

Charles H. Atwood
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Nomination for the Regents' Scholarship of Teaching and Learning Awards

Fundamentally my research group's work is focused on improving student performance in the CHEM 1211/1212 sequence at the University of Georgia. This Freshman Chemistry sequence is large, servicing ~2000 students per year, and one of the make or break courses for science students at UGA. Freshman chemistry is the first science course for virtually every student at the University. Success in this course determines whether or not students continue in a science curriculum at the University. My group is keenly aware of its pivotal role in preparing students for scientific careers. Consequently, our primary research questions are:

- 1) Can we effectively design assessment instruments which both assess student performance and indicate those areas of the Freshman Chemistry curriculum that are responsible for poor performance in these courses?
- 2) Once areas of the curriculum are identified as problematic for students, can we design and implement in-class and out-of-class interventions that improve student performance?
- 3) Can our interventions be shown at a statistically significant level to systematically improve student performance in Freshman Chemistry?
- 4) Can we design and implement laboratory experiences for the students which instruct them in the use of important techniques and require them to use that knowledge in designing their own experiments to solve a specific problem?

Teaching in the Freshman Chemistry sequence at the University of Georgia is performed by an assortment of academic staff members, Franklin Teaching Fellows (teaching postdocs), and tenure-track faculty. Consequently, any programmatic changes in teaching philosophy must address the diverse nature of the individuals teaching these classes. Prior to my arrival at the University, these classes were strictly hide-bound lectures using overhead projectors with little or no opportunity for student-teacher interaction. We are now in the midst of the transition from faculty centered lectures to student centered instruction. This process has been evolutionary not revolutionary because our faculty and staff resist major changes but are receptive to incremental steps in their instructional environment. Consequently, my teaching philosophy is built around five major concepts.

- 1) Uphold the high standards in teaching, assessment, and student mentoring that are expected from a research I University's Chemistry Department.
- 2) Determine those chemical concepts that most clearly are problematic for students and address those problems systematically.
- 3) Be an effective and consistent mentor for the Freshman Chemistry students at the University of Georgia by showing them respect, guidance when necessary, and interacting with them in a variety of settings.
- 4) Expect excellence from my colleagues, students, and most importantly, myself.

- 5) Until every student in Freshman Chemistry legitimately earns an A, we can and must improve the course.

Beginning in 2000, under my direction, the freshman chemistry program at UGA built and instituted a computerized testing program, JExam, for use in administering hour exams and homework for the CHEM 1211 and 1212 classes (1-3). Initial tests were given on JExam in the fall of 2000. All hour tests in CHEM 1211 and 1212 from 2000 to present have been given on JExam with the student performance data from those tests being stored in the JExam database. In spring semester of 2005, I developed a research group beginning with my first graduate student, Ms. Kimberly Schurmeier. Kimberly began analysis of the complete student performance data set using a modern psychometric analysis tool, Item Response Theory (IRT) (4-11). IRT has given us a much more complete and detailed insight into the misconceptions and thought processes which plague student performance in CHEM 1211 and 1212 than we could have determined in almost any other fashion.

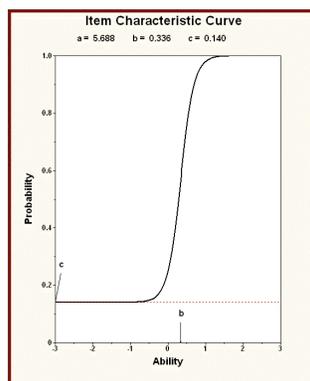
Most educators are familiar with Classical Test Theory (CTT) which calculates for a given test the median, mean, mode, etc., and determines a test item discrimination factor by comparing the performance on a question for the top quartile of students to the bottom quartile. IRT determines similar information for test items but does so holistically by comparing assessment results across the entire spectrum of student responses not just in comparison to the mean. Once a test is completed, raw data for the students' performance on a test, in the form of 1's for correct answers and 0's for incorrect answers, is input into an algorithmic fitting program which fits the data to the fundamental IRT formula.

$$P(\theta) = c + (1 - c) \frac{1}{1 + e^{-a(\theta - b)}} \text{ where :}$$

θ = ability level, a = discrimination factor, b = difficulty factor, c = guessing parameter

$P(\theta)$ is the probability that a student having a given ability level, θ , will answer that test item correctly. Roughly, we may think of θ , the ability level, as the student's knowledge in the subject matter. For example, an A student would have a higher ability level (typically in a UGA Freshman Chemistry class $\theta > 1.75$) than a B student ($1.10 < \theta < 1.75$) than a C student, etc. The discrimination factor, a , indicates how well the test item separates students that answer the question. Test items with high discrimination factors clearly distinguish students with higher ability levels from those with a lower ability. The difficulty factor, b , indicates how "hard" the question is. A difficulty level of -2 for a question indicates a question that only the poorest students would miss. Difficulty levels near 0 are test items that high C students, B, and A students answer correctly and low C, D, and F students routinely miss. Test items with a difficulty level of 2 or higher are answered only by the very brightest students. Finally, IRT can calculate the percentage of students that correctly answered the question simply by guessing. This is displayed as c , the guessing parameter, which is the percentage of students who guessed the question's answer. A c value of 0.18 indicates that 18% of the students guessed the right answer. All of this information is displayed in an Item Characteristic Curve, **Figure 1**, for one of our test items. IRT requires a large sample size (more than 200 responses to any test item) to have statistical validity. In all of the discussions given below, no item was tested on fewer than 200 students. Many test items have been tested on more than 5000 students. Our statistical validity for the test items is extraordinarily high (12-13).

