GENERATING INTEREST IN COMPUTER SCIENCE THROUGH MIDDLE-SCHOOL ANDROID SUMMER CAMPS

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ABSTRACT

We conducted a week-long summer camp to promote interest in computer science among middle-school students. The camp primarily used self-paced video tutorials to teach programming concepts using the App Inventor for Android programming environment. Based on strong interest from students and parents as well as positive survey feedback, we conclude that the camp was very successful. We have made the camp resources, including 36 video tutorials, freely available at http://artsci.drake.edu/mathcs/appcamp, and they may be used in future camps at any institution.

INTRODUCTION

Many STEM disciplines like biology and mathematics are introduced to students in structured courses throughout their middle school and high school careers. Students begin to develop interests in these areas early on through regular coursework. On the other hand, areas like computer science are not typically covered in such a systematic way, so encouraging interest at an early age in the field is more challenging. However, some approaches, like intensive summer camps, have track records for fostering increased interest in computing [1]. In an effort to help attract students to computing and combat the negative stereotype that computing is "nerdy" and unattractive [3, 9], we used the recent mobile app trend as a hook for a computer programming summer camp for 7th and 8th graders.

The use of Initial Learning Environments (ILEs) such as Alice [2], Scratch [13], Lego Mindstorms NXT [5], and Greenfoot [4] have provided a graphical, drag-and-drop "blocks-based" or "syntax-free" programming environment to facilitate the algorithmic thinking needed for computing while removing the syntax that can make programming daunting for newcomers. Programs are constructed by connecting up compatible blocks that represent programming constructs and fit together like a jigsaw puzzle.

Our camp used App Inventor for Android [15], a relatively new ILE, that allows for the creation of Android apps in a beginner-friendly environment like those that have made other ILEs attractive. Developing apps for smartphones is a particularly attractive method to introduce computing to middle schoolers, particularly to females and minorities [12]. A 2010 survey found that 33% of Americans ages 15-24 own a smartphone. Females account for 55% of smartphone users in the US ages 15-24. Among the 15-24 year old US smartphone users, 83% are considered an "advanced data user",

using smartphones beyond calls and text messages. Mobile device ownership is amongst the highest in minority groups: 45% among Asians, Hispanics, and Pacific Islanders, and 33% among African Americans [11].

Utilization of mobile devices is also becoming prevalent inside the classroom as teachers are adopting mobile technology for pedagogical reasons [6, 7, 8]. Thus, students come to the camp already familiar with the technology and can immediately see the utility in designing their own programs.

In the rest of the paper, we present an overview of the camp, an analysis of the data we collected, a reflection on lessons learned from running the camp, and we finish with conclusions and an invitation to other institutions to use/extend our materials.

CAMP OVERVIEW
Our camp was targeted at incoming 7th and 8th graders. While we feel confident that camp content is accessible to even younger students (say, as young as 5th grade), our limited experience with elementary-school classroom management led us to stick with students with longer attention spans and higher maturity levels. We also kept our first camp relatively small (twelve students) to allow for more individual attention.

Recruiting students
To recruit campers, an email was sent to area middle school principals asking them to forward the camp information to teachers and/or parents. The "App Camp" idea was extremely attractive to parents and students. The camp filled in 24 hours. Without any further advertising, 45 students had expressed interest and were put on a waiting list.

A private grant (Iowa Space Grant Consortium) for STEM education provided us with an appropriate summer stipend to develop the content and administer the camp. A registration fee of $60 per student paid for lunches at the college cafeteria and a t-shirt we had developed by a graphic design student. We felt that a modest registration fee was appropriate to ensure that students registered in the camp were committed and would not simply reserve a spot but not attend.

Camp Materials
App Inventor was used in another camp taught by Krishnendu Roy at Valdosta State University [14]. Roy used both App Inventor and Lego Mindstorm NXT, and a portion of the App Inventor content was delivered with five video tutorials. Our camp expands on this idea with a much larger focus on both App Inventor and video-delivered content.

Prior to the camp, we developed 36 five to ten minute instructional videos that can be downloaded via iTunesU. Each video explains an element of App Inventor and walks through the process of developing an app. The example apps built on work from the official App Inventor tutorials [10] and one exercise from the Valdosta State camp [14] as well as original apps developed specifically for our camp. Students watched the videos at their workstations (with headphones for audio) in a self-paced manner.

