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edited by
John Kenkel
Southeast Community College
Lincoln, NE 68520-1227

Undertaking Chemical Research at a Community College

by David R. Brown

In the November 2005 *JCE* Gaglione presented a broad overview of research at community colleges in which he gave examples of research-active two-year campuses *(1)*. That report suggested reasons for the traditional scarcity of chemical research in community colleges, along with a historical perspective of the emergence of departments that engage in research. Furthermore it lauded the value of research as a mechanism for increasing student recruitment, retention, and successful transfer to baccalaureate-granting institutions. This paper continues discussion of this important issue and offers a glimpse of how the chemistry department at Southwestern College was able to enter the arena of research and how those activities have borne academic fruit.

There are numerous examples in the literature that describe the value of undergraduate research to students *(2–25)*. Engaging in research is also a valuable experience for chemistry faculty who can infuse the discovery-based mindset of the research laboratory into teaching settings, thereby keeping curricula fresh, engaging, and stimulating.

The Winds of Change

Gaglione cited time constraints placed on faculty who carry heavy teaching loads along with the fact that the traditional academic preparation for community college professors did not include doctoral degrees in the chemical sciences as reasons for the historical dearth of research at community colleges. However, one of those factors inhibiting research at the community college has diminished in recent years. Chemistry departments at many community colleges are now seeing an influx of new hires who possess doctorates. According to the U.S. Bureau of Labor Statistics, while tenure-track faculty positions at four-year institutions are predicted to remain highly competitive for Ph.D. recipients, a greater abundance of positions at community colleges will be available to them *(26)*.

This shift of educators with a significant background in research from the traditional path leading to four-year institutions to one leading to community colleges is stimulating the growth of research activities in community colleges. At the 2YC$_3$ Conference held at Harper College in November 2005, presentations by faculty members from several community colleges highlighted research projects that involved community college faculty and students. Additionally a roundtable discussion focused on issues associated with conducting research at community colleges. It was apparent from the conference proceedings that the "underground existence" of chemical research being undertaken at community colleges is making its way to the surface.

Establishing a Research Program

Among the challenges of engaging in research in community colleges is having the necessary resources and facilities to carry out that research. Depending upon the nature of the research interests of the investigator, this can be a formidable, often prohibitive aspect of establishing a research program. Most community college chemistry departments are designed solely for teaching purposes, having laboratories and equipment to support instruction but not research. Furthermore, departmental supply budgets are often not sufficient to promote or support the needs of extensive research projects. However, some research areas have more extensive financial investments than others.

For instance, with the advent of relatively sophisticated software for computational research now capable of running on inexpensive desktop PCs, a researcher interested in the many applications of computers in chemistry (e.g., ab initio and semiempirical quantum mechanics, molecular modeling, molecular dynamics, bio- and chemoinformatics, structure prediction, statistical mechanics) can engage in exciting research activities on a relatively modest budget. Other projects involving the use of costly reagents and/or biochemicals or state-of-the-art instrumentation may require heftier budgets.

Research projects undertaken in the setting of a community college are no different from those carried out in four-year institutions: all benefit from grant support. Gaglione mentioned NSF funding as a means to make research efforts a reality in community college chemistry departments. We at Southwestern College can attest to the impact of NSF grants. The majority of the projects in which we have been engaged have involved instrumentation funded by an NSF grant.[1] That allowed us to acquire a collection of analytical instrumentation that includes NMR, FTIR, and UV–Vis spectrometers, along with HPLC and GC/MS systems. These instruments have opened doors to many research projects that almost certainly would not otherwise have been possible. Results have been reported in several journal publications and conference proceedings *(27–32)*.

One major distinction between a community college and a four-year college or university is the depth of the pool of students who have had sufficient training in chemistry to be effective research assistants. In the traditional four-year setting, students usually join the research group of a professor in their junior or senior year. By the time a typical community college student has had equivalent preparation (namely a year of general chemistry, a year of organic chemistry, and perhaps analytical chemistry), he or she is ready to graduate

with an Associate's degree and/or transfer to a four-year institution. Thus, in order to recruit and involve community college students in research activities one needs to develop a keen sense for identifying those students who may be able to participate in a research group during their first or second year of studies.

One venue that has turned out to be a recruitment "gold mine" is the Preparation for General Chemistry (Prep Chem) course. By regularly teaching lecture and laboratory sections of this course, one is able to find those "nuggets" that show the promise to become productive research assistants whose longevity at the college is sufficient to make significant contributions to research projects. Obviously students' entry points into research should be commensurate with their academic level, but as they advance in coursework the depth of their research explorations, along with their levels of responsibility and independence, can be increased.

As is the case for researchers at all levels, collaborative partnerships within institutions and between institutions are extremely common. Considering the characteristically limited resources available at community colleges, collaborating with colleagues at four-year institutions can be very important. Such partnerships benefit all parties. Community college students are able to participate in activities at four-year institutions, while the research pursuits of the community college faculty are enhanced by the interactions. Investigators at four-year institutions have an opportunity to expand their research groups by including community college personnel in their projects. Many investigators at four-year institutions have more than a sufficient amount of work to undertake in their groups and should view colleagues at community colleges who have demonstrated competence in their field as valuable resources. Moreover, the community college partner may be able to offer the research group at the four-year institution techniques and resources not immediately at their disposal. For example, two particular projects in which we have been involved were made possible because the NSF grant allowed us to purchase an FTIR spectrometer, along with an Attenuated Total Reflectance (ATR) attachment. With ATR, we are able to record IR spectra from samples that are opaque to IR radiation. For such substances traditional transmission IR spectroscopy cannot be used. However, with the ATR attachment, we were able to perform measurements of water content in human cells *(29, 31)* and detect trace organic impurities on various metal oxide powders *(27, 28)*.

Initiating a New Paradigm

The role of community college chemistry departments has historically been one of providing high quality instruction in chemistry, and this should always remain a truth. A significant proportion of lower-division chemistry in the U.S. is taught in community colleges, and a large number of minority students begin their education at a community college. One manifestation of this is the ACS Scholars Program *(33),* which aims to support and encourage minority students who study at community colleges to pursue education in the chemical sciences.

As the importance of including students in research as early as practical in their undergraduate education is becoming more widely accepted, community colleges should develop avenues to offer research experiences to their students. Gaglione noted, however, that the typical faculty teaching load at a community college does not facilitate research activity. The need to offer students the highest quality education and to enable them to be as successful as possible, forces the hands of campus leadership and possibly state legislators to recognize a need for significant change of the system by which teaching loads are assigned, calculated, and credited. Offering compensation for directing student research in community colleges is the exception and not the rule.

Research at a community college can be as exciting and fruitful as at a four-year institution. The lives of community college students who participate in research are changed indelibly in a positive fashion, and this sort of experience should be widespread and routine. Many of the challenges faced by researchers are similar at both types of institutions, but there are uniquely prohibitive challenges faced by community college investigators. To overcome these challenges requires systemic change within the community college framework. As formidable as these changes may be, it is imperative to the education of our students that they be made.

Note

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David R. Brown is a member of the Department of Chemistry, Southwestern College, Chula Vista, CA 91910; dbrown@swccd.edu.