An Introduction to Code.org

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Abstract—**Computational thinking and computer programming are permeating the landscape of today's schools. In order to prepare students for 21st-century careers, students of all ages need to learn fundamental skills in a developmentally appropriate way. How can that best be accomplished? What is Code.org? How can teachers use it in the classroom? This paper gives an introduction to the site, provides information about its free curriculum, and describes how teachers can begin using this in their classrooms.**

Keywords-computational thinking; coding; teaching; elementary education; 21st-century learning.

I. INTRODUCTION

In September 2017, the White House announced a $200 million per year commitment to implement computer science programs in America's schools. The funds were distributed immediately with the goal of increasing participation by all students but especially women and underrepresented minorities [4]. Currently, 20 US states have changed policy to support computer science education and ongoing work continues in 30 US states [1]. One of the organizations to spearhead this movement with prominent companies is Code.org.

Code.org is a non-profit organization dedicated to expanding access to computer science and increasing participation by women and underrepresented minorities. In Code.org's online courses, 45% of students are girls and 48% are underrepresented minorities, and in Code.org's high school classrooms, 37% are girls, and 56% African American or Hispanic. In partnership with corporations and foundations like Facebook, Amazon, Microsoft, and Google, Code.org is devoted to the vision that every student in every school should have the opportunity to learn computer science [2]. Code.org works to increase diversity in computer science because it is able to reach students of all backgrounds regardless of skill level or location. Its courses are available in over 50 languages and are used by students in over 180 countries [1]. Code.org can be used on any device with an Internet connection, and a specific app is not necessary to use it on a tablet or Smartphone.

This paper will provide a thorough introduction to the site Code.org and many of its offerings for students of all ages. Section 2 will take a look at the goals of Code.org and how teachers around the world are using this to help encourage learning in computer science. Section 3 takes a closer look at Code.org's curriculum and how teachers can best use the resources in their classrooms. Special consideration is given to teachers in Section 4. Lesson plans, professional development, and teacher accounts are all discussed. Finally, Section 5 concludes with some final thoughts about the future of this site and how it can continue impacting all learners.

II. GOALS OF CODE.ORG

Code.org utilizes eight specific goals and metrics within its program. These goals include improving diversity in computer science, inspiring students, creating powerful courses, and reaching classrooms. Nearly 700,000 teachers have signed up to teach introductory courses using Code Studio, and over 21 million students have been enrolled, 9 million of which are female. The goal of preparing new computer science teachers is being met through professional development sessions conducted both online and in-person. Over 57,000 new teachers have been prepared to teach computer science across grades K-12 using Code.org's computer science curriculum. Code.org works to meet the goals of changing school district curriculums, setting up policies to support computer science, and implementing computer science programs on a global scale by partnering with 120 of the largest United States school districts to add computer science to their curriculum. These districts are far-reaching and teach almost 10% of all students in the United States, 15% of which are Hispanic and African American students [1].

Code.org can be used by students of all ages, including adults. Learners from any age group can be targeted, and the content is free. Creating an account provides teachers with an easy-to-understand key which allows them to see how students are progressing through each of the lessons. Assessments and surveys can be conducted for middle to high school students to help them prepare for the Advanced Placement (AP) test in computer science. Code.org has an entire curriculum for AP computer science in addition to courses that teach Java for older students [5].

III. CODE.ORG CURRICULUM

Code Studio is where Code.org's full course catalog is housed. These courses take students through step-by-step modules independently, and the site automatically advances them to the next lesson upon completion. For each of the modules, there are videos and directions for students. The videos are also transcribed with still pictures to allow students

to slow down the play or refer back to specific parts. Lessons are grouped for students in grades K-12, but using a tablet or touchscreen device can allow even younger students to experience Code.org [3].

For students in grades K-5, there are both "Express Courses" and fundamental courses for elementary schools. The "Express Courses" serve as great options for students getting started on their own because they are guided and have students using drag and drop blocks for coding. Pre-reader express, designed for children ages four to eight, combines the best of the kindergarten and first grade courses. The Express Course, for students ages nine to eighteen, provides an introduction to computer science and combines the best of the elementary school curriculum for older students [3]. Students start by learning the basics with simple directions like "move forward" or "move backward." Younger students can improve their understanding of positional words to make sure they are prepared for the following modules. As they move through the modules, they can program the characters to turn left or right, a great way to teach directional skills, and then eventually by number of degrees or even pixels.

Six courses are provided in the computer science fundamentals for elementary schools curriculum. Courses A and B are designed for pre-readers in elementary school classrooms. Course A provides an introduction for pre-readers aged four to seven, and while Course B is similar, it provides more variety for older students aged five to eight. Courses C through F are designed for older students in elementary classrooms. Course C, for students ages six to ten, teaches basics of computer science and allows students to create art, stories, and games. Course D, for ages seven through eleven, provides a review of Course C and then goes further with learning algorithms, nested loops, and conditionals. Course E introduces functions, and Course F, for ages nine through thirteen, combines all of the fundamentals to create more advanced art, stories, and games. All of these courses use themes that are relatable to the students including characters Angry Birds, Moana, Star Wars, Minecraft and Frozen [3].

Students in grades 6 to 12 have the opportunity to build real working apps, games, and websites using block coding, Java, Cascading Style Sheets (CSS), and HTML. The App Lab allows students to design and easily share apps using coding with blocks or Java. The Game Lab immerses students in a more complex programming environments with both animations and characters. Finally, the Web Lab allows students to make simple webpages using HTML and CSS. If students are able to successfully move through all of these courses and labs, Code.org provides links to third-party sites to teach even more difficult concepts [3].

IV. CODE.ORG FOR TEACHERS

Teachers can learn how to use Code.org from both the student-side and the teacher-side through Code.org's professional development opportunities that work to lower the level of "coding intimidation" for learners of all ages [5]. Code.org offers no cost teacher workshops both in person and online. Lesson plans are provided throughout each level to help teach the information, and current documents are supplied to show teachers the importance of computer science and computer science education. Because the site is so guided, especially the lessons on the computer, students can move through at their own pace, and it essentially teaches the students. This is especially helpful even if the teacher is not totally comfortable with the level of programming. There are also "Unplugged Activities" that have videos and full lesson plans for teachers to use in their classrooms. These activities do not require any type of technology or devices in the classroom but still teach the concepts of computational thinking [5].

V. CONCLUSIONS

Code.org is a non-profit organization was launched in 2013 with the goal of expanding access to computer science and increasing participation in computer science by girls and underrepresented students of color. They believe that all students should have the opportunity to learn computer science and that it should be part of the core curriculum within a school. The programs within Code.org meet students where they are at and enable all students the opportunity to learn about computer science and programming.

Currently, 20 percent of students in the United States have accounts on Code.org, and tens of millions have tried activities on the site [1]. Because of Code.org's dedication to diversity, in the future it could be beneficial to create even more opportunities for differentiation. While it is available in over 50 languages, it would be incredibly advantageous to take steps toward courses designed specifically for students with special needs. In the past two years using Code.org with K-4 students, the site is constantly evolving to best meet the needs of all 21st century learners.

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