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Best Practices: The Neuroscience Program at Central Michigan University

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The original design of our program at Central Michigan University (CMU) and its evolving curriculum were directly influenced by Faculty for Undergraduate (FUN) workshops at Davidson College, Oberlin College, Trinity College, and Macalester College. The course content, laboratory exercises, and pedagogy used were informed by excellent articles in *the Journal of Undergraduate Neuroscience Education* (JUNE) and presentations at these FUN workshops and meetings over the years. Like the program at Baldwin-Wallace College, which was a previous winner of the Undergraduate Neuroscience Program of the Year Award, as selected by the Committee on Neuroscience Departments and Programs (CNDP) of the Society for Neuroscience (SfN, our program stresses the importance of inquiry-based, hands-on research experience for our undergraduates and utilizes a peer-mentoring system. A

distinct advantage that is employed at CMU is the use of graduate student mentors, which allows us to expand our peer-mentorship to distinct research teams that are focused on a specific research project. Developing our program was not easy. The present manuscript reviews the long and arduous journey (including ways in which we navigated some difficult internal political issues) we made to build a strong program. Hopefully, this description may prove helpful for other evolving programs, in terms of avoiding certain pitfalls and overcoming obstacles, as well as selecting practices that have proven to be successful at our institution.

Key words: student-centered research, neuroscience pedagogy, neuroscience curriculum, peer-mentoring, TEAM approach to student research, academic politics.

As a new Assistant Professor at Central Michigan University (CMU) in 1987, I was struggling to set up a lab with the \$3500 start-up provided and a 250-square-foot room used to store light bulbs and fans, as well as wrestling with three new course preparations. Obviously, I was forced early to think outside the box and sought the counsel of others who faced similar circumstances. Fortunately, there was a group of colleagues who were facing some of the same obstacles and barriers and the formation of the Faculty for Undergraduate Neuroscience (FUN) became a lifeline for me and my hopes of building a neuroscience program at CMU. The early steps in the evolution of our program are documented in two Occasional Papers from the Project Kaleidoscope/FUN workshops at Davidson College (Dunbar, 1998) and Trinity College (Dunbar, 2001). In 1999, we formalized our program in neuroscience by getting state approval for conferring the B.S. degree in neuroscience, therefore offering the first neuroscience major in the state of Michigan. Our initial curriculum followed suggestions that were outlined at the FUN workshop at Davidson College (see Ramirez et al., 1998). Our undergraduate major in neuroscience became one of the fastest growing programs on campus, but by 2006, we were feeling the growth pains of the program. The major problem we faced was accommodating all the new majors in our required directed research course, which featured the hands-on, inquiry-based, student-centered research that was a cornerstone recommendation from our FUN workshops (see Hardwick et al., 2006). In essence we were a victim of our own success, as we lacked the necessary number of faculty members to handle all of the new students in our program.

To help remedy this situation and to bolster the overall research productivity of our program, we embarked upon establishing a rather unique, mentorship graduate program in neuroscience, which would not only provide M.S. and Ph.D. students with focused, intense training in specific research problems, but would also offer these students opportunities to develop leadership and mentoring skills at a level beyond what most other graduate programs in neuroscience offered. By establishing this program, our hope was that these graduate students could help mentor the growing number of undergraduate neuroscience majors as an important part of their training.

OBTAINING ADMINISTRATIVE APPROVAL

Attributed to the late, former Secretary of State, Henry Kissinger is the claim that "academic politics is by far the worst type, precisely because the stakes are so low." During the years between 2006 and 2008, when my colleagues and I were trying to establish a graduate program in neuroscience, Kissinger's words hit home, as we encountered unimaginable obstacles from completely unanticipated parts of the university. Our first major hurdle was to get approval through the academic planning council (APC), which consisted of several deans and administrators and was chaired by the Provost. We put together what we thought was a very cogent and compelling case for a new M.S. and Ph.D. program in neuroscience. In many ways, the time was ripe for us to move on this, as the administration at CMU had become enamored with the idea that the institution needed to bolster its reputation by increasing its classification from a comprehensive university that was primarily involved in

undergraduate education to a research-intensive university, more in line with the three major research-intensive universities in the state (University of Michigan, Michigan State University, and Wayne State University). One of our sister schools, Western Michigan University was also embarking upon this path, sharing the same hope that the CMU administration held, which was based on the assumption that if they could be in a classification that was closer to the big three, then it was likely that state allocations would be more in line with those given to the major research universities in the state. Another critical element for the timing of this proposal is that CMU recalled 1% of its base budget from all units and decided to use this for base funding for new programs at that time.

