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Community Chairs as a Catalyst for Campus Collaboration in STEM

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Abstract

Strong collaborative partnerships are critical to the ongoing success of any urban or metropolitan university in its efforts to build the science, technology, engineering, and mathematics (STEM) career pathways so critical to our nation. At the University of Nebraska at Omaha, we have established a faculty leadership structure of "community chairs" that work across colleges to support campus priorities. This paper describes UNO's STEM community chair model, including selected initiatives, impacts, and challenges to date.

Universities provide the intellectual fuel that drives innovation for a community, whether that community is a city, state, nation, or even a global one. Metropolitan universities need to be particularly attentive to the community in which they reside, and to the priorities of that community, to help both the community and the university itself to thrive. One growing priority that is being shared by metropolitan communities across the United States, and by the country at large, is that of science, technology, engineering, and mathematics (STEM) education. There is a growing concern across the nation that we are not producing enough STEM professionals to meet our needs, especially as compared to many other countries around the world. National reports, such as the 2010 *Rising Above the Gathering Storm Revisited*, paint an alarming picture (National Academy of Sciences, National Academy of Engineering, and Institute of Medicine 2010), where the academic "pipelines" or pathways through universities to produce STEM professionals are in relatively bad shape, facing some of the most daunting challenges for student recruitment, retention, and graduation among all campus majors (Singer 2011). At the same time, STEM workforce needs are expected to grow substantially (Carnevale, Smith, and Strohl 2010). As careers in STEM fields themselves advance, there is an increasing need to focus both the process of learning and the content learned for such ever-changing workforce needs (Dostis 2013; National Science Board 2010). President Obama, in a previous State of the Union Address, called the need to attend to STEM education as a critical "Sputnik moment" for our country (Obama 2011).

Yet how does a metropolitan university, with limited resources but excellent community partners, synergize to contribute aggressively to both local and national needs in STEM education? The National Academy of Sciences has suggested two key elements, STEM pathway "innovation" and university collaboration with P-16 education (National Academy of Sciences 2010). Further, organizations such as the

National Governors Association reinforce the critical need for effective partnerships that engage a P-16 conversation on STEM pathways (National Governors Association 2011). Metropolitan universities, with their typically close P-16 relationships, strong community partners in business and industry, and willingness for trying new educational strategies, may well be the perfect environment for creating the innovations necessary to rise to the challenges of STEM education and to successfully recruit, retain, and graduate the needed STEM professionals (Barakos, Lujan, and Strang 2012; Tyson et al. 2007).

The University of Nebraska at Omaha (UNO) decided to aggressively embrace this national imperative for STEM education innovation by establishing a campus STEM priority (one of just five campus priorities) and creating a new faculty interdisciplinary leadership strategy, called "community chairs." The role of the community chairs is to work across colleges, lead initiatives, and build partnerships between the University and the community. Funding community chairs became a key objective of UNO's capital campaign, which ran from 2009 to 2014 and resulted in capturing the community's vision and passion for creating unique pathways to STEM excellence. This article describes how UNO approached this vision by establishing four community chairs to address the campus STEM priority, as well as the successes and challenges to date and the next steps for this new interdisciplinary leadership effort.

The Community Chair Concept at UNO

To fully understand the concept and operation of community chairs at UNO, it is important to first understand our metropolitan university and the community that we serve. This is important because, at its very heart, the community chair concept is about being responsive to the local community. At UNO, that community is Omaha, Nebraska, and the surrounding urban area, which includes Council Bluffs, Iowa, just across the Missouri River. UNO is the largest institution of higher education in this metropolitan area, which has a population of 865,000. UNO itself is based in the middle of the city of Omaha and offers 126 baccalaureate degrees, more than 60 graduate degree and certificate programs, as well as 9 doctoral degrees in a wide range of disciplines. UNO has a total undergraduate student enrollment of 11,554 and a graduate enrollment of 3,037 (as of Summer 2014). There is diversity at UNO in the student population; 18 percent of the students are minorities, while 44 percent are first-generation college students. Over the past five years, nearly 1 in 8 students were STEM majors, or nearly 1,500 UNO undergraduate students per year. Challenges in STEM education experienced across the United States are present here as well, and a review of UNO data shows that among first-year first-time students declaring a STEM major over the past five years, approximately 68 percent were retained at UNO. Retention rates for STEM majors at UNO are generally about 5 percent below campus-wide retention rates, mirroring national statistics (Gentile 2011; Ingersoll and Perda 2010), where nearly 40 percent of undergraduate students eventually leave engineering majors, 50 percent leave the physical and biological sciences, and 60 percent leave mathematics (Samueli 2010).

