EXPERIENCE IN BECOMING LEARNERS IN THE ASSESSMENT COMMUNITY

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Approximately ten years ago, I began my personal interest in developing assessment materials while teaching a lower division introductory chemistry to non-science majors, primarily as part of San Jose State University (SJSU) General Education Curriculum. Although I have no formal education in assessment since my graduate degree is in chemistry, I just thought it was an important component as I began my career in chemical education. While teaching this course, I realized that the curriculum and pedagogy seemed to be working well. Students seemed to learn the fundamental concepts in chemistry and understood how chemistry applied to their everyday lives. In an effort to document my observations, I designed a mid-semester survey that requested background information such as previous math and science coursework, learning styles, and what they liked about the curriculum. I also wanted to know why they chose not to pursue careers in science.

I continued to administer this survey and used the results to develop and improve this curriculum. Although I realized that I had developed a very informal survey, I felt that it did provide me with useful data. Since I was pursuing a career in chemical education research, I wanted a research method to formally conduct educational research. I literally stumbled on the action research model for qualitative research. This cyclic research method is a perfect match for research in curricular development, implementation, and assessment. It involves a cyclic pattern of planning, implementing, observing, reflection, then back to planning, etc. I have used this method for all my curricular and assessment projects to date.

One project was to conduct an outside formal evaluation of my chemistry curriculum for non-science majors. Ms. Penberthy helped refine my mid-semester survey while Mr. Kosciak created an in-depth attitudinal end-of-semester survey. The data was analyzed at the LEAD Center at Madison and confirmed the success of my non-science chemistry curriculum. While this mechanism worked for the duration of the grant, I was faced with abandoning these instruments or conducting the survey and the analyses at SJSU. I chose the latter. Through SJSU's Office of Institutional Research, I worked closely with Mr. Steve Aquino to transfer the survey to SJSU's mechanism for developing and analyzing surveys. Currently, both surveys are part of my assessment plan for this course. The invaluable results and outcomes have facilitated important learning and teaching changes including collaborative and cooperative "active" learning in both lecture and laboratory as well as a strong commitment to teach chemical concepts and topics that are relevant to one's everyday life.

Without the formal education in learning theories, pedagogies or assessment techniques, I have had the good fortune to work closely with a few experts in these fields who have provided me with strategies for conducting this type of research. In 1994, as a subcontractor with the University of Wisconsin-Madison's NSF "New Traditions" Project for Systemic Reform of the Undergraduate Chemistry Curriculum, the Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center, especially Dr. Susan Millar, Ms. Debby Penberthy, and Mr. Steve Kosciak, provided incredible assessment strategies for two curricular projects under the auspices of this grant.

This essay was prepared for the 2002 PKAL Roundtable on the Future, *Assessment in the Service of Student Learning*

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Perhaps the best experience with the LEAD Center was their assessment strategies for a new innovative four semester course sequence that blended general and organic chemistry. My colleague, Dr Stephen Branz, and I designed the curriculum, but Dr. Millar, Ms. Penberthy and Mr. Kosciak designed the assessment plans. These plans included many facets of both formative and summative assessment techniques, including pre- and post-surveys, student and instructor interviews, and class observations. The bottom line was that it was a successful curricular experiment. And, I learned how to design assessment tools, implement assessment strategies, and analyze assessment results.

These two assessment experiences with the LEAD Center have been pivotal points in my scholarly activities in assessment. In fact, they have catalyzed assessment activities in two other major projects that I am currently involved in.

Since 1994, I have been involved as Program Administrator with the NSF-funded SJSU/IBM Almaden Research Center Analytical and Surface Chemistry of Materials. This program, currently funded under the Grant Opportunities for Academic Liaison with Industry (GOALI) initiative, provides summer research experiences to primarily highly qualified undergraduate students from across the country. In 1996, I began a small assessment program to determine the students' expectations, which college courses best prepared the students for their summer research project, and what skills, knowledge, and understanding did the students leave the summer program with. The goals were to investigate what type of course-work best prepared students for conducting research in industry and to document what students gain from participating in this type of summer research program.

In 1999, my colleague, Dr. Malinda Pauly and I, expanded and revised the assessment strategy to include group discussion as well as pre- and post-program written surveys. The open group discussion allowed us to engage and follow-up immediately with students as a group. However, we have found it difficult to document or capture the spirit or direction of the dialogue. We also developed the second generation of written surveys that contained more specific questions and addressed the original assessment goals, but now contained follow-up questions. An advantage of conducting pre- and post-program surveys is that we can correlate similar questions between surveys to investigate if students' summer research experiences change their perceptions about their own educational background, their learning, and technical research. Although interpreting our results as been quite challenging, we hope to publish our findings in early 2002.

Last year, NSF requested that we conduct long-term assessment of this summer research program to determine its success. It is one of the few academic/industrial partnerships that has been funded continuously by NSF since 1994. Therefore, it presents an excellent opportunity to determine how this summer research program has influenced the participants' subsequent careers. We hope to send a web-based survey to all part participants in early 2002.

The second assessment project that I am responsible for is developing, implementing, and analyzing instructor and student web-based field testing surveys for the American Chemical Society's and W.H. Freeman Publishers' "Chemistry" curricular textbook project. This innovative textbook for science majors will present relevant concepts in chemistry in a different context and order than do other general chemistry texts. The learning and teaching strategies presented in this text are based upon recent outcomes in chemical education research. The chemical principles are illustrated by student-led activities that often serve as an introduction to a specific chemical principle. Instructors then lead the discussion to direct and assess students' understanding and reasoning. Throughout the text, concepts are revisited in a different, yet more advanced, context. Initial analysis of the assessment data from the Fall 2001 semester indicate that this innovative curriculum is versatile in a variety of university environments and effective in enhancing student learning in general chemistry.

Even with the diversity of such assessment projects, I do enjoy the challenge of assessment research. One major challenge that I also face is convincing colleagues of the value of conducting assessment research. I think the main problem is that many scientific colleagues simply lack a

basic understanding of exactly what is assessment research. In presenting my assessment research to various audiences, I find it effective to first explain how assessment research fits into the qualitative action research model. Then, I explain that basic laboratory research often involves creating experiments that have one control and one variable while assessment research involves dealing with numerous variables with little or no controls. The assessment laboratory is usually the classroom or the learning environment. I try to convince them that research in assessment can be more challenging than traditional laboratory research because of all the many dimensional variables involved with student learning.

Finally, I conclude with the crucial importance of the scholarship of teaching. With an ever-changing student learning environment in our undergraduate classrooms, we must develop effective assessment techniques to understand how students learn and apply their knowledge. We need to constantly strive to provide the highest quality of learning and teaching strategies. Assessment and evaluation of assessment data provides us with useful information to insure this quality.

In my experiences with assessment, I just happened to try one simple assessment survey in my non-science majors chemistry course. Now, I find more and more exciting opportunities to be involved with assessment research, as described above. ■