Microteaching: Ad-Hoc Networks, Binary Heaps, Variables in Hedy, Loops, Lists, and Data Storage

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ABSTRACT

SIGCSE is packed with teaching insights and inspiration. However, we get these insights and inspiration from hearing our colleagues talk about their teaching. Why not *watch* them teach? This session does exactly that! Six exceptional educators will present innovative content just as they would to their students. The moderator, Colleen Lewis, will describe their pedagogical moves and how they connect to education research. The goal of the session is to inspire SIGCSE attendees by highlighting innovative instruction by exceptional educators. Attendees can adopt the content and/or pedagogical moves from each microteaching example.

KEYWORDS

pedagogy; pedagogical content knowledge; innovating teaching

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1 INTRODUCTION AND STRUCTURE

The session will highlight innovative explanations and pedagogical moves (like "Nifty Assignments" but for instruction). The goal of the session is to model general pedagogical techniques and pedagogical techniques applicable to teaching specific content. Each of six exceptional educators will teach the audience something (7 minutes each). After each teaching demonstration, Colleen Lewis will draw the attention of the audience to particular pedagogical moves that the instruction included (2 minutes). These educators and educators in the past [3–5] were selected because they are inspiring, engaging, and effective teachers.

2 EXCEPTIONAL EDUCATORS

2.1 Binary Heaps - Jason M. Grant

Binary heaps are simple, powerful, and efficient data structures. Min heaps feature an O(n) time complexity for retrieving the smallest element, making them an excellent choice for priority queues. Heaps can also be used for sorting, providing runtimes equivalent to merge sort without the enormous space requirements. In this segment, I will cover a basic implementation of binary heaps and discuss applicable use cases for this data structure.

Jason Grant is an Assistant Professor of CS at Villanova University. His research interests include biometrics and computer vision. He earned his BS from the University of Maryland, Baltimore County and serves at the president of the Meyerhoff Scholars alumni chapter. He completed his MS and PhD from the University of Notre Dame and previously taught at Middlebury College.

2.2 Ad-Hoc Networks - Christine Bassem

Ad-hoc networks are a type of dynamic wireless networks, with no central authority coordinating the communication between machines. In this exercise, students learn about data routing algorithms by acting as a *node* in such a network. We start by forming the network, with students connecting to their neighbors based on their proximity. Then, a pair of students are chosen to act as the

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source and destination of the data transmission. Once these *nodes* are determined, all participating students are expected to forward the data from the source to the destination, following the rules of the routing protocol being investigated. In a typical in-person classroom, index cards are used for message passing. In a virtual setup, this is replaced by an online chatting mechanism, in which students take turns sending messages. By the end of this exercise, students understand the challenges of coordination within wireless ad-hoc networks and they can conceptually evaluate different routing algorithms against each other. Finally, they are encouraged to think about the added challenges of node mobility, network errors, and privacy concerns within such networks.

Christine is an assistant professor at Wellesley College. She enjoys teaching networks, distributed computing, and algorithms to undergraduate CS students, as well as helping high school students with understanding mathematical and computational concepts.

2.3 Variables in Hedy Levels 1 and 2 - Felienne Hermans

Hedy (www.hedycode.com) [1, 2] is a free and open-source, *gradual* programming language. Hedy starts very simple—initially you can print by just typing "print Hello SIGSCE"—and gradually adds more complex concepts and accompanying syntax. In this session I will show how to teach variables within Hedy's levels, first implicitly in level 1 and then explicit with naming in level 2.

Felienne is associate professor at the Leiden Institute of Advanced CS at Leiden University, where she heads the PERL research group, focused on programming education. Felienne is the creator of the Hedy language. She also works at the Vrije Universiteit Amsterdam one day a week, where she teaches prospective CS teachers.

2.4 Loops - Angel Kuo

Students learning Java need to understand the complex sequences of steps embedded within the syntax of loops. Using an interactive slide system called Desmos, I will show how I help students compare the syntax and semantics of `for`-loops and `while`-loops.

Angel Kuo is a high school math and CS teacher in Alhambra Unified School District. She is also a Math for America Los Angeles fellow and a National Boards certified teacher.

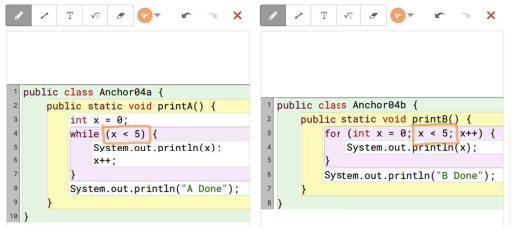

Figure 1: Student annotation of loops in Desmos

2.5 Lists - Art Lopez

Lists are a central topic in the Advanced Placement CS Principles (AP CS P) course. However, they can be taught intuitively by building upon students' everyday knowledge of working with lists. I will demonstrate this using PearDeck, which is a Google Slides add-on that enables students to interact with a slide deck and allows me to see students' responses in real time. Working with examples of lists of people, I will introduce list construction, insert, and remove.

Art Lopez is a Project Manager for the Coding Our Future project, which is a collaboration between the San Diego Unified School District and the University of California, San Diego Educational Studies Department and Center for Research on Educational Equity, Assessment & Teaching Excellence (CREATE). The project provides 3rd – 8th grade CS curriculum units in both English and Spanish, teacher professional development, and micro-credential certifications. After 36 years, Mr. Lopez retired from teaching high school AP CS A and AP CS Principles. Mr. Lopez has served the Computer Science Teachers Association (CSTA) as a 9-12 representative on the Board of Directors and LatinX Affinity Group Lead Committee member. Mr. Lopez is the past President of the CSTA-San Diego Chapter and served on the committee for the California CS Standards.

2.6 Data Storage - Beth Trushkowsky

Computer systems courses are often students' first in-depth look at different types of computer memory. In their introductory CS courses, students typically write programs where all the data they use fits in main memory and thus have trouble reasoning about, say, how to write a program to sort data if the data exceeds the capacity of main memory. A key theme in my Databases course is reasoning about the difference between data stored in main memory versus on a hard disk drive. I will explain how I use physical props in my teaching to help students understand the different places in a computer that data can be stored as well as the performance implications of moving data between these storage locations.

Beth Trushkowsky is an Associate Professor of CS at Harvey Mudd College. Her current research interests focus on using crowdsourcing within query processing systems such as a database management system to broaden the scope of questions users can ask about data. Trushkowsky has also worked on scalable database systems and cloud computing. She received her BS degree in CS from Duke and her MS and PhD degrees in CS from UC Berkeley.

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