UNO shares important STEM interests with the city of Omaha and the area P-16 school districts and has a particularly unique partnership with the Omaha Public Schools (OPS). This important community partner is by far the largest and most diverse school district in Nebraska with a total enrollment of more than 50,000 students. Of these students, 66.4 percent are minorities and 74 percent receive free and reduced lunch (Omaha Public Schools 2012). The district represents approximately 30 percent of the state's overall student population. In OPS, there are more than ninety different languages and dialects spoken by students attending the district's seven high schools, eleven middle schools, and sixty-three elementary schools. More than two-thirds of all UNO students come from the Omaha metropolitan area, and of those, 34 percent are graduates of OPS. In addition, more than 60 percent of the STEM teachers in OPS (and across the metropolitan area) have received their degree from UNO. OPS is continually searching for and hiring secondary STEM teachers from UNO, so the University is a critical contributor to P-16 STEM instruction.

To strive for the strongest link possible among UNO STEM initiatives, P-16 districts, and community partners (such as the Chamber of Commerce and local businesses), the first community chair was established relatively quickly. The role of this community chair was conceptualized in 2010, building upon the vision and generosity of a very important university benefactor, Dr. George Haddix. UNO administrators and faculty, along with representatives from the University of Nebraska Foundation, collaborated with Dr. Haddix to define the Community Chair in STEM Education. As a former UNO mathematics professor himself, Dr. Haddix was instrumental in founding a series of highly successful STEM companies. Through his university and business experience, he realized that faculty leadership was critical to innovation and believed faculty leadership positions could be structured to synergize interdisciplinary efforts that crossed departmental, college, and university boundaries. Unique to this design was the collaboration of strong community-based partners that were essential to achieving the ambitious goals of community chairs.

Dr. Haddix provided a generous endowment for the first community chair position at UNO, with a focus on interdisciplinary STEM education, and Dr. Neal Grandgenett in the College of Education was the inaugural recipient. This first position recognized the important role that a College of Education, in direct collaboration with a College of Arts and Sciences, could provide in supporting educational innovations across a university campus. The name of the position also honored Dr. Haddix's late wife, Sally Haddix, who was a well-respected elementary teacher in the Omaha metropolitan area. The deans of the Colleges of Education, Arts and Sciences, and Information Science and Technology then stepped forward to help lead the campus STEM priority and to support the community chair in working across colleges on initiatives of significant interest to faculties in each of those three founding colleges.

Community chairs essentially establish groups of faculty and community partners willing to undertake bold and innovative initiatives to further a campus priority. A famous African proverb suggests that "if you want to go quickly then go alone, but if

you want to go far, then go together." The overall vision of the community chair position is in many ways like that African proverb in that significant long-range interdisciplinary STEM pathway efforts must be done in a collaborative way, across multiple colleges and community organizations. Such efforts require bringing together the expertise of a number of faculty and community stakeholders. Thus, first and foremost, the community chair concept centers around the idea of "community building" and creating "conditions that matter" on a university campus (Kuh et al. 2005). In the role of community chair, the lead faculty member helps lead and synergize efforts that bring people together, helps people build a common vision for shared efforts, and mentors additional leaders to help the initiative grow and evolve. In so doing, the community chair essentially "chairs" collaborative efforts across colleges as an official university leader.

