COMPUTING WITH A COMMUNITY FOCUS: OUTCOMES FROM AN APP INVENTOR SUMMER CAMP FOR MIDDLE SCHOOL STUDENTS *

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ABSTRACT

This paper describes the design and evaluation of a one-week App Inventor summer camp for middle school students with an explicit focus on addressing local community needs. The community focus of the camp was designed to appeal to a broad range of students. We conducted an in-depth interview study to examine its impact on students' attitudes and perceptions, and supplemented this with results from project evaluation. Our results indicate that students had positive experiences in learning and creating real apps for solving community problems. Focusing on local community needs can also help to motivate students' interest in creating apps and in learning more about computer science. Students became more confident in creating apps as well as in using apps to solve community problems, and the camp was successful in welcoming a diverse set of students into computing.

INTRODUCTION

The Middle School Pathways in Computer Science (CS Pathways) is a partnership among the University of Massachusetts Lowell, Tri-City Technology Education Collaborative (TRITEC) and the school districts of Medford and Everett to bring year-round computing experiences to all middle school students in the partner school districts. Additionally, the grant is funding summer computing camps for district students, to provide deeper experiences for students introduced to computing during the school year program. This paper reports on findings from the first year of summer camps, which were attended by 72 students.

This project's focus is to engage students in making mobile apps for socially beneficial purposes. For the summer camps, we recruited local community partners to present their organization's work to students, and then we supported students in developing apps that would support these organizations' missions. This approach is intended to broaden participation in computing-engaging both girls and boys and ethnically diverse students. This paper describes the design and evaluation of the summer camp and its impact on students' attitudes and perceptions.

RELATED WORK

Recent work has demonstrated the power of providing purposeful contexts for computer science to broaden participation. Buckley et al. [2] introduced the phrase "socially relevant computing" to describe the use of computing for solving problems of personal and societal interest to students. This approach was shown to attract and retain students in computer science with a curriculum centered on solving meaningful real-world problems. Also at the university level, the HFOSS project (humanitarian free and open-source software) [e.g., 9] and Enhancing the Social Good project [6] use these approaches. At the secondary level, related approaches include the Exploring CS curriculum, which emphasizes the use of "culturally relevant instructional materials" [5], and "culturally responsive computing education" [4]. Others have focused on contextualizing computing, e.g., in a narrative environment like Storytelling Alice [8] and the Media Computing project [7]. In its entrepreneurial contest, the Technovation Challenge inspires middle and high school girls to use computing as agent for social good [3].

We elected to use App Inventor, a blocks-based programming system, as the design environment for our project. Previously, we successfully used App Inventor as the basis for a non-majors undergraduate course, and experienced first-hand the excitement and expressive power it provided to students [10]. We had also conducted a formative study with middle school students, and prior work demonstrated its success in middle school summer camps [11]. We concurred that App Inventor can be used to democratize computing-to provide the expressive power of computing to all learners, not only the "small group of technically elite" [12].

The CS PATHWAYS SUMMER CAMP

Curriculum and Activities

Our summer camp focused on introducing participants to building apps that served the local community. We provided scaffolding to support their design and development, including organizing group brainstorming for project ideas, sharing intermediate work with peer reviews, and a final project expo attended by parents, school leadership and community partners. The camps met for six hours a day for a week (Monday through Friday), totaling 30 hours of instructional time. Most students worked in pairs throughout the camp. The camp agenda was:

Day 1: Introduction to camp; pre-surveys; building your first app (based on MIT's text-to-speech "TalkToMe" app).

Day 2: Continued work in App Inventor; introducing the canvas, sprites, media objects, and using a text label as a score variable; visit and conversation with community partners.

Day 3: Group discussion and brainstorming for app ideas; initial work on community apps; visit and conversation with industry professionals.

Day 4: Work on community apps and group sharing of progress; starting research interviews.

Day 5: Final work on community apps; research interviews; debugging game assessment; "App Fair" expo; pathways into computer science; post-survey.

During the camp, students successfully developed apps that were designed to address community issues. Students developed apps on topics ranging from local farmers' markets, healthy food and nutrition facts, invasive species and local trees, to providing users with information about recycling.

Participants

72 students were recruited from the two partner districts. 28% of students reported that they had participated in the CS Pathways curriculum during the academic year, and a total of 46% had had some experience of coding. The project aimed to recruit middle school students, but in one district, participants ranged in age from 4th grade through 10th grade. Of those who completed the final survey, 33% were female and 67% were male. The students were racially and ethnically diverse with 15% reporting their race/ethnicity as African American, 15% as Asian, 43% as Caucasian, and 11% as Latino with the remaining students reporting they were other ethnicities. The majority of students spoke English at home (78%), but over one third reported speaking other languages as well (37%).

