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Kimberly Cousins TSSA Winter 2014

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TSSA Report—Winter 2014

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Using funds from the TSSA, Winter 2014 (along with additional research funds for an additional day), I attended two days of Division of Chemical Education Symposia at the National Meeting of the American Chemical Society, Dallas TX: Process Oriented Guided Inquiry Learning (March 17) and George C. Pimentel Award in Chemical Education: Symposium in Honor of Thomas J. Greenbowe (March 18).

A detailed account of the two days of symposia follows. In summary, I was surrounded by a group of chemical educators who genuinely want to improve student learning, even when it removes students and/or colleagues from their comfort zones. These pioneers and practitioners use active learning, computer simulation, and inquiry laboratories with their own students, and develop new materials for others to use. They (or their evaluation colleagues) find ways to demonstrate the success of the learning methods.

I also found a number of themes that are being developed in our WIDER grant faculty learning community in the College of Natural Sciences. In particular, many of the speakers demonstrated the importance of evaluation and reporting as part of scholarly teaching; faculty and student attitudes and student gains from non-traditional teaching methods were central themes of talks as well as WIDER discussions; student's abilities to think and communicate in the discipline arose several times; and even the importance of working with like minded colleagues was stressed.

The 3/17 morning POGIL (Process Oriented Guided Inquiry Learning) session was primarily for developments in general chemistry courses. After an introduction by POGIL organizer Rick Moog, several faculty (and a few students) shared their own experiences and successes with POGIL.

One multi-investigator, multi-institution team from Midwestern universities (***Karen L Anderson***[1]*, Janelle A Arjoon*[2]*, Daniel King*[3]*, Jennifer E Lewis*[2]*, Douglas Latch*[4]*, Susan Sutheimer*[5]*, Gail Webster*[6]*, Cathy Middlecamp*[7]*, Richard S Moog*[8]) developed, tested, and used feedback to improve a series of climate change modules for general chemistry. Based on the field tests on multiple campuses, project personnel recommend adding questions to activities that probe why students provide given answers, in order improve the instructor's understanding of student misconceptions.

In his "Role of POGIL activities in facilitating student discourse in chemistry," Abdi M. Warfa described a Guided Inquiry activity using physical molecular models for an introductory chemistry class. He observed the students' responses

when answering corresponding clicker questions showing symbols describing dissolving a salt. He observed scientific *"discourse" (talking like a chemist)* among students trying to steer their groups toward the correct answer.

Martin D. Perry presented Implementing POGIL activities with peer instructors. He described the use of peer instructors in modest sized classes of second semester general chemistry. The peer instructors were undergraduates who had taken the class as previously in POGIL style; some had also taking or were taking a POGIL Biochemistry or POGIL Physical Chemistry class. The Peers attended classes on a rotating basis to assist with POGIL facilitation. They also held peer led session guided inquiry/problem solving sessions, as well as office hours in evenings (for a residential campus). With the peer sessions/peer mentors, Dr. Perry saw noted increases in pass rates and larger portions of A's and B's than previously. Peer instructors (PI's) Timothy Horton and Kelsey Willis (and one other) shared their experiences. The PI's felt students could relate to them better than faculty, that they had adequate training, and the Peer experience helped them prepare for professional exams. They also shared their mixed feelings about being *students* (not PI's) in a POGIL environment, not entirely positive.

Panel Discussion for the morning session (POGIL in General Chemistry) focused on department and administrative buy in and on promoting student enthusiasm for the method. The consensus was that departmental/administrative buy in should start by talking to them *before* implementing the methods, and bolstered by student performance data.

In the afternoon session, several faculty shared developments in upper division and even graduate courses using POGIL. A funded project Development and implementation of POGIL physical chemistry experiments by a community of practitioners (Alexander Grushow, Sally S Hunnicutt, Robert Whitnell) sought to develop and field test POGIL physical chemistry experiments on several campuses. The project helped build a community of physical chemists to read and test each others' projects. The talk introduced the language of POGIL module development, which can use the National Office after "beta" testing to "certify" the unit.

Sean Garrett-Roe described his frustration after lecturing first year in a graduate level statistical mechanics and thermodynamics class, and his second year efforts to develop a series of Guided Inquiry (GI) activities to teach the course. His teaching evaluation scores went way up this second time, providing administrator buy-in.

Sayo O. Fakayode described improvements to his laboratory course, in "From cookbook to guided inquiry laboratory experiments (GILEs) in analytical chemistry laboratory curriculum: Challenges and role of instructors for effective design and GILEs implementation". The instructor at a small HBCU instituted a

series of “real world” analysis projects for upper division analytical chemistry course. For example, he guides students to determine (with help of literature) that quantitative analysis of iron in food would be best using atomic absorption. Different student groups choose different food samples, and decide how to extract iron. He encountered some resistance initially from students and faculty, but both eventually got on board.

Jeffrey M. Carney described the design of a new POGIL laboratory in organic chemistry to replace the original SN1/SN2 experiment. He used different groups testing different factors (substrate, solvent, concentrations, leaving group) and combining data to help students learn factors effecting reaction prior to lecture course discussion. He wants to potentially develop a faculty group to develop organic GI experiments. His experiment uses very simple techniques, as do the experiments of the physical chemists in an earlier talk.