Our presentation to the APC went well and we felt that most of the committee members liked our idea, but the major stumbling block came from a question posed by the Provost at that time: how much grant money will the program generate? We justified the cost of the graduate program (six assistantships) based on the tuition generated by the undergraduate program. The problem with our justification is that our program is an interdisciplinary program and did not have its own cost center, so we were at the mercy of the six departments and three colleges that housed the program faculty to provide an equitable portion of the revenues that we helped generate, but would otherwise go directly to the coffers of the three colleges. The Provost was not interested in setting up a cumbersome accounting system and wanted us to support the program almost exclusively on overhead monies garnered from grants obtained by the program faculty. When he saw our projected budget for grant revenues of \$400k per year (which was approximately \$50k per year per faculty member) he turned beat red and pronounced that he expected us to “bring in millions” each year. This became a major stumbling block, as he would not sign the APC approval form until we came back with a more “reasonable” estimate before the next APC meeting. It became obvious that he wanted us to promise him and the APC that we would cover all costs of the program via external funds.

Just prior to the next APC meeting, the Provost convened a special meeting of key members of the APC, including my dean, the Vice President of Research, and all of the neuroscience program faculty members. At that meeting, the Provost again asked us to provide him with a revised estimate of how much grant dollars our program would generate. When we reiterated that our best estimate was still \$400k per year, he was visibly upset and in frustration blurted out “I want you to lie to me.” Clearly, the Provost wanted us to provide numbers that he knew would impress the Board of Trustees, but we never envisioned our program becoming as research intensive as that of the likes of the University of Michigan, let alone conceiving of an almost instant transformation to this level, so we did not promise what we knew would be nearly impossible to deliver. Fortunately, the Provost was sufficiently kind-hearted to approve our proposal, just in time for us to submit it to the Graduate Council. We were relieved to know that we still had about three weeks left to get this

through the Graduate Council and the Academic Senate for their approval.

GETTING GRADUATE COUNCIL APPROVAL

My colleagues and I were very relieved to know we had passed what we thought would be our major hurdle to get our program launched. However, our joy and optimism did not last very long when we realized we were being blindsided by colleagues from Biology, one of the contributing departments to our program. Because we expected that our proposal would sail through the Graduate Council on merit alone, we were shocked when we were given several pages of questions and requests for more information by members of the Executive Committee of the Graduate Council.

Our problem was that we failed to do the necessary legwork—the one-on-one, face-to-face meetings with each member of the Graduate Council. We should have learned from history that what made Lyndon Johnson such an effective legislator is that he always knew he had enough votes *before* he ever submitted a bill. We were simply overconfident that the strong curriculum we proposed, the solid research records of our faculty, and the strength of our undergraduate program would translate into a slam dunk for instant approval of our program. As such, we were stunned that the Executive Committee (composed of two Biology faculty members and the Graduate Dean) demanded that we provide complete responses to their long list of questions, which included requests for detailed comparisons of our program to many others. By the time we received this list we only had a few days to respond if we hoped to bring this to a vote at the next week’s Graduate Council meeting.

It was obvious to us that this was a sabotage tactic to ensure that we would not be able to bring our proposal to the academic senate before the end of the semester, which meant that our best window of opportunity to ever get this program would likely close. But why were our Biology colleagues doing this? The answer should have been obvious to us, but we were too focused on the value that our program would bring to CMU that we overlooked the possible downsides. What upset our colleagues in Biology was that the addition of new Ph.D. programs would bring CMU closer to a level in which we would make it ineligible for RUI (Research in Undergraduate Institution) funding (although adoption of our program, alone, would not have made us ineligible at that time). Nonetheless, several Biology faculty members were fearful that CMU would soon be ineligible for RUI grants, which was a lifeline for many of them. This explained why Biology had two representatives on the Graduate Council and why both of them lobbied to be members (Chair and Secretary) of the Executive Committee who controlled the agenda for the meetings.