Sequences of videos are followed by exercises that allow students to work on their own using skills introduced in the videos. Students spent the last camp day developing a completely original app.

This means of content delivery was very successful. It relieved us from having to perform live demonstrations and let the students work at their own pace. Students could revisit elements of the videos that did not make sense upon the initial viewing. Additionally, students could pause the video walkthrough and work alongside the demonstration or watch the video to completion and work on the exercise on their own. Another advantage of having the content delivered via iTunesU is that all students who were not able to attend the camp could watch the content from home. The camp URL containing links to the videos and links to the image files is http://artsci.drake.edu/mathcs/appcamp.

Day	Activity Name	Number of 5-10 minute segments	Concept/Skill Developed
1	Hello World	1	Introduction to App Inventor, Buttons, Sounds
	Rock Band	1	Multiple Buttons
	Paint Pot (part 1)	6	Canvas Drawing
2	Paint Pot (part 2)	5	Arguments, Variables
	Mole Mash	4	Procedures, Timers
3	Pong	5	Animation, if statements
	Presidents Quiz	5	Lists
4	Starship Lander	9	Accelerometer, Multiple Screens, Loops
5	Original App		

DATA COLLECTION AND ANALYSIS

In order to assess the impact of the camp on students' attitudes and beliefs about computer science, we conducted a survey at the beginning and end of the week. To eliminate a prejudicial bias as much as possible, we asked students to fill out the survey before introducing the first video or handing out the Android smartphones on the first day of the camp. The survey was repeated at the end of the camp. The students are asked to answer honestly and not to put their names on the paper. For each item on the survey, we use a Lickert scale where students were asked to indicate if they strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), or strongly agreed (5). The table below shows the survey questions along with the pre- and post-camp response average.

Question	Pre	Post
I am confident I can learn basic computer concepts.	4.46	4.75
I like to use computers to solve problems.	4.00	4.42
Knowing how to use computers will help me with my future job.	4.31	4.17
I like thinking about using technology to do new things.	4.54	4.50
Programming (creating new programs or tools on computers) is hard.	3.15	3.08

Girls can do computer programming	4.62	4.67
Boys can do computer programming.	4.62	4.67
*Computer jobs are boring.	2.08	2.08
*I know more than my friends about computers.	3.46	3.75
My family encourages me to use computers	3.69	3.92
I like the challenge of programming computers.	3.92	4.17
I am interested in a career that uses computers to do new things.	4.15	4.08
I liked this camp.	n/a	4.75
I had fun at this camp	n/a	4.67
This camp made me want to know more about developing technology	n/a	4.42
I would recommend this camp to my friends.	n/a	4.50

While we cannot make any statistically significant conclusions in change of attitudes due to the camp, we did notice that the students came in with overall very positive views toward computing, and this attitude was maintained through the end of the week after getting hands-on experience. The results also show a slight increase in positive disposition to computing. The starred questions are repeated from the Valdosta State camp survey, and the results were similar. Our students, like the Valdosta State campers, did not indicate any perception about gender differences in computing abilities [14].

Written responses to questions and anecdotal evidence further support that the students found the camp enjoyable. For example, students had to be reminded on multiple occasions that it was time to leave at the end of the day.

Student Responses
In response to the exit survey question "What did you learn this week". One student remarked, "I learned a lot more about computer programming by fun activities and programming the apps." Another student said, "learning how to make my own app was awesome and getting to meet new people". Finally, a different student made the following comment: "Probably learning how to make the pong apps and doing the challenges like the straight line tool in paint pot"

Parent Responses
In email correspondences with the parents, all viewed the camp as worthwhile and beneficial:

"We were very happy with the camp. Our son enjoyed every minute of it & learned so much. As parents we loved that it was easy to find, organized & always ran on time."

"My son was excited to go to camp every day. We were thrilled that he enjoyed it in addition to learning so much. I appreciated the updates from Dr. Urness. I would highly recommend this camp."

"... I can't wait to get home each day and hear all the stuff he learned and to see how excited he is. He has loved every minute of it!"

"Thank you for a great camp... [our son] was challenged and looked forward to camp each day."

