

Jeremy Nevitt

EDUC 6133 – Program Assessment

Dr. Michael Hinman

Stockton University

Introduction

According to a New York Times article written in the beginning of 2021 by Neelesh Misra, “In India, parents are being aggressively sold the idea that their children must start coding at 4 or 5 or be future failures.” The idea that students need to learn to code has been a large push of the 21st Century in many school communities. It is said that coding teaches students to create their own content, not just consume it. Coding builds the self-esteem students seem to be lacking through building an inclusive community where students work together to solve large scale problems and cultivates a safe place where students can fail and learn from their mistakes. It is a tool that spans cultures and language barriers and bridges the gap between educational inequities according to academic coach Merle Huerta. So if we know the advantages of students learning code, how do we know that students are not only obtaining the right information but also retaining that information? The purpose of this program assessment is to determine whether the Project STEM coding curriculum is an effective tool to ensure students have a strong foundation in coding principles through determining if students show a mastery of the three core coding topics; 1. Understanding Input, Output and Basic Syntax, 2. Using code for Number Calculations and Data, and 3. Using code to Make Decisions.

Review

The program in question is the Project STEM CS Python Fundamentals curriculum. Project STEM is a company that packages online curriculum and resources in Computer Science for teachers starting with programs in early elementary up to high school advanced placement courses. Project STEM provides the majority of their curriculum to schools through the Amazon Future Engineer Program. According to its website, “Amazon Future Engineer is a

comprehensive childhood-to-career program aimed at increasing access to computer science education for children and young adults from underserved and underrepresented communities.”

At Palmyra High School, the application into the Amazon Future Engineer program was submitted in the Winter/Early spring of 2020. After an interview process, Palmyra High School was admitted into the Amazon Future Engineering program in the Fall of 2020 for the 2020-2021 school year. The first course that was run that year was the Project STEM CS Python Fundamentals curriculum which was taught in a hybrid school setting. Since then, the curriculum of Project STEM Computer Science Advanced Placement - Principles was added in the 2022-2023 school year as well as plans to add the Project STEM Computer Science Advanced Placement - A Java curriculum for the 2023-2024 school year.

The Project STEM CS Python Fundamentals curriculum is described as “an introductory-level course for students brand new to programming and computer science. In this course, students will learn problem-solving strategies, software design, and the foundations of computer science.” The program consists of multiple units each on a principle of computer science and coding while using the coding language of python to achieve this. Each unit consists of somewhere between seven and eleven lessons on multiple subtopics of the principle covered in the unit. Within each lesson, there are three videos for students to watch, one giving an objective of the lesson, the second covering the topics of the lesson with one to two examples of code showing how to achieve the selected topic, and then a third video covering any vocabulary within the lesson. A written summary is provided for students to read of the topics covered in the lesson with a repetition of the coded examples. Following the summary, students are asked to answer one to ten multiple choice questions to check their understanding. Finally students need to write one to two programs based on a problem given to them on the topic covered in the

lesson (i.e. write a program that calculates the GPA of a student, write a program that would simulate a dice roll and what number each player would receive, etc.). At the middle of the unit, students must complete a multiple choice quiz on the topics they learned so far. At the end of the unit, students complete a test that has a mixture of 20 multiple choice questions with an additional coded exercise they need to complete.

Implementation

Although the program has proven well for the district, and has continued to have zero cost to the district through the Amazon Future Engineer program in addition to offered the opportunity for expansion of new computer science courses, the question remains as to whether this program and this curriculum provide students the knowledge and skills they need to show mastery of coding topics. Looking at test scores based on the 2020-2021 and 2021-2022 school year, it was determined that students did not show full mastery of the topics (Class average of 90% or higher on Unit Tests). To close these gaps, additional coding practice was added to the course to help students show mastery on their unit tests in the 2022-2023 school year.

