. Bootstrap teachers who provided student assessment data come from different educational settings. Notably, significant gains in algebra skills were demonstrated among students at schools that are attended by a majority of racial and ethnic minority and low income students, and were documented at public, magnet, selective enrollment, and private schools. Finally, students in both middle and high schools experienced gains in their algebra skills.

[7] In the current sample, there is student assessment data for only a single teacher with a math degree. The students in this class *did* show overall gains on the assessment. However, because the sample included only twelve students, the gains appear only marginally significant despite being comparable to gains documented for students whose teacher had a computer science degree.

[8] While it cannot be deemed certain that student assessment data came from a class within the teacher's main teaching assignment, this assumption has been made for the purposes of this analysis.

Table 4: Growth in Student Assessment Performance by School Characteristics

Student Body Characteristic	Teachers	Number of Assessed Students	Average Change in Number Correct on Assessment From Pre-Assessment to Post-Assessment (max=39)
Type of School			
NON-PUBLIC	2	91	6.7***
TRADITIONAL PUBLIC	7	204	10.2***
PUBLIC MAGNET OR SELECTIVE ENROLLMENT	3	83	5.0***
Highest Grade in School			
MIDDLE SCHOOL	6	276	9.2***
HIGH SCHOOL	6	99	5.4***
Minority Representation in School			
MORE THAN 50 PERCENT OF STUDENTS IDENTIFY AS BLACK OR HISPANIC	6	131	5.8***
Economic Status of Student Body[9]			
MORE THAN 50 PERCENT OF STUDENTS RECEIVE FREE OR REDUCED PRICE LUNCH	6	153	7.8***

** p<.01, *** p<.001

FINDING #4: Bootstrap Trainings and Support Resources Are of High Quality

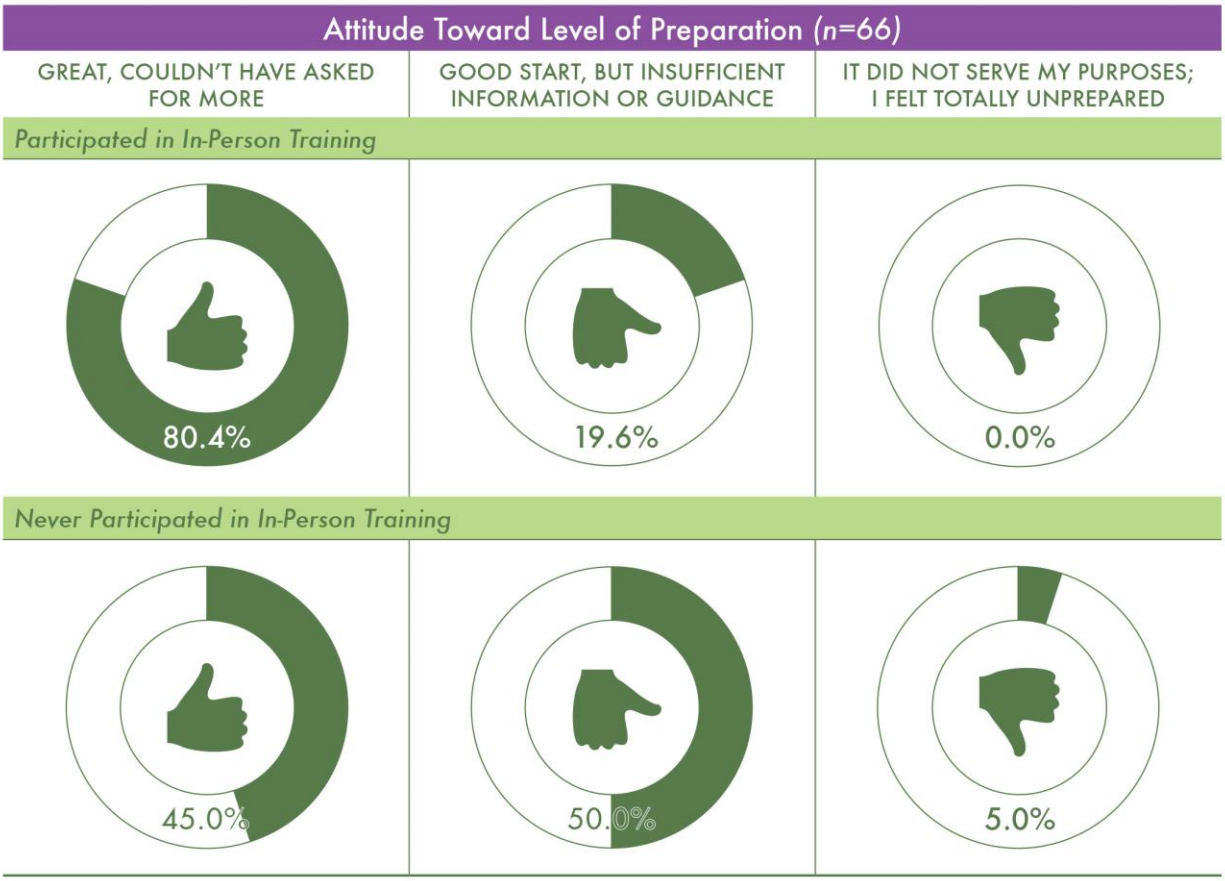
Bootstrap makes its materials publicly available to any teacher, but its primary method of disseminating its curricula is through in-person trainings. In addition to these in-person trainings, Bootstrap offers a wide array of resources to its teachers, including its website, on-demand technical assistance, and other supports. The evaluation explored the extent to which these in-person trainings and supports are useful to teachers. A clear finding that emerged is that teachers perceive the Bootstrap in-person trainings and support resources to be of high quality. Teachers indicated that the in-person trainings were very useful in preparing them to teach Bootstrap, and that the resources effectively supported them in the overall implementation of the curriculum.

