USC Viterbi
School of Engineering
VAST: Adopt-a-School, Adopt-a-Teacher

GOOD NEIGHBORSCAMPAIGN

SPECIALTY FAMILY FOUNDATION

BOTS EXTERNAL EVALUATION ANNUAL REPORT
For the 2019-2020 Academic year

June 25, 2020

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SPEAR

STEM · Program Evaluation · Assessment · Research

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" I love the BOTS program because it also works as an incentive to students. They need to know math, reading and writing to learn to code and program Spheros so it inspires students to put more effort in their work not to mention it changes the culture and vibe of the classroom because the students are exposed to opportunities they have never had before."

Excecutive Summary

The goal of the Building Opportunities with Teachers in Schools (BOTS) program is to help teachers and students within East Los Angeles (LA) schools serving low-income neighborhoods gain equitable access to 21st-century digital skills. This includes building demonstrable ability in computational thinking and understanding of the social significance of computer science to ensure agency in a global context increasingly reliant on sophisticated computational processes. BOTS helps build digital equity by forming a Research-Practitioner Partnership between East LA elementary schools and the USC Viterbi K-12 STEM Center to support first and second-grade teachers in a robotics-based Community of Practice (COP) throughout the academic year. The 2019-2020 BOTS program supported a total of 8 teachers from four different schools. The program was funded by grants from the USC Good Neighbors Campaign and the Specialty Family Foundation, as well as in-kind contributions from the USC Viterbi K-12 STEM Center, the partner schools, and USC student organizations.

Prior to each workshop experience, the evaluation team and project leadership met to discuss learning goals for the session. Survey instruments were designed to measure teachers' knowledge and dispositions. Participants reported high levels of agreement, understanding, and confidence in the learning goals and articulated a transfer of that knowledge into the classroom. Results indicate that the teachers showed learning gains for each topic surveyed and for the program as a whole.

During the 2018-19 program year, BOTS training and classroom implementations were interrupted by the LAUSD strikes and were again interrupted in 2019-2020 due to the Covid-19 pandemic. Despite these obstacles, teacher enthusiasm and engagement with BOTS remained high.

Conclusions and recommendations:

"I think coding opens up a whole new avenue of opportunities for our students. Not enough students of color are involved in technology and science. "

Goal Summary: *To help teachers and students in East LA gain equal access to 21st-century digital skills, building demonstrable ability in computational thinking and understanding of the social significance of computer science.*

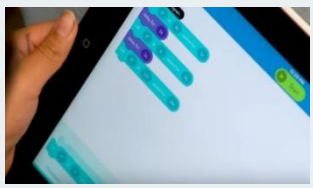
Conclusions:

The participants have an overall positive view of the BOTS program and see the student impact of teaching coding and programming in their classrooms as it relates to the intended goal of this project. Teachers value BOTS in their classroom and feel it contributes to student understanding and the importance of coding/programming as well as growing confidence, improving communication, instilling persistence, developing critical thinking and collaboration skills, and increasing student equity.

The teachers reported that their knowledge of coding and the value it presented to their students was a direct result of their participation in BOTS and were more aware of the connection of computer science and robotics to their curriculum. The participants also felt an increase in their overall confidence regarding coding and programming skills and their ability to integrate and to impart those capabilities in their students. All participants reported that they would recommend BOTS to their peer educators.

While participants reported that implementing BOTS was relatively easy to incorporate into their curriculum, finding the time to integrate BOTS into their curriculum proved to be the biggest challenge for teachers. Covid-19 also added to the time issue as many teachers were in mid-lesson when schools moved online. Loss of personal interaction with students and access to equipment and materials essentially stopped the implementation of BOTS. Few problems were experienced with the actual materials when teachers were using them in the classroom. Appendices F - J contains the participant's personal thoughts about their experience in the BOTS program.

"Besides the benefits to the students, the program for teachers is amazing. I feel like I've been exposed to something I've never had before and I'm giving that experience to my students."



Recommendations:

The BOTS program is having the intended impact on its participant group and is meeting the goals stated above. It is recommended that the program continue and that additional funding is allocated, or sought out, to increase the number of participants and schools. The following recommendations are encouraged:

- **Continue efforts to get robot units into the classroom as early as possible**, so that teachers are encouraged to use them early in the training process.

- As with most educators, time is perceived as the greatest challenge regarding program implementation in the classroom. **Continue to highlight state and national standards, including English language arts and math standards, within the BOTS program/curriculum** to encourage educators to see opportunities for seamless and cross-disciplinary implementation. Additionally, **develop strong relationships with BOTS school principals and administrators** to ensure they see the value of the program and that they support their teachers in managing and navigating administrative and academic responsibilities that impact teachers' time for program implementation.

- In an effort to grow the Open-Education Resources (OERs) developed through BOTS, **continue to develop an OER strategy for lesson plans, assessments, and materials for educators.**

- Through survey feedback, teachers shared curriculum modifications such as pairing students or using small groups until they became comfortable with the material. **Devise a method for documenting shared modifications by teachers for future use in BOTS training.**

"The most helpful aspect of the program was the trainings because I was able to collaborate and get ideas from other teachers, Mary, Kendall, Ashley and Maria [USC project team members] were also extremely helpful in answering any questions or concerns I had."

- New participants reported that they received much help from previous BOTS participants who acted as participant-mentors during the training. The experience they provide can be invaluable as BOTS grows and expands. **Allow previous participants to continue to participate in BOTS in some form.**

- Capstone projects demonstrated the learned skills of BOTS participants for infusing computer science into lessons using state and national standards. **Make capstone projects a permanent requirement of BOTS and put lesson plans into a template format and make all available in an online OER database.**

- The BOTS program has a demonstrable impact on teachers and students that can be readily scaled to reach more of the program's intended audience. Financial resources, however, are limiting its approach. **Apply for additional funding to expand the reach of the program toward its goal of increasing digital equity for students through teacher professional development.**

Introduction

The goal of the Building Opportunities with Teachers in Schools (BOTS) program is to help teachers and students within East Los Angeles (LA) schools serving low-income neighborhoods gain equitable access to 21st-century digital skills. This includes building demonstrable ability in computational thinking and understanding of the social significance of computer science to ensure agency in a global context increasingly reliant on sophisticated computational processes. BOTS helps build digital equity by forming a Research-Practitioner Partnership between East LA elementary schools and the USC Viterbi K-12 STEM Center to support first and second-grade teachers in a robotics-based Community of Practice (COP) throughout the academic year. The 2019-2020 BOTS program supported a total of 8 teachers from four different schools. The program was funded by grants from the USC Good Neighbors Campaign and the Specialty Family Foundation, as well as in-kind contributions from the USC Viterbi K-12 STEM Center, the partner schools, and USC student organizations.

"I think what they [students] liked most of all was a different outlet to learning a new subject that they wouldn't have been exposed to without this program."

***Goal Summary*:** To help teachers and students in East LA gain equal access to 21st century digital skills, building demonstrable ability in computational thinking and understanding of the social significance of computer science.

Evaluation

Evaluation project start date was September 1, 2019. The evaluation end date is no later than August 30, 2020.

Four professional development (PD) workshops were evaluated on the following dates:

PD Workshop 1: September 14, 2019
PD Workshop 3: November 16, 2019
PD Workshop 5: February 22, 2020
PD Workshop 7: Cancelled due to Covid-19 Pandemic – End of year survey sent out on May 25, 2020.

PD Workshops 2, 4, & 6 were conducted for learning reinforcement and were not surveyed. Each workshop consisted of specific goals listed in the figures below and were conducted by the BOTS leadership team along with graduate student assistants. Teacher reflective surveys were conducted after each workshop to measure the learning gains of the PD Workshop goals (Appendices A, B, C, & D). In addition to participation in the workshops, teachers were provided with oral and written (Appendix E) directions for developing a capstone project on how to integrate their current curriculum standards using BOTS. All participants completed the capstone project.

"I believe BOTS is such an important program for the kids in this digital age. It gives them more options for the future."

A survey link was sent to the BOTS leadership team who then dispersed it to participants. SPEAR reported back to the leadership the participants who filled out the survey and BOTS leadership followed up on any participants that did not respond. A data summary report for each workshop evaluated was presented to the BOTS leadership team.

Participants are K-1, 1st, or 2nd grade teachers originating from four East LA elementary schools. Seventy percent (70%) of the attendees were teachers who participated in BOTS during the previous year. All participants completed the surveys for the workshops they attended

"I think my students struggled most with learning how to problem solve on their own, to find the bugs and create codes independently without seeking my help as soon as they feel challenged. I think my kids needed to have more time to learn that it's a process that's tedious and at times stressful but must be completed by them because that's the point of coding."

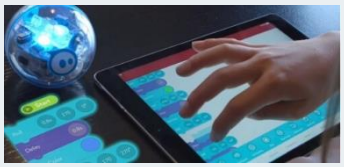
Below is an overview of the intended goals for the workshops listed.

PD Workshop 1:

# of participants: 10
Goals: Knowledge of coding topics discussed
Confidence in teaching coding skills
Understanding of coding importance

PD Workshop 3:
# of participants: 8
Goals: Understanding how to code the Sphero robot
Confidence in teaching Sphero skills

PD Workshop 5:
# of participants: 5



"The once a month classes at USC were helpful because we got to practice everything before teaching it to the kids. Everyone was so helpful, nice and patient."

Goals: Understanding directional/angular and loop coding
Teaching logistics and behavioral handling of Spheros
Increasing confidence in teaching Sphero skills

PD Workshop 7:

# of participants: 8 – completion of capstone project

Goals: Culminating the Sphero learning for this year
Capstone project reveal
Student benefits and future participation
Participant analysis of program

Participant Information

Participants in the 2019-2020 BOTS program were a mix of new and returning teachers as indicated in the figure below.

Figure 1: Percentage of new and returning teachers.