Among all the campers, we interviewed 15 students in total with full attendance who were rising 7th through 10th graders: eight 7th graders, four 8th graders, two 9th graders and one 10th grader. 7 of the 15 students were female.

METHODOLOGY

An external evaluator conducted evaluations on the quality of the summer camp. Students in the camp were asked to complete baseline and follow-up surveys with questions about use of technology including apps, confidence and frequency of use, and identification of terms associated with computer science.

To further understand its impact on students' attitudes and perceptions, we conducted a semi-structured interview with a subset of the campers on the end of Day 4 and Day 5, during the stage of finishing final projects. This interview was designed to understand participants' perspectives, experiences and programming practices through engaging them in conversations about their final projects and the design and developing processes, informed by an artifact-based interview approach proposed by Brennan and Resnick [1]. Each interview lasted about 20 minutes. All interviews were transcribed and then coded using thematic analysis. Those common ideas clustered into three major themes on attitudes and experiences that are presented in the next section: addressing community needs, positive App Inventor experience, and interest in learning computer science. Interview data related to computing knowledge and skills will be further considered in combination with other data resources (e.g., students' apps and reflection sheets) as future research plans.

FINDINGS

Evaluation of Summer Camp

Overall, students provided favorable evaluation of the summer camp. Students were asked to evaluate the overall quality of the summer camp experience as well as specific aspects of the summer camp including instruction, interactions with other students, faculty, community contacts, and experiences of creating apps. On a 5-point scale, with 5=high quality and 1=low quality, students rated each aspect highly, with values near or above 4 (see Figure 1).

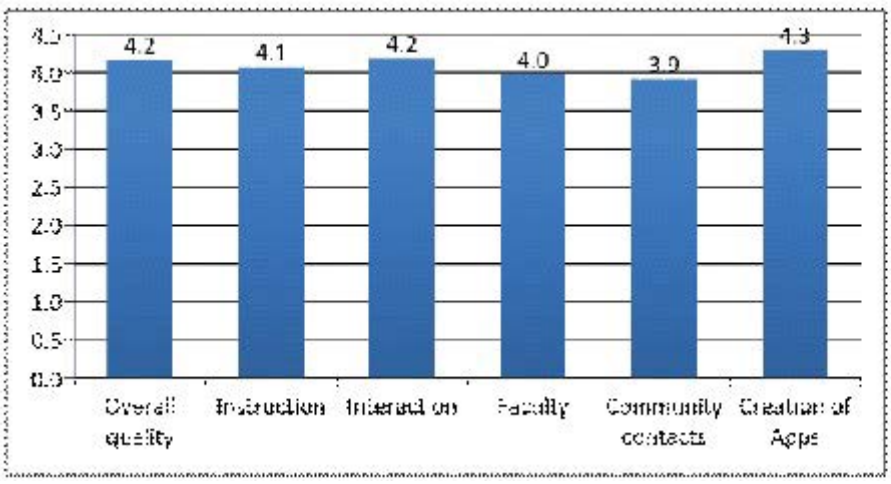

Figure 1. Students' Evaluations of the Summer Camp (Scale 1=Low, 5=High)

Change in Confidence

After participating in the camp, students' ratings regarding confidence in creating apps increased significantly when compared with baseline confidence ratings (Pre-Survey: M=2.62, SD=1.60; Post-Survey: M=4.15, SD= 1.11; t(51)= -6.03, $p<.001$). The summer camp focused on creating apps for community needs and two-tailed dependent t-test analysis revealed that students' confidence in using apps to solve community problems also increased significantly (Pre-Survey: M=1.80, SD=1.25; Post-Survey: M=3.90, SD=1.14; t(50)= -8.88, $p<.001$).

Furthermore, a regression analysis found that gender and minority status were not predictive of post-camp confidence in creating apps and confidence in using apps to solve community problems. Regression results showed a statistically significant relationship between participating in the camp and confidence in creating apps (R^2=21. F(3, 105) = 8.89, $p<.001$), but gender and minority status were not significantly associated with this outcome ($p<.31$ and $p<.30$ respectively). Similarly, gender and minority status were not significantly predictive of confidence in using apps to solve community problems ($p<.91$ and $p<.10$ respectively). This intervention is designed to engage typically underserved youth. These findings highlight that the intervention was equally successful for all participants.

