Introducing Middle School Students to Basic Computer Programming Skills Using Web based App Inventor Application

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***Abstract*—Computer technology is one of the driving forces of the US economy. The Bureau of Labor Statistics (BLS) predicts that a 30% increase in demand for software developers by 2020 in the United States [1]. The BLS also predicts between an 18% to 31% growth in salaries in the various computer related professions. To get interest in the computer science field and fill these new jobs the Auburn University (AU) Laboratory for Education and Assistive Technology (LEAT) K12 research and inclusive outreach program developed an innovative App Inventor curriculum to teach the children basic computing skills.**

Keywords- K12 Computer Science inclusive outreach; App Inventor

I. INTRODUCTION

Computer technology is one of the driving forces of the US economy through innovations made by firms like Google, Microsoft, Apple, Facebook and Twitter. The Bureau of Labor Statistics (BLS) predicts that a 30% increase in demand for software developers by 2020 in the United States [1]. The BLS also predicts between an 18% to 31% growth in salaries in the various computer related professions, making computer science related jobs very lucrative career options and thus attractive to students. Yet, rigorous Computer Science (CS) is dramatically under-taught in US's schools. In Alabama, CS Education remained marginalized in a reflection of the situation in the rest of the country. Whereas women currently receive more than half of all the undergraduate degrees granted in the U.S, they earn only 11% of computing degrees [2]. The number of special needs girls who complete a CS undergraduate degree is particularly low; less than 6 % of undergraduate degrees are awarded to students with disabilities annually [3]. People often consider CS a boy's activity where a group of geeks play a violent game in an isolated room, and girls do not want to be considered nerdy. One way to change young women's perception about CS is to provide an engaging CS programming experience that is related to their own personal interests while they work with successful female mentors.

II. ROBO CAMP K12 RESEARCH AND OUTREACH PROGRAM

Today, a record 197 students took the CS AP exam in May 2014. It is also important to point out that Alabama was one of the nation's leaders in the rate of African-Americans who received qualifying scores on the CS AP exam – 75% of African-Americans received a 3 or better on the CS A in recently [4]. While the qualifying rate seems impressive, only 8 such students took the exam. High School women account for 47% of all AP Calculus test-takers, but only 18% of those who take the CS AP test are women. Thus, there are rapidly expanding educational resources for HS students who have an interest and basic skills for CS education, but few women, underrepresented minorities and rural students are engaged in these CS offerings, due in large part to insufficient middle school engagement in CS.

For the past seven years, the Auburn University (AU) Laboratory for Education and Assistive Technology (LEAT) K12 research and inclusive outreach program developed to introduce students (especially girls and students with disabilities) to CS and computational thinking [5]. CS Unplugged [6], Carnegie Mellon University Alice Programming System [7], Microsoft Kodu programming environment [8], Massachusetts Institute of Technology (MIT) App Inventor [9], Lego Mindstorms NXT, EV3 and Tetrix robots, 3D printing are few of the applications used to teach concepts of computer programming and robotics. LEAT team offered several successful k12 teacher development workshops. Offered each semester since 2007, the Robo Camp [10] is an AU K-12 CS outreach program designed to enhance students' knowledge in computing and robotics fields and to offer graduate students a hands-on experience in working with K12 school aged students.

III. APP INVENTOR CURRICULUM COMPONENTS

Robo Camp team has designed a twenty hours informal curriculum using App Inventor (AppI) and CS Unplugged (CSU).

A. Computer Science Unplugged

CSU is a set of non-programming kinesthetic learning activities used to facilitate understanding of CS concepts.

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CSU-type activities can help students recognize and learn difficult concepts that may not be made explicit in a particular programming environment [11]. By providing this exposure and then discussing the concept, students can start to understand and identify CS concepts in different programming environments. As recommended in [12] this as a worthwhile investigation into how CSU activities combined with visual programming environments can facilitate deeper understanding of computation and its application.

B. App Inventor

AppI is a web-based drag-and-drop visual programming tool for designing and building mobile apps for Android. AppI promotes a new era of personal mobile computing in which people are empowered to design, create, and use meaningful mobile technology solutions for their daily lives, in endlessly unique situations. AppI's intuitive programming concept and incremental development capabilities allow the developer to focus on the app programming logic rather than the syntax of the coding language, fostering digital literacy for all [13].

IV. APP INVETOR CURRICULUM

The informal AppI curriculum is usually taught in four days camps.

A. Day 1 Basic programing skills

Day 1 starts with an overview of how AppI works, which includes the My Projects Page, App Designer Window, and Blocks Editor. After reviewing the App Inventor system, students build their first application called *Hello Aubie*, which reinforces the skills needed to use MIT App Inventor. Then students go over basic programing skills which includes variables, if statements, if-else statements, methods, and loops. To reinforce these skills, students progressively add new code to the *Hello Aubie* application. While creating the application, students are introduced to basic quality assurance skills by pointing out faults and then being asked to suggest solutions to resolve each step.

B. Day 2 Accessibility

Day 2 focuses on accessibility and first introduces students to different types of disabilities (e.g. communication, hearing/visual impaired, physical, and learning) by playing a game that gives examples of some type of accessibility technology and has the children guess the disability that is assists with. Students work on a talking calculator application, which shows how a visually impaired person may interact with a calculator. Then we cover the concept of random number generation creating a dice application. Lastly we play a game called Java Jump created by Kevin Cree, which is similar to *Shoots and Ladders*, but uses Java syntax to decide the direction of each move.

C. Day 3 Robotics

Day 3 uses AppI and a Lego Mindstorm (LM) robot to reinforce accessibility. The day starts by making a standard controller for the LM robot, which includes forward, back, left, right and stop controls. This exercise shows how to program the different peripherals the LM offer, which includes 2 motors and a sonic sensor. After we complete this project, we build off of it and continue to reinforce the idea of accessibility by creating a voice controlled LM controller. This project is added to the standard controller and allows students to speak commands directly to the Android device and follow the preprogramed movements. While creating this application we sress the importance of applications like this and how the concept could assist people with limited or no mobility.

D. Day 4 Robotics and Binary Numbers

Day 4 continues robotics by adding some additional peripherals and teaching children how to convert binary numbers into decimal format. We start by explaining binary number and how they are converted to decimal numbers using the CSU Binary Numbers activity. We add an additional peripheral, the light sensor, then build an application that runs the LM robot over a set of paper tiles that are light and dark, light being 1 and dark being 0. Each time the LM steps to the next tile it reads out the new binary number. While doing this, students participate and calculate each number and use the LM to verify their calculation.

V. CONCLUSION

We are continuing to develop the AppI curriculum and we closely collaborate with the App Inventor developing team so we can implement the latest environment features. We are especially interested in new components related with Accessibility and Robotics.

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