An Online Google Workshop for High School teachers

Dr. Afrin NAZ, West Virginia University Inst. of Tech.

Dr. Afrin Naz is an assistant professor at the Computer Science and Information Systems department at West Virginia University Institute of Technology. She is working with high school teachers to inspire the K-12 students to the STEM fields. In last four years Dr. Naz and her team launched six workshops for high school teachers. Currently her team is training the high school teachers to offer online materials to supplement their face-to-face classroom.

Dr. Mingyu Lu, West Virginia University Institute of Technology

Mingyu Lu received the B.S. and M.S. degrees in electrical engineering from Tsinghua University, Beijing, China, in 1995 and 1997 respectively, and the Ph.D. degree in electrical engineering from the University of Illinois at Urbana-Champaign in 2002. From 1997 to 2002, he was a research assistant at the Department of Electrical and Computer Engineering in the University of Illinois at Urbana-Champaign. From 2002 to 2005, he was a postdoctoral research associate at the Electromagnetics Laboratory in the University of Illinois at Urbana-Champaign. He was an assistant professor with the Department of Electrical Engineering, the University of Texas at Arlington from 2005 to 2012. He joined the Department of Electrical and Computer Engineering, West Virginia University Institute of Technology as an assistant professor in 2012. His current research interests include wireless power transmission, radar systems, microwave remote sensing, antenna design, and computational electromagnetics. He was the recipient of the first prize award in the student paper competition of the IEEE International Antennas and Propagation Symposium, Boston, MA in 2001. He served as the chair of Antennas and Propagation Society of IEEE Fort Worth Chapter from 2006 to 2011.

An Online Google Computer Science for High School Workshop

(Research-to-Practice, Strand 4)

Abstract

In the summer of 2014, an online Computer Science for High School Workshop was organized by West Virginia University Institute of Technology, with sponsorship from Google Inc. The online workshop lasted for four weeks, starting on July 19th and ending on August 18th. 123 high school teachers from USA and Canada registered for the workshop. The workshop offered two tracks: software track and hardware track. In the software track, the participants learned programming language Java; and the hardware track instructed basic computer architecture to the participants. Both tracks include three types of sessions: theoretical, hands-on, and discussion. The online workshop was completely based upon Google tools. Specifically, the course materials (such as PowerPoint slides and videos) were delivered using Google Course Builder, and live sessions and tutoring sessions were offered through Google Hangouts. During the four-week workshop, 24-hour online support was provided to the participants. In order to maintain efficient communication with the participants, multiple methods were employed, including e-mail, Google Hangouts On Air, and Piazza. Assessment was conducted primarily via a series of surveys before and after the workshop, which included both formative measures and summative evaluations to address the workshop's effectiveness. The surveys demonstrate that the participants' average "after-the-workshop" knowledge is significantly higher than their average "before-the-workshop" knowledge (3.6 versus 2.7 on a 5-point scale). Moreover after the workshop, most of the participants stated that they had less concern regarding teaching computer science. Our university students are offering online support to the workshop participants until August 2015.

Motivation and goals

In the summer of 2013, we organized a two-day Google Computer Science for High School Workshop on the campus of West Virginia University Institute of Technology[1]. Fourteen (14) high school teachers attended the workshop. A series of surveys indicate that our 2013 workshop was well received by the participating high school teachers, and moreover, a few teachers have successfully incorporated what they learned at the workshop to improve their teaching. In the summer of 2014, we organized Google Computer Science for High School Workshop once again, with the workshop's format changed to be "completely online." Compared with our 2013 workshop, the 2014 workshop aims to reach more high school teachers and thus achieve more impact. Our 2014 workshop has the following seven (7) specific goals.

Goal 1 Provide online professional development opportunity in the discipline of computer science to high school teachers.

Goal 2 Instruct fundamental computer science knowledge to high school teachers.

Goal 3 Help high school teachers address their curriculum standards.

Goal 4 Train high school teachers to integrate modern pedagogical tools with their teaching.

Goal 5 Acquaint high school teachers with cutting-edge computing technologies.

Goal 6 Establish networking among high school teachers and university educators.

Goal 7 Attract minorities to the computing field.