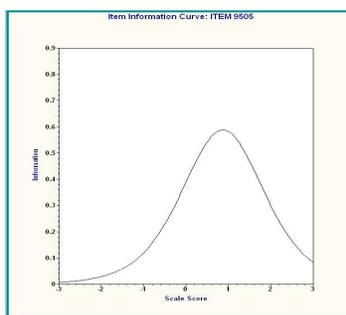
Figure 1. Item Characteristic Curve for the Test Question “What is the name of this ionic compound? $\text{Al}(\text{NO}_3)_3$ How many ions are present in one formula unit of $\text{Al}(\text{NO}_3)_3$?”



The discrimination factor, as determined from the slope of the curve, is displayed at the top of the graph and has a value of 5.688. This highly discriminating question has one of the highest discrimination factors of any question in our test bank. This question has a difficulty level of 0.336 which indicates that this question is one which C and higher students answer correctly while D and F students miss it. 14.0% of the students guessed the correct answer based upon the c value of 0.140. $P(\theta)$ is the black curve drawn on the figure. Notice that the curve indicates that students having an ability greater than 0.336 have a high probability of correctly answering the question while those with ability levels less than 0.336 have a sharply decreasing probability of correctly answering the question. We have similar information on every question in our test bank of over 12,000 questions.

IRT analysis also indicates for each test item which ability level students we are garnering the most information about. This is displayed in **Figure 2**, an item information curve for test item 9505. From this figure, we see that this question, which requires the students to balance an oxidation-reduction reaction and to determine which species are oxidized, reduced, and are the oxidizing and reducing agents, gives us the most information about students who have an ability level centered about 0.867 (high C student ability). However this question tells us very little about students with low abilities since nearly all of them missed the question nor does it give us much information on students with very high ability levels because essentially all of them correctly answered the question (12-13).

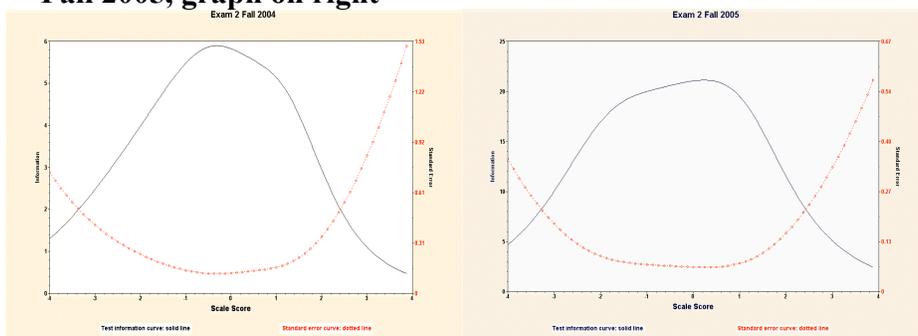
Figure 2. Item Information Curve for a Balancing Oxidation-Reduction Reaction Question



From our IRT analysis of our more than 12,000 questions in the JExam database plus all 30 tests given from fall 2000 to spring 2005, we clearly delineated those test questions which discriminated D and higher students from F students, C and higher students from D students, and so forth through the entire grade range. Beginning in fall semester of 2005, we built the CHEM 1211 and 1212 tests based upon our research. In particular, every test was constructed utilizing 2 or 3 questions which discriminated between A and B students, 3 or 4 that discriminated B and C students, and so forth through the grade range scale. Instituting this procedure brought to our attention that our previous tests had not properly assessed our students across the entire grade spectrum. Most of the test questions assessed C level students while few of them assessed A and B students or D and F students. A comparison of the Test Information Curves for test 2, fall 2004 (given before IRT analysis was performed) with test 2, fall 2005 (given after IRT analysis) indicates our improvement. Both curves shown in **Figure 3** are summations of the item information curves (similar to figure 2) for a test's entire set of questions (12-13).

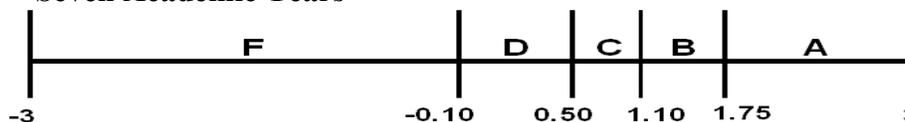
Notice how sharply the Test Information Curve for fall 2004 is peaked around the C student ability level. However, the fall 2005 curve is spread over a larger range of student abilities indicating that the fall 2005 test assessed a broader range of student abilities. Furthermore, the y-axis for fall 2004 extends to a value of 6 while the fall 2005 curve y-axis value is 25. The fall 2005 curve peaks at 21 indicating that we have gathered 3.5 times more information about our students over a broader range of abilities using the fall 2005 assessment compared to fall 2004. By using an IRT-based assessment, we have significantly improved our ability to distinguish A students from B students from C students and so forth.