Bootstrap's in-person trainings provide the most robust opportunity for teachers to learn how to teach the curriculum. The majority of teachers (64 percent) attended an in-person Bootstrap training, while about a quarter received on-demand technical assistance only. Perhaps not surprisingly, teachers who attended in-person trainings felt more fully prepared to implement Bootstrap than those who self-trained using Bootstrap materials that are publicly available. Eighty percent of teachers who participated in Bootstrap's in-person trainings reported that they felt adequately prepared for implementing Bootstrap, whereas only 45 percent of those who self-taught (meaning that they accessed resources, including possibly on-demand technical assistance) felt that they were adequately prepared. Slightly more than one-quarter participated in multiple training sessions and/or received twenty-five hours or more of in-person training. While a majority of teachers accessed Bootstrap's technical assistance resources,

[9] The economic status could not be classified for one school with 76 tested students.

teachers who participated in the in-person trainings were generally more aware of the resources available to them (and accessed them more frequently) than those who did not receive any in-person training.

Table 4: Impact of In-Person Training on Whether Teachers Felt Training and Technical Assistance Fully Prepared Them to Teach Bootstrap



Interestingly, student outcomes did not seem to be greatly affected by whether or not a teacher had participated in Bootstrap's in-person trainings. However, this conclusion was drawn by comparing the gains in algebraic knowledge of students from several Bootstrap-trained teachers to the documented gains by students from just one self-trained teacher who accessed many Bootstrap resources, including on-demand technical assistance. In both cases, students experienced significant gains in math, suggesting that perhaps in-person training is less critical for very committed and skilled teachers.[10]