In the initial conceptualization of these important positions, it was realized that the support structures for the community chair positions would need to be carefully designed to allow the chairs to quickly accomplish tasks across departments and colleges and to collaborate closely and aggressively with community stakeholders. It was felt that having the chair reside in a single department, but with responsibilities to involve multiple departments and colleges in undertaking projects, was the best approach. This single base of support was also seen as more helpful to the community chairs themselves, since being hosted by two departments makes it difficult for a faculty member to focus on leading high level tasks and essentially requires them to attend primarily to the routine operational efforts of both departments, rather than innovative interdisciplinary efforts. Thus, the community chairs were designated to be a faculty member positioned in one department but empowered and tasked with the responsibility to build collaboration across departments in leading campus priority initiatives.

The community chair position was essentially structured to have four key support elements, which included: 1) a monthly stipend, 2) a yearly revolving budget, 3) a reduced teaching load, and 4) priority access to the dean in the host college as well as to the deans in other colleges. Community chairs are the highest-ranking chairs at UNO and are designed to provide a strong incentive for recruiting, retaining, and rewarding distinguished faculty. The operational budget has a signature authority assigned to the community chair, with a required authorization of the dean in the host college. The operational budget of the community chair is to be used to support the STEM initiatives facilitated by the position and directly support activities such as: hiring a student worker, covering meeting costs, supporting conference travel, funding receptions, hiring grant writers or similar consultants, holding mini-conferences, or bringing in STEM speakers. The reduced teaching load encourages the faculty member to design and to teach new and innovative interdisciplinary courses that could serve as a model for other faculty members engaged in instructional innovations, such as distance or blended learning, flipped classrooms, or inquiry-based learning. For priority access to the deans, it was seen as both the responsibility and opportunity for the community chair to meet with the deans regularly, to update them on tasks, to request any needed college resources and support, and to generally request leadership help in crossing boundaries and meeting administrative challenges. At UNO, three

deans were officially designated to oversee the STEM community chairs (and the STEM campus priority), including the deans of the Colleges of Education, Arts and Sciences, and Information Science and Technology.

The application process to become a community chair was designed to be a formal process, similar to that followed for other campus positions, requiring an application for the position and a University-based selection or search committee. This selection committee would typically include at least: a dean or their designate, two to three STEM faculty members representing more than one college, and at least one STEM community partner, such as a P-16 school district, business, or other community stakeholder. The candidates would submit a letter of application, a full vita, and a two- to three-page statement on their personal vision for the community chair position. For stable leadership, the community chair position was also designated so that it could be renewed every three years, provided that there was a successful review and a resubmission of the application materials. In addition to the three-year reapplication process, the individual holding the community chair position would be expected to submit a brief annual report of progress to the supervising deans. For community chairs that were endowed by an external donor, the community chairs would also report yearly to that important benefactor.

Four key characteristics of a community chair were identified—successful applicants would be 1) effective communicators; 2) strong in all three areas of teaching, research, and service; 3) interested and experienced in interdisciplinary work, and most importantly, 4) energetic and willing leaders. To establish a strong foundation for the community chair structure, it was decided that the first community chair would serve as the lead community chair and would, therefore, need to be an internal candidate who was both tenured and already engaged in community efforts, which would also help this first position to be an advocate for newer community chairs. The ability to effectively launch the chair concept with a strong and well-respected STEM leader would create a foundation on which to build an outstanding team of community chairs across the STEM disciplines. The intent was that later community chairs could be tenured or nontenured. Each of the additional community chair searches would be designated as external searches, although internal candidates would also be welcomed.

The First STEM Community Chair: STEM Education

As mentioned previously, the first community chair position at UNO was to be filled by a College of Education faculty member, within the context of a strong and close partnership with the College of Arts and Sciences, as well as periodic collaborations with other UNO colleges, the University of Nebraska system, P-16 schools, and community stakeholders. This position, with an internal search process of tenured faculty members, was designated by the title of the Dr. George and Sally Haddix Community Chair of STEM Education to both honor Dr. Haddix and his wife and to specifically recognize that general "STEM Education" was the focus of the position. Dr. Neal Grandgenett, a mathematics education professor with twenty years of service to UNO and a strong teaching, research, and service record, was selected for the first community chair

position. The following were set as the expectations of this important position, which was targeted to be a model and catalyst for future community chair positions:

Expectations of the Community Chair in STEM Education

- Help to conceptualize and to advance STEM education initiatives at UNO.