Addressing Community Needs

During the interviews, students explained their ideas for final projects. Per the community partners' missions, most of the apps (12 of 15) were aimed at addressing a specific community need, such as healthy eating, farmers' market and tree protection. For example, one student reported (s)he made the app to address the need of healthier eating in the local community:

> [P10]: "So, our app is called Healthy Medford. Because people are not eating healthy in Medford, we decided to make an app that has different healthy recipes that families can make and are really easy and affordable."

Students reported their community-focused project ideas were mainly inspired by the community partners' visits. Nine students explicitly explained how their projects were connected with these visits. Here is one example:

> [P15]: "Trees are just a really great part of society. When [the visitor] came in and she was talking about protecting trees, I was like, 'You know what? I'm going to do an app about trees.' …That was cool."

Positive App Inventor Experience

Students who participated in the interviews reported positive experiences in the summer camp. They perceived App Inventor as "fun and cool", and felt proud of the products they created through the camp.

First, students reported that it was a fun experience to develop apps using App Inventor. They explicitly mentioned they would tell friends that App Inventor was fun and

cool. In particular, one student further explained that being able to help people by creating apps adds its value:

> [P5]: "It was awesome. [It can] help people on apps for like healthy choices. We could guide them to make better choices [for healthy eating]."

Second, students reported that the most fun part about App Inventor was being able to try out and see the actual apps work. 7 of 15 students explicitly expressed this point during the interviews. One student further explained that it was fun to make a real app connected with their personal interest.

> [P6]: "[The most fun part is to] actually make my own app, because I love to play apps on my tablet. So, it's kind of nice to know how people make it."

Third, students felt proud of themselves after completing their final projects, as one student reported below:

> [P7]: "Yeah, I'm proud of it. It's sort of complex… and maybe someone else that doesn't know as much as I do couldn't be able to do that."

Describing App Inventor

Students were asked how they would introduce App Inventor to their friends. In addition to describing it as a tool for creating apps, 9 students provided favorable comments seeing it as powerful and not difficult to create apps. First, students understood they could code by drag-and-drop and have control with it:

> [P11]: "It's pretty much something you can use to create apps. You can code with it. You drag blocks out of the left side. It has a math control and a bunch of other sections… You could have it pretty much control almost anything."

Second, students felt it was not difficult to use App Inventor once they understood the language of App Inventor. In particular, one student commented that creating apps was not hard-as long as you have commitment. Improving the community became a good motivation for building apps:

> [P2]: "It's not a hard program to use, but it takes some commitment. Without commitment, you have no reason to make an app… This is something that I would like to do for my community and it should improve the community."

Interest in Learning Computer Science & App Inventor

During the interviews, students explicitly expressed their interest in learning more about computer science. 12 of the 15 students reported they were interested in learning computer science with varied focus. Five students said they would like to learn more about programming/coding or build things. Another three students explicitly said they wanted to learn more about app-making. Five students also expressed interest in making more/better apps after the camp. For example, one student shared his/her plans for new apps as stated below:

[P2]: “I would like to continue making more apps, because I have found this to be a very enjoyable hobby… I'm hoping to make some more informational apps about reptiles, because I'm a reptilian enthusiast.”

REFLECTION AND DISCUSSION

Although students reported positive experiences in this camp, there were some challenges and difficulties students encountered during their participation. Students reported three major challenges (with at least 4 of the 15 students mentioned the same issue): device/Wi-Fi connection, working with multiple screens, and screen design. First, students felt frustrated when they lost network connection, which was required to run the apps on Android devices. Meanwhile, the requirements of an Android device and network connection can also prevent some students from using App Inventor outside of the camp. Second, students reported it was challenging to work with multiple screens because App Inventor does not allow copying components across screens. Third, students reported that it was difficult to make screen design in App Inventor. Some design operations such as setting screen layout and changing label size were not straightforward for them, which required using some specific features (e.g., using picture frame) to make the design work.

These were all technical issues with App Inventor-not conceptual challenges. Although these challenges seem trivial, young learners, especially novice programmers, can get frustrated. Students might spend lots of time working on these design issues.

CONCLUSIONS

Our project is distinctive in that our summer camp explicitly focused on developing apps for local communities. We included community partners, and provided camp participants with an introductory service-learning experience. Our project shows how this can be done, and that this approach was effective and inspiring across our diverse range of participants including both genders. Our findings indicate that focusing on local community needs can help to motivate students' interest in creating apps and learning more about computer science. Students demonstrated some level of comfort with App Inventor and became more confident in creating apps as well as in using apps to solve community problems.

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