Sensing the closing of our best window of opportunity, we had to work day and night (literally) to answer all the questions posed—not just once or twice—but three weeks in a row before the Graduate Dean finally demanded that the proposed program went to the Council for a vote. All Council members (but two) voted to approve the proposed new program. However, the lack of sleep and stress

nearly killed me—I literally developed pneumonia in an effort to get this through. Our last hurdle came at the last Academic Senate meeting of the year, when the Chair of the Biology Department and member of the Senate tried to send the proposal back to the Graduate Council (which would have killed our chances of getting the program). However, this time we did the necessary legwork and lobbied hard with fellow members of the Senate (for which I served as Secretary and, thus, as a member of the Senate Executive Committee). The motion to send back our proposal for further review by the Graduate Council failed and the program was nearly unanimously approved by the Senate at its very last meeting of the year.

POLITICAL LESSONS LEARNED

There are a few key lessons that can be gleaned from our experiences that might prove useful to others who may be contemplating setting up a neuroscience program. First, I would strongly recommend, if at all possible, to establish a neuroscience department, rather than program. Obviously, this would require more preparation and work at the beginning, but unless you are adept at herding cats, it will save a lot of headaches in the long run. Secondly, do not take any vote by any academic committee member for granted. Do your legwork and meet with as many committee members as you can, in person, and as far in advance as possible to have a good idea where things stand. It is never fun to be blind-sided, but it could be very costly if it occurs when timing is vital. Finally, be honest and be persistent. If you provide honest responses and are consistent with your message, most people will appreciate your efforts and provide honest feedback in return.

THE GRADUATE ADVANTAGE

By 2008, the M.S. and Ph.D. programs in neuroscience were officially approved by the CMU Board of Trustees and the Michigan Council of State University Presidents. Our first group of students entered the program that Fall, with focused research interests that matched closely to those of their chosen faculty mentor and, even more importantly for our undergraduate program, a desire to help teach and mentor our neuroscience majors. Although extra efforts were needed to establish protocols for our first group of graduate students, they adapted remarkably well to our system. Unlike many other graduate programs, ours did not provide formal rotations, although the faculty members in our program were very collaborative, which provided additional faculty supervision beyond that given by the student's mentor.

Most impressive was the immediate, positive impact the new graduate students brought to our undergraduate program. We immediately assigned one or two teams (one senior and three or four other undergraduates) to each of our graduate students with the expectation that these undergraduates would be given a research question for which they had to provide a rationale for why it was important to study and to devise ideas as to how best to address this question. This was challenging for both the undergraduates and the graduate students, but sparked

lively conversations and fresh ideas and insights from both groups, which in turn, significantly improved the proposals for our collective lab work. The senior member for each team was responsible for conducting the pilot work and help the younger students learn the critical techniques used for the project. Oftentimes, the instructor would work with the entire team when the methods were new to the graduate student, but often the graduate student was able to adequately train the undergraduate teams on their own.

The level of discussion at our weekly lab meetings was substantially elevated with the addition of the graduate students and we often had combined lab meetings with faculty colleagues and his or her students, especially when there were collaborative projects or studies that were similar in some ways. This cross-fertilization of expertise and new perspectives enriched all of us—faculty, graduate students, and undergraduates. The impact was palpable in the classrooms as well, especially in the neuroscience seminar class, which represented our capstone course for the neuroscience major. Many of our undergraduates were functioning at a graduate student level. This was particularly true for advanced undergraduates (often research team leaders) who opted to take our Neuroscience Foundations course (a new required course for all our graduate students). This rigorous, year-long course went through, chapter by chapter, Kandel, Schwartz, and Jessell's "Principles of Neural Science" text, which was augmented by graduate-level discussions and presentations. The impact on the undergraduates that took advantage of this new opportunity was profound. It was clear that our hopes that the new graduate program would not detract from, but would, indeed, *enhance* our existing undergraduate program, was achieved at a level that exceeded our wildest dreams.

