Ed02: 2-2:30 p.m. integrating Lab and Lecture in graduate Physics Courses for teachers

*Invited – Dan L. MacIsaac, SUNY Buffalo State College, Buffalo, NY 14222; dnmacisaac@gmail.com*

*David S. Abbott, Kathleen A. Falconer, Luanna S. Gomez, SUNY Buffalo State College Physics*

We describe graduate physics courses for physics teachers taught since 2002 that blend lab and lecture and prepare teachers for doing the same in their own instruction. The ASU Modeling Physics curriculum (Hestenes et al.), SDSU PET Curriculum (Goldberg et al.) and activities from Chabay and Sherwood are discussed, as is the use of RTOP to promote reflective teaching practice, the use and promotion of reflective writing (reading logs, learning commentaries, daily journals, limited and multiple drafted lab reports), extended classroom discourse and course projects. We report pre- and post-course teacher conceptual learning and efficacy data, and describe ongoing research into the impact of these behaviors in the student learning of the teachers who took our graduate classes.

Slides

Intro

Abstract

Photo and Numbers

Modeling Crse Schedules

Reg Semester Schedule

Where does Time come from? / Text (Rdg Logs) / Reflection (Desbien Journals & Goldberg Learning Commentaries)

Discourse (WBs; DD1, centrality of scientific argumentation)

Videoclip

Results and comments

Questions

Refs

Hestenes/Dukerich ASU Modeling Physics Workshops:

* PHY620: Modeling Mechanics; PHY622: Modeling E&M + more (12cr total; 6weeks total summers)
* Total immersion modeling; practice using curriculum and WhiteBoards/discourse as students and teachers; afterwards it is easier for teachers to model than to teach otherwise

Physics teaching as Jazz/Blues (Braunschweig; modeling.asu.edu). These are your Blues scales:

Chabay and Sherwood (Matter & Interaction) mainly added to PHY622 -- microscopic models of charge; electrostatic/current electric linkages; calculus and electric fields

Knight (Physics) especially conceptual workbook activities for WhiteBoarding in class; Cf. Gauss’ Law activities

Goldberg, Robinson and Otero Physics for Everyday Thinking (PET) Scientific Argumentation (NGSS; scientific discourse; model building)

* energy based curriculum suitable for K-12 science
* simulations; WhiteBoards
* explicit model building/testing/refining in Ch4 (domain model of magnetism)
* learn to use videos and transcripts to analyze children’s learning

Use of RTOP to promote reflective teaching practice

(MacIsaac, Falconer, Hickman)

Use and promotion of reflective writing:

Apple textbook reading logs (modified from Apple, 2000): 2 sided one page form for text-based readings; gives credit for reading while removing same from class. *Form and examples available from the author.*

Goldberg learning commentaries (modified from Golberg CPU/PET; see Abbott rubric): 3-6 paragraph focused essay reflecting on physics learning on one specific topic – what you believed originally, what happened to change your thinking; what do you believe now.
*Rubric and examples available from author.*

Desbien daily journals: Handwritten journal consisting of four entries per class:

Class date,

bullet list of class activity(ies),

developed discussion of physics ideas learning using multiple representations, sketches, drawings, plots, mathematics and words as sufficient to describe the ideas learned (may require several pages)

Guiding question to help focus next days’ learning: what is the big unanswered question for me?

If class is missed, leave 1-2 pages and later fill in what was done to make up for the missed activity. Journals can be collected upon demand at any time during class; are collected and scored frequently.

*Scanned journal examples available from author.*

extended classroom discourse startup and examples

Discourse on Day 1 (DD1) modified Desbiens day one assignment – plan, present, refine and carry out an underspecified, real world numeric problem assignment: how many baseballs are required to fill the hallway, how many bricks to build the technology building, how many pavers to cover the student union quad, how many blades of grass on the lawn outside the science building, how many leaves on the tagged tree etc. Also google “how many ping pong balls to fill a 747”

RTOP4 circle whiteboard video; Desbien & Megowan dissertations <http://modeling.asu.edu/Projects-Resources.html>

course projects.

We report pre- and post-course teacher conceptual learning and efficacy data, and describe ongoing research into the impact of these behaviors in the student learning of the teachers who took our graduate classes.

Results

Audience change: In 2004 NYSED physics teacher certification changed

FROM a provisional/permanent certificate expecting 18cr of college physics and a content exam

TO an initial/professional certificate requiring 24/30cr of college physics, a content exam, AND regular professional development

Teachers holding older provisional certificates had five years (were grandfathered) to make the transition. In 2003-2004 the great majority of our summer course students were teachers seeking credit to apply to the older certification rules, after 2009 most teachers enrolled are now matriculated graduate students in a coherent program, and from 2004-2009 there was a gradual transition from credit only to degree seeking students enrolled in summer courses.

Summer enrollment trends: 2003-2007 we enrolled roughly 30 teachers per summer in either 620 *or* 622; since 2009 about 25 in both, then 17 per summer in both, with a precipitous drop this summer (less than 10 each in 510 and 620, cancelled 622) due to WNY teacher hiring/ retention/ economic downturn. We are currently seeing a surge in program enrollment for next summer.

CONCEPTUAL GAINS

PHY620: Modeling Mechanics was offered 2004, 2006, then 2008-present; average FCI gain <g> 2006 and 2008 was 0.47; FMCE 2009-present <g> = 0.38. We moved from FCI to FMCE b/c the FCI is now a curricular topic in PHY500 (another course in the program).

PHY622: Modeling E&M++ was offered odd numbered years 2003-2009, then 2010-2011; average DIRECT and CSEM gains were 0.33; we have recently moved to the more modern BEMA instrument from CSEM with similar gains. 622 saw a strong leap in 2010 conceptual gains we feel was due to the quality of achieved discourse, we are now trying to reliably reach that discourse level with our students.

EFFICACY: Enochs’ Science Teaching Efficacy Beliefs Instrument (STEBI) score gains show no statistically significant change and therefore no harm in teacher efficacy due to summer courses. The Maryland Collaborative for Teacher Preparation Attitudes Instrument (MCTP) regularly shows statistically significant growth in all subscales save the Beliefs about NOMS subscale.

ONGOING RESEARCH: Just started a small project tracking MSEd (Physics) graduates and RTOPing classes, collecting pre-post FCI and NYSED Regents Physics scores to do correlational study of a small number of WNY physics teachers. Cf. DUE1035360 WNY Noyce Scholars Partnership: A NSF Noyce Phase II Scholarship and Stipend Project PI: Luanna Gomez, Lead Researcher: Kathleen Falconer.