- Mentor, encourage, support, and advocate for UNO colleagues, including newer STEM community chairs, in undertaking their own STEM initiatives.

- Become a catalyst to STEM efforts that go across UNO colleges and departments.

- Help to build strong STEM partnerships between UNO and K12 districts.

- Lead a "STEM Leadership Team" of UNO/K12/community partners.

- Work on collaborative grant proposals to help fund STEM-related projects.

- Strive to integrate UNO STEM initiatives with other wider university efforts.

- Contribute to research on STEM assessment, evaluation, and program development.

It was expected that this first position would help to facilitate focused and strategically planned STEM education efforts across UNO that would lead to higher quality STEM teachers in the P-16 schools, as well as cross-campus partnerships. For example, one of the first initiatives that the community chair was encouraged to work on was a discipline-based pathway for teachers, particularly in the College of Arts and Sciences but with strong support from the College of Education. This *Math Degree Teaching Pathway* would offer students the opportunity to earn both a mathematics degree and a teaching endorsement. Students would graduate with a stronger, broader, and deeper understanding of mathematical content, and they would also be more likely to continue with graduate mathematics work that could support dual enrollment opportunities in the schools. This initiative, which was a priority goal of the funder, became the first signature work of the community chairs. The commitment to this initiative was essential to building trust and fostering the relationship with our funder. The success of this initiative was an important element that led to the funding of additional community chairs. Details of this success are described later in the article in the section on the accomplishments of the community chairs.

The Second STEM Community Chair: Mathematics

After the first STEM community chair had been successfully in place for about a year, including efforts to clearly define the campus STEM priority with a white paper that was later to become the foundation for a STEM Strategic Plan, we began to pursue a second community chair position. At this time, it seemed critical to place a community chair position within the College of Arts and Sciences to help to synergize efforts with the Community Chair of STEM Education. In particular, new efforts on a Mathematics Degree Teaching Pathway were underway that would allow a mathematics education major to receive a mathematics discipline degree with a concentration in education for state certification. This initiative not only supported the vision of the funder, but it

appeared to have a growing potential for expanding the mathematics teacher pipeline in the local area and was of significant interest to OPS and the surrounding school districts. A community chair based in the mathematics department could be helpful in curriculum changes needed to align the Mathematics degree requirements with teacher certification requirements. The goal was for students interested in high school mathematics teaching to be able to get either a degree in mathematics, the current degree in education, or perhaps even create an opportunity for a double major.

The second community chair was designated the Dr. George Haddix Community Chair in Mathematics. An external search was conducted, including visits to conferences and postings to the American Mathematical Society, and eventually, the faculty search team selected an excellent external candidate, Dr. Angie Hodge, who started the position in August 2011.

This second community chair position, like the first, had a similar stipend, budget, reduced teaching load, and administrative access. This second position was designated to be either a tenured or non-tenured position, depending upon the applicant. Dr. Hodge's upward trajectory, teaching, research, and service accomplishments were very impressive to the search team, even with just four years in higher education as an assistant professor. Her former position at North Dakota State University was a joint appointment in both mathematics and mathematics education, so she had the experience needed to lead efforts that crossed colleges. She was offered and accepted the position as a nontenured assistant mathematics professor within a tenure-track line.

The designated requirements of this position included the following:

Expectations of the Community Chair in Mathematics

- Provide leadership in setting up an effective program to increase the quantity and quality of high school mathematics teachers in the metro Omaha area.

- Encourage, council, and support UNO undergraduate mathematics majors to consider a career as a secondary mathematics teacher.

- Develop new outreach programs to encourage nontraditional students, minority students, and other students with mathematically rich backgrounds to consider becoming a secondary mathematics teacher.

- Work closely with the UNO College of Education, specifically the Haddix Community Chair in STEM Education, to design an attractive and timely route for both mathematics majors and nontraditional returning students to become Nebraska certified for teaching at the secondary level.