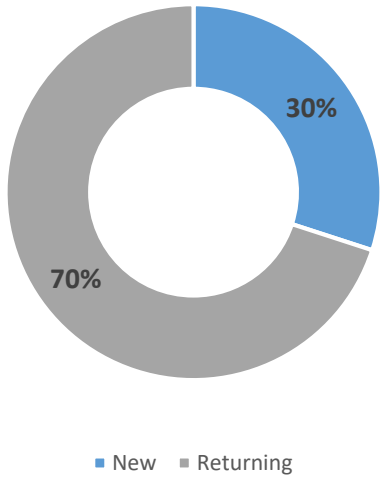
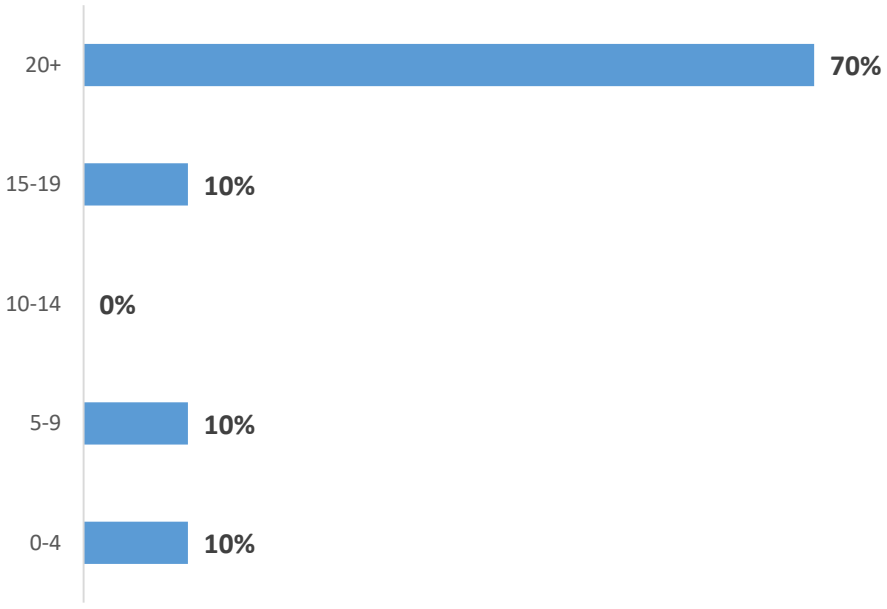


Figure 2: Number of years teaching experience.



"… [the students] like that it's hands on whether it's unplugged or plugged they always have something to do that's engaging."

Survey Results

The participant reflective surveys asked teachers to relate their knowledge, confidence, or understanding of topics before the workshop and after the workshop. A summative survey was conducted at the end of the 2019-2020 program that asked teachers about their overall impression and impact of the BOTS program.

The figures below indicate the specific topics and questions presented to teachers. The individual responses were quantified, where appropriate, to develop group before and after weighted averages generating a percentage indicating growth in the topic. In other instances, answers were quantified, where appropriate, based on yes/no or level of agreement responses, and appropriate participant quotes (from open-ended questions) are included to support the data.

"…my students frequently make connections to the robotics/coding program and curriculum."

Learning Gains

Project leadership defined several learning goals for the faculty at each workshop event. Overall, participants reported high levels of agreement, understanding, and confidence that they met the learning goals and could transfer that knowledge into the classroom. The results indicate that the teachers showed learning gains and increased confidence for each topic surveyed and the program as a whole.

Workshop 1 Data Analysis

Figure 3. Please rate your knowledge of the following topics before and after attending today's [Workshop 1] BOTS workshop...

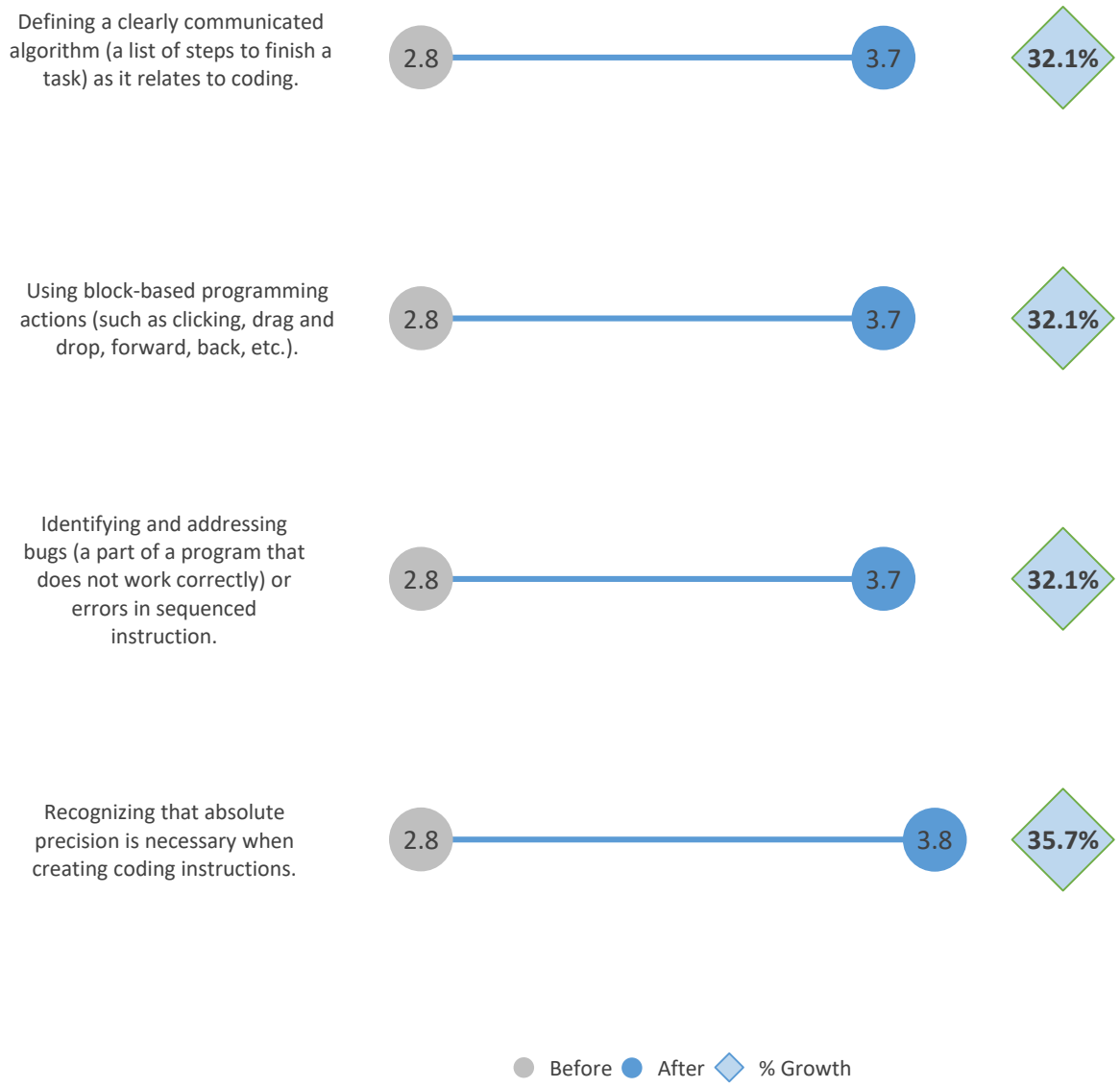
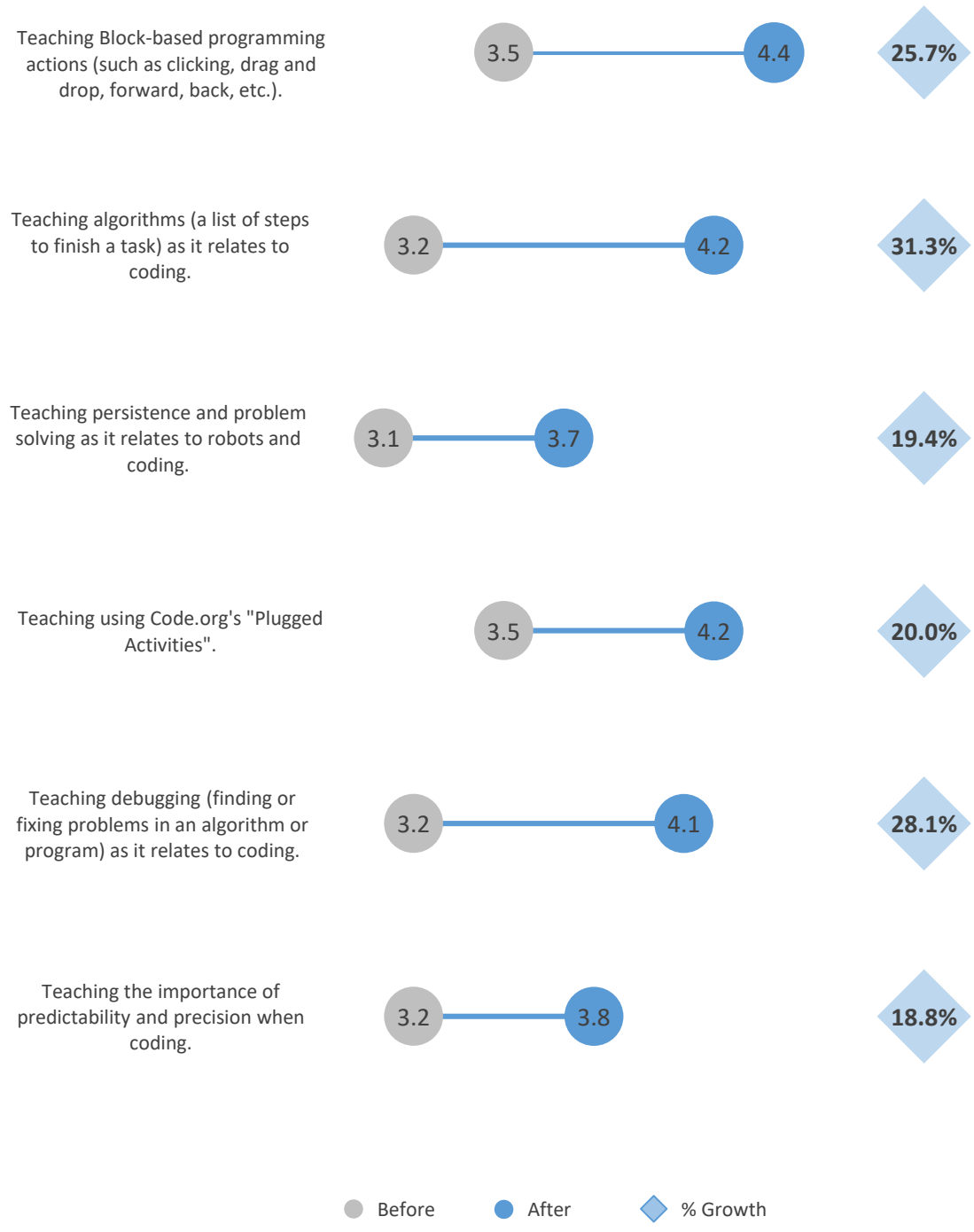


Figure 4. Please rate your level of confidence in teaching the following skills to your students before and after the workshop session.