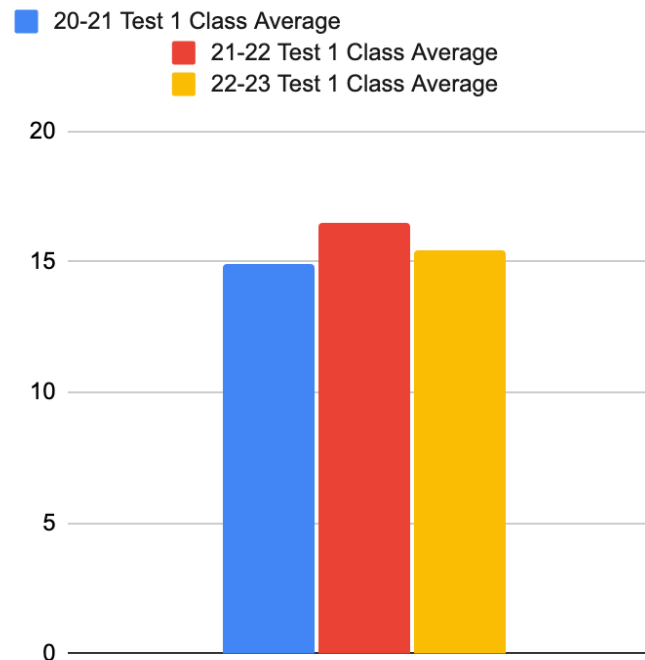
The additional coding practices included extra problems students needed to solve through the use of code. The website “Python Tutor” was used to “visualize” student’s code to give them a better understanding of each step the code executes. After students write their code, the python visualizer goes through each line of code and keeps track of any variables that are stored and any outputs of the code in addition to what order they are executed.

Findings & Data

With the addition of these additional coding practices, it is hypothesized that the class average test score should go up for each of the tests taken at the end of each unit. For this

hypothesis to be true, the class average should be a 90% or higher (18/20) to show that students are attaining mastery in each of the topics.

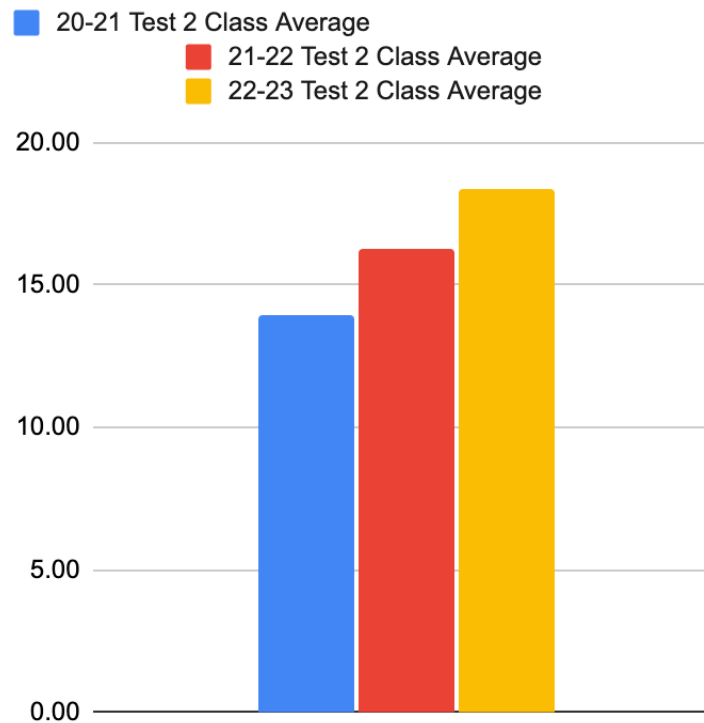
For the first test, students were tested on understanding input, output and basic syntax. The same test was given to all students over the past three years. It should be noted that the class size of each yearly cohort has increased over the past 3 years. The class in 2020-2021 only had 15 students while the 2021-2022 school year had 18 students and the 2022-2023 class has a total of 20 students. After administering the first test the class averages read as follows: 20-21: 14.96/20 or 74.75%; 21-22 16.5/20 or 82.5%; and 22-23 15.45/20 or 77.25%.