SUCCESS-DRIVEN ADJUSTMENTS

Within five years of the start of our graduate program the growth and reputation of our undergraduate program reached new heights. Our students were getting into top-ranked graduate programs, medical schools, and other professional programs. Many of our students co-authored major publications and some had first-author publications. At one point, during this five-year period, 8 of the 10 (two per year) winners of the Outstanding Undergraduate Research Poster Presentation Awards at the Michigan Chapter for the Society for Neuroscience were won by CMU neuroscience majors. Many of our undergraduates presented at national meetings, some as FUN Travel Award winners, including one second-place finisher in the German Graduate School Poster Competition at the poster session of one of our FUN socials.

However, the success of our program translated into a doubling of the number of majors during this period of time, a situation that made it impossible to adequately provide every student with the hands-on, inquiry-based research that was the hallmark of our program. Given that we were an interdisciplinary program and not a department, and thus had only indirect access to some of the money we generated and could only ask associated departments to consider hiring neuroscientists to help us handle the

growing number of majors, we were forced into making the decision to drop the research requirement in our major.

In order to accommodate the growing number of neuroscience majors, we decided to have two tracks—a General Track and a Graduate Preparation Track, in which the latter was the only one that included a research requirement for each student. The Graduate Preparation Track required students to take the graduate-level Neuroscience Foundations course as well as our directed research course. Majors in both tracks were still required to take two semesters of neuroscience seminar, our capstone course.

To date, this new system seems to be working out fairly well. Most of the students who have aspirations for professional schools, such as Physical Assistant, Physical Therapy, and Occupational Therapy tend to opt for the General Track, while many of the pre-med neuroscience majors and all of those who aspire to go to graduate school in neuroscience tend to opt for the Graduate Preparation Track. The one problem that appears to be emerging from our adoption of this new system is that the level of critiques of assigned articles and of oral presentations in our seminar course has fallen during our last two assessment cycles. This suggests that students who are not involved in our directed research courses have more difficulty integrating the information they are receiving in their classes than students who opt for more extensive hands-on research experience required in our Graduate Preparation Track. We will be testing this directly in the next few assessment cycles and may need to make adjustments to rectify this (such as requiring an additional semester of seminar beyond the two we now require for those students in the General Track).

BEST PRACTICES FOR OUR PROGRAM

In 2013, the Committee on Neuroscience Departments and Programs or the Society for Neuroscience selected our program as the Outstanding Undergraduate Neuroscience Program. As can be ascertained by reading the case study of our program (Dunbar, 2013), much of the credit for our success can be attributed to our vigilance in trying, modifying, and adopting best practices in neuroscience pedagogy. The FUN workshops have been particularly useful in helping us design and adapt our curriculum over the years. Perhaps the most helpful resource we have used came after the launching of FUN's *Journal of Undergraduate Neuroscience Education (JUNE)* in 2002. *JUNE* has provided us with a wealth of useful ideas and information and it has greatly enriched how we teach our classes, what lab techniques and equipment we use, and what new developments are on the horizon, precisely what the journal was designed to do (see Lom, 2002).

Perhaps the most profoundly influential article in *JUNE* that positively impacted our program at CMU was by Mickely, Kenmuir, and Remmers-Roeber (2003), which provided a model system that proved successful at Baldwin-Wallace College and was readily adaptable to our program at CMU. The peer-mentorship and team-building model proved to be very effective for use and our further adaptation of this system, which involved integrating our

new graduate students into this team concept, provided an exponential boost for us. As described in the case study we presented to SfN (see Dunbar, 2013) our expansion of the TEAM ("Together, Everyone Achieves More") system to three tiers (student, graduate student, and faculty) has been a major key to our success.

NEW CHALLENGES AND THE NEXT STEPS

Recently, CMU has launched a new medical school (the second class of students started this academic year). This development has provided several exciting opportunities, as we have been able to add three new faculty members to our program (whose home department will be in the new College of Medicine). The implementation of the new medical school has also come with some very real threats to our neuroscience program, especially involving loss of laboratory and vivarium space. The initial plan for the medical school was to hire teachers and use the existing faculty members in various departments to help with the teaching and research needs. However, after the first accreditation visits, it became clear that the medical school would need to hire more foundation faculty and researchers. Given that CMU had not built adequate lab or animal facilities to accommodate this need, some of the existing lab space on campus had to be re-allocated to the medical school. In addition, new costs, such as per diems for student research projects that involve animals, have been imposed to help free up more vivarium space for the new hires in the medical school.