Workshop 3 Data Analysis

Figure 5. Please rate your level of agreement in teaching the following skills to your students before and after the workshop session.

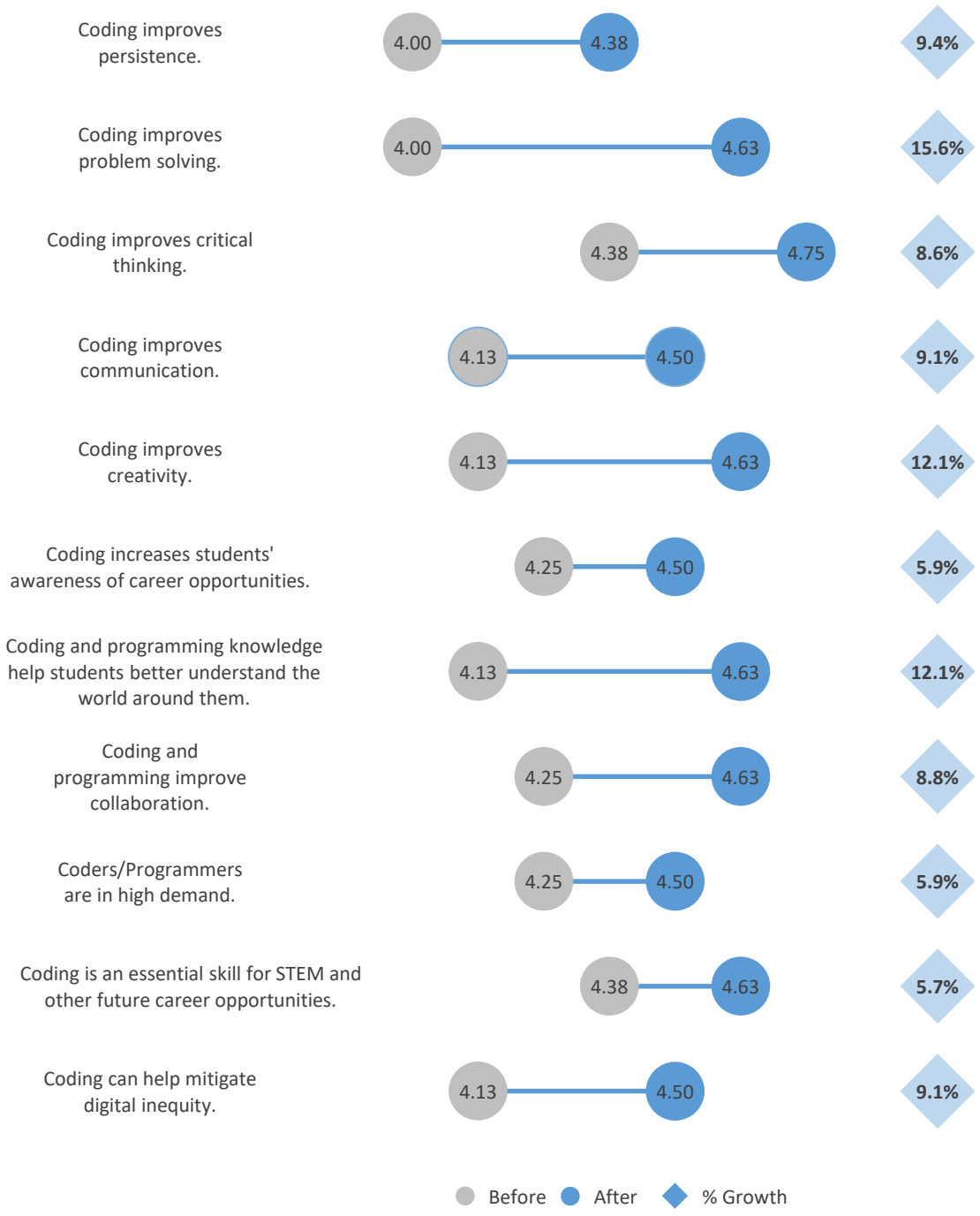
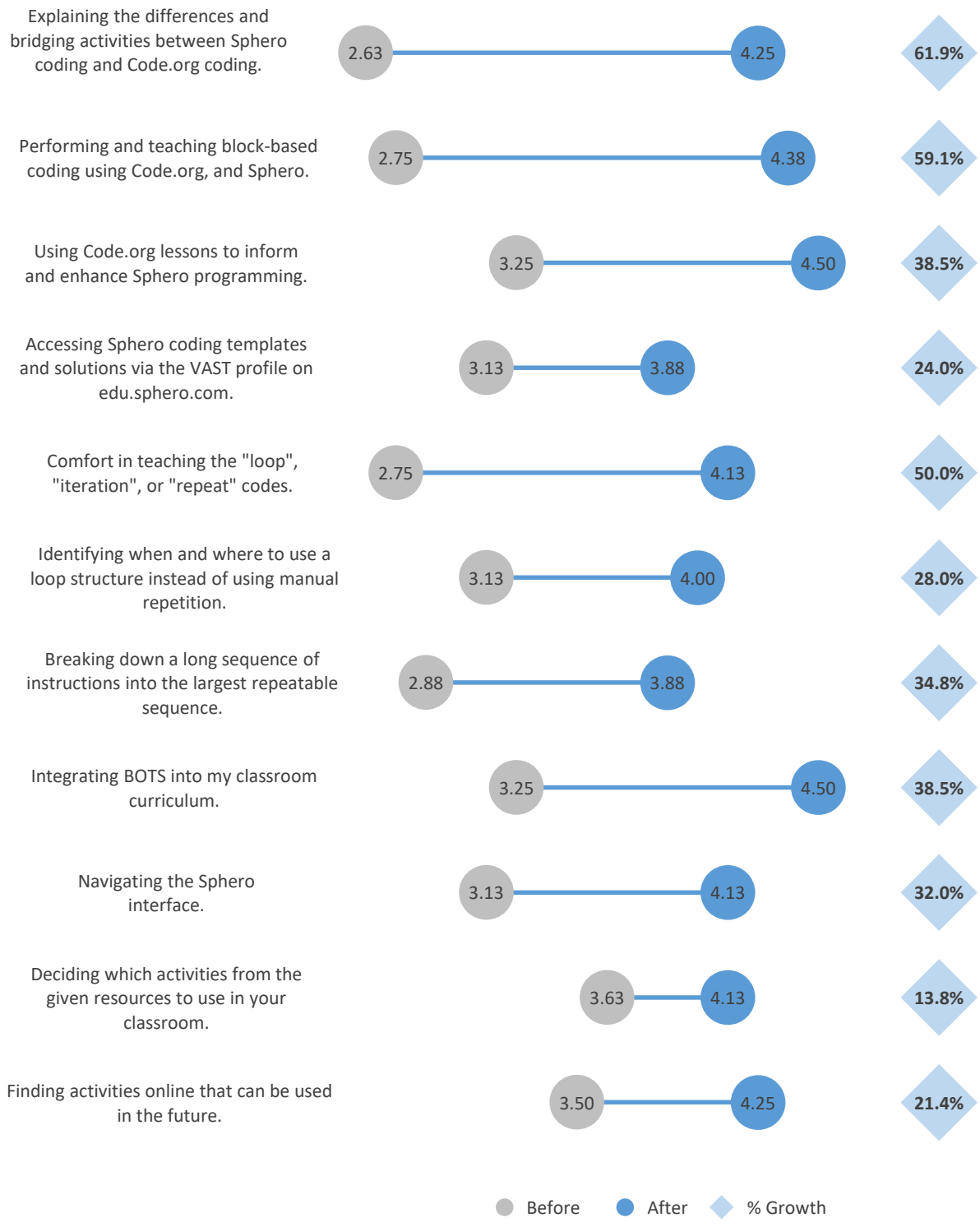
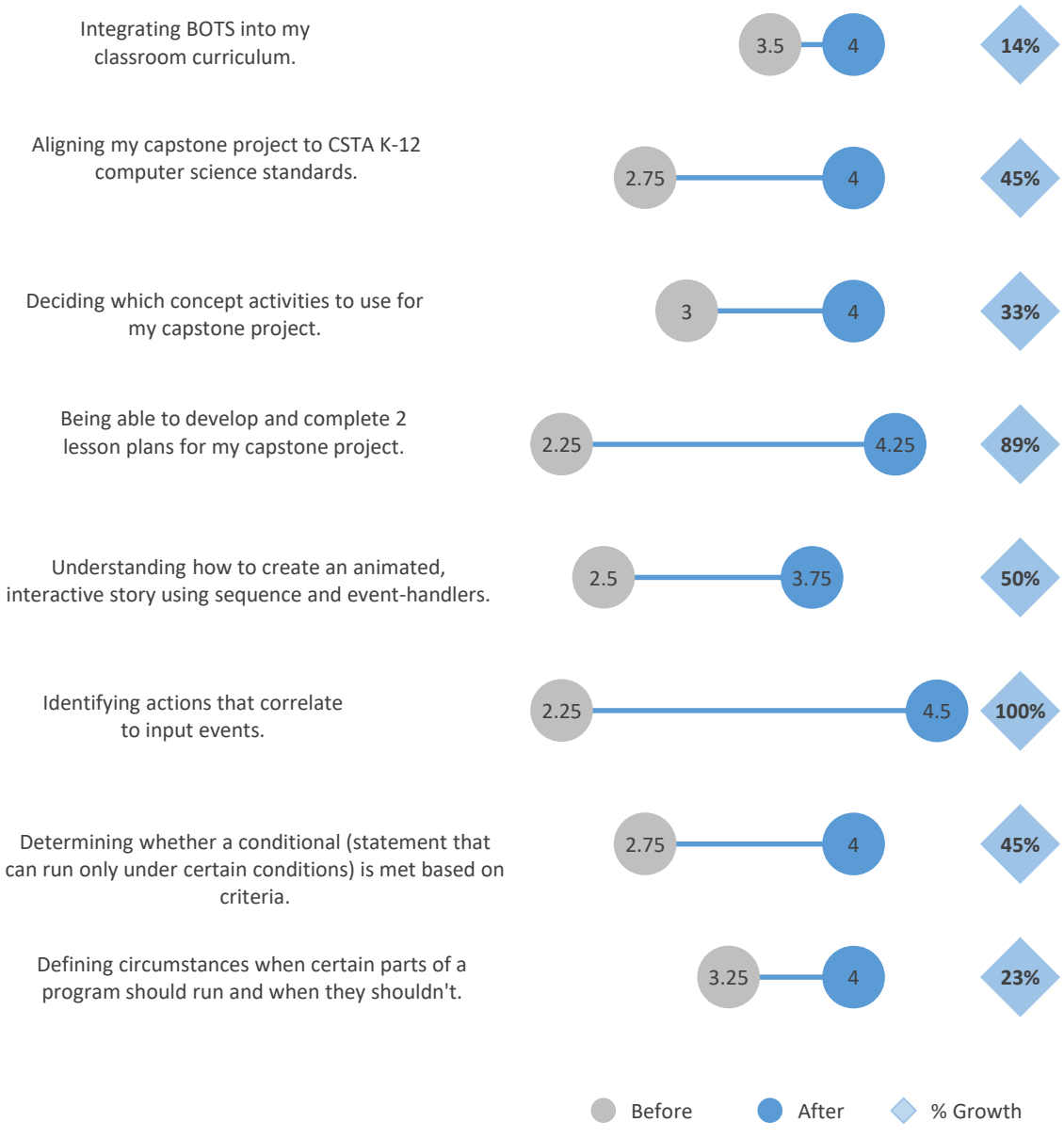