The seven goals above are adapted from those of our 2013 workshop. A few modifications were made based upon the surveys collected from the 2013 workshop. For instance in 2013, several high school teachers mentioned that they always met technical difficulties when they attempted to employ computer in their teaching and they strongly desired technical supports. Goal 4 above is tailored in response to this demand; to be specific, high school teachers will be trained with a few software tools at the 2014 workshop and year-round online support will be provided after the workshop. Also in the surveys, most of the local high school teachers indicated they prefer web-based instructions and web-based resources, largely due to the unique geographic and traffic situation in our area. Thus, changing the workshop's format to online (as stated in Goal 1) is expected to enhance the impact of our workshop significantly.

As a matter of fact, "online" is a widely-employed method to teach computer science nowadays. The best example is probably Code.org, a non-profit online community dedicated to expanding participation in computer science[2]; the online videos distributed by Code.org include Bill Gates (from Microsoft) teaching "if-else" and Mark Zuckerberb (from Facebook) teaching "repeat loop." CS4Alabama[3] and GUTS (Growing Up Thinking Scientifically)[4] are two other successful programs that offer year-round free online instructions in computer science. The online Computer Science for High School Workshop presented in this paper is one of the few pilot programs sponsored by Google, aiming to promote computer science education worldwidely[5].

Participants

123 high school teachers from USA and Canada registered for the workshop. About 80% of the participating teachers have at least 6 years of teaching experience. Approximately two-thirds of the participants taught computer science or other IT-related subjects in the past; and, most of the remaining one-third participants taught STEM subjects (but not computer science). When asked "why are you interested in participating in this workshop," 40% of the participants indicated that

they chose to teach computer science, 20% of the participants answered they had been assigned to teach computer science, and 35% of the participants said they were considering teaching computer science in the future.

Implementation of the workshop

Our Computer Science for High School Workshop in 2014 was delivered completely online. The contents of our workshop are classified into two tracks: software track and hardware track. The homepage of our software track is depicted in Figure 1.

Figure 1: Homepage of the software track of our online workshop

Both the software track and hardware track include three different types of sessions: theoretical, hands-on, and discussion sessions. Next, these three types are briefly described.

Theoretical sessions

Theoretical sessions intend to educate the audience about the fundamental knowledge related to computer software and hardware. In both the software track and hardware track, theoretical sessions included eight units. Each unit further included multiple lessons along with specific activities. The lesson materials were posted through Google Course Builder, so that the audience could access them any time. Each theoretical session offered PowerPoint slides and video tutorials. Figure 2 shows a snapshot of video tutorial in a theoretical session on Java programming.

Hands-on sessions

Two types of hands-on sessions were offered: lab sessions and pedagogical tool training sessions. To be specific, lab sessions supplemented the theoretical sessions and pedagogical tool training sessions provided training on how to employ modern software tools to achieve curricular innovations. For instance, the software track included multiple labs for the audience to write,

compile, and debug computer programs. The tools instructed at our workshop included Google Course Builder, Google Hangouts, Piazza, and Wix. All the hands-on sessions offered PowerPoint slides and video tutorials. In Figure 3, a lab in the hardware track is demonstrated.

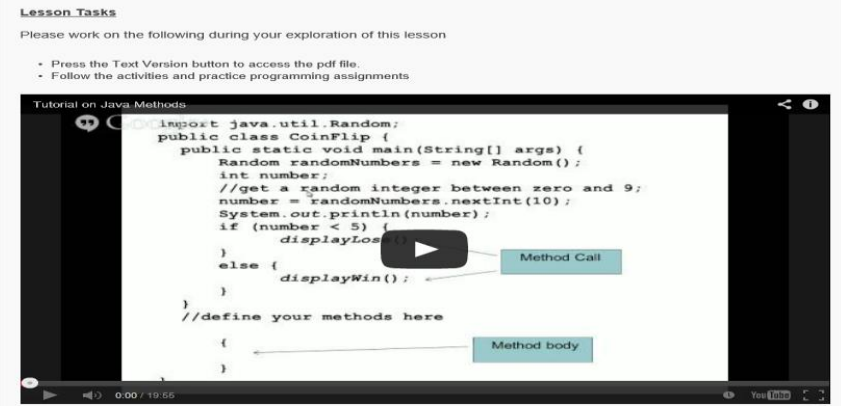

Figure 2: A snapshot of video tutorial in a theoretical session on Java programming

Figure 3: A snapshot of a lab in the hardware track

Discussion sessions

Our workshop has multiple discussion sessions. In one session "networking," the participants exchanged their teaching experience and discussed how to prepare high school students for college majors related to computer. Another session "attracting minority" was devoted to inspiring students from minority (including female) groups to choose computer/computing as their college major. In another session "cutting-edge technologies," we presented several cutting-edge computing technologies to high school teachers. Piazza was used for questions and answers in the discussion sessions.