Finally, Susanne M Lewis shared her implementation of clickers as part of a small class POGIL implementation. She found that the clickers helped keep students on track better than the more “open ended” POGIL experience before clickers, and that she has overcome resistance from other faculty members who have discovered her POGIL graduates are better prepared for subsequent coursework than previous classes.

The afternoon panel discussion included comments about how POGIL was the original “flipped classroom” and that POGIL was originally imagined as a laboratory technique. Since implementing POGIL in a lab was more difficulty, the POGIL movement has taken off primarily in the classroom, but pioneers like the day’s presenters are leading the project to full circle. Mention was also made of the Writing Heuristic as a way to build Guided Inquiry in the laboratory. The originator of the Writing Heuristic, Tom Greenbowe, is being honored at Tuesday’s Pimentel Award Symposium.

On 3/18 I attended said award symposium, which included a variety of speakers who have worked with Tom Greenbowe on a variety of Chemical Education projects, including in using images and animations and in using a variety of approaches to Guided Inquiry, in teaching chemistry

Charles H Atwood described a series of changes made to the University of Utah’s general chemistry program. These include using more open-ended chemistry experiments; for these they found TA training was important for success, and improved student attitudes. They have also tried a flipped classroom model, in which reading and/or video lectures before class prepare students to work group problems (with occasional interruptions for clicker question check of understanding) replacing in-class lectures. They’ve noticed increase competence with solving challenging problems among students.

Elizabeth M Dorland highlighted a number of older images and newer video images (some of them Tom's) for enhancing student understanding of chemistry.

Michael J. Sanger, presented results of a multi part research project, in which students were shown two different animations (one simpler, one more complex but more accurate) for a redox reaction. By varying the order of presentation with intervening interviews, his team determined that, (1) students got a better concept understanding after simple vs. complex; (2) Adding complex after simple didn't help much; (2) adding simple after complex helped a lot.

Donald J. Wink, one of the other Science Writing Heuristic (SWH) pioneers talked about thinking about the chemistry instructional lab differently. He argued that the SWH makes students responsible for preparing for lab, and interpreting data. This is very different from a "formula" lab; although students think SWH is harder, they also believe they learn more, and many prefer it to cookbook labs.

Steven Gravelle described how the SWH is implemented gradually as one proceeds through the curriculum at Saint Vincent's College. This prepared students well for their senior research experience.

The afternoon session started with a talk by Pratibha Varma-Nelson on cyber peer-led team learning (cPLTL) workshops. These sessions were remote buy synchronous. After trying different technologies settled on an Adobe product as server, with each participant having both a web cam and a document cam for the session. The cPLTL replaced in person, required, out of class PLTL sessions, and all sessions were recorded for research purposes, and for helping instructors understand student difficulties. The instructors had more success if one session were devoted to introducing the technology; GChem course success for cPLTL participants was slightly lower than for in-person PLTL participants; this may be because social support was missing. Google hangouts is a possible free alternative to expensive Adobe conferencing software.

Rick Moog talked about assessing POGIL in second year HS Chemistry classes (not AP), and the need for good project evaluation tools. He described a current study using two different tools for this evaluation as pre/post test measurements: (1) an attitude survey from JCE, and (2) a knowledge of chemistry survey. He found that initial attitudes of beginning high school chemistry students different from entering college freshmen chemistry students, but are similar across different types of high schools, and similar to attitudes of freshmen HS biology students.

James H Reeves talked about the development of an end-of-course general chemistry laboratory examination through the ACS Exams institute. This exam, the most expensive ACS exam to date, has taken seven years to develop, and is

the first to be offered online exclusively. The exam uses a few experiments that test experiment design, data analysis, conclusions, and so forth, using a few common experiments, including video content.

George M. Bodner described what he has learned by watching successful and unsuccessful undergraduate problem solver over the last few years: the pathway to success is not linear; success requires persistence; drawing and/or writing down ideals and trial and error are essential steps for problem solvers across chemistry.

Thomas Holme described working at the exams institute, and on what is important to know in chemistry*. ACS exams are built on the following anchoring concepts (all questions fall into these types): atoms, bonding, structure/function relationship, reactions, kinetics, thermodynamics, experiment, visualization, intermolecular forces, equilibrium.* This may be an important summary of what our department at CSUSB should be assessing through Taskstream.

In his "Evolution of simulations in chemical education William Vining demonstrated a range of his work on visualization and computer tutorials spanning the past few decades.

Why do we search for alternate pedagogies like SWT or POGIL?
Diane M Bunce verbalized the need for alternative pedagogies (like SWT and POGIL). She said that our students don't learn to *think like chemists* if all we do is talk at them and ask them to "get the right answer". These alternative pedagogies promote the kinds of thinking we want students to do.

Before, during, and after class inquiry activities
John I Gelder, We were asked to "explore" Gelder's website of activities developed to promote thinking before, during and after class and provide feedback. He then introduced the award address speaker.

During his award address, Thomas J. Greenbowe talked about how important collaboration has been to help him help others teach, how he doesn't like to teach large classes, and about his recent experiences at University of Oregon with large lecture active learning and *Faculty learning Communities*.