Figure 6. Please rate your level of confidence in teaching the following skills to your students before and after the workshop session.



Workshop 5 Data Analysis

Figure 7. Please rate your level of confidence before and after attending today's BOTS workshop session.



Summative Post-Survey Data Analysis

Figure 8. STUDENT IMPACTS: After implementing BOTS in the classroom, the teachers observed the following:

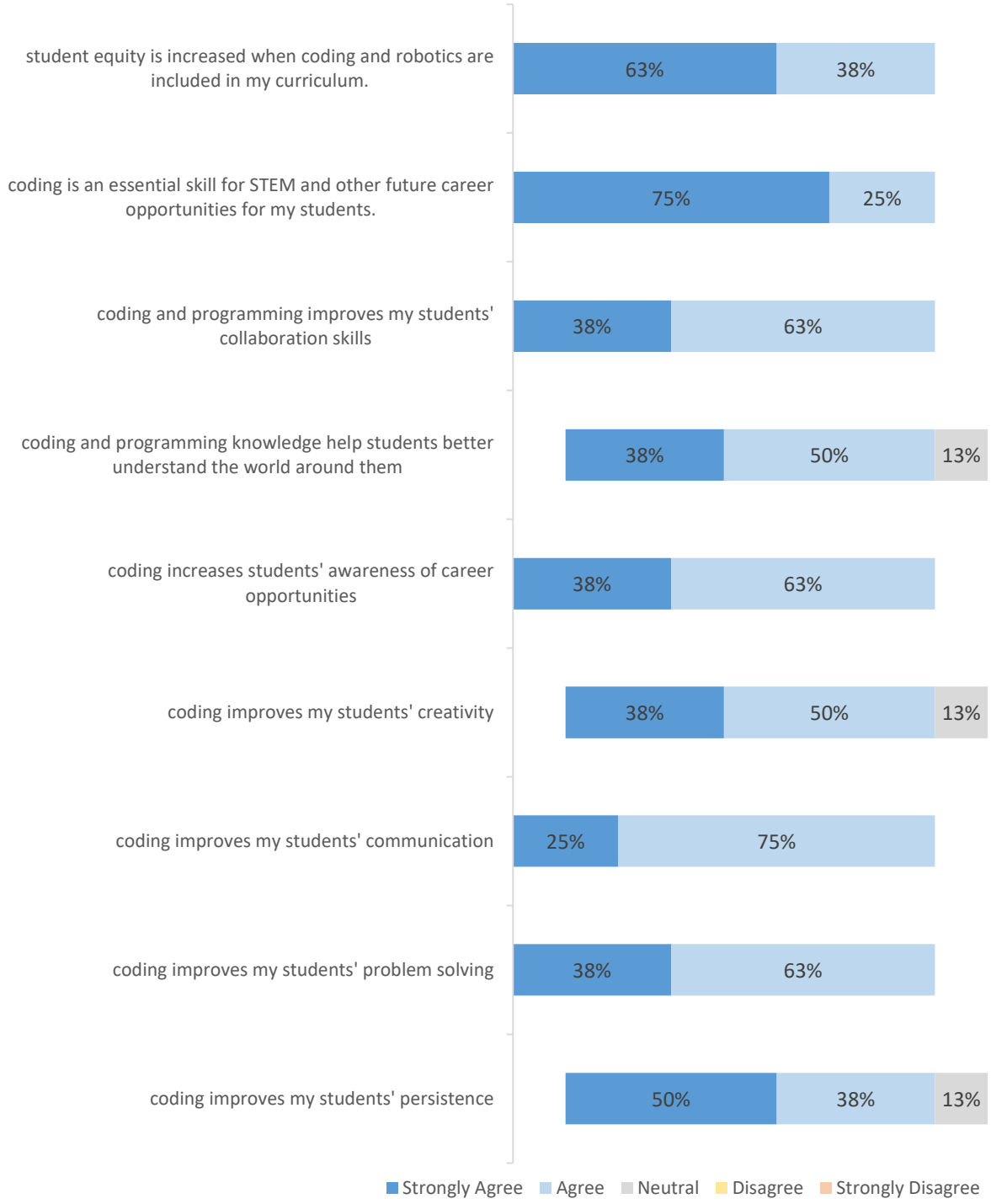


Figure 9. TEACHER IMPACTS: Teachers observed the following about BOTS:

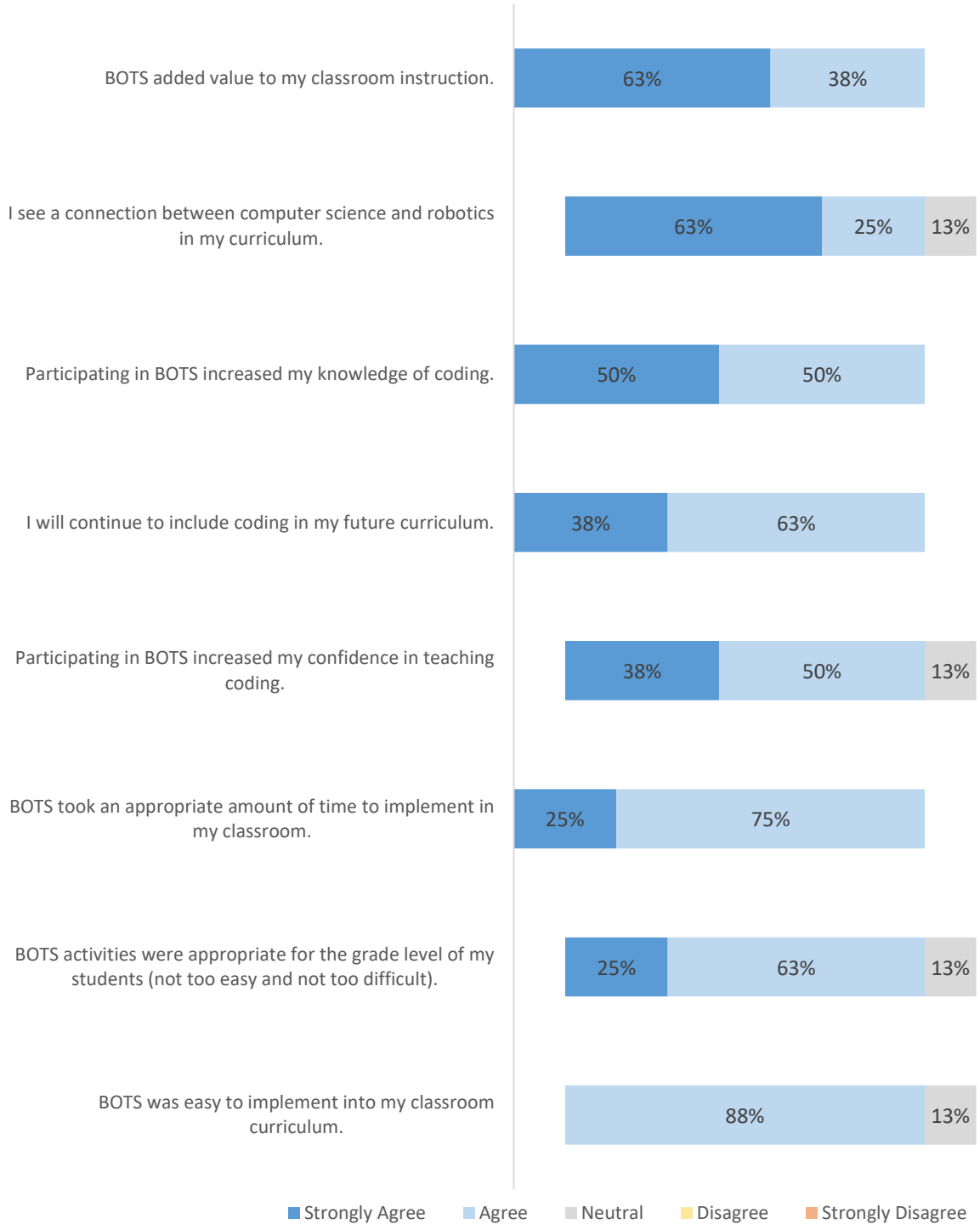
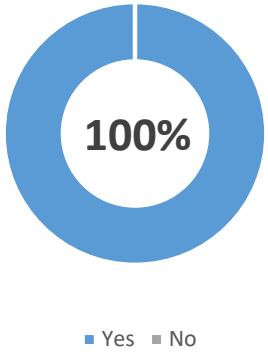