FINDING #5: The Majority of Teachers are Implementing Bootstrap With Fidelity

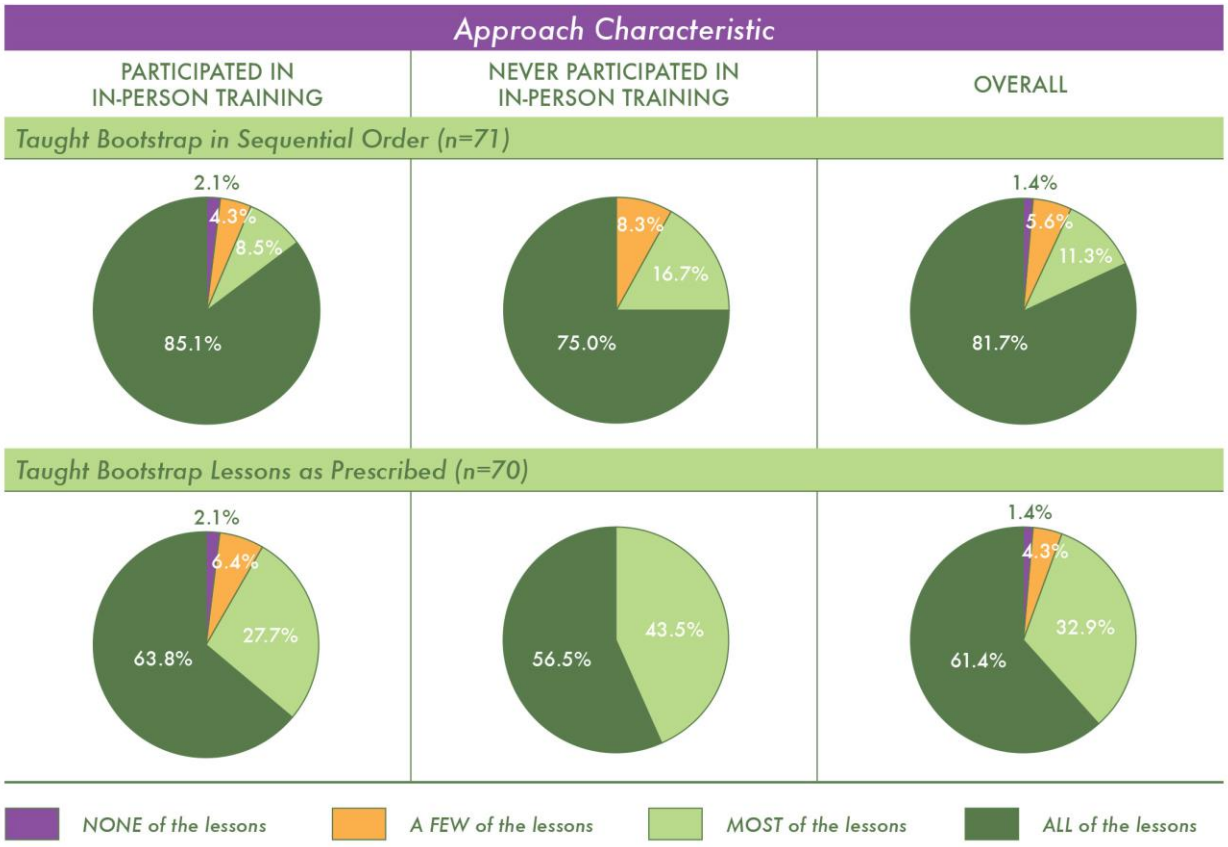
Programs like Bootstrap grapple with the extent to which their curricula must be implemented with fidelity, and how much it should and can be customized to meet the needs of the schools, teachers, and

[10] This teacher has six years' experience as a computer science teacher. She heavily utilized Bootstrap's on-demand technical assistance resources, including online forums/discussion groups, calls/emails with Bootstrap staff, and YouTube videos. She reported using each of the six Bootstrap tools "all of the time." She is operating the program in a school that is not strongly supportive of the effort.

students it is serving. Accordingly, a central question of this evaluation was to what extent are teachers implementing Bootstrap with fidelity and is fidelity related to student outcomes?

Bootstrap's curricula are carefully designed to build on skills from one lesson to the next, and the majority of teachers (82 percent), irrespective of their Bootstrap training experience, recognized this by teaching all the lessons in the prescribed sequential order (only 7 percent taught just a few or none of the lessons in order; see Table 5). Teachers were less likely to implement the lessons as prescribed in the curriculum materials; just under two-thirds (61 percent) of teachers overall taught every lesson as designed (only 6 percent taught just a few or none of the lessons as prescribed; see Table 5). Teachers who had more training were more likely to implement the Bootstrap curriculum as prescribed.