- Serve as a professional mentor for mathematics majors who express interest in considering a career in secondary mathematics education.

- Work closely with UNO College of Education faculty to enhance the preparation of secondary education mathematics majors within the College of Education.

- Work closely with other Mathematics faculty in support of other departmental initiatives in mathematics education in pursuit of effective teaching of mathematics at all levels.

- Become a community resource for secondary mathematics by working with Omaha area education groups such as the Metropolitan Omaha Educational Consortium (MOEC).

- Pursue and acquire additional funding to help implement and expand the above program.

- Become an active member of the national mathematics education community by attending meetings, making presentations, serving on extramural boards and committees, and in general publicizing the efforts and successes of UNO to improve secondary education in mathematics.

The two community chairs then worked on numerous initiatives as the STEM priority continued to be synergized on campus, including a formal campus-wide STEM Strategic Plan that is described later in the accomplishment section. One of the first combined efforts of the two community chairs was to establish a formal STEM Leadership Team that included faculty representatives from each of the UNO colleges and that helped to plan, prioritize, and undertake STEM activities on campus. Today (2014), the leadership team includes seventeen faculty members on campus who routinely attend meetings, help to chair initiatives and grant proposals, and generally work to operationalize the UNO STEM priority as it is described later in the article.

The Third STEM Community Chair: Computer Science

During this last year, two additional community chairs have been added to the UNO STEM priority effort. These two additional community chairs were brought on board by having a matched funding process, where a Community Chair in Science was contributed by one donor, if another donor would step up to contribute a Community Chair in Computer Science, with the University contributing the two additional lines necessary to make the new positions. National searches were conducted, with internal candidates also encouraged to apply for the position. The first of these two chairs to be hired was Dr. Brian Dorn, who assumed the Union Pacific Community Chair of Computer Science Education in fall 2013. He was an experienced new faculty member coming from a tenure-track post at another institution, and he brought two existing NSF grants related to STEM education with him to the new position.

Following the existing community chair format, this position was structured to provide leadership in computer science and information technology education efforts, further supporting STEM education interests that were already surfacing in the Computer Science Department related to improving undergraduate curriculum and pedagogy, P-12 teacher training, and discipline-based education research in computing supported by external funding. The following expectations were established for this new community chair position:

Expectations of the Community Chair in Computer Science

- Build relationships related to computer science and technology education across UNO departments that improve STEM instruction and attract more STEM majors.

- Provide leadership in initiatives related to computer science education that might result in new computer science education courses, programs, and external funding initiatives.

- Work closely with the UNO College of Education in developing effective programs to increase the quantity and quality of elementary, middle, and high school computer science instruction.

- Build enthusiasm across the UNO faculty in the pursuit of initiatives and grants related to computer science education at UNO.

- Coordinate the vision of UNO computer science education initiatives that connect to local schools and that encourage students to consider being a STEM/STEM Education major at UNO.

- Serve as a professional contact, advocate, or mentor for teachers who express interests in a career in computer science education.

- Become a community resource for computer science education by working with Omaha-area education groups, such as the Omaha Public Schools, Metropolitan Omaha Educational Consortium (MOEC), and other districts.

- Pursue an active teaching, research, and service agenda related to computer science education.

- Support synergy and potential collaborative efforts for statewide initiatives in computer science education by working with other NU campuses and faculty.

The third community chair, with his focus of building computer science education, has already been very successful in initiating some bold efforts in computer science education in the first year of the position. In particular, new initiatives have been established for a supplemental endorsement in computer science education for practicing teachers, new graduate courses in computer science education, as well as significant computer science education grant-related initiatives. We describe some of these efforts in more detail in the general accomplishment areas of this article.

The Fourth STEM Community Chair: Science

The fourth, and newest, community chair in UNO STEM Education was established as the Haddix Community Chair of Science and was funded within the match agreement with the funding of the Community Chair of Computer Science, as mentioned earlier. An extensive external search was undertaken, with internal candidates able to apply for the position, by a search committee involving six STEM faculty members and the Associate Vice Chancellor of Research. The selection process involved ads in national journals, personalized searches at national conferences, and a general review of rising stars in STEM education across the country.

