

CUR Fellow's Address

Undergraduate Research as a Life-Changing Activity

CUR Biennial National Conference, Washington, D.C., June 29, 2014

I am humbled to be here receiving this award, especially because I could rattle off the names of a dozen or more CUR people who are deserving of this award. In any case, though, you are stuck with me for the next 40 minutes and I hope you enjoy the ride. Let me begin by thanking some people. First, my wife Beth and my daughters Michelle and Erica. You are my great loves. And secondly, my students who enrich my life every day and make me come to work rather than playing golf or going to the beach. I will start by talking a little bit about my own professional journey, discuss my research program, make some arguments I have made over the years on the importance of undergraduate research, and follow this with some commentary on what I think CUR is all about and what it has meant to me.

1. My Journey

Simply put, I love to teach and work in my lab, and I love to work with students. I am dedicated to student success and student outcomes, and this dedication shapes both my teaching style and my research agenda. Where did these feelings come from? Well, primarily, I am motivated by my memories of being an undergraduate student. I can still remember how I was very unsure of what I was most interested in and what I wanted to do with my life. I knew only that I loved to read, to solve puzzles and to think broadly about issues. Yet, I had no sense of where those interests might take me or what might be best for me. That changed when my organic chemistry professor, John Williams, at Rhode Island College asked me to do research with him in his lab. Suddenly, overnight it seemed, everything changed. I had a focus, a clear picture of what I most enjoyed, and a sense of what my future might hold. Now, that is *my* story. There is another perspective to the story and it comes from that organic chemistry teacher and undergraduate research director at Rhode Island College, John Williams. He speaks of the unformed me, the one who was a little less developed. Here is what he said to me in a recent communication:

Mitch:

The pre-enlightenment encounter with you that sticks is an encounter on the second floor of Clarke Science in a crowd of students changing classes. I think you were then currently in my organic class. You looked hung-over, staring blankly off into the distance “dressed” in a “fashion” that was a

stretch even for undergraduates at the time really old jeans, ripped up sneakers and a WWII-vintage ripped, worn, and faded olive drab fatigue jacket, with Jesus-length hair and beard commensurate with your wardrobe: totally disheveled. All I could think to say as I stopped you and (sort of) got your attention was: “Malachowski, when are you going to get off your ass?” You gave me a puzzled look-I don’t remember if you gave me an answer — it was a tough question for a pop quiz — and continued on down the hallway.

While hesitant to assert the logical fallacy of a post hoc propter hoc argument, that event seemed to mark a turning point in your, well, getting off your ass.

I remain, with fond regards, a proud mentor

John

Well, this experience did much more than simply shape my intellectual life. It also showed me the powerful impact a professor can have in helping a student find direction and purpose in life. To this day, I can say that at least once a week I find myself reflecting in some way back to my own undergraduate experiences and applying the lessons I learned then in interactions with my own students. And yes, I got a new wardrobe, cut my hair, and shaved and here I am.

2. My Research Program

I view myself as both an educator and a scientist, and I think that these two facets of my professional life are intimately intertwined. My research efforts are of two types: the first is experimentally driven and revolves around the synthesis of novel compounds that can be used for a variety of practical purposes, while the second focuses on exploring the role of faculty research at undergraduate institutions and its impact on students and student learning.

First, let me talk about the chemical side. There are many different types of chemistry and many different kinds of chemists. Some like to perform calculations, some study biological systems, some prefer to study the interaction of molecules with light, while others relish synthesizing new molecules. By training I am a synthetic organic chemist so I am interested in the preparation of new molecules. The act

of creation, whether in the laboratory or through the baking of one's own bread, in the building of a house or in the creation of a painting, seems to me to be one of humankind's innate desires. This adaptation of nature by chemists has been a driving force for many new, and oftentimes improved, aspects of our lives.

Let me tell you another story. Before I went to the University of San Diego in 1984, I taught at Gettysburg College and during my time there, I wrote a grant proposal to the Research Corporation that, amazingly, was funded. When I look back at the quality of the writing in that proposal, I have a good laugh, but I like to think that I have come a long way since that time. However, in rereading that proposal, one thing does stand out to me. It is still one of the best research ideas I have ever had. Let me give you a little background. In the early 1980's, there was a great deal of interest in binding small molecules or ions within cavities. This was being pursued for many reasons, including an interest in extracting metals from the environment. The most common molecules being used as the host were crown ethers that had oxygens that could coordinate to ions such as Na⁺ or K⁺. There also were a small number of hosts that could bind negatively charged ions called anions. In my grant proposal, I intended to bind anions and cations within the same host as I was interested in binding molecules that had both a negative end and a positive one with the most common example being amino acids. The Research Corporation liked the idea, and we worked on it for about a year until one miserable day when I was reading the literature and discovered that the French chemist Jean Marie Lehn and his army of post-docs and graduate students had done exactly what we had proposed. And of course, with all his resources, he also was able to not only show how to do it, but was then able to make a series of compounds that made ours superfluous. So out of necessity, our research moved into new areas. And we have been scooped at least twice since.