Figure 3. Test Information Curves for Exam 2 Fall 2004, graph on left, and Test 2 Fall 2005, graph on right



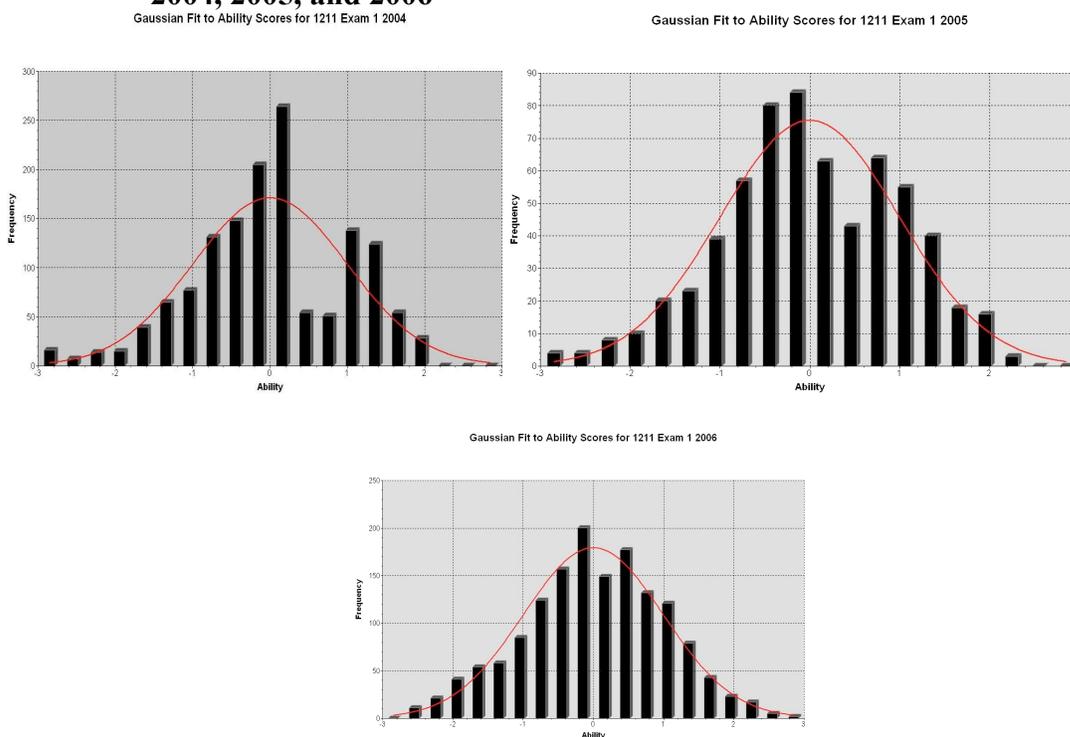
In the course of our analysis we discovered that since initiation of testing on JExam in fall of 2000 the student ability required to attain any letter grade has remained essentially constant. Unwittingly, our previous assessments generated an absolute grading scale for UGA that is independent of the incoming students constituting our freshman classes. To make an A, B, C, etc. in CHEM 1211 and 1212 at UGA has required the same student ability level for the last seven academic years. That grading scale is shown below in **Figure 4**.

Figure 4. Absolute Grading Scale for CHEM 1211 and 1212 at UGA Over the Last Seven Academic Years



Our determination that we have developed an absolute grading scale has the important instructional benefit of providing an absolute metric to determine what effects any changes made in instruction have on the students' performance. For example, in **Figure 5** are three graphs for the 1st CHEM 1211 fall exams in 2004, 2005, and 2006. These graphs, plots of the Gaussian fit to ability scores, show the typical bell-shaped curve superimposed upon the students' abilities. Notice that in 2004, prior to any use of IRT, our students had a very clear bimodal distribution in ability levels. However, as we instituted IRT analysis along with more effective assessment and teaching, the bimodal character of the distribution has nearly disappeared while the student ability levels have gradually shifted higher. Both indicate the progress in student achievement the changes instituted in our teaching program have made.

Figure 5. Gaussian Fit to Ability Scores for CHEM 1211 Exam 1 in Fall Semesters 2004, 2005, and 2006



After a full year of IRT analysis during academic year 2005-2006, we examined all of the test question topics, found which topics had the highest ability levels (*I4-I5*), and identified the seven most troublesome topics for our students which are listed below:

1. Understanding the structure of ionic compounds
2. Unit conversion problems, particularly converting from volume to area or height
3. Molecular polarity
4. Intermolecular forces
5. Understanding quantum numbers
6. Distinguishing the terms strong, weak, concentrated and dilute
7. Inorganic nomenclature

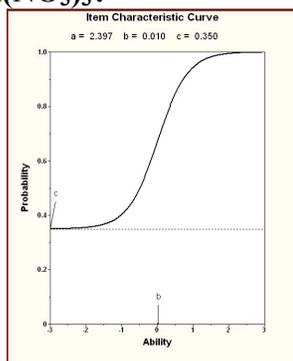
Hopefully, this description of IRT analysis has not left you befuddled. On the surface it may appear that we are just trying to find a better way to assign grades but nothing could be further from the truth. Imagine walking into your class at the start of the semester knowing with an incredible degree of confidence what topics this year's

students will struggle with, which parts of those topics you need to stress to improve their performance, and a better way to assess if your changes are effective. Furthermore, it's not just that I know it but every person who teaches in the Freshman Chemistry program knows it. My postdoctoral teaching fellow, Carrie Shepler, told me shortly after she arrived that, "The hard part of teaching a class is knowing what the students don't know and you have already solved that problem for me." Now that we were armed with this knowledge, we set out to address the problematic issues attempting to help our students.

