Microteaching: Recursion, Coding Style, Creative Coding, Inheritance and Polymorphism, Loops, and the Internet

Colleen M. Lewis
Computer Science Dept.
Harvey Mudd College
Claremont, CA, USA
lewis@cs.hmc.edu

Daniel D. Garcia
EECS Department
UC Berkeley
Berkeley, CA, USA
ddgarcia@berkeley.edu

Helen H. Hu
Computer Science Dept.
Westminster College
Salt Lake City, UT USA
hhu@westminstercollege.edu

Saber Khan
Packer Collegiate Inst. &
Processing Fdn
Brooklyn, NY, USA
mrkhanatndv@gmail.com

Nigamanth Sridhar
Department of EE and CS
Cleveland State University
Cleveland, OH, USA
n.sridhar1@csuohio.edu

Bryan Twarek
San Francisco Unified
School District
San Francisco, CA, USA
twarekb@sfsud.edu

Chinma Uche
Academy of Aerospace and
Engineering
Windsor, CT, USA
cuche@crec.org

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 just watch them teach? This session does exactly that. Six exceptional educators will present their favorite piece of innovative lecture content just as they would their students. The moderator, Colleen Lewis, will describe the central pedagogical move within the innovation and how this connects to education research. The goal of the session is to inspire SIGCSE attendees by highlighting innovative instruction by exceptional educators. The specific content of the innovative instruction may be applicable for some attendees, and the discussion of the underlying pedagogical move within each innovation can be applied across the attendees' teaching.

1 SUMMARY AND STRUCTURE

Each of six exceptional educators will be given ten minutes to teach the audience something. After this, the moderator will draw the attention of the audience to particular pedagogical moves that the instruction included. Attendees can see a new approach to introducing a topic or a new pedagogical move. No matter what, we expect attendees will be taking ideas from this session directly back to their teaching!

A Special Session of this style was first run at SIGCSE in 2018, and it was well attended and received. The format is based upon a practice in chemistry of sharing "Five Slides About," which introduce a topic in a novel or concise way (https://www.ionicviper.org/types/five_slides_about). Resources

from each of the presenters will be shared on CSTeachingTips.org.

4 EXCEPTIONAL EDUCATORS

4.1 Recursion with "Vee" - Dan Garcia

In our Beauty and Joy of Computing (BJC) CS0 class at UC Berkeley, we introduce recursion using E. Paul Goldenberg's "Vee" project. It starts innocently enough...a sprite is positioned at the bottom of the stage and told to draw a "V" shape picture by running the vee command. vee has the sprite turn left, move out, and run a random shape command (square, circle or triangle) from the shapes list, which draws a random embellishment on the end of the left branch. Then it backs up and does the same thing on the right side. We run the program together a few times in class; the result is mostly yawns. Then (and here's the magic), we add vee itself to the shapes list. Students are asked to sketch what they think will happen and share their sketches with their neighbors. We then re-run vee (and cross our fingers). When vee generates a beautiful and flowering tree (especially if it happens on the first try), there is often a collective gasp from the hundreds of students. We emphasize that the vee command didn't change, but now vee can call vee, which can call vee, and so on. We go on to show that the same ideas behind vee can be used to create an arbitrarily long English sentence.

Dan is a Teaching Professor in the EECS department at the University of California, Berkeley.

4.2 Coding Style with POGIL - Helen Hu

POGIL (Process Oriented Guided Inquiry Learning) engages students by grouping them in teams to work collaboratively through activities and construct their own understanding of CS content. POGIL activities are carefully designed to foster student

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

SIGCSE '19, February 27–March 2, 2019, Minneapolis, MN, USA

© 2019 Copyright is held by the owner/author(s).

ACM ISBN 978-1-4503-5890-3/19/02.

<https://doi.org/10.1145/3287324.3287514>

Figure 1: The vee command in Snap (above) and resulting images before (left) and after (right) vee is added to the list of shapes.

learning by guiding students through a learning cycle of exploration, concept invention, and application. In this short lesson, I will demonstrate how a POGIL activity would lead students to discover and invent programming style rules in an introductory programming class.

Helen Hu is a Professor and Chair of Computer Science (CS) at Westminster College.

4.3 Creative Coding with p5.js - Saber Khan

p5.js is creative coding library that evolved from Processing, the popular Java library used by visual artists. With built-in functions and variables p5.js provides an exciting avenue to learn coding. I will show how to create simple shapes using the library, how to move the shapes, and finally how to make them interactive. The lesson will involve variables, loops, conditional statements and formatting. This introductory lesson, one I give at the start of the semester for students who only know block-based code, provides students with a new paradigm for using text to create interesting sketches based on their creativity. The lesson ends with an assignment for students to create their own original design.

Saber Khan is a middle and high school CS teacher at Packer Collegiate Institute in Brooklyn, NY, and a Processing Foundation Fellow for K12 Outreach.

4.4 Inheritance & Polymorphism - Nigamanth Sridhar

Students in a CS1 course learning about object-oriented programming have to get a strong understanding of inheritance and polymorphism. These topics form the foundation for students in a CS major to be able to build skills and understanding of later topics and courses. Yet, students often view inheritance and polymorphism in a high “syntax-specific” manner, which promulgates a large number of misconceptions that later manifest in serious misuse of object-oriented features in a language such as Java or Python. This lesson is focused on decoupling the concepts of inheritance and polymorphism from the syntax that is used to establish these relationships.

Nigamanth Sridhar is a Professor of CS at Cleveland State University. He also serves as the Dean of the College of Graduate Studies.

4.5 Loops through Dance! - Bryan Twarek

Unplugged activities are intentionally designed kinesthetic lessons that help students digest complicated concepts in ways that relate to their own lives. Something that is done in an unplugged environment can often set the stage for or review a concept done in a plugged environment. Both are vital pieces of the curriculum as they build student knowledge and understanding in different ways. In this lesson, I will show how we explore the concept of loops through an unplugged dance activity. I designed the lesson for an introductory middle grades course, but it can be adapted across K-12+ grade levels.

Bryan Twarek (BT) is CS Program Administrator at the San Francisco Unified School District (SFUSD), where he oversees policy, curriculum, and professional development for PK-12 CS education.

4.6 The Internet – Chinma Uche

The growth of CS has led to diversity in AP CSP classrooms where students come in with different backgrounds and levels of preparation. To provide opportunities for success, teachers have begun to develop dynamic classrooms that use student centered activities and cooperative learning structures to engage all students. An effective tool for getting a diverse classroom to learn well is questioning. Questioning creates the opportunity for students to ask questions that they have to each other and then think through the material together. Questioning proves useful when approaching the CSP big idea, “the Internet.” Through unplugged activities and student developed questions, students can more successfully grapple with key concepts. Questioning can also be useful for teacher professional development.

Chinma Uche is a high school Math and CS teacher in a school that started offering AP CSP to all 9th grade students in 2017 as a way of broadening participation in computing.