LESSONS LEARNED

We used CS unplugged (http://csunplugged.org/) each day to help illustrate problem solving skills used in computer science, as well as introduce some computing concepts such as binary numbers and error-correcting codes. These exercises were done in groups and were used as ice-breaking activities and breaks during elongated programming sessions. Furthermore, having non-computer activities planned was particularly useful when the computer lab lost power for a stretch of ten minutes.

Much of the camp is individual. Students are plugged-in to their computer with headphones which worked very well for keeping the students engaged in the content. However, breaks that require interaction are also greatly appreciated by the students.

Only two of our twelve campers were female. One of the female campers said that she would have liked to be at the camp with more girls. In the future, we plan to set aside a significant number of seats for girls, perhaps even a full section of the camp.

The technical components of the camp are only one half of the process. Registration forms, liability waivers, and collecting checks, also requires a significant amount of preparation. For instance, neglecting to indicate if t-shirt sizes on the registration form are adult or youth sizes caused confusion and required follow-up communications to correct.

CONCLUSION

Given the success of the camp as measured by the overwhelming student and parent interest, positive survey responses, and positive feedback; we intend to expand the camp and offer it again in future summers. We released the video tutorials that we produced under a Creative Commons license and encourage their use by others interested in running similar camps. These allow for groups with limited programming expertise to get a camp up-and-running very quickly. We view the camp as being appropriate for a wide range of organizations including universities, high schools, youth club programs, etc.

REFERENCES

[1] Adams, J. C., Alice, middle schoolers & the imaginary worlds camps, *SIGCSE Bull.* 39, (1), 307-311, 2007.
[2] Cooper, S., Dann, W., Pausch, R., Alice: a 3-D tool for introductory programming concepts. *J. Comput. Sci. Coll.* 15, (5), 107-116. 2000.
[3] Ericson, B., McKlin, T., Effective and sustainable computing summer camps. *Proceedings of the 43rd ACM technical symposium on Computer Science Education (SIGCSE '12),* 289-294, 2012.

[4] Henriksen, P., Kölling, M., Greenfoot: combining object visualisation with interaction. *Companion to the 19th annual ACM SIGPLAN conference on object-oriented programming systems, languages, and applications (OOPSLA '04),* 73-82, 2004.

[5] Kelly, J. F., *Lego Mindstorms NXT-G Programming Guide*, Apress. 2012.

[6] Liaw, S.-S., Huang, H.-M., A Case of Study of Investigating Users' Acceptance toward Mobile Learning, *Recent Progress in Data Engineering and Internet Technology*, 299-305, 2012.

[7] Looi, C.-K., Seow, P., Zhang, B., So, H.-J., Chen, W., Wong, L.-H., Leveraging mobile technology for sustainable seamless learning: a research agenda. *British Journal of Educational Technology* 41, (2), 154-169. 2010.

[8] Luckin, R., Du Boulay, B., Smith, H., Underwood, J., Fitzpatrick, G., Holmberg, J., Kerawalla, L., Tunley, H., Brewster, D., Pearce, D., Using mobile technology to create flexible learning contexts. *Journal of interactive media in education* 2, 2005.

[9] Margolis, J., Fisher, A. *Unlocking the Clubhouse: Women in Computing*, Cambridge, MA: MIT Press, 2002.

[10] Massachusetts Institute of Technology. App Inventor Tutorials. http://appinventor.mit.edu/explore/content/tutorials.html , retrieved November 26, 2012.

[11]The Nielsen Company. Among Mobile Phone Users, Hispanics, Asians are Most-Likely Smartphone Owners in the U.S., 2011, http://blog.nielsen.com/nielsenwire/consumer/among- mobile-phone-users-hispanics-asians-are-most-likely- smartphone-owners-in-the-u-s/ , retrieved December 5, 2011

[12] The Nielsen Company. Mobile Youth Around the World, 2010, http://www.nielsen.com/content/dam/corporate /us/en/reports-downloads/2010%20Reports/Nielsen- Mobile-Youth-Around-The-World-Dec-2010.pdf , retrieved August 3, 2012

[13] Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B., Kafai, Y., Scratch: programming for all. *Commun. ACM* 52, (11), 60-67, 2009.

[14] Roy, K., App inventor for android: report from a summer camp, *Proceedings of the 43rd ACM technical symposium on Computer Science Education (SIGCSE '12),* 283-288, 2012

[15] Wolber, D., Abelson, H., *App Inventor*, O'Reilly Media, 2011.