Of the seven topics discussed above, it was apparent that understanding ionic compounds' structure is crucial to so many subsequent concepts in chemistry. **Figure 1** is an item characteristic curve for a question on this topic given in fall 2005. Notice that this question discriminates so highly that it is essentially a gatekeeper question. Students who answer this question correctly typically have an excellent chance of passing CHEM 1211. Students that cannot answer it correctly are almost guaranteed to withdraw from or fail the course. Based upon this information I decided that all four instructors in CHEM 1211 for fall 2006 must be shown the data described above and told to emphasize ionic compound structure in the five sections taught in the fall of 2006. In particular, the faculty was instructed to have the students draw their representations of ionic compounds containing polyatomic ions like Na_3PO_4 . In-class pop quizzes based upon using this knowledge were given and used as teaching opportunities. Evening help sessions where this concept was emphasized were employed. More in-depth homework and in-class problems addressing this concept were given. Finally, we gave much harder practice exams prior to the tests where the concept of understanding the structure of ionic compounds was emphasized.

When the same question was used in the first exam for fall 2006, the item characteristic curve shown in **Figure 6** resulted. Notice that not only is the question slightly less discriminating but also the ability level has dropped from 0.336 to 0.100. In other words, students that in 2005 would have missed this question are now getting it correct. More of the lower ability students are now answering the question.

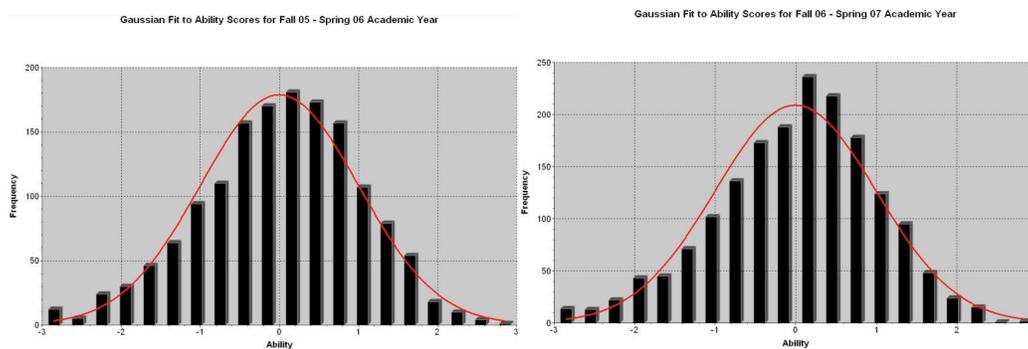
Figure 6. Item Characteristic Curve, Fall 2006 for the Test Question "What is the name of this ionic compound? $\text{Al}(\text{NO}_3)_3$ How many ions are present in one formula unit of $\text{Al}(\text{NO}_3)_3$?"



As mentioned above, understanding this important concept should help the students in subsequent portions of CHEM 1211. Was there an improvement in the students' performance over the entire year? Given below in **Figure 7** are the Gaussian fit to ability curves comparing the results of the ~750 students that completed CHEM 1211 and 1212 in academic year 2005-2006 and the ~ 950 students that completed CHEM 1211 and 1212 in academic year 2006-2007.

Careful examination of these curves shows that there is an improvement in the students' overall abilities comparing one year to the next after our emphasis on ionic compounds. This is just the first iteration of our consistently improving instruction based upon our IRT analysis of student performance. As we learn more about those things which impede our students' learning we will address them and hopefully improve their performance in CHEM 1211 and 1212.

Figure 7. Gaussian Fit to Ability Curves for Academic Years 2005-2006 and 2006-2007.



In addition to the IRT analysis, I have also instituted several other modifications to our program. Every semester we have 3 to 6 former students who took CHEM 1211 and 1212 the previous year making either an A or B sit in on the class as Peer Tutors. In this capacity they are asked to assist the students whenever an in-class problem is given, answer students' questions on WebCT, and to tutor students that request that help. This has been a very successful program which has helped the new students in 1211 and 1212 mature as college students.

Under my direction, after every test in academic year 2006-2007 in CHEM 1211 and 1212 Carrie Shepler, interviewed several students on why and how they have worked specific exam questions. In her selection process, Dr. Shepler invited 10 students that made an A on the test, 10 that made a B, and so forth. Her work is designed to identify those thought characteristics which separate A students from B students, etc. She has identified that higher ability students "own", i.e. understand and claim as their personal resource, their knowledge while lower ability students rely upon knowledge from an external source, usually their instructor. Her work also identified the importance of vocabulary to students of differing abilities. For example, higher ability students easily transition from 3.5 molar to 3.5 molarity or to 3.5 M, all three different methods of writing a solution's concentration. However, lower ability students perceive these as nonequivalent and therefore stumbling blocks to their learning chemistry. This academic year Carrie gave practice exams before each test which contained questions designed to determine the statistical occurrence of the flaws in student understanding which she detected in her post-test interviews. That data is presently being analyzed. One of our next goals is to develop a system inside JExam that will immediately recognize when a student has missed one of the concepts that is important for their success in CHEM 1211 or 1212. The system will then tell us who that student is so that we can intervene. These "in-time interventions" should permit us to help students correct their learning mistake very early in the process before it becomes a concrete misconception in their thinking.

My “Survival Guide for General Chemistry with Math Review and Predictor Questions” published in 2007 by Thomson Brooks/Cole incorporates major points of our IRT research. For example, the predictor questions are some of the highly discriminating questions from our JExam databank. This very successful guide is now in its second edition and has sold over 22,000 copies at more than 43 universities and colleges including, Purdue University, UT-Austin, San Francisco State University, and California State University-Long Beach. Richard Morrison and I are presently writing a textbook which incorporates many of the research findings we have gleaned over the last five years. Through our textbook we hope to disseminate this knowledge directly to students across the United States. Beginning in the fall of 2008, JExam will be used in the General Chemistry program at the Virginia Polytechnic and State University in Blacksburg, VA where we will ascertain if the learning problems of UGA students are also present in Virginia Tech students.