As seen in the chart, we can see that there was no increase in scores on the first test with the help of the additional resources given to students. The class average score for 22-23 went down from the year prior from 82.5% to 77.25%.

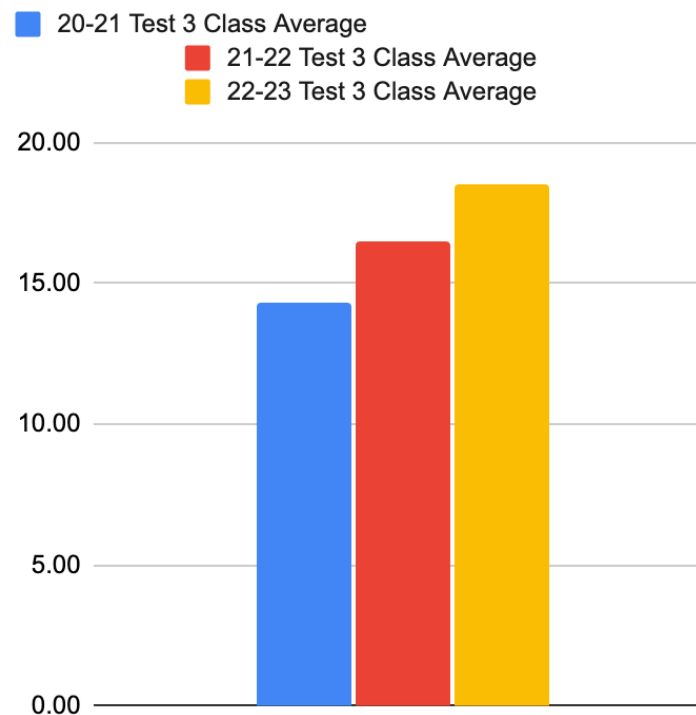
For the second test, students were tested on the topic of using code for number calculations and data. After administering the second test the class averages read as follows:

20-21: 13.95/20 or 69.75%; 21-22 16.28/20 or 81.4%; and 22-23 18.39/20 or 91.95%.



As seen on the chart, the 22-23 class had an increase in the class average on Test 2 compared to the previous two years. Also by attaining a class average of over 90%, it can be concluded that the students attained mastery of the subject topic.

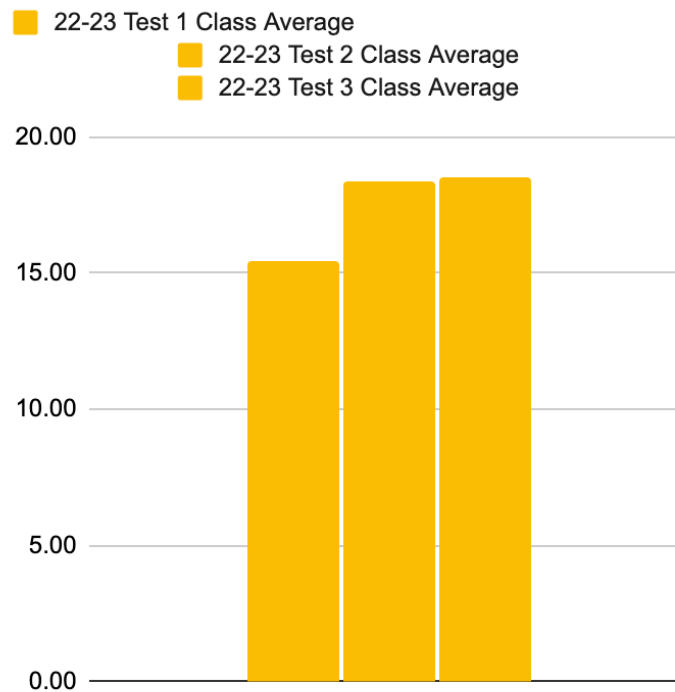
For the third test, students were tested on the topic of using code to make decisions. After administering the third test the class averages read as follows: 20-21: 14.32/20 or 71.6%; 21-22 16.51/20 or 82.5%; and 22-23 18.55/20 or 92.75%.