Table 5: Approach to Teaching Bootstrap



Teachers revealed that the two key reasons they changed the curriculum were time constraints and the need to align the curriculum with students' ability levels. Notably, 58 percent of both trained and untrained teachers believed they needed more time to teach the curriculum, and 40 percent of teachers felt that they would have benefitted from more supplementary lessons.[11] Bootstrap training was a factor in how closely teachers followed the curriculum: more untrained than trained teachers added lessons to the curriculum (50 percent versus 28 percent, respectively).

[11] Bootstrap recognizes that its teachers are instructing students at various levels of proficiency and offer supplementary lessons to teachers.

Bootstrap's curricula have six core teaching tools that teachers are trained to use for implementation. Overall, the majority of teachers reported using these tools "all or most of the time" when teaching Bootstrap. Teachers are taught how to use these tools during in-person trainings, and teachers who participated in in-person trainings *did* use these tools at higher rates, suggesting that the training was effective in reinforcing how critical the tools are to implementing the curriculum.

Finally, supplementary student lessons are also offered by Bootstrap. The survey revealed that most teachers (93 percent) accessed and used at least some of the available supplementary lessons and that 40 percent of teachers felt that they would have benefitted from more supplementary lessons.

Perhaps not surprisingly, among the sample of teachers who provided student assessment data, there was little variation in their fidelity to the curriculum,[12] which makes it hard to assess if differences in the way Bootstrap is implemented are associated with students' knowledge gains. Teachers who provided student assessment data varied only in the number of lessons taught and the extent to which they used supplementary materials. Overall, no matter how many Bootstrap lessons were taught, students experienced similar levels of knowledge gain. However, the teaching of more lessons was positively related to students' growth on the composition section of the assessment. Also, teachers who used more supplementary materials had students who experienced greater gains in their math skills both overall and in the area of word problems specifically.

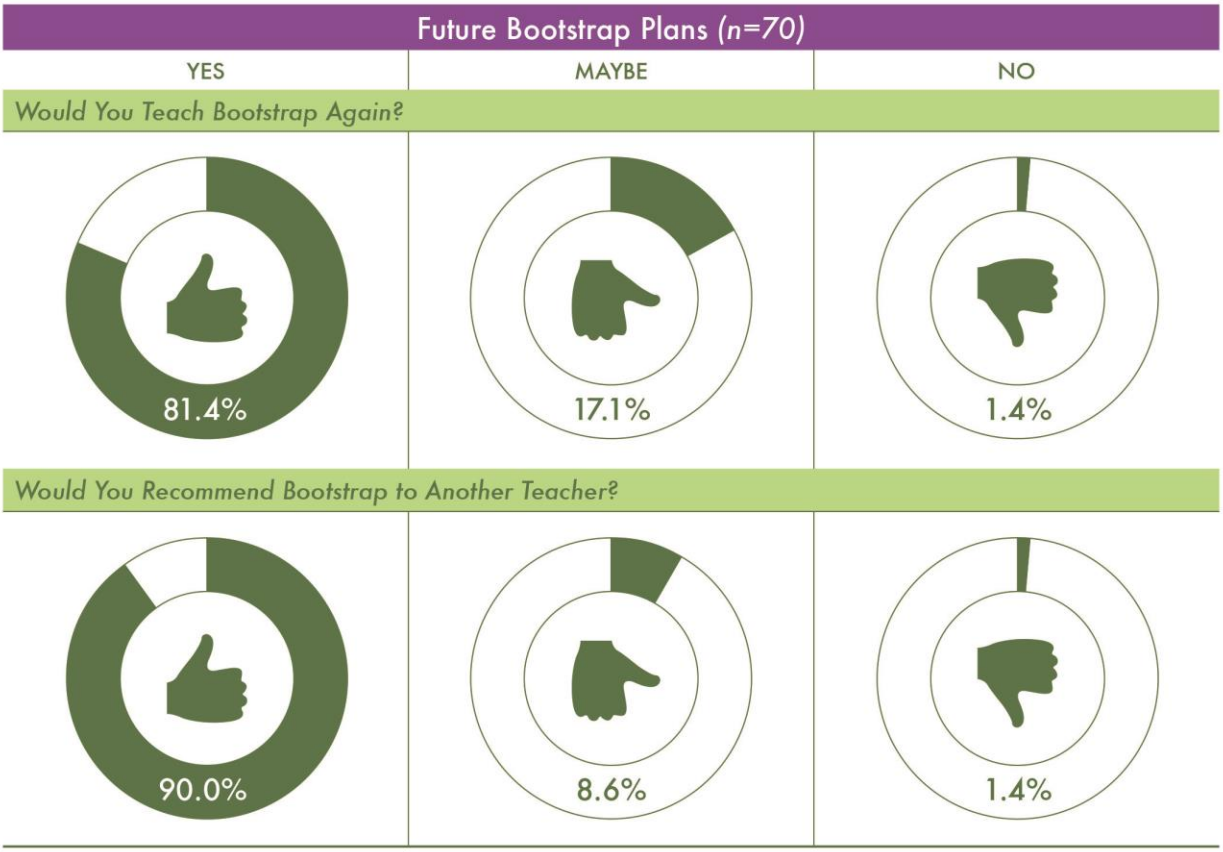
As mentioned above, Bootstrap's curriculum uses six key tools of teaching. Generally, teachers submitting student assessment data used these tools regularly, which leaves little variation upon which the relationship between student outcomes and the fidelity to Bootstrap's curriculum can be explored. However, with the variations that did exist, student knowledge gains persisted even where teachers reported infrequent to no use of the tools, suggesting that these teachers were able to use their expertise to reference the tools only when they believed that students might benefit from the reinforcement. However, it also suggests that some teachers were able to determine that their students were in a position to tackle the material without continual explicit reference to the tools.