Our lab program has also undergone significant changes under my direction. Initially all of our labs were cookbook attempts to show students several techniques or reconfirm the value of some physical/chemical quantity. Students approached this as drudgery with little or no connection to their lives. In 2005 Bobby Stanton, Lin Zhu and I published a lab manual which incorporates the use of MeasureNet, an electronic laboratory data collection tool, with several inquiry based labs. After 4 to 6 weeks of instruction on lab techniques, our students are required to design and perform their own experiment using two or three of these techniques. This exercise requires some very high order thinking on the part of the students as well as integrating writing into our lab curriculum. We have found this experience to be essential in the learning experience of our undergraduate students. The second edition of our lab manual will be published in 2009.

In summary, Dr. Atwood’s scholarly activity is truly a research project centered upon 1) data collection through carefully crafted assessments, 2) data analysis via IRT, post-test interviews, and practice tests 3) changes in instruction based upon informed data driven insights into student misconceptions and problem areas, 4) improvement of instruction with valid statistical results, and 4) dissemination of results via invited lectures, presentations at regional and national meetings, and publication of results.

References:

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3. Atwood, C. H.; Lautenschlager, G. J.; Marsh, R. L.; Martin, J. G.; Caughran, J. A., Initial Results from Computerized Assessment of Large Freshman Chemistry Classes at the University of Georgia. In *225th American Chemical Society National Meeting*, New Orleans, LA, 2003.
4. Bhakta, B.; Tennant, A.; Horton, M.; Lawton, G.; Andrich, D., Using item response theory to explore the psychometric properties of extended matching questions examination in undergraduate medical education. *BMC Medical Education* **2005**, *5*, (9).

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14. Mulford, D. R. a. R., W.R., An Inventory for Alternate conceptions among First-Semester General Chemistry Students. *Journal of Chemical Education* **2002**, 79, (6), 739-744.
15. Nicoll, G., A report of undergraduates' bonding misconceptions. *International Journal of Science Education* **2001**, 23, (7), 707-730.

Charles H. Atwood

PRESENT POSITION

Professor
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EDUCATION

Millsaps College
Jackson, Mississippi 39210
(graduated Cum Laude - B. S. Chemistry, May 1974)

The Florida State University
Tallahassee, Florida 32306
(graduated - Ph.D. in Nuclear/Inorganic Chemistry,
May 1979, Major Professor - Dr. R. K. Sheline)

PROFESSIONAL POSITIONS HELD 2000 to 2008

Professor
The University of Georgia
Department of Chemistry
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July 2007 – present

Associate Professor
The University of Georgia
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July 1995 – June 2007

PEDAGOGICAL GRANTS FUNDED 2000 to 2008

1. "Expansion and Improvement of Computerized Testing in Chemistry, Mathematics, and the College of Veterinary Sciences" by Charles H. Atwood funded on November 17, 2000 by the University of Georgia's Learning Technologies Grant Fund for \$130,450.00 over two years.
2. "Laboratory Information Management Systems for Freshman Chemistry Labs" by Charles H. Atwood, Bobby J. Stanton, Peter M. Smith, and Julianne M. Braun funded on October 26th, 2001 by the University of Georgia's Learning Technologies Grant Fund for \$68,602.
3. "Laboratory Information Management Systems for Freshman Chemistry Labs" by Charles H. Atwood, Bobby Stanton, Lin Zhu, and Joel Caughran funded on October 25, 2002 by the University of Georgia's Learning Technologies Grant Fund for \$35,580.
4. "Misconception Busters I" by Charles H. Atwood funded in August 2004 by the Project

- for Reform in Science and Mathematics for \$4000.
5. "Peer Tutoring in Large Freshman Chemistry Classes" by Charles H. Atwood funded in August 2004 by the Project for Reform in Science and Mathematics for \$6000.
 6. "Laboratory Information Management Systems for Chemistry Courses" by James Anderson, Bobby Stanton, Charles Atwood and Lin Zhu funded in November 2004 by the University of Georgia's Learning Technologies Grant Fund for \$86,541.
 7. "Misconception Busters I" Grant Renewal by Charles H. Atwood funded in April 2005 by the Project for Reform in Science and Mathematics for \$2000.
 8. "Peer Tutoring in Large Freshman Chemistry Classes" by Charles H. Atwood funded in May 2005 by the Project for Reform in Science and Mathematics for \$4000.
 9. "Analysis of Computer Based Assessments in the UGA General Chemistry Program" by Charles H. Atwood funded in May 2005 by the Project for Reform in Science and Mathematics for \$4000.
 10. Half-time Research Assistantship for Ms. Kimberly Schurmeier, a graduate student in the Chemical Education program at the University of Georgia funded in August 2005 by the Project for Reform in Science and Mathematics for \$10,000.
 11. "Continued Analysis of Computer Based Assessments and Peer Tutoring in the UGA General Chemistry Program with a New Development of Chemistry Elicitation Questions" by Charles H. Atwood funded on July 14, 2006 by the Project for Reform in Science and Mathematics for \$42,050.
 12. "Support for JExam" by Charles H. Atwood on January 9, 2007 by the Student Technology Fund Contingency Fees for \$30,000.
 13. "Support for JExam" by Charles H. Atwood August, 2007 by the Offices of the Provost and the Vice President for Instruction for \$30,000.
 14. "Continued Analysis of Computer Based Assessments and Peer Tutoring in the UGA General Chemistry Program" by Charles H. Atwood funded on August 1, 2008 by the Project for Reform in Science and Mathematics for \$11,800.

