Special Session: Converting Your Teaching (or Even Your Whole Department!) to Active Learning via POGIL

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1. SUMMARY

POGIL (Process Oriented Guided Inquiry Learning) is a form of active learning where students work collaboratively through activities designed to guide them to discover concepts on their own. POGIL is based on the principle that students will learn and retain more when they construct their own understanding of the computer science (CS) content. Working in groups of three to four, students develop *process skills*, such as problem solving, communication, and teamwork. This special session will first provide SIGCSE attendees the opportunity to experience a CS POGIL activity for themselves. We will then discuss different ways that instructors might adopt POGIL for use in their classroom, and how the adoption of POGIL by multiple instructors in a department can change the culture of the department.

2. OBJECTIVE

Recent educational research has demonstrated that learning outcomes tend to improve as student engagement progresses from *Passive* (read, watch) to *Active* (copy, rehearse) to *Constructive* (explain, generate, reflect) to *Interactive* (discuss, debate) [1]. While there are many forms of collaborative learning which encourage constructive and interactive student engagement [3, 6, 7], relatively few faculty seek out and adopt them by searching the literature. Changes in one's teaching practices occur more frequently via personal interaction with other educators [2].

The presenters of this special session belong to departments where multiple faculty have embraced collaborative learn-

ing after adopting POGIL. We will discuss how POGIL has served as a mechanism for creating a departmental culture committed to active learning. This special session will model POGIL facilitation techniques and provide an interactive venue for asking questions about how to implement activities in participants' specific classrooms. We will also share our POGIL materials, experiences from our own teaching, and how POGIL became widely adopted in our departments. Finally, we will provide information about the support available to computing faculty adopting POGIL for introductory computing classes through a project funded by the National Science Foundation's IUSE Program (Improving Undergraduate STEM Education).

3. OUTLINE

5 minutes	<i>Introduction to POGIL</i>
30 minutes	<i>Interactive Hands-on Activity:</i> Experience POGIL as Students Would
5 minutes	<i>Techniques for Gaining Student Buy-in</i>
10 minutes	<i>Our Departmental Experiences with POGIL:</i> Westminster College (Hu) James Madison University (Mayfield) Berea College (Pearce)
5 minutes	<i>Using POGIL in Your Department:</i> Learning More About POGIL Adoption
20 minutes	Q&A Discussion

Following a five-minute overview of POGIL, the audience will work in small groups through a POGIL activity in order to experience POGIL as students. After a short discussion about techniques for gaining student buy-in, each presenter will then speak about how POGIL has been adopted by other instructors in our departments, and how these adoptions have impacted the cultures of our departments. We will then provide tips on learning more about POGIL, where to find POGIL materials for different classes, different ways POGIL can be adopted, and what supports exist for faculty who wish to adopt POGIL (<http://introcpogil.org>), before concluding with a question and answer discussion on POGIL and strategies for departmental change.

3.1 Helen Hu

A Chemistry professor at Westminster College first introduced me to teaching with POGIL, when we co-taught an introductory programming class for scientists in 2005 [4]. After a few semesters of using POGIL in the science course and then attending my first POGIL workshop, I started writing

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POGIL activities for my traditional introductory programming course for CS majors (CS1). Within the first two years of adopting POGIL in CS1, the pass rates for female students in Westminster's CS1 increased over our historical rates [5]. This success convinced the other faculty in the Westminster CS department to use POGIL activities in their CS1 courses. They may have been more receptive to adopting a change to their teaching because it was supported by existing POGIL activities that could easily be adapted for their students.

All three full-time faculty and one adjunct instructor in our department have since attended a three-day POGIL workshop, and everyone has tried POGIL in at least one class. Some faculty have tried writing their own POGIL activities, whereas others encourage POGIL-like group collaboration in their upper-division classes without formal POGIL activities. There now appears to be a stronger commitment to collaborative learning in most Westminster CS classes, and active learning is now considered a hiring criteria.

3.2 Chris Mayfield

My department offers multiple sections (classes) for introductory programming and data structures (CS1 and CS2) in order to keep class sizes down to 25–30 students. As a result, we typically have several faculty teaching the introductory courses each semester. I first learned about POGIL several years ago while teaching CS1 with two other faculty who had previously attended POGIL workshops. We decided that semester to keep all six of our courses in sync by using the same activities and labs. Through this experience, I began to learn how POGIL activities are structured and how to encourage collaborative learning in the classroom. My colleagues made it very easy for me to adopt POGIL by including me in the revision of course materials and answering questions along the way.

In recent years, every faculty member we have hired has demonstrated a strong commitment to evidence-based teaching practices. They have subsequently introduced the department to Team-Based Learning, Peer Instruction, Peer-Led Teaming Learning, and other active learning strategies. The department's openness to these pedagogies can be attributed in part to the success that senior faculty have had over the years with POGIL. Getting colleagues to attend 1-day or 3-day POGIL workshops is a great first step to changing the culture of an entire department to support active learning.

3.3 Jan Pearce

I began my career teaching both CS and mathematics courses, and I learned about the power of collaboration and peer discussion via the seminal work of Uri Triesman. Triesman demonstrated that by providing a challenging, yet emotionally supportive, collaborative learning environment featuring peer discussion, students learned and thrived. Flying in the face of hypotheses that suggested systemic reasons for minority under-performance in STEM fields, Triesman found that Black and Latino participants in his workshops outperformed students of all other ethnicities who were not in his workshops. Black students in his workshops with math SAT scores in the low 600s performed comparably in mathematics courses to White and Asian students with math SAT scores in the mid-700s [8]. Triesman's work cast serious doubt upon the belief among some faculty that minority students fail STEM courses and leave STEM majors because of poor preparation or the inability to handle the rigor.

Not long after discovering Triesman's work, a biologist at Berea who was then on the national POGIL leadership team

introduced me to POGIL. This introduction launched me into high utilization of the POGIL framework in all my classes. Like Westminster, active learning is an important criterion for hiring in CS at Berea. All four of Berea's CS faculty utilize collaborative, inquiry-based pedagogies, and all have attended one or more workshops in which POGIL was utilized and highlighted, and our department has reaped additional benefit from our adoption of POGIL. Collaborating on the writing and editing of POGIL activities has served to build trust, making it easier to smoothly rotate instructors in and out of our courses since all of the work we have each put into course development will not be lost.

4. EXPECTATIONS

This special session will appeal to all who are interested in incorporating more active learning in their classrooms, as well as those interested in shifting the cultures of their departments towards more active and collaborative learning. Attendees will experience how students discover concepts for themselves while working through a POGIL activity. They will also see how POGIL has been adopted by different instructors, how to access POGIL materials, and how to learn more through POGIL workshops and regional meetings.

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