But of course, there is a lesson in all this and that is, at PUI's, we should sometimes get scooped. I learned from those who came before me in CUR, that our aspirations should be to do research that is cutting edge. That we should be competing in the intellectual realm of our disciplines at the highest possible level, that we should not simply be dabbling in our fields, that we should not settle for "research-lite." And in doing so, we will be competing with those with many more resources and person power. And it certainly will take longer to do what we want to do, but we should still be competing in the world of cutting edge ideas. I take a perverse pleasure in having been scooped by Professor Lehn as he was awarded the 1987 Nobel Prize in Chemistry for his work on molecules that serve as hosts for guest molecules. I was in Stockholm just last week giving a talk, but regrettably, it was not at the

Nobel Prize ceremony. But they did let me pay to go and visit their museum.

In the past five years or so, I have returned to my Gettysburg roots and have been working on molecules that can capture other molecules in their cavities in very different ways than the crown ether type macrocycles do. The molecules we now make are called metal organic frameworks, and they bring together the best of what we know about organic molecules, as well as what happens when they coordinate to metal ions. This field of chemistry is one of the fastest growing areas of chemistry because of the potential use of these compounds for catalysis, materials, and in nanotechnology. The progression from the nucleus, the atom, and the molecule to the supramolecule represents steps up the ladder of complexity. In essence, we make a collection of mononuclear species and then link them together into complex molecular arrays.

We have made some nice contributions to this field in a relatively short amount of time through our pioneering work with compounds called dipyrromethenes. Once we make the organic portion, we bind it to one metal such as cobalt and then add a second metal (silver) to make the metal organic framework. We are now in the process of trying to bind other molecules in these cavities.

3. Undergraduate Research and Its Connection to Student Outcomes

Along with my chemistry research, my research program also involves probing the role of faculty research and scholarship at PUI's. In this work, I ask questions such as why we engage in research at PUI's; what are the positive outcomes for the faculty, departments and institutions; what are the impacts on students; and how do we manage the monumental changes occurring at our institutions related to the new expectations towards scholarship. I have published some 25 papers in this area, but today I would like to probe three issues that I have considered over the years.

One of the most dramatic changes that has occurred on our campuses over the past 25 years has been the increased expectations for faculty to engage in original scholarship that leads to publishable results. We have reached the point where for many faculty, it is hard to remember a time when faculty didn't embrace a "teacher/scholar" model. But of course this was not always the case. Universities have adapted, changed, and evolved since John Henry Newman wrote in 1852:

"a University ... is a place of teaching universal knowledge. This implies that its object is ... the diffusion and extension of knowledge rather than the advancement. If its object were scientific and philo-

sophical discovery, I do not see why a University should have students." (Newman, 1947).

When I began my faculty career, the great faculty divide was between those who did research and those who did not. Much angst and many wrung hands later, this is no longer the case. With large numbers of retirements and the hiring of many new research-active faculty, at many institutions nearly all of the faculty are now engaged in research activities.

However, I believe that there is a great cultural divide that has sprung up around how groups of faculty spend their time and the goals of their research activities. The new line of demarcation that differentiates the faculty is no longer between those who do and those who don't, but instead is between those who engage students in their research and those who do not. *The fundamental purposes of research using these two models is quite different.* For faculty who engage in undergraduate research, one of the main goals of their research is its impact on student learning. So, let me be as clear as possible. I believe that there is a wide chasm between many faculty on our campuses when it comes to the goals of his or her research. And if a faculty member doesn't believe that one of the goals of his or her scholarship should include having a positive impact on student learning and student outcomes, he or she will not engage in UR activities.

So why do I feel so strongly about this point, that research should be pursued that has a positive impact on students and student learning? I am still concerned that PUI's are evolving into miniature versions of PhD granting institutions, even though PUI's have very different missions. For many years, I have written and discussed the importance of student-centered approaches to scholarship and have discussed the negative consequences of research that does not include students. Let me briefly summarize those arguments by using the language of Alexander Astin, who has shown that the faculty's research orientation versus their student orientation reflects not only how they spend their time, but also their personal goals and values and their interest in and accessibility to students. Simply put, as more and more faculty at PUI's spend more and more of their time engaged in research that does not include students, there is a tremendous shift of faculty from the student-oriented camp to the research-oriented camp. Astin (and a number of other researchers such as Pascarella) have shown that the extent to which faculty are student-oriented has tremendous positive impacts on student satisfaction, learning, and affective development.