SCHOLARSHIP OF TEACHING AND LEARNING - PRESENTATIONS AT REGIONAL AND NATIONAL MEETINGS – 2000 to 2008

1. "Chemical Information, Teaching Tools, and Help – The WebCT Chemistry Community" presented to the 16th Biennial Conference on Chemical Education held July 30th – August 3rd, 2000 in Ann Arbor, MI.
2. "COMPUTERIZED TESTING IN LARGE CHEMISTRY CLASSES" presented to the Pacifichem 2000 meeting held December 14th-19th, 2000 in Honolulu, HI.
3. "INTERNET-BASED TESTING IN FRESHMAN CHEMISTRY" with Jacob G. Martin and Joel A. Caughran presented to the 221st ACS National Meeting held April 1-5, 2001, in San Diego, CA.
4. "JEXAM - JAVA-Based Replacement For Multiple-Choice Exams", Joel A. Caughran, Jacob G. Martin, Charles H. Atwood, presented at the 53rd Annual Meeting of the Southeastern Region of the American Chemical Society, Savannah, Georgia, September 23-26, 2001.
5. "COMPUTERIZED ASSESSMENT, INTERPRETATION, AND COGNITION: MIXING THE THREE", Charles H. Atwood, Jacob G. Martin, Joel A. Caughran, and Erick A. Lauber, presented at the 223rd ACS National Meeting held April 7th -11th, 2002, in Orlando, FL.

6. "INITIAL RESULTS FROM COMPUTERIZED ASSESSMENT OF LARGE FRESHMAN CHEMISTRY CLASSES AT THE UNIVERSITY OF GEORGIA", Charles H. Atwood, Gary J. Lautenschlager, Richard L. Marsh, Jacob G. Martin, and Joel A. Caughran, presented at the 225th ACS National Meeting held March 23-27, 2003, in New Orleans, LA.
7. "LONGITUDINAL STUDIES OF STUDENT PERFORMANCE USING AN INTEGRATED COMPUTERIZED HOMEWORK AND TESTING SYSTEM" Charles H. Atwood, Jacob G. Martin, and Joel A. Caughran, presented at the 227th ACS National Meeting held March 28- April 1, 2004, in Anaheim, CA.
8. "TACKLING MISCONCEPTIONS USING DEMONSTRATIONS" Charles H. Atwood and Joel M. Shimkus presented at the 229th National Meeting of the American Chemical Society held in San Diego, CA on March 13th - 17th, 2005.
9. "INTERPRETING AN ASSESSMENT NMR'S SIGNALS" Charles H. Atwood and Kimberly D. Schurmeier presented at the 231st National Meeting of the American Chemical Society held in Atlanta, GA on March 26th - 30th, 2006.
10. "GENERAL CHEMISTRY QUESTIONS THAT DISCRIMINATE BETWEEN A, B, C, D, AND F STUDENTS" Charles H. Atwood and Kimberly D. Schurmeier presented at the 231st National Meeting of the American Chemical Society held in Atlanta, GA on March 26th - 30th, 2006.
11. "Some Important Points to Emphasize When Teaching Thermodynamics to Freshmen" Charles H. Atwood and Kimberly D. Schurmeier presented at the 58th Southeast Regional Meeting of the American Chemical Society held in Augusta, GA on November 2nd - 5th, 2006 at the invitation of the symposium organizer, Sharmistha Basu-Dutt.
12. "Examining general chemistry students' thought processes via interviews" Carrie G. Shepler, Kimberly D. Schurmeier, and Charles H Atwood presented at the 233rd National Meeting of the American Chemical Society held in Chicago, IL on March 25th - 29th, 2007.
13. "Interventions planned for general chemistry topics based on IRT assessment" Kimberly D. Schurmeier, Carrie G. Shepler, and Charles H. Atwood presented at the 233rd National Meeting of the American Chemical Society held in Chicago, IL on March 25th - 29th, 2007.
14. "How IRT and post test interviews have impacted our teaching" Charles H Atwood, Kimberly D. Schurmeier, and Carrie G. Shepler presented at the 233rd National Meeting of the American Chemical Society held in Chicago, IL on March 25th - 29th, 2007.
15. "Computer Based Assessments, Peer Tutors, and Elicitation Questions in the UGA General Chemistry Program" Charles H. Atwood, Carrie G. Shepler and Kimberly D. Schurmeier presented at the 2007 Northeast Georgia Regional PRISM Annual Meeting "Rigor and Innovation in Undergraduate Education" held in Athens, GA on April 28, 2007.
16. "Using Item Response Theory and Post Test Interviews to Improve Assessment in Large General Chemistry Classes" Charles H. Atwood, Carrie G. Shepler and Kimberly D. Schurmeier presented at the SoTL Commons Conference held in Statesboro, GA on November 1-2, 2007.
17. "Using Item Response Theory Analysis of Test Questions to Improve Student

Performance in Large General Chemistry Classes” Charles H. Atwood, Kimberly D. Schurmeier, Carrie G. Shepler, and Gary J. Lautenschlager presented at the Science in Savannah Symposium held in Savannah, GA on February 28-29, 2008.