The agendas of the software track and hardware track are displayed in Tables I and II, respectively.

Table I: Agenda of software track

Week	Date	Content
1	7/19	Theoretical session: Introduction to Java
	7/20	Theoretical session: Java fundamentals
	7/21	Theoretical session: Different data types Hands-on session: Pedagogical tool training on Piazza
	7/22	Hands-on session: Pedagogical tool training on Jcreator
	7/23	Theoretical session: Introduction to algorithms
	7/24	Hands-on session: Pedagogical tool training on HOA
	7/25	Hands-on session: Lab 1, general questions and answers
2	7/28	Theoretical session: Java methods and files
	7/29	Hands-on session: Group Hangouts
	7/30	Hands-on session: Group Hangouts
	7/31	Theoretical session: Class and objects Hands-on session: Lab 2
	8/1	Discussion session: Networking
3	8/4	Theoretical session: Array
	8/5	Hands-on session: Group Hangouts
	8/6	Hands-on session: Pedagogical tool training on web development
	8/7	Theoretical session: Stack Hands-on session: Lab 3
	8/8	Discussion session: Cutting-edge technologies Hands-on session: Group Hangouts
4	8/11	Theoretical session: Sorting
	8/12	Hands-on session: Group Hangouts
	8/13	Theoretical session: Conclusions
	8/14	Test
	8/15	Discussion session: Attracting minorities in computer science

Table II: Agenda of hardware track

Week	Date	Content
1	7/19	Theoretical session: Under the cover
	7/20	Theoretical session: Revisiting numbers
	7/21	Theoretical session: Performance Hands-on session: Pedagogical tool training on Piazza
	7/22	Theoretical session: Below your program
	7/23	Theoretical session: Instructions
	7/24	Hands-on session: Pedagogical tool training on HOA
	7/25	Hands-on session: Lab 1, general questions and answers
2	7/28	Theoretical session: More on instructions
	7/30	Theoretical session: Integer and floating point operations
	7/31	Hands-on session: Group Hangouts
	8/1	Discussion session: Networking
3	8/4	Theoretical session: CPU
	8/6	Theoretical session: Hazards Hands-on session: Pedagogical tool training on Web development
	8/7	Hands-on session: Group Hangouts
	8/8	Discussion session: Cutting-edge technologies
4	8/11	Theoretical session: Memory
	8/13	Theoretical session: Conclusions
	8/14	Hands-on session: Group Hangouts Test
	8/15	Hands-on session: HOA Discussion session: Attracting minorities in computer science

Efficient and effective communication with our participants was one of our top priorities in the workshop. During our four-week workshop, 24-hour online support was provided to the participants. Our average response time was less than 30 minutes, which was well appreciated by the participants. We made sure that at least one teaching assistant is available to answer

questions any time during the four weeks. Specifically, we utilized the following four communication means.

(1) One-to-one tutoring through e-mails

(2) Group tutoring through Google Hangouts

(3) Live sessions through Google Hangouts On Air

(4) Discussion board through Piazza

Tutoring through e-mail or group Hangouts were apparently more personal ways for the participants to interact with the teaching assistants. However since we only had three teaching assistants, it was impossible to reply all the questions in the timely manner via e-mails and group Hangouts. As a remedy, we offered live online sessions with Hangouts On Air and discussion board with Piazza. Through the live sessions with Hangouts On Air, we provided opportunities for the entire class to listen to the instructor and to ask questions in chat mode. All the Hangouts On Air sessions were recorded and archived for future access. Via discussion board, questions and answers were posted and open to all the participants. A hands-on training session was offered at the beginning of our workshop to familiarize the participants with all the available options (that is, Course Builder, Hangouts, and discussion board).

Results

A series of surveys were administered by Google to the participants before and after our Computer Science for High School Workshop. Overall, the survey results indicate that our workshop is a success. Some of the specific results are presented in this section.