The flip side is that when faculty are research-oriented and do not involve students, there are severe negative

consequences on student outcomes. Does anyone really believe that as we move to a model of faculty research that does not include students and student learning as one of its goals we can somehow elude these negative outcomes? I don't believe this is possible, and I believe we need to own up to the risks involved in our campus-wide teacher-scholar models. There are many who disagree with this contention, but I challenge each and every one of them to a duel at 20 paces. No weapons are allowed, only the facts and data supported by the literature. I guarantee that this is a fight I can win every time because of the fine work of the people I just mentioned. My call then is for us to not only reflect on what impact our research is having on our disciplines, departments, institutions, and careers, but to also ask what it is doing, both positive and negative, to our students and student learning. In departments or disciplines where faculty are research-active but don't involve students, they are having a negative impact on students.

So I contend that we should consider an alternative mission statement for research at PUIs:

"Research performed on our campus is pursued primarily as a means to enhance the intellectual climate and for its positive impacts on student learning. In order to directly impact students, all faculty in all departments involved in scholarship should include students in their work. Secondary benefits to the faculty and the institution are also of importance, but enhancing student learning is of primary importance. Decisions regarding hiring, resource allocations, faculty loads and rank and tenure decisions will be determined primarily by the impact of the research on student learning."

What is CUR's responsibility in all this? What is our role in all of this? I think that CUR needs to continue to be vocal in speaking to broader institutional and professional issues, rather than serving as a one-issue organization. As we've matured as an organization, we have taken on more responsibilities for helping shape our institutions in ways that go beyond simply embedding more research on our campuses. We need to continue to speak out on the importance of a research-rich curriculum and the centrality of teaching at all institutions. I am very biased here, but I believe that PUIs are still in the best position to serve as models for all that higher education can be, and I am advocating that we ensure that the correct balance is maintained between our professional activities so that we continue to satisfy the needs of our students, faculty and institutions.

4. CUR

Let me shift and make a few comments about CUR as an organization. First, a quote:

“This party comes from the grass roots. It has grown from the soil of the people’s hard necessities.”

This coining of the term “grassroots,” from Albert Beveridge’s speech at the 1912 Bull Moose Convention in Chicago, was part of the origins of Teddy Roosevelt’s Progressive Party. Well, a CUR national conference probably has little in common with the Bull Moose Convention (although you can fill in your own joke here) except for the mutual description of each group as being “grassroots” in nature. CUR was founded in the mid-1970’s as a grassroots organization, one that sprang from the soil (minds and hearts) of a group of faculty members who had a passion for their work and engaging their students in the laboratory. On the surface, much is different about CUR compared to how we were in our formative years. We began as a small group of chemists from liberal arts colleges and expanded into other natural science disciplines, math, and engineering and then into the social sciences. We brought in those from public institutions and some from PhD granting institutions. We have welcomed grants officers and directors of undergraduate research programs. We instituted a national office, originally at UNC-Asheville, and now in Washington, DC. We are bigger (over 10,000 members) and we include numerous disciplines, with people from almost the entire spectrum of higher education. We even have connected with faculty and institutions in Canada, Australia, and the UK among other countries.

So what of our grassroots nature? Have we discarded it? Well, not really. Our national office and its staff are real treasures, but one indication that we do retain our grassroots character can be gleaned by going to the CUR website. If you look at the list of programs that we offer, you will certainly be looking at a list of ideas that originated in the minds of individual CUR members. Whether you look at the consulting service, mentoring network, the speakers bureau, CUR Institutes, the *CUR Quarterly* or almost any other offering, you will find embedded in the program one or more CUR volunteers. The list is telling in that it shows that the power of CUR is still embodied in its members and I hope that this remains the case.

Certainly there is a complex structure to the organization, with many moving parts. But at its core, CUR is a group of people, a group that is committed to their research and their students and students’ learning. CUR is a community and

indeed, it is a grassroots community where initiatives spring forth and are replicated and enhanced across the country.

In many ways though, CUR serves as a faculty development organization and certainly as a support group for faculty. I recall my first CUR meeting in 1990 at Trinity College in San Antonio. I was amazed at the talks and workshops and plenaries I attended, as I felt a deep kinship for the ideas and approaches being discussed. But of course, what was most striking were the people and their interest in sharing with me much of what I was trying to build in my own research program. And it was invigorating to interact in deep conversations about what really matters to our students and to us with so many people from other disciplines. The CUR spirit of sharing and collaborating was a welcome respite from other professional meetings where competition and one-upmanship were at their core. The early CUR values still permeate the organization and it clearly is evident in the proceedings this week.

More than anything, CUR is an expression of our shared culture and shared values. In many ways, CUR makes a statement about what we value—curiosity, academic rigor, striving for understanding, pushing ourselves beyond the here and now, and our interest in being both teachers and practitioners-teacher/scholars. May these ideals live a long and prosperous life.