SCHOLARSHIP OF TEACHING AND LEARNING – INVITED LECTURES

2000 to 2008

1. “MISCONCEPTION BUSTERS – I” presented at the statewide PRISM conference held, February 26, 2005 at the Westin Savannah in Savannah, GA.
2. “PEER TUTORING IN LARGE GENERAL CHEMISTRY CLASSES AT UGA” N. Blocton, R. Fischer-Tripodi, A. Huff, H. Monitz, S. Shams, and Charles H. Atwood presented at the Northeast Georgia PRISM Conference, April 18, 2005, held at Brasstown Valley Resort in Hiawassee, GA.
3. “TACKLING MISCONCEPTIONS USING IN-CLASS DEMONSTRATIONS”, presented at the Northeast Georgia PRISM Conference, April 19, 2005, held at Brasstown Valley Resort in Hiawassee, GA.
4. “AFTER YOU HAVE BUILT A COMPUTERIZED TESTING PROGRAM, WHAT DO YOU DO WITH IT?” Charles H. Atwood and Jacob G. Martin, presented to the Learning Technology Consortium at the University of Georgia’s Center for Continuing Education on April 21st, 2005 at the invitation of Sherry Clouser, the conference organizer.
5. “TACKLING MISCONCEPTIONS USING IN-CLASS DEMONSTRATIONS”, presented at the NSF critical site visit for the PRISM project, June 16, 2005 at the Marietta Conference Center in Marietta, GA at the invitation of the Northeast Georgia PRISM leadership.
6. “WHICH GENERAL CHEMISTRY QUESTIONS DISCRIMINATE BETWEEN A, B, C, D, AND F STUDENTS?” Charles H. Atwood and Kimberly D. Schurmeier, presented at the PRISM statewide conference held, October 14 and 15, 2005 at the Marietta Conference Center in Marietta, GA at the invitation of the Northeast Georgia PRISM leadership.
7. “WHICH GENERAL CHEMISTRY QUESTIONS DISCRIMINATE BETWEEN A, B, C, D, AND F STUDENTS?” Kimberly D. Schurmeier and Charles H. Atwood, presented at the SASTE conference held, October 15, 2005 at Aderhold Hall in Athens, GA at the invitation of the Northeast Georgia PRISM leadership.
8. “Computerized Testing – An Assessment NMR” Charles H. Atwood and Kimberly D. Schurmeier, presented at the 2006 Meeting of the Southeast Chemistry Chairs held, April 22 and 23, 2006 at the E.F. Yerby Conference Center in Oxford, MS at the invitation of the Charles Hussey, Chair of the Meeting.
9. “Which General Chemistry Questions Discriminate Between A, B, C, D, and F Students?” Kimberly D. Schurmeier and Charles H. Atwood, presented at the Northeast Georgia Regional PRISM conference held, April 21, 2006 at the Embassy Suites Hotel in Atlanta, GA.
10. “PEER TUTORING IN LARGE GENERAL CHEMISTRY CLASSES AT UGA” M. Lipsitz, E. Kantor, E. Monahan, G. Burnham, G. Burnham, K. Ta, and Charles H. Atwood presented at the Northeast Georgia Regional PRISM conference held, April 21, 2006 at the Embassy Suites Hotel in Atlanta, GA.

11. "Computerized Testing - A Method to Measure Student Abilities" Charles H. Atwood and Kimberly D. Schurmeier presented to the students, faculty, and staff of the Chemistry Department Jackson State University, Jackson, MS on September 29, 2006 at the invitation of the Chemistry Department.
12. "After One Year of IRT What Have We Learned and Done?" Charles H. Atwood and Kimberly D. Schurmeier presented to the Northeast Georgia PRISM Regional Coordinating Committee on October 19, 2006 at the invitation of the Regional Coordinating Committee.
13. "After One Year of IRT What Have We Learned and Done?" Charles H. Atwood and Kimberly D. Schurmeier presented to the PRISM State Institute on November 4, 2006 at the invitation of the Northeast Georgia PRISM leadership.
14. "Computerized Testing - A Method to Measure Student Abilities" Charles H. Atwood, Kimberly D. Schurmeier, and Carrie G. Shepler presented to the students, faculty, and staff of the Chemistry Department West Virginia University, Morgantown, WV on January 17, 2007 at the invitation of the Chemistry Department.
15. "Computerized Testing - A Method to Measure Student Abilities" Charles H. Atwood, Kimberly D. Schurmeier, and Carrie G. Shepler presented to the students, faculty, and staff of the Chemistry Department University of Alabama-Birmingham, Birmingham, AL on February 15, 2007 at the invitation of the Chemistry Department.
16. "Computerized Testing - A Method to Measure Student Abilities" Charles H. Atwood, Kimberly D. Schurmeier, and Carrie G. Shepler presented to the faculty, and staff of the University of Georgia, at the University Symposium held at Unicoi State Park in Helen, GA on March 31, 2007 at the invitation of the Symposium Organizers.
17. "General Chemistry Student Learning Issues Garnered from Post-Test Interviews", Charles H. Atwood, Carrie G. Shepler and Kimberly D. Schurmeier presented at the 2007 Southeast Regional Meeting of the American chemical Society held in Greenville, SC on October 25, 2007 as a portion of the symposium "Using Chemistry Education Research to Improve Teaching and Learning" at the invitation of the organizer, Melanie M. Cooper.
18. "Using the National Science Digital Library in Your Classroom" Charles H. Atwood presented to the PRISM Misconceptions in Chemistry Learning Community on February 6th, 2008 at the invitation of the leader, Dr. Dava Coleman.
19. "Using the National Science Digital Library in Your Classroom" Charles H. Atwood presented to the PRISM Regional Coordinating Committee on February 21st, 2008 at the invitation of the UGA PRISM coordinator, Dr. Dava Coleman.