FINDING #6: Teachers Think Bootstrap is an Effective Program, but That Some Key Improvements Could be Made

Teachers are the key element in the implementation of Bootstrap, and are critical to igniting students' interest in STEM subject areas. Accordingly, it is important to consider the impact Bootstrap has had on the teachers themselves. First, teachers were asked if they would teach Bootstrap again in the future and if they would recommend Bootstrap to a fellow teacher. Their responses were overwhelmingly favorable, with just over 80 percent of teachers planning to teach Bootstrap again. An even greater number of teachers (90 percent) would recommend Bootstrap to another teacher. Those teachers who were unsure about whether they would teach it again, but nevertheless would recommend it to others, explained that they wished the curriculum was more closely aligned with standards, and that it was too short to serve as an entire course.

[12] Teachers who submitted student assessment data likely represent an especially committed subset of Bootstrap teachers. For more information on this limitation, please see the appendix.

Table 6: Teachers' Future Plans with Bootstrap



Second, the majority of Bootstrap teachers indicated that teaching Bootstrap made a positive impact on their teaching. The greatest impact was on the teachers' commitment to teaching math or programming, followed by their having gained a better understanding of the strengths and challenges schools face in teaching math and programming courses. Importantly, about one in five (21 percent) teachers indicated that Bootstrap had positively affected their teaching skills to a "great extent."

Table 7: The Impact of Teaching Bootstrap on the Teacher

Area of Impact	Extent of Impact on the Teacher from Teaching Bootstrap		
	Not at all/very little	*Somewhat*	*To a great extent*
Commitment to teaching math and/or programming (n=63)	11.1%	46.0%	42.9%
Awareness of the needs and resources of students and families served by your school (n=61)	31.1%	45.9%	23.0%
Understanding of the strengths and challenges of schools in teaching math and programming (n=60)	10.0%	55.0%	35.0%
Ability to work as a member of a "team teaching" environment (n=63)	41.3%	42.9%	15.9%
Overall teaching skills (n=62)	24.2%	54.8%	21.0%

Using a series of statements aimed at finding out what teachers specifically did or did not like about teaching the Bootstrap curriculum, over a quarter of the teachers reported that they did *not* think students made adequate progress each week and that there should be more time allotted for teaching each lesson. On the flip side, 94 percent of teachers indicated that Bootstrap is an effective curriculum for teaching programming skills, while 93 percent indicated that Bootstrap is an effective curriculum for teaching math skills. When asked about specific barriers to their success, teachers rated a lack of assessment of skills growth in math and technology, problems with students working in teams, and a misalignment between Bootstrap and what the teacher needs to achieve in the classroom as the three most significant implementation challenges.