Figure 10. 100% of teachers would recommend BOTS to their peers



"Besides the benefits to the students, the program for teachers is amazing. I feel like I've been exposed to something I've never had before and I'm giving that experience to my students. I felt supported and guided throughout the whole year which was most important to me because it's difficult navigating something new on your own let alone teaching it to a bunch of kiddos. "

"The biggest reason why I'd recommend this program is because it exposes students to a whole new world of possibilities in exposing them to a new realm of careers, helping them with their computer skills, problem solving skills, communication skills, team work, to name a few."

"I think coding opens up a whole new avenue of opportunities for our students. Not enough students of color are involved in technology and science."

"Student learn to collaborate using the BOTS terms. It improves their critical thinking skills. It also improves their creativity."

"I think most students enjoy the program and learn a good deal about technology and see aspects they were unfamiliar with."

"Students need to be exposed to computer science as early as possible. Many teachers in LAUSD don't have that experience or knowledge on how to teacher computer science. This program is a great way to introduce computer science to teachers. "

Figure 11. Student's computational skills improved this school year as a result of implementing BOTS in the classroom.

"My students have become better problem solvers and are able to quickly find solutions."

"Implementing BOTS in my classroom has helped my students with their computer skills in numerous ways."

"… initially intimidated by the concept of robotics but once they begin the program, they become really comfortable using the computer and exploring other features on the computer such as the internet browser and settings."

"As the year progressed students become more self-confident and figured out how to solve the puzzles. Pair partnering also helped as the students helped each other."

"BOTS helped my student's computational skills."

"It taught them how to follow directions when they used code.org."

"…my students frequently make connections to the robotics/coding program and curriculum."

"My students are more confident in using the computers and have become more aware and competent in using keyboard keys they had not used previously."

"…students were so eager to be creative. They loved creating their binary bracelets and extending to other activities, like guessing a word using binary codes or vice versa."

Figure 12. Covid-19 impact on teachers

"I wish I would have been able to use the Spheros more. Our time with them was not as long as I wish it would have been. I also would have loved to see and hear the ideas the other teachers had in regards to their project and how they planned to use the program in other subject areas."

"The kids continued to work on code.org from home during this Covid-19 pandemic. It was a challenge for the kids and their parents to solve some of the codes. We encouraged them not to give up to keep trying and have a growth mindset. I hope to do this again next year. I really appreciate all your help and support. :)"

"Our last day in the classroom was 3/13/20, so it cut our pacing plan short. Not all students have been connecting through technology."

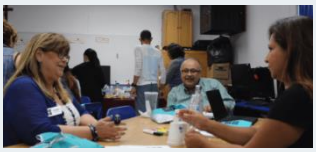
"Since I missed two sessions before Covid-19 and the rest after Covid-19 I feel like I need a refresher training. I wish I could have finished. It took me longer to finish my capstone project because of other obligations (trainings, lesson plans, childcare, etc.)"

"Ashley, Kendal, and Maria [USC project team members] were able to visit our classroom right before the pandemic caused us to close down. That was an amazing experience for my class, because of the stay at home orders we were not able to complete our program. I was also not able to implement my capstone project with my class. I completed the capstone project but do not have access to my classroom as I had before, therefore I was not able to submit the worksheets I created for my lesson. My students (through distant learning) express that they want to continue to work on code but I find it difficult to help them through distant learning because everyone is at a different level and I can't scaffold for them as I would in class. "

"The Covid-19 pandemic has increased my workload and has left little time for anything else. The anxiety and uncertainty that comes with not knowing if I am safe when I go out for needed supplies has added to my stress level. We were not able to finish our schedule meetings/learning because of the pandemic and it seemed to leave the program unfinished as well as the Sphero lessons my students and I had been looking forward to."

"During the last week of school March 9, I was finishing testing my language learners on the state testing (ELPAC) which is a one to one test and it took over a month to complete. I didn't finish testing, I needed 2 students. My plan was once the testing was completed I was going to catch up on my BOTS lessons. I didn't happen."

"I was in the middle of my project when Covid-19 pandemic happened. There was only one group that was able to complete the plugged activity."



"Our time with them [USC] was not as long as I wish it would have been. I also would have loved to see and hear the ideas the other teachers had in regards to their projects [interrupted by Covid-19] and how they planned to use the program in other subject areas."

Capstone Project Summary

The BOTS teacher professional development program encouraged teachers to utilize both Code.org and Sphero.edu lessons, as well as their own creativity and knowledge of best teaching practices, to successfully implement coding and robotics within their grade classrooms in the form of a capstone project. Clear expectations of the project were given orally and in writing (Appendix E).

The project consisted of developing two lessons plans that complemented the concepts covered in the BOTS program. One lesson was to be an "unplugged" activity (i.e. does not require any electronic equipment) teaching a topic of the teachers' choosing from a selected list. The second lesson was to be either a plugged (i.e. does require electronic equipment) or unplugged activity that utilizes Code.org or Sphero to teach a topic that extends beyond the Computer Science Standards into Common Core (Math or English Language Arts) or Next Generation Science Standards. The activity was related in some way to a topic selected from the given topic list.

Capstone projects were to be presented in-person to the other BOTS teacher participants and some invited guests so that participants could continue to learn from each other and grow in their capacity to effectively engage students in coding and robotics. Due to Covid-19 and teachers dealing with new challenges, capstone projects were not presented and instead made available online to the other participants. The projects were reviewed by Dr. Sondra LoRe, the primary evaluator on the project, who holds, in addition to a PhD, a Masters in Early Childhood Education in Curriculum and Instruction and has written, evaluated, and assessed K-12 curriculum for over 20 years. Dr. LoRe found that the capstone lessons developed by the participants have met or exceeded the guidelines set by the BOTS leadership team. A summary of the projects can be found in Appendix K.

Conclusions and Recommendations

Goal Summary: *To help teachers and students in East LA gain equal access to 21st century digital skills, building demonstrable ability in computational thinking and understanding of the social significance of computer science.*

" I thank Mary, Kendall, Ashley, and Maria [USC project team members] for all their help because I wouldn't have been able to teach this without learning it from them first and having them guide me and problem solve with me throughout the year."

Conclusions:

The participants have an overall positive view of the BOTS program and see the student impact of teaching coding and programming in their classrooms as it relates to the intended goal of this project. Teachers value BOTS in their classroom and feel it contributes to student understanding and the importance of coding/programming as well as growing confidence, improving communication, instilling persistence, developing critical thinking and collaboration skills, and increasing student equity.

The teachers reported that their knowledge of coding and the value it presented to their students was a direct result of their participation in BOTS and were more aware of the connection of computer science and robotics to their curriculum. The participants also felt an increase in their overall confidence regarding coding and programming skills and their ability to integrate and to impart those capabilities in their students. All participants reported that they would recommend BOTS to their peer educators.

While participants reported that implementing BOTS was relatively easy to incorporate into their curriculum, finding the time to integrate BOTS into their curriculum proved to be the biggest challenge for teachers. Covid-19 also added to the time issue as many teachers were in mid-lesson when schools moved online. Loss of personal interaction with students and access to equipment and materials essentially stopped the implementation of BOTS. Few problems were experienced with the actual materials when teachers were using them in the classroom.

Appendices F - J contains the participant's personal thoughts about their experience in the BOTS program.

Recommendations:

The BOTS program is having the intended impact on its participant group and is meeting the goals stated above. It is recommended that the program continue and that additional funding is allocated, or sought out, to increase the number of participants and schools. The following recommendations are encouraged:

➢ **Continue efforts to get robot units into the classroom as early as possible**, so that teachers are encouraged to use them early in the training process.

➢ As with most educators, time is perceived as the greatest challenge regarding program implementation in the classroom. **Continue to highlight state and national standards, including English language arts and math standards, within the BOTS program/curriculum** to encourage educators to see opportunities for seamless and cross-disciplinary implementation. Additionally, **develop strong relationships with BOTS school principals and administrators** to ensure they see the value of the program and that they support their teachers in managing and navigating administrative and academic responsibilities that impact teachers' time for program implementation.

"My biggest challenge was making time in an already full curriculum to teach BOTS."