The most important item of the surveys is the participants' self-assessment of their computer science knowledge. The survey results in Table III shows that the participants observe significant improvement of their computer science knowledge after the workshop. Specifically, 7% of participants rated their knowledge to be "very high" after the workshop, 50% of the participants found their knowledge in the "high" category (whereas only 17% of the participants were in the "high" category before the workshop), and particularly after the workshop, the numbers of participants in the "very low" and "low" categories were zero. To be more specific, the average "after-the-workshop" computer science knowledge is 3.6 on a 5-point scale, significantly higher than the average "before-the-workshop" knowledge 2.7.

Table IV is on the participants' average concern levels (on a 5-point scale) regarding teaching computer science. In almost every category, the participants have less concern after the workshop than before the workshop. The only exception is the last item "deciding whether I want to teach CS," in which concern level increases slightly from 1.7 to 1.8 after the workshop.

Table III: Survey results of the participants' self-assessment of their computer science knowledge

	Before workshop	After workshop
Very high	0% of participants	7% of participants
High	17% of participants	50% of participants
Moderate	40% of participants	43% of participants
Low	40% of participants	0% of participants
Very low	3% of participants	0% of participants

Table IV: Survey results of the participants' average concern level regarding teaching computer science

	Before workshop	After workshop
Working with others to improve how CS is taught	2.5	2.1
Improving how I teach CS	3.2	2.5
Improving student learning outcomes	3.3	2.8
Finding out what students need to known	3.1	2.6
Preparing to teach my course	3.0	2.5
Assessing my ability to teach CS	2.6	2.3
Understanding what teaching CS requires	2.8	2.2
Understanding what CS is	2.2	1.8
Deciding whether I want to teach CS	1.7	1.8

An encouraging outcome revealed by the post-workshop surveys is that, 47% of our participants agree on "the workshop achieving a sense of community." We find it a strong evidence supporting "online teaching could be as accommodating as regular face-to-face teaching."

In the post-workshop surveys, the participants were asked a question "if you are a teacher, what portion of what you learned in this course you will incorporate into curriculum?" We are very delighted to learn that, 60% of the participants plan to use at least 25% of our activities and resources in their teaching. Indeed during the workshop, our participants frequently requested permission for them to use our lecture slides, assignments, and video tutorials in their classrooms. In response, we kept most of our materials available online for extended time after the workshop to allow the participants to make copies. Below are some of the comments from our participants.

- *"I just watched the video on the Parts of a Computer. It was excellent. I would like to use this video as well as some of the PowerPoints in my Information Processing classes. Do we have permission to do this?"*

- *"Do we have permission to use Materials with our students. Please can you answer this question?"*
- *"Do we have permission to share materials from this class with our students? I hope it's okay. The HTML slideshow was excellent, and I want to be able to share it with my students. I also want to share the Hexadecimal Binary Table and some other information with them. Please let me know. I'm wanting to show them some of these things very soon."*

Several participants have laid out solid plans to incorporate what they learned from the workshop into their teaching (in the workshop budget, $3,000 is reserved for the participants to conduct post-workshop activities). Our university students are offering online support to the workshop participants until August 2015.

As indicated by the responses to the last question of post-workshop surveys, 63% of our participants would recommend the workshop to others, the remaining 37% were neutral, and none of the participants selected "do not recommend."

Conclusions

In the summer of 2014, we organized an online Computer Science for High School Workshop, with sponsorship from Google Inc. 123 high school teachers from USA and Canada registered for the four-week workshop. The online workshop was delivered using Google tools including Course Builder and Hangouts, and 24-hour online support was offered to the participants during the four-week workshop period. Survey results demonstrate that the participants' average "after-the-workshop" knowledge is significantly higher than their average "before-the-workshop" knowledge (3.6 versus 2.7 on a 5-point scale). Moreover after the workshop, 63% of the participants specified they would recommend the workshop to others, and 60% of the participants planned to incorporate at least 25% of the workshop activities/resources into their teaching. Our university students are offering online support to the workshop participants until August 2015.

Acknowledgment

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References

1. A. Naz and M. Lu, "A Google computer science for high school workshop," presented at the 121st ASEE Annual Conference and Exposition, Indianapolis, IN, June 2014.
2. https://code.org/educate/videos
3. http://cs10kcommunity.org/event/cs4hs-mooc-online-course-computer-science-principles-high-school-csp4hs
4. http://www.projectguts.org/node/home
5. http://www.cs4hs.com/