Research Project Title: **Instituting Cognitive Load Theory into JExam and Implementing Project Learning into CHEM 1211 and 1212**

**Purpose/Background:** Describe the purpose of the research project and explain its significance. Describe any necessary background or context (e.g., course lecture or lab, number of students in class, partners involved).

Both grants involve the CHEM 1211 and 1212 classes at UGA. These are large freshman chemistry programs serving some 2000 students per semester. There are no partners other than the Chemical Education group at UGA.

**Purpose:** To institute a new method (Cognitive Load Theory) of helping students to improve their understanding of chemistry as they work on their homework. In the grant on implementing problem based learning to submit a grant to NSF on Problem Based learning and to begin implementation of the project in CHEM 1211 and 1212.

**Description of Project (progress to date):** Describe the implementation of the research project and include specific, pertinent activities.

An NSF grant (Problem Based Instruction Initiative, PBI2) was submitted on January 12th. John Moody, one of my grad students, is presently developing several of the problems that we wish to institute into the courses. We are planning to begin implementation of this project in fall 2009. We also submitted an NIH grant in this area at the end of April. Both grants are still out for review.

Jason Rosenberg, my JExam programmer, is presently developing the code that will allow us to implement Cognitive Load Theory (CLT) into JExam. Derek Behmke, one of my grad students, has identified which homework questions we will first use for Cognitive Load Theory. He has also developed a flow chart for the question generation routine. Jason has begun some implementation of the code and is checking it out. We hope to begin using this code at that start of fall semester 2009.

**Data Collection and Analysis:** Describe types of data collected and methods of analysis.

The majority of our data will be numerical responses collected either on JExam or with clickers. From there it will be analyzed using Classical Test Theory, Item Response Theory, Cognitive Load Theory or Cognitive Diagnostic Theory.

**Findings:** Describe your findings and how the research project impacted student learning. Shown below are normalized student frequency vs. IRT ability graphs for the academic years 2004-2005 (left most graph) to 2008-2009 (right most graph). In these graphs we have taken the data for all 5 years (some 8000 students, 2950 questions) and analyzed them simultaneously using IRT. The data was normalized by fixing the parameters for the 2nd test of 2006-2007 then allowing BILOG-MG3 to vary the data for the other tests and students until the program converged. Data for students from each year was separated and plotted in Excel to show the year to year variations of student performance. As you can see, there has been a gradual but steady improvement in student performance over the years as we have changed our instruction to address student misconceptions. It is our belief that when we fully implement these two grants, we shall see similar, measurable continued improvements in student performance.
Conclusions/Recommendations: Describe any conclusions and recommendations based on findings and overall study (not already covered in your findings section).

At this point in time we are still developing the tools to implement both grant projects. This is a lot of work.

Dissemination: Include information concerning presentation proposals you have submitted this year (e.g., seminars, conference presentations, roundtable presentations) and/or articles submitted to journals.

1. Derek and John attended the Chemical Education Research Conference for Graduate Students held at the University of Miami in Ohio held June 6th and 7th. They both presented posters on their work on these projects.
2. Derek attended the Teaching Matters Conference held at Gordon College in Barnesville, GA on March 27-28, 2009 where he spoke on IM-Chem: Instant Messaging to Decrease Student Anonymity and Passivity in large General Chemistry Courses.
3. My former graduate student, Kimberly Schurmeier, graduated in May from UGA after submitting her dissertation, “Analyzing and Improving General Chemistry Teaching and Assessment Using Item Response Theory.”
5. Panel Session Participant – “Learning from Scholarly Teaching Projects” along with Pat Marsteller from Emory University and Norris Armstrong form the University of Georgia at the USG STEM Initiative State Institute held in Stone Mountain, GA on February 27-28, 2009 at the invitation of the Institute Organizer, Judy Awong-Taylor.
6. Chemistry Disciplinary Caucus Leader along with Paul Chen from Spelman College at the USG STEM Initiative State Institute held in Stone Mountain, GA on February 27-28, 2009 at the invitation of the Institute Organizer, Judy Awong-Taylor.
7. “Item Response Theory and Its Implications for Chemistry Teaching and Learning” Charles H. Atwood, Kimberly D. Schurmeier, and Carrie G. Shepler presented to the Georgia RESA Collaborative on August 26, 2008 held at the Foundry Park Inn in Athens, GA at the invitation of the Thomas Koballa, RESA Collaborative Organizer.
presented to the faculty, staff and students of Georgia State University on October 24, 2008 at the invitation of Doyle Barrow, the general chemistry coordinator at Georgia State University.

9. “Item Response Theory and Its Implications for Chemistry Teaching and Learning” Charles H. Atwood, Kimberly D. Schurmeier, and Carrie G. Shepler presented to the Admissions Education Day on January 29, 2009 held in Terrell Hall on the campus of the University of Georgia at the invitation of Nancy McDuff, Director of Admissions.

10. “Analyzing and Improving General Chemistry Teaching and Assessment Using Item Response Theory” presented to the Governor’s Teaching Fellows Program Summer Symposium 2009 at the Institute of Higher Education on the campus of University of Georgia on May 12th, 2009 at the invitation of Marguerite Koepke, Director, Governor’s Teaching Fellows Program.

Final reports should be no longer than three pages. Submit by June 1, 2009 to Nancy Vandergrift at vandergr@uga.edu