➢ In an effort to grow the Open-Education Resources (OERs) developed through BOTS, **continue to develop an OER strategy for lesson plans, assessments, and materials for educators.**

➢ Through survey feedback, teachers shared curriculum modifications such as pairing students or using small groups until they became comfortable with the material. **Devise a method for documenting shared modifications by teachers for future use in BOTS training.**

➢ New participants reported that they received much help from previous BOTS participants who acted as participant-mentors during the training. The experience they provide can be invaluable as BOTS grows and expands. **Allow previous participants to continue to participate in BOTS in some form.**

➢ Capstone projects demonstrated the learned skills of BOTS participants for infusing computer science into lessons using state and national standards. **Make capstone projects a permanent requirement of BOTS and put lesson plans into a template format and make all available in an online OER database.**

"Having Spheros in our class definitely made all the difference because they had the opportunity to program them and see their codes come to life."

Appendix A

BOTS Workshop 1 Survey Questions (9/14/19):

1) **SURVEY MESSAGE: Thank you for taking a moment to provide us with your feedback regarding the BOTS Workshop you recently attended. Your responses will be used to help improve future program experiences.**
2) **Please type your first name, last name, and email address.**

First Name, Last Name, email address

3) **Is this your first time attending a BOTS teacher workshop?**

Yes, No; Skip to: Q4 If No; Skip to: Q6 If Yes

4) **What did you find most useful about the BOTS Workshops last school year? (Open-ended)**

5) **What would you like to learn in the BOTS Workshops this year? (Open-ended)**

6) **Have you completed the 2019 Code.org's CS Fundamentals Training?**

Yes, No

7) **Please rate your knowledge of the following before and after attending today's BOTS workshop session:**

Scale: Extremely knowledgeable, Very knowledgeable, Moderately knowledgeable, Slightly knowledgeable, Not knowledgeable at all

- Defining a clearly communicated algorithm (a list of steps to finish a task) as it relates to coding.
- Using block-based programming actions (such as clicking, drag and drop, forward, back, etc.).
- Identifying and addressing bugs (a part of a program that does not work correctly) or errors in sequenced instruction.
- Recognizing that absolute precision is necessary when creating coding instructions.

8) **Please rate your level of confidence in teaching the following skills to your students before and after attending BOTS workshop session**

Scale: Very confident, Somewhat confident, Neither/Neutral, Little confidence, Not confident at all

- Teaching Block-based programming actions (such as clicking, drag and drop, forward, back, etc.).
- Teaching algorithms (a list of steps to finish a task) as it relates to coding.
- Teaching persistence and problem solving as it relates to robots and coding.
- Teaching using Code.org's "Plugged Activities".
- Teaching debugging (finding or fixing problems in an algorithm or program) as it relates to coding.
- Teaching the importance of predictability and precision when coding.

9) **How would you describe computer science to your students? (Open-ended)**

10) What did you like best about today's BOTS Workshop? (Open-ended)

11) How can today's BOTS Workshop be improved? (Open-ended)

12) How was the speed or pacing of today's workshop?
Too fast, Just right, Too Slow
Please describe:(Open-ended)

13) Please select how many years you have been teaching?
0-4, 5-9, -10-14, 15-19, 20+

14) Do your students currently have access to computer devices (desktop, laptop, tablet, other) in your classroom?
Yes, No; Skip to: Q16 If Yes; Skip to: Q15 If No

15) Do you know why your students do not have access to computer devices in your classroom? (Open-ended)

16) Please describe how your students use computer devices in your classroom. (Open-ended)

17) Any additional comments or questions? (Open-ended)

18) END OF SURVEY MESSAGE: Thank you for completing this survey. Your feedback will help us to improve the BOTS program.

Appendix B

BOTS Workshop 3 Survey Questions (11/16/19):

1) **SURVEY MESSAGE: Thank you for taking a moment to provide us with your feedback regarding the BOTS Workshop you recently attended. Your responses will be used to help improve future program experiences.**
2) **Please type your first name, last name, and email address.**

First Name, Last Name

3) **Please rate your level of confidence in teaching the following skills to your students before and after attending BOTS workshop session**

Scale: Very confident, Somewhat confident, Neither/Neutral, Little confidence, Not confident at all

- Explaining the differences and bridging activities between Sphero coding and Code.org coding.
- Performing and teaching block-based coding using Code.org, and Sphero.
- Using Code.org lessons to inform and enhance Sphero programming.
- Accessing Sphero coding templates and solutions via the VAST profile on edu.sphero.com.
- Comfort in teaching the "loop", "iteration", or "repeat" codes.
- Identifying when and where to use a loop structure instead of using manual repetition.
- Breaking down a long sequence of instructions into the largest repeatable sequence.
- Integrating BOTS into my classroom curriculum.
- Navigating the Sphero interface.
- Deciding which activities from the given resources to use in your classroom.
- Finding activities online that can be used in the future.

4) **Please rate your level of agreement to the following statements:**

Scale: Strongly Agree, Agree. Neutral, Disagree, Strongly Disagree

- Coding improves persistence.
- Coding improves problem solving.
- Coding improves critical thinking.
- Coding improves communication.
- Coding improves creativity.
- Coding increases students' awareness of career opportunities.
- Coding and programming knowledge help students better understand the world around them.
- Coding and programming improve collaboration.
- Coders/Programmers are in high demand.
- Coding is an essential skill for STEM and other future career opportunities.
- Coding can help mitigate digital inequity.

5) **In what ways have you noticed a change in your student's computational thinking skills as a result of the BOTS training? (Open-ended)**

6) **Have you already introduced Spheros in your classroom?**

Yes, No; Skip to: Q8 If Yes; Skip to: Q7 If No

7) **When do you plan to introduce the Spheros in your classroom? (Open-ended)**

8) **Do you feel like the BOTS team has provided you with the necessary resources for implementation of the BOTS program in your classroom thus far?**

Yes, No; Skip to: Q10 If Yes; Skip to: Q9 If No

9) **Please explain how the BOTS team can better support you? (Open-ended)**

10) **Please share any additional comments or questions, about today's workshop or the program as a whole. (Open-ended)**

11) END OF SURVEY MESSAGE: **Thank you for completing this survey. Your feedback will help us to improve the BOTS program.**

Appendix C

BOTS Workshop 5 Survey Questions (2/22/20):

1) **SURVEY MESSAGE: Thank you for taking a moment to provide us with your feedback regarding the BOTS Workshop. Your responses will be used to help improve future program experiences.**

2) **Please type your first name, last name, and email address.**
First Name, Last Name

3) **Please rate your level of confidence in teaching the following skills to your students before and after attending BOTS workshop session**
Scale: Very confident, Somewhat confident, Neither/Neutral, Little confidence, Not confident at all
   - Defining circumstances when certain parts of a program should run and when they shouldn't.
   - Determining whether a conditional (statement that can run only under certain conditions) is met based on criteria.
   - Identifying actions that correlate to input events.
   - Understanding how to create an animated, interactive story using sequence and event-handlers.
   - Being able to develop and complete 2 lesson plans for my capstone project.
   - Deciding which concept activities to use for my capstone project.
   - Aligning my capstone project to CSTA K-12 computer science standards.
   - Integrating BOTS into my classroom curriculum.

4) **The following statements relate to the capstone project:**
Scale: No Not Sure Yes
   - The capstone project was communicated clearly to me.
   - The written directions I received were helpful to me.
   - I understand what is required of me for the capstone project.

5) **In what ways have you noticed a change in your own computational thinking skills as a result of the BOTS training? (Open-ended)**

6) **Have you already introduced Spheros in your classroom?**
Yes, No; Skip to: Q8 If Yes Skip to: Q7 If No

7) **When do you plan to introduce the Spheros in your classroom? (Open-ended)**

8) **Do you feel like the BOTS team has provided you with the necessary resources for implementation of the BOTS program in your classroom thus far?**
Yes, No; Skip to: Q10 If Yes; Skip to: Q9 If No.

9) **Please explain how the BOTS team can better support you? (Open-ended)**

10) **Please share any additional comments or questions, about today's workshop or the program as a whole. (Open-ended)**

11) END OF SURVEY MESSAGE: **Thank you for completing this survey. Your feedback will help us to improve the BOTS program.**

Appendix D

BOTS Post-Program Survey Questions (distributed 5/25/20)

1) **SURVEY MESSAGE: Thank you for taking a moment to provide us with feedback regarding your overall experience with BOTS. Your responses will be used to help improve future program experiences.**

2) **Please type your first name, last name, and email address.**
First Name, Last Name

3) **Please rate your level of agreement to the following statements. After implementing BOTS in my classroom, I observed the following:**
Scale: Strongly Agree, Agree. Neutral, Disagree, Strongly Disagree
- coding improves my students' persistence
- coding improves my students' problem solving
- coding improves my students' communication
- coding improves my students' creativity
- coding increases students' awareness of career opportunities
- coding and programming knowledge help students better understand the world around them
- coding and programming improves my students' collaboration skills
- coding is an essential skill for STEM and other future career opportunities for my students.
- student equity is increased when coding and robotics are included in my curriculum.

4) **In what ways have you noticed your students' computational skills improved this school year as a result of implementing BOTS in your classroom? (open-ended)**

5) **What do you think your students enjoyed most about BOTS? (open-ended)**

6) **What do you think your students struggled with the most in BOTS? (open-ended)**

7) **Please rate your level of agreement to the following statements:**
Scale: Strongly Agree, Agree. Neutral, Disagree, Strongly Disagree
- Participating in BOTS increased my knowledge of coding.
- Participating in BOTS increased my confidence in teaching coding.
- BOTS added value to my classroom instruction.
- BOTS was easy to implement into my classroom curriculum.
- BOTS took an appropriate amount of time to implement in my classroom.
- BOTS activities were appropriate for the grade level of my students (not too easy and not too difficult).
- I see a connection between computer science and robotics in my curriculum.
- I will continue to include coding in my future curriculum.