As seen on the chart, the 22-23 class had an increase again in the class average on Test 3 compared to the previous two years. Also by attaining a class average of over 90%, it can be concluded that the students again attained mastery of the subject topic.

Discussion

The findings of this program assessment did see an improvement of the class averages after the additional resources were given. As seen, the student class average attained mastery status on Test 2 and Test 3 after the implementation of additional resources to the class. Additionally, each test saw a higher class average and an increase in scores between Test 1 through Test 3. This can be seen on the chart below.



By showing this increase, we can assert that the additional coding practices and resources have been helpful to the students and allowed them to attain that mastery status. However, it can be argued that a few outliers are still in place within this study. One of the main outliers that we can argue is the test scores of 20-21. Within that school year, as mentioned previously, students were taught in a hybrid setting with the majority of students receiving instruction at home. Students viewed the topics and videos through the online program of Zoom so it very much can be argued that the low scores are due to this compared to the in person learning environment. However to prove that this is not the case, we need to look at the scores from the 21-22 school year. All students were taught in person and used the Project STEM lessons strictly. However they did have the advantage of working with peers within the classroom setting. This did allow an increase in class averages compared to the previous year with the class averages reading as follows for the first three tests; 82.5%, 81.4%, and 82.5%. Although we see an increase from the previous year, we did not meet our goal of mastery (90% or higher).

By looking at the data from the 22-23 school year, we start off rocky with students not attaining mastery on the first test as well as the class average also dropping from the previous year. Again students from this year were given extra exercises and resources to help them attain that mastery status. However this quickly changes when we look at Test 2 and Test 3 for the year. Both Test 2 and Test 3 were increases in class averages from the previous two years as well as students attained mastery on both of those tests.

Conclusion

Data confirms that the additional resources being provided to the students has helped increase their test scores and help to attain class mastery. We see this through the charts representing the class average test scores. The conclusion is that Project STEM does set up a framework for a great coding and computer science program, but additionally resources are needed for students at Palmyra High School to attain mastery. We can speculate that this could be for varying reasons such as students not watching the video lessons when they are presented to the class or students not paying attention to the readings but we can assert that the extra hands on practice does lift them over the hump needed to attain mastery. With these additional resources, students will have a stronger knowledge of coding and computer science principles that they can take with them onto new challenges they may face in later education and careers.

References

- 11, Skill StruckFebruary, and Written bySkill StruckSkill Struck makes computer science engaging and accessible to all demographics of students. Skill Struck provides relevant and valuable resources for teachers. . “Blog.” *10 Reasons Why Schools Should Teach Coding - Skill Struck*, 11 Feb. 2022,
<https://www.skillstruck.com/blog/10-reasons-why-schools-should-teach-coding#:~:text=Coding%20teaches%20problem%2Dsolving%20and,after%20high%20school%20and%20beyond.>
- “Discover All the Possibilities Computer Science Brings.” *A FE US*, A FE US,
<https://www.amazonfutureengineer.com/>.
- Huerta, Merle. “Coding in the Classroom: A Long-Overdue Inclusion.” *Edutopia*, George Lucas Educational Foundation, 17 Apr. 2015,
<https://www.edutopia.org/blog/coding-classroom-long-overdue-inclusion-merle-huerta>.
- “IU Project STEM.” *IU Project STEM*, <https://www.iuprojectstem.org/>.
- Misra, Neelesh. “Do Children Really Need to Learn to Code?” *The New York Times*, The New York Times, 2 Jan. 2021,
<https://www.nytimes.com/2021/01/02/opinion/teaching-coding-schools-india.html>