To meet this new challenge, we are hoping to launch a new "School of Neuroscience." The "School" would function more like a quasi-department than an interdisciplinary program. We hope to attract major donations and perhaps have a named school in the near future. We were successful last year in winning a competitive internal grant to add three more faculty lines for our neuroscience program and we hope to establish a home base with a network of integrated labs in the Brain Research and Integrative Neuroscience (BRAIN) Center at CMU. We are revising our Bylaws to include a core faculty component, which will be composed of faculty members who have a contractual commitment (of about 50%) to our program to augment the general program faculty (who have no such obligations). We will also be re-vamping our curriculum to include a stronger research methods course and a more rigorous, year-long basic neuroscience course for our majors in the General Track. We are also planning on establishing a one-semester introductory (survey) course in neuroscience and add a neuroscience minor, as well as an accelerated M.S. degree (the latter for students in the Graduate Preparation Track of our major who can start their M.S. program during their senior year). These are exciting new initiatives that we hope will elevate our program and provide us with more economic autonomy to help ensure its long-term survival.

CONCLUSIONS

The neuroscience program at CMU has come a long way from its humble beginnings in 1987. With the help and guidance of colleagues in FUN, particularly through the

many workshops over the years, we were able to establish the first undergraduate neuroscience major in the state of Michigan in 1999. With the advent of *JUNE* in 2002, our program benefitted substantially from the plethora of new ideas, techniques, and protocols that greatly enriched our classes and research programs. Major keys to our most recent success came from the model system used at Baldwin-Wallace College and the establishment of our graduate program in neuroscience in 2008. Our program blossomed by the adaptation of a three-tiered TEAM approach, in which undergraduates worked together with graduate students, who in turn worked with faculty members, who, in turn, comprise an intensely collaborative (faculty team level) environment that allows free exchange of information, ideas, and expertise amongst the inter-related labs in our program. Over the past three decades, the evolution of our program has been the result of overcoming enormous barriers, including several internal political conflicts. In many cases, we have emerged stronger because of this, and these experiences may serve us well as we face our newest challenges. In the last analysis, if we keep true to our mission of putting our students' education first, our efforts will continue to pay huge dividends for both our students and the overall status of our growing program.

REFERENCES

- Dunbar GL (1998) A neuroscience program at a comprehensive state university: the Central Michigan University Story. Occasional Paper on Neuroscience, 1998 Proceedings from the PKAL Workshop on Interdisciplinary Connections. <http://www.pkal.org/documents/OccasionalPaperOnNeuroscience.cfm>.
- Dunbar GL (2001) Establishing an undergraduate neuroscience program at a medium-sized state university: Chapter two of the Central Michigan University story. Paper given at the 2001 Undergraduate Neuroscience Education Workshop at Trinity College: From the Enchanted Loom to the World-Wide Web: <http://www.pkal.org/documents/CMUDevelopment.pdf>.
- Dunbar GL (2013) Case study: The undergraduate neuroscience program at Central Michigan University. Submitted to the Society for Neuroscience: www.sfn.org/~media/SfN/.../NDP/CMU One Pager for SfN.org.ashx.
- Hardwick JC, Kerchner M, Lom B, Ramirez JJ, Wiertelak EP (2006) From faculty for Undergraduate Neuroscience: Encouraging innovation in undergraduate neuroscience education by supporting student research and faculty development. *CBE Life Sci Educ* 5:86–90.
- Lom, B (2002) Introducing The *Journal of Undergraduate Neuroscience (JUNE)*. *J Undergrad Neurosci Educ* 1:E1.
- Mickley GA, Kenmuir C, Remmers-Roeber D (2003) Mentoring undergraduate students in neuroscience research: A model system at Baldwin-Wallace College. *J Undergrad Neurosci Educ* 1:A28-A35.
- Ramirez JJ, Aanonsen L, Dunbar G, Hill W, Paul CA, Smith D (1998) Undergraduate education in the neurosciences: four blueprints, pp. 27-33. Occasional Paper on Neuroscience, 1998 Proceedings from the PKAL Workshop on Interdisciplinary Connections. <http://www.pkal.org/documents/OccasionalPaperOnNeuroscience.cfm>.

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