SCHOLARSHIP OF TEACHING AND LEARNING – PUBLISHED PAPERS AND BOOKS – 2000 to 2008

1. Charles H. Atwood, James W. Taylor, and Pat A. Hutchings, **WHY ARE CHEMISTS AND OTHER SCIENTISTS AFRAID OF THE PEER REVIEW OF TEACHING?** Journal of Chemical Education, Vol. 77, No. 2, February 2000, pp. 239-243.
2. Charles H. Atwood, Joel A. Caughran, and Jacob G. Martin **"INSTRUCTIONAL TECHNOLOGY FOR ASSESSMENT"**, a chapter in **"Teaching with Technology"** Brown, D.G., Ed.; Anker Publishing Company, Inc. Bolton, MA, 2000, pp. 95-99.

3. Joel A. Caughran, Jacob G. Martin, Charles H. Atwood, "**JExam - A Java-based Exam Engine**", presented via CONFICHEM in the Fall 2001 session entitled "On-Line Teaching Methods", October 13-19, 2001.
4. Charles H. Atwood, "**Survival Guide for General Chemistry with Math Review**", April 2004, Brooks/Cole, Thomson Learning, Inc.
5. Bobby J. Stanton, Lin Zhu, and Charles H. Atwood, "**Experiments for General Chemistry featuring MeasureNet**", published in April 2005, Brooks/Cole, Thomson Learning, Inc. 2006 Copyright.
6. Charles H. Atwood, "**Radon in Homes – Recent Developments**", Journal of Chemical Education, Vol. 83, No. 10, October 2006, 1436-1439, an invited paper for the National Chemistry Week theme "Your Home - It's All Built on Chemistry".
7. Charles H. Atwood with Carrie G. Shepler, "**Survival Guide for General Chemistry with Math Review and Predictor Questions**", March 2007, Brooks/Cole, Thomson Learning, Inc.
8. Kimberly D. Schurmeier, Carrie G. Shepler, Charles H. Atwood, and Gary J. Lautenschlager, "**Using Item Response Theory to Assess Undergraduate General Chemistry Understanding**", under revision for resubmission to the Journal of Chemical Education.
9. Richard W. Morrison, Charles H. Atwood, and Joel A. Caughran, "**Survival Guide for General, Organic, and Biological Chemistry**", October 2007, Brooks/Cole, Cengage Learning, Inc.

TEACHING AWARDS/RECOGNITIONS

1. 1985 G. A. Philbrook Award for Excellence in Teaching Undergraduate Chemistry presented by the Northeast Georgia Section of the American Chemical Society in recognition of outstanding achievement in teaching undergraduate chemistry.
2. 1999 Professor of the Year Award presented by the Student Affiliates of the American Chemical Society Chapter at the University of Georgia.
3. Russell Hall "Last Lecture" Series Guest Lecturer Fall 2004.
4. Member of the University of Georgia Teaching Academy, October 24th, 2006-present.
5. Student Government Association Certificate of Appreciation January 16, 2007.

PEDAGOGICAL COMMITTEE MEMBERSHIP – 1995 to 2007

1. Facilitator for the Natural Sciences discussion session at the American Association of Higher Education's Symposium entitled "**Peer Review of Teaching - From Idea to Prototype**" held in Albuquerque, NM on June 20th-22nd, 1997.
2. Organizer and Chair of the Symposium entitled "**Nuclear Chemistry at Yucca Mountain, in the News, and in the Classroom**" held at the 214th National Meeting of the American Chemical Society in Las Vegas, NV on September 8th - 12th, 1997.
3. Organizer and Chair of the Symposium entitled "**Practical Techniques and Procedures for the Improvement of Teaching and Learning Garnered from the American Association of Higher Education's "Peer Review of Teaching" Project**" held at the 15th Biennial Conference on Chemical Education in Waterloo, Ontario, Canada on August 13th -19th, 1998.
4. Organizer and Chair of the Symposium entitled "**Testing with Technology**" held at the 2000 International Chemical Congress of the Pacific Basin Societies in Honolulu,

Hawaii on December 14th -19th, 2000.

5. Member of the Chemical Education Division's Committee to prepare the 2006 American Chemical Society General Chemistry Second Term Exam.
6. Member of the Chemistry Content Team for the Georgia Assessment for the Certification of Educators administered by the Georgia Professional Standards Commission from Fall 2005 to present.
7. Appointed Chair in November 2007 of the Chemical Education Division of the American Chemical Society's Committee to prepare the 2010 American Chemical Society General Chemistry Second Term Exam.
8. Appointed Member in January 2008 of the Chemical Education Division of the American Chemical Society's International Affairs Committee.

PEDAGOGICAL TELECONFERENCE

Charles H. Atwood, Joel A. Caughran, Thomas Reeves, and Margaret Holt, "**Creating Learning Environments**", produced by the Office of Information and Instructional Technology of the Board of Regents of the University System of Georgia and presented on April 12th, 1999 to the entire University System.