8) **Please describe what aspect(s) of the BOTS professional development program were the most helpful to you as a teacher. (open-ended)**

9) **Please describe your challenges/obstacles in using BOTS in your classroom. (open-ended)**

10) **Did you (or will you be able to) complete the capstone project?**
Yes, No; Skip to: Q12 If Yes; Skip to: Q11 If No.

11) **Why were you unable to complete the capstone project? (Open-ended)**

12) **If there is one thing you could change about the BOTS program, what would it be and why? (Open-ended)**

13) **Based on your overall experience with BOTS, would you recommend BOTS to other teachers?**
Yes, No; Display Next Question: If Yes

14) **Please describe why you would recommend BOTS to other teachers. (Open-ended)**

15) **Please describe why you would not recommend BOTS to other teachers. (Open-ended)**

16) **Please add any additional comments including how the Covid-19 pandemic may have impacted your workshop participation, classroom implementation, or capstone project completion. (Open-ended)**

17) END OF SURVEY MESSAGE: **Thank you for completing this survey. Your feedback will help us to improve the BOTS program.**

Appendix E

Capstone Project Expectations

BOTS 2019-2020 Capstone Project

The BOTS teacher professional development program encourages teachers to utilize both Code.org and Sphero.edu lessons, as well as their own creativity and knowledge of best teaching practices, to successfully implement coding and robotics within their first and second grade classrooms.

One of the greatest assets of BOTS is the opportunity for teachers to share best practices for implementing coding and robotics in the classroom with fellow teachers. For the program, you will complete a capstone, or final, project. The project will be **two lessons plans that you have developed** that complement the concepts covered in the BOTS program. These can be lessons you implemented during the BOTS program year or lessons that you might implement in the future.

Lesson #1 – Unplugged Activity: This will be an unplugged activity teaching a topic of your choosing selected from the Topic List below.

Lesson #2 – Cross-curricular Activity: This will be either a plugged or unplugged activity that utilizes Code.org or Sphero to teach a topic that extends beyond the Computer Science Standards into Common Core (Math or English Language Arts) or Next Generation Science Standards. This activity should be related in some way to a topic selected from the Topic List below (can be the same or different topic used in Lesson #1).

At the end of our program, we will be sharing our capstone projects with brief presentation to the other BOTS teacher participants and some invited guests. In this way, we hope that you can continue to learn from each other and grow in your capacity to effectively engage students in coding and robotics. If you implement any of your lessons, please take photos to include in your presentation.

Topic List:

- Algorithms
- Debugging
- Angles
- Relationship between time and distance
- Loops
- Events
- Sensors
- Understanding variables

Things to include in each lesson plan:

- Lesson Name
- Code.org/Sphero topic – *see Topic List.*
- Standards alignment – *List the standard(s) your lesson is aligned with.*
- Lesson Overview – *short paragraph describing the lesson or activity.*
- Learning Objective – *a list of things students will be able to do by completing the lesson.*
- Estimated time for the lesson
- Materials
- Lesson guide – *Outline of steps to take to implement the lesson.*
- Additional materials – *Worksheets, handouts, PowerPoint slides, photos of lesson in the classroom, etc.*

Due: Friday, April 3rd, 2020
Submission: Please email Kendall, Ashley, and Mary your completed project in Word or PDF format at the following emails: kwork@usc.edu, asperez@usc.edu, kbonapar@usc.edu**.** A final BOTS session will take place in April or early May where you will do a short presentation (5-8 minutes) sharing your two lessons. More details to follow.
****

Example Lesson #1 Plan:

Lesson Name: My Robotic Friends Jr.
Code.org/Sphero Topic: Algorithms
Standards Alignment: CSTA K-12 Computer Science Standards (2017). AP - Algorithms & Programming -
1A-AP-09: Model the way programs store and manipulate data by using numbers or other symbols to represent information.

Overview: Using a set of symbols in place of code, students will design algorithms to instruct a "robot" to stack cups in different patterns. Students will take turns participating as the robot, responding only to the algorithm defined by their peers. This segment teaches students the connection between symbols and actions, the difference between an algorithm and a program, and the valuable skill of debugging.
Learning Objectives - Students will be able to:

- Attend to precision when creating instructions
- Identify and address bugs or errors in sequenced instructions

Estimated Time: 45 minutes

Materials:
- One stack of 20 paper cups (or paper trapezoids) for each group of 2-3 students.
- Display or handouts of the symbols from My Robotic Friends Symbol Key where students can reference throughout the lesson.
- (Optional) One My Robotic Friends - Cup Stacking Ideas handout per group of 2-3 students.
- Journal or notebook for each student.

Lesson Guide:
Warm Up (5 min)
Talking to Robots

Display: Watch one of the videos below to give students context for the types of things that robots can do: Asimov by Honda (3:58), Dancing Lego Robot (1:35)
Discuss: Refer to the video that you chose and ask students how they think that the robot knew what to do. Does a robot really "understand" what you say? Is it worried about getting in trouble if it doesn't do what it's told?
Say: Robots can only do what they've been told to do, but we don't just tell them using words. In order to do something, a robot needs to have a list of steps that it can read. Today, we are going to learn what it takes to make that happen.

Activity (30 min)
Introduction and Modeling

Set Up: Have stacks of cups or cut paper trapezoids available for groups.

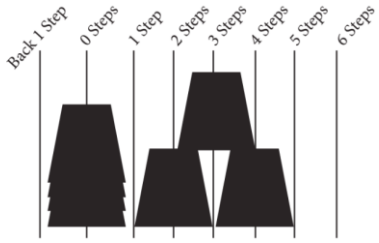
Display: Display My Robotic Friends - Symbol Key or write the allowed actions on the board - make sure these are in a place where they can be seen for the whole activity. Explain to the class that these will be the only four actions that they can use for this exercise. For this task, they will instruct their "robot" friend to build a specific cup stack using only the commands listed on the key.

Model: In order to explain how the instructions are intended to work, model for the class how to create and follow an algorithm for replicating a simple pattern. Place a single stack of cups in front of you to start.

Display: Hold up the pattern you plan to model. A simple three cup pattern is a great place to start.

Prompt: Ask the class what the first instruction should be, using only the four instructions allowed. The first move should be to "pick up cup." If students suggest something else from the list, perform that action and allow them to see their error. If they suggest something not from the list, make a clear malfunction reaction and let them know that the command is not understood.

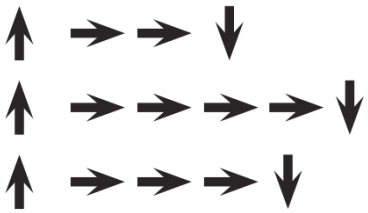
With cup in hand, ask the class to continue giving you instructions until the first cup is placed. This is a great place to clarify that "step forward" and "step backward" each imply moving half a cup width. See the image below for reference.



Continue asking for instructions from the classroom until you have completed the entire design.

Once your stack is complete, point out that they just gave you a list of steps for completing a task. That's an algorithm. Algorithms are great for sharing ideas, but spelling them out word by word can take a long time. That's what the symbols are for! When you change an algorithm into symbols that a robot (or computer) understands, that's called programming.

Ask the class to help you write the "program" for that first move by changing the text into an arrow. Then work with them to write down the rest of the moves necessary to complete the pattern. Depending on the confidence of your students, you might switch back and forth frequently between acting as the "robot" and writing down the code, or you might push them to write the whole program before you will implement it. One possible solution looks like this:



Volunteer: Once the class has completed the model program, ask one of the students to come up and act as the "robot" to ensure that the program really works. Encourage them to say the instructions out loud as they "run" the code.

Programming Your Robots

Group: Place students into groups of 4. Each group should then further break down into two pairs - each pair will develop their own program to be "run" by the other pair.

Distribute: Give each group one stack of cups or paper cutouts.

Display: Show My Robotic Friends - Cup Stacking Ideas to the class or hand out individual copies for groups to use. Have each pair (not group) choose which idea they would like their robots to do. Try to push for an easier idea for the first time, then have them choose a more complex design later on. Encourage pairs to keep their choice secret from the other half of their group.

Discuss: Give each pair time to discuss how the stack should be built, using only the provided symbols. Make sure each group writes down the "program" somewhere for the "robot" to read later.

Do: Once both of the group's pairs have completed their programs, they can take turns being "robots" for each other by following the instructions the other pair wrote. Encourage students to watch their "robot" closely to ensure that they are following instructions. If a student sees a bug and raises their hand, have the robot finish the instructions to the best of their ability. Afterward, have the students discuss the potential bug and come up with solutions. Continue repeating until the stack is built properly.

Circulate: Look for groups who are trying to take shortcuts by adding extra things (like numbers) to their code. Praise them for their ingenuity, but remind them that for this exercise, the robots do not understand anything but the provided symbols. If you like, you can hint that they should save their brilliant solution for the next time they play this game, since they might get the chance to use their invention soon!

Iterate: Depending on the time available, mix up the pairs and give them a chance to do a different pattern. Each time groups repeat the process, encourage them to choose a more challenging pattern.

Discuss: After everyone has had a chance to be the robot, bring the class back together to discuss their experience. In particular, discuss as a class: What was the most difficult part of coming up with the instructions? Did anyone find a bug in your instructions once your robot started following them? What was the bug? Why do you think you didn't notice it when writing the program?
When you were the robot, what was the hardest part of following the instructions you were given?

Wrap Up (10 min)

Journaling

Having students write about what they learned, why it's useful, and how they feel about it can help solidify any knowledge they obtained today and build a review sheet for them to look to in the future. Journal Prompts: Draw one of the Feeling Faces - Emotion Images that shows how you felt about today's lesson in the corner of your journal page. Draw your own stack of cups that you would like to see a robot build. Can you create a program for that cup stack?

Example Lesson #2 Plan:

Lesson Name: Story Time with Sphero
Code.org/Sphero Topic: Angles
Standards Alignment: CSTA K-12 Computer Science Standards (2017). AP - Algorithms & Programming -
1A-AP-09: Model the way programs store and manipulate data by using numbers or other symbols to represent information.