5. It is Very Much About the Students

If there is one thing that I have kept in the front of my mind all these years, it is how hard it really is to be a student. I remember the confusion I had in trying to decide who and what I wanted to be as an undergraduate and where I wanted to go with my life. I lived in a dorm with amazingly unmotivated, party-loving mates; I played on the basketball team; I had a job; I loved doing science. And I was living away from home for the first time. It was hard to be focused and it was hard to be consistent and it was at a time when we were nowhere near as career-oriented as students are now. And compared to parents now, our parents largely left us to our own devices. So, I believe the best thing that all faculty could do is to put themselves back in the world of being a student and try to learn something new. Try to learn how to play golf or play the guitar or learn a foreign language. Take lessons and see what it is like to be a student again. See how focused you are and how consistent you are and see how hard it is to do the homework as you balance your life. In doing so, you will get a taste of what our students experience every day. And they are doing it with coping skills that are much less developed than ours.

6. The Future

I've never been known as a seer or a prophet but I would like to comment on what I think the future of undergraduate research might look like. First, it will be institutionalized on most of our campuses. This is not an easy task, but I say this with some confidence as I have worked with over 400 institutions interested in doing this very thing, and I see the internal and external drivers in place for this to happen. External calls from employers for students to have better problem solving and critical thinking skills are driving some of this. And so are state legislatures and funding agencies and other professional societies. Internally, connecting UR with other high-impact practices and the power that goes with that collection of activities has really taken hold on our campuses.

There also is growing interest in linking UR with internationalization efforts and community-based research activities in ways that bring out the best in all of these. And there is still an interest in using UR as a way to enhance admissions of high quality students and for retention of students from many different backgrounds. These efforts speak to the importance of our endeavors. The days of UR as a boutique program offered for only the best and brightest and honors students is now in our past. Egalitarian approaches to our work are now carrying the day. So the challenge for us is how to engage that vast variety of students and student types and support them with high quality experiences that speak to how they are and where they came from.

What of the activity of UR itself? Will it change? We have never really definitively agreed upon what UR is and what it isn't. And in many respects, we don't need to come to a consensus. But as practitioners from many different backgrounds engage in these activities, we will expand the reach of UR and enhance our understanding of what is possible with our students. And UR will become the norm, possibly even to the point where it is required by the majority of our departments and campuses. It is possible that a Research (R) requirement for all our students will be put in place on our campuses in ways that are similar to diversity or writing requirements now.

And our next great frontier is still the curriculum, as it is fertile ground for helping students become discoverers of new knowledge. Over the past decade, the interest in a research-rich curriculum has exploded and is the number one goal that institutions who attend our workshops identify and want to embrace.

The future of UR is bright and in many respects we have won the battle, as UR is now generally accepted as a high impact

practice, and we have done a much better job in evaluating and assessing our enterprise. But there is much to do to close the deal and many skirmishes over teaching loads, resources, tenure and promotion expectations, and the purposes of research at PUI's. Let's have at it and continue to take these on.

So how do I bring this to some closure? Let me do so by showing you what the educational literature says about what matters most in college (Astin, 1993). Students are greatly influenced when they have multiple homes on campus including clubs, organizations, intramural sports, sororities, etc. I would argue that if we studied the faculty, we would find the same need, as we are all more productive, happier, and professionally alive when we find multiple homes on campus, and in the rest of our professional lives. I will conclude by saying that of all the organizations I have been involved in, CUR is the one that makes me feel most at home. It is the place where I am nurtured, I am challenged, I am supported, and where I feel the most affinities. For this I thank all of you. You are my family.

In summary, I have devoted my professional life to my students, my teaching, and my research. In doing so, I have been driven by the need to pass on to my students what was given to me nearly 40 years ago. I like to think that some day in some way, they too will pass along these gifts to another generation: the gifts of caring, teaching, mentoring, and inspiring. As a teacher, I like to think, as Newton said, we stand on the shoulders of giants.

7. Acknowledgments

So many people have impacted my professional life and have helped shape the person I have become. It started with John Williams at Rhode Island College who to this day is the finest example of what it means to be a teacher-scholar. My research advisor at the University of North Carolina, Tom Sorrell, was so much like John that it is uncanny that I ended up working for both of them. And of course, my CUR friends Mike Nelson, Jeff Osborn, Kerry Karukstis, Tim Elgren, Jill Singer, Beth Ambos, Tom Wenzel, Charlotte Otto, Nancy Hensel, and a host of others have made this such an enjoyable ride. All my love to all of you.

References

- Astin, Alexander W. 1993. *What Matters in College? Four Critical Years Revisited*. San Francisco: Jossey-Bass.
- Newman, John Henry Cardinal. 1947. *The Idea of a University*. New York: Longmans, Green, and Co.