SUMMARY

Bootstrap is an innovative model for teaching computer programming and math skills to middle and high school students. Teachers who implement Bootstrap are diverse in many ways, and, therefore, have the potential to engage a diverse body of students, including those underrepresented in STEM. Students whose assessment data was submitted for this study demonstrated significant and meaningful gains in their math skills, and while these gains cannot be definitively linked to Bootstrap, some evidence suggests that the gains may be attributed to the curriculum. Teachers from different backgrounds, and types of schools were successful in implementing Bootstrap, and many felt that Bootstrap positively affected them as teachers. Finally, the findings presented herein suggest that Bootstrap can be implemented successfully in a variety of settings and with varying levels of support (although in-person training seems to produce the most robust implementation of the curriculum). Even more critically, the study found that the Bootstrap curriculum can be implemented successfully by math or computer teachers alike, as well as those who teach different subjects, are from different demographic backgrounds, with different levels of education, and who teach in different types of schools at varying grade levels.

APPENDIX

Data Sources

This Bootstrap evaluation relied on two data sources: a teacher survey and student assessments. Both sources are described in detail below.

TEACHER SURVEY

To assess the teacher experience, Bootstrap teachers were asked to complete a thirty-minute online survey that included questions about demographics; educational achievement; characteristics about the schools in which they teach; experiences with Bootstrap trainings and other resources; successes and challenges in implementing Bootstrap; and the impact Bootstrap has had on their skills and attitudes related to teaching.[13] Teachers were eligible to be entered into a raffle for an incentive once they completed the survey. Because MAI and Bootstrap were interested in learning more about the *implementation* of Bootstrap in schools, the survey was only offered to teachers who had significant exposure to the program. Teachers were excluded from eligibility if they:

- were preparing to implement Bootstrap for the first time, but had not yet done so;
- were teaching Bootstrap in out-of-school programs; and/or if they
- had not taught at least half of the lessons of the prescribed curriculum.

While over 300 teachers attempted to complete the Bootstrap survey at some point during the evaluation, only ninety-six were eligible for inclusion and completed it.

STUDENT ASSESSMENT

To explore the outcomes of students who participated in Bootstrap, pre- and post-assessments were designed by Bootstrap leadership and administered to students by their teachers before and after presenting the Bootstrap curricula. Each assessment had thirty-nine questions that looked specifically at core algebraic concepts, including composition of functions, connecting multiple representations of functions, and solving word problems. The assessment questions underwent cognitive pre-testing, validity, and reliability testing during the 2012–2013 academic year. Both assessments were designed to be completed within forty-five minutes by students aged twelve through fifteen, using only a pencil and paper. Facilitating the assessments was not a criterion for participating in Bootstrap, and only twelve teachers submitted their students' results. Given that participation by teachers was not mandatory, it can be assumed that only teachers who were the most self-motivated and committed to the Bootstrap program chose to participate.

Limitations of This Evaluation

While every effort was made by MAI and Bootstrap leaders to mitigate some of the challenges encountered during the evaluation process, there remain certain limitations to this evaluation. These limitations are described below to provide context to the remainder of this report.

[13] Teachers were informed about the survey via email and via Bootstrap's website and Facebook page at select intervals (about once a month or once every two months) over the eighteen-month evaluation period.