Overview: Given a maze with several vocabulary words on different paths, students will program their sphero to follow their desired path and create a story with vocabulary words picked up on their path. Students may take turns programming parts of the path, selecting to follow one or two words of their choice. This teaches reading comprehension and storytelling to students, whilst enforcing the topic of angles/degrees.
Learning Objectives - Students will be able to:

- Cooperatively program their sphero through a path
- Create short stories from a pool of vocabulary words

Estimated Time: 45 minutes

Materials:

- Paper tiles
- Vocabulary words
- Sphero(s)
- Sphero Edu app on compatible device(s)

Lesson Guide:
Insert step-by-step description of the activity here, approximately 1-2 pages

Appendix F

Teachers suggested possible changes to the BOTS program to make it more successful.

"I don't think I would change the program. I think I just wish I had more time in class to work on it. "

"Overall I'm really happy with the BOTS program, I really like it. I think it would be more helpful [to] provide some support in guiding us on different possible ways to implement the lessons in class because it is a new subject to me that I learned alongside my students. Now that I'm more familiar with the subject I have more ideas on how to teach it to my students. :) I thank Mary, Kendall, Ashley, and Maria [USC project team members] for all their help because I wouldn't have been able to teach this without learning it from them first and having them guide me and problem solve with me throughout the year."

"It would be nice if you could visit our school/classroom more than once. The kids really enjoyed when you came to our school."

"I think it is great as is."

"If we could add on more classes within a school. We need to see computer science expand to the upper grades."

"Nothing. The trainings were well done. I believe BOTS is such an important program for the kids in this digital age. It gives them more options for the future."

"Provide teachers syllabus at the beginning."

"I would like to see it school site based because it would be more convenient. For next year, I would also like more in class instruction/modeling to students from our facilitators."

Appendix G

Students enjoyed most about BOTS.

"The majority of my students truly enjoyed programming the Sphero. They loved exploring the app and finding different things they could do with the Sphero, such as change the color."

"I think it varies within my class. Some students enjoy the coding aspect more whereas other students enjoy fixing bugs within codes. Having Spheros in our class definitely made all the difference because they had the opportunity to program them and see their codes come to life. Some of my students love that there's structure to a code but I think what they liked most of all was a different outlet to learning a new subject (that they wouldn't have been exposed to without this program) I think they like that it's hands on whether it's unplugged or plugged they always have something to do that's engaging."

"They really enjoyed working with the Spheros."

"They loved the BOT robot and the majority of students liked coding games."

"My students loved the Spheros. "

"They enjoyed programming the Spheros the most."

"Using the Sphero(s) was definitely a joy: Creating mazes and guiding the Sphero(s)."

"My students really liked painting with the Sphero BOTS and they liked the coding."

Appendix H

Students had some struggles with BOTS.

"Because it was their 2nd year with BOTS, most had a strong understanding of how the program worked and already knew the basics. However, I had some who struggled with the concepts, but it is the same students I see also struggle in class."

"I think my students struggled most with learning how to problem solve on their own, to find the bugs and create codes independently without seeking my help as soon as they feel challenged. I think my kids needed to have more time to learn that it's a process that's tedious and at times stressful but must be completed by them because that's the point of coding. Without the crisis [Covid-19 pandemic] I think they would've adjusted better."

"As they advanced in code.org the students struggled with problem solving. They had trouble solving their codes and depended on me."

"My kinder[garten] students had trouble with the reading."

"They struggled most with controlling the Spheros."

"They struggled with the angles and directionality."

"A few students were nervous at the beginning when we started using the Sphero(s). But they felt comfortable when the most experience students were showing them how to use them."

"As the coding activities increased in difficulty, such as programming 3 steps and using loops, some of my students became frustrated."

Appendix I

The biggest challenge teachers faced using BOTS.

"My biggest challenge was time. I only have my kids for 3 hours a day. Sometimes when I was not able to complete a math, religion, or social studies lesson in a week, I had to move my coding lesson or reduce the time, which was so hard. My kids always asked for more time, but there were times when it was not possible."

"My biggest obstacle was not having enough devices that connected to the Spheros. The adults that helped me with the Spheros and students and I used our phones to program the Spheros. I think after the PDs we've had and now having some experience I feel more comfortable in implementing this in my classroom more cohesively whereas in the beginning I had no clue how to start this program in my class because its 1 adult to 24 students however I know have a better understanding of how to begin and implement the program in my classroom... listening to other teacher share their experiences and having Kendall and Ashley [USC graduate students] constantly guide me in learning the program itself really helped because then I would learn how to go about it with my students."

"The biggest challenge was time. We had so much going on this year with WASC. "

"I had a combo K/1 class. I think the lessons were difficult for a group of students."

"The pandemic."

"For me, it was finding the time to implement unplugged activities. Students found many of the mazes challenging."

"Sometimes, I didn't have enough time to teach the lesson because of other responsibilities. But I enjoy the program."

"My biggest challenge was making time in an already full curriculum to teach BOTS. A big obstacle was the limited computer access. During my limited computer time, my students also had to spend required time on multiple assessments and Reading labs."

Appendix J

The BOTS professional development program was helpful to teachers.

“I truly enjoyed the hands on experiences we had. I learn better and retain more information when I am hands on. “

“The most helpful aspect of the program was the trainings because I was able to collaborate and get ideas from other teachers, Mary, Kendall, Ashley and Maria [USC project team members] were also extremely helpful in answering any questions/concerns I had. If I ran into a challenge during the program, I was able to bring it the PDs to get help. My favorite was when they visited our campus I am so grateful they were able to come because it was right before quarantine started, it was a blast.”

“The once a month classes at USC were helpful because we got to practice everything before teaching it to the kids. Everyone was so helpful, nice and patient.”

“Doing the lessons designed for our students.”

“The lessons during the Professional Development on Saturdays.”

“Hands on learning such as programming the Spheros using different variables.”

“I always enjoyed attending BOTS trainings.”

“I really enjoyed the hands-on, "I do, you do" time.”

Appendix K

Capstone Project Summary

Lesson Name	Lesson Overview
Making Binary Numbers	Students are introduced to the binary system and learn that the binary system is a language that computers understand. Students learn that the binary number system is a combination of the digits 0 and 1. Information can be expressed through a combination of these two numbers.
Eddy Gets His Ball	Toy dog must retrieve his toy ball by following a path laid out using playing cards. This activity helps students learn about algorithms and the job of computer programmers.
Debugging the Maze	Students will create an algorithm using these symbols (arrow symbols). Students will create an algorithm with bug(s) based on a maze. When students are paired up, one of the students must identify what the bug is and debug it.
Sphero Art with Jackson Pollack	Students will create art inspired by Jackson Pollack using the Spheros. They will program the sphero using different colored paints on a white canvas or paper to create their masterpiece. Will their paintings be simple or complex? Does adding more algorithms make your art more complex or less?
Real Life Algorithms / Life Science- plant life	In preparation of this lesson we watched a video, Plant a Seed. I then introduced the new vocabulary word Algorithm. I explained that algorithms are steps to do something and algorithms are part of our daily life. We can write down the steps of an event or activity we do.
My Robotic Friend	Students will pretend to take turns being robots and have a set of symbols for instructions. Each student will take turns guiding each other on completing a task. They have to guide their robot by using symbols just like in programming. They will learn a new vocabulary word Debugging and that would mean fixing a mistake.
Looping for Cheeseburgers	This lesson will help the students prepare for coding loops over the length of this course. In small groups, the students will work together in a physical activity where they will create a code for a program.
Adding with my robotic friend	With the given maze that has addition equations, the students will program their sphero to follow the path and solve the addition equations found along the path. Students will take turns programming the sphero and solving an equation. This reinforces the skill of adding with regrouping, while also reinforcing the topic of angles and degrees.

Pokemon Unplugged	Using a set of symbols in place of code, students will design algorithms to instruct a "robot" (sphero) to collect Pokemon on a board game. Students will take turns participating as the robot (moving the paper manipulative along the board), responding only to the algorithm defined by their peers. This segment teaches students to identify when loops can be used to simplify the code and reach their objective.
Pokémon - Spelling Words	Given a maze with several spelling words on different paths, students will program their sphero to follow their desired path and create a story with vocabulary words picked up on their path. Students may take turns programming parts of the path, selecting to follow one or two words of their choice. This teaches reading comprehension and storytelling to students, whilst enforcing the topic of angles/degrees.
Binary Bracelets	By using binary codes, students will understand how something from real life can translate into a series of on's and off's or zeros and ones.
Visiting Continents with Sphero	Students will be given a maze with the names of the seven continents. Every time the Sphero SPRK stops at a continent, it will speak the name of the continent and play a sound.
Find the Buildings	This unplugged lesson will integrate our Social Studies Alive! Lesson 3 to use as an unplugged activity to prepare students for the coding exercises they will be participating in during the course of our Code.org lessons. Students will work in whole group as well as with their seat partner to navigate their way through a map.
Painting Like Jackson	Teacher will read aloud the book "Action Jackson" by Jan Greenburg and Sandra Jordan to the class and discuss lines, composition, design, and artistic technique. Students will take turns using the Sphero Robots to create their own work of art inspired by Jackson Pollock using the Sphero Draw program within the Sphero Edu App.
Valentine Unplugged Cupid Challenge	Using a set of commands (program) in place of code, students will design algorithms to direct a "Cupid" to collect different items in a specific order. Students will work with a partner. Together they will come up with the program for cupid to collect all his items. This segment teaches students to identify when loops can be used to simplify the code and reach their objective.
Cupid's - Addition and Subtraction True or False	Given a maze with several Valentine images on the different paths, students will program their Sphero to follow their desired path to determine if the addition and subtraction equation task card they pick up along the way on their path is true or false. Students may take turns programming parts of the path. This will give the students practice determining if addition and subtraction equations are equal or not (true or false) enforcing the topic of angles/degrees.