TEACHER SURVEY

The evaluation team attempted to obtain a robust number of teachers who were willing to respond to the survey; however, due to several factors, the number of respondents was less than expected. As a result, the teacher sample may or may not be representative of the full population of teachers who have implemented Bootstrap or participated in workshops. It is certain that many other teachers implemented the curriculum in schools; however, Bootstrap relied heavily on its partners (Code.org and CSNYC) to conduct teacher outreach about the survey. In some cases, these partners did not send out the survey to teachers as frequently as recommended. In addition, certain partners required the teachers to complete a preliminary survey before the Bootstrap survey. Given these circumstances, some teachers may not have even known about the survey, or may have not wanted to complete more than one survey. Finally, teachers who had not made enough progress with the curriculum to complete the survey when they initially accessed it have chosen not to complete it at a later date.

This evaluation report includes a final sample of ninety-six teachers out of the 325 who initially attempted to complete the survey.

STUDENT ASSESSMENT

The student assessment data derives from an even smaller subsample of the teachers who participated in the teacher survey—twelve teachers in total facilitated and submitted student assessments to Bootstrap. This low number is due to the fact that many teachers either did not conduct the pre- and post-assessments, or did so, but did not submit them to Bootstrap. Again, because the teachers who did submit the assessments are assumed to be a unique subset of highly motivated teachers, the student outcomes presented herein may or may not be representative of the experiences of other students who have participated in Bootstrap.

The assessment scores were used to determine whether there was a change in students' mastery of algebraic concepts from before they participated in Bootstrap to after they experienced the curriculum. However, it is important to note that, because of the design of the assessment and evaluation, improved mastery cannot necessarily be attributed to Bootstrap. If the pre-assessment was administered at the beginning of the school year, before the students experienced their school's traditional algebra course as well as the Bootstrap curriculum, improvements shown in the post-assessment could be attributed to *either* the school's algebra course or the Bootstrap curriculum.

If, however, the pre-assessment was administered closer to the end of the school year, just prior to the implementation of the Bootstrap curriculum, improvements from one assessment to another could more likely be attributed to Bootstrap. The issue that then presents itself, however, is that students who already completed the majority of the traditional algebra course are more likely to have mastered the material before the pre-assessment, and so have little room for growth between the two assessments. Unfortunately, when during the school year the assessments were administered in each case is unknown.

Along with the secondary limitations of both the teacher survey and the student assessments listed above, the small sample sizes for both groups limited the ability to detect statistical differences; differences between groups would have to be very large to achieve this. Because of this, this report highlights meaningful substantive differences for consideration, even in the absence of statistical significance.

Profile of Teachers Submitting Student Assessment Data

Before answering the key research questions associated with the student assessment data, the evaluation sought to understand: (1) if the teachers in the student assessment sample differed from the Bootstrap teachers who only completed the teacher survey, and (2) what the actual results of the students' pre- and post-assessments were.

Are the teachers who provided student assessment data similar to others who did not?

Table A shows that although the sample of teachers who submitted student assessment data is a unique sample of teachers who were motivated to provide assessment data to Bootstrap, their backgrounds (when it came to gender, type of school in which they teach, grade level of school in which they teach, degree type, and the number of years they have been teaching) *were* similar to the teachers who did not provide student assessment data. The two samples differed only when it came to age and having a connection to a Bootstrap partnership organization. Teachers who provided student assessment data were a little older than teachers who did not, and a greater percentage of them were associated with a partnership organization (Code.org, or CSNYC).

Table A: Background of Bootstrap Teachers With and Without Student Assessment Data

Background Characteristic	Percentage of Respondents Without Student Data (*n*=84)	Percentage of Respondents With Student Data (*n*=12)
Gender		
FEMALE	58.3%	58.3%
MALE	41.7%	41.7%
Age		
19–39	45.7%	27.3%
40–49	30.9%	45.5%
50 AND ABOVE	23.5%	27.3%
Teach in Public School	77.6%	83.3%
Highest Grade Level in School		
ELEMENTARY SCHOOL	7.5%	0.0%
MIDDLE SCHOOL	49.3%	50.0%
HIGH SCHOOL	43.3%	50.0%
Type of Degree Held (n=96)		
NEITHER MATH NOR COMPUTER-RELATED DEGREE	57.1%	66.7%
MATH DEGREE	17.9%	8.3%
COMPUTER SCIENCE, COMPUTER PROGRAMMING, OR COMPUTER ENGINEERING DEGREE	20.2%	25.0%
BOTH MATH AND COMPUTER-RELATED DEGREE	4.8%	0.0%
Years Since Starting Teaching (n=85)		
1–3	21.9%	16.7%
4–10	30.1%	33.3%
11 OR MORE	48.0%	50.0%
Main Teaching Assignment (n=79)		
COMPUTER SCIENCE	23.9%	33.3%
MATH AT ALGEBRA 1 LEVEL OR ABOVE	37.3%	25.0%
MATH BELOW ALGEBRA 1 LEVEL	25.4%	33.3%
OTHER SUBJECT	13.4%	8.3%
Linked to Partnership Organization (n=96)		
CODE.ORG	17.9%	25.0%
CSNYC	4.8%	33.3%
NEITHER	77.4%	41.7%

Just as Table A above compares the background characteristics of teachers with and without student assessment data, Tables B and C, below, compare the two groups of teachers on a subset of items to assess their attitudes toward teaching Bootstrap. If the two groups of teachers had similar experiences teaching Bootstrap, this could indicate that the teachers included in the assessment sample may be more broadly representative of Bootstrap teachers as a whole.

The data presented in Table B are encouraging. Although the subset of teachers with student assessment data rate their Bootstrap experiences slightly more favorably on each item, the difference is only significant on the final item. Teachers with student assessment data are more likely to believe that their students make adequate progress with their lessons each week. If the teachers from both groups are correct in their differential assessment of their students' progress, this could mean that other students might not show such favorable progress if assessment data for them had been made available. When asked if students were grasping the concepts taught at Bootstrap, however, teacher reports were not significantly different across the two groups.

Table B: Attitudes Toward Teaching Bootstrap

Bootstrap-Related Statement	Mean Response	
	Respondents Without Student Data (n=54)	*Respondents With Student Data (n=12)*
Bootstrap is an effective curriculum for teaching students programming skills (n=65)	3.21	3.33
Bootstrap is an effective curriculum for teaching students math skills (n=66)	3.17	3.25
Students are grasping the concepts taught at Bootstrap (n=63)	2.94	3.08
The lessons are at the right pace and level for our students (n=65)	2.87	3.00
Participants make adequate progress with their lessons and programming assignments each week (n=64)	2.79	3.25*

Note: Response options range from strongly disagree (1) through strongly agree (4), where 4 is the most favorable response.

The data presented in Table C further support general similarities between the experiences of teachers with and without student assessment data. The one statistically significant difference between the two groups of teachers indicates that teachers with student assessment data are more confident in their own math skills than teachers without student assessment data; however, there is not a significant difference in how the two groups of teachers rate the sufficiency of the math skills of their students.

Because the two groups of teachers show so many similarities in both background and experience, the evaluation team feels comfortable using the available student assessment data as a proxy for the experience of the students of all teachers who were surveyed about the Bootstrap curriculum. However, it is critical to keep in mind that only ninety-six teachers (out of a pool of more than 300) completed the survey, and that they too likely represent a select subset of teachers who are very committed and connected to Bootstrap and/or its concept, as represented by their willingness to complete the survey and implement the curriculum.

Table C: Attitudes Toward Teaching Bootstrap

Bootstrap-Related Statement	Mean Response[11]	
	Respondents Without Student Data (n=54)	*Respondents With Student Data (n=12)*
Students are not interested in Bootstrap (n=65)	1.83	1.58
I/my teaching team do/does not have the math skills needed to do Bootstrap (n=63)	1.90	1.33*
I/my teaching team do/does not have the technology/ programming skills needed to do Bootstrap (n=65)	2.08	1.83
Students do not have the math skills needed to do Bootstrap (n=64)	2.00	2.25

Note: Response options range from strongly disagree (1) through strongly agree (4), where 4 is the most favorable response.