An internal candidate who was already becoming well known nationally and locally for her science education initiatives, with numerous grants as well as some impressive scientific research, Dr. Christine Cutucache, was selected for the position. Dr. Cutucache completed all of her higher education across the Nebraska University system, thereby providing opportunities for strong cross-campus collaborations. Dr. Cutucache earned her Bachelor of Science at the University of Nebraska at Kearney and a doctorate from the University of Nebraska Medical Center. After completing her degrees, she taught at the instructor level in the Department of Biology at the University of Nebraska at Omaha. She was the first choice of the search committee and assumed her official status as the new Community Chair of Science at the end of the spring semester of 2014.

The expectations of the newest community chair position were established with wide input from leading STEM faculty across the campus and formalized within the position description. Those expectations now follow:

Expectations of the Community Chair in Science

- Build relationships related to science education across UNO departments that improve STEM instruction and that attract more STEM majors.

- Build a process synergizing undergraduate and graduate student enthusiasm, service, and outreach in the local schools and after school programs related to STEM education excellence and support.

- Serve as a professional contact or mentor for STEM majors who express an interest in a career in science and/or science education pathways.

- Work closely with the UNO College of Education faculty in developing effective programs to increase the quantity and quality of elementary, middle, and high school science teachers.

- Build enthusiasm and communication across the UNO STEM faculty in the pursuit of strengthening science-education-related initiatives and grants at UNO.

- Assist in the strategic planning for an effective vision of UNO outreach programs in science education that connect to local schools and that encourage students to consider being a STEM/STEM Education major.

- Become a community resource for science education by working with Omaha area education groups such as the Omaha Public Schools, Metropolitan Omaha Educational Consortium (MOEC), and various private foundations interested in enhancing STEM education.

- Maintain a competitive research profile in discipline-based education research (DBER, a National Research Council priority).

- Pursue an active teaching, research, and service agenda related to science education within the context of the host science department at UNO.

The newest community chair, based in the Department of Biology, quickly welcomed the duties of the position. Due to her existing strong reputation and relationships with faculty across the UNO campus, the chair started very rapidly to synergize and lead efforts in science education, using a variety of objectives consistent with the UNO STEM Strategic Plan. These efforts included further building a UNO-based student outreach organization in STEM Education for local after school programs; developing a model "learning inventory" to investigate challenges with student recruitment, retention, and graduation refinements within a particular STEM department; and various funding efforts, including successful funding for student outreach that partnered aggressively with the Omaha Public Schools. These successes are described further in the accomplishments of the community chairs.

Establishing a Wider STEM Leadership Team

As the four community chairs were added over the duration of the four years that the UNO STEM priority has been in place, a faculty STEM Leadership Team was also steadily expanded and formalized. This team represents faculty leadership across the campus and includes faculty who are interested in leading STEM initiatives and expanding interdisciplinary STEM efforts, particularly in connection to STEM education. As an administrative structure and approval process, the three lead deans of the STEM priority (the deans of Education, Arts and Sciences, and Information Science and Technology) were established as an administrative oversight team, which works through the community chairs and regularly communicates with respective department chairs. In addition, the Vice Chancellor of Research, a long-time champion of the STEM concept on campus, is a frequent advocate, supporter, and mentor to the STEM community chairs, particularly related to STEM grant proposals.

The current members of the STEM Leadership Team are identified below (Table 1). The committee is chaired by the Community Chair of STEM Education. A faculty member who also has an Academic Affairs assignment serves as co-chair, which allows for direct coordination with the Office of Academic Affairs. An assistant chair status is also provided to each of the community chairs so they can easily coordinate among the faculty members both on the committee and leading initiatives across campus. Members are recommended by the community chairs, discussed with the existing membership of the committee, and appointed by the representative dean of a college to help to represent the college. The committee includes a core group of tenured faculty who are well experienced at UNO and who provide additional leadership when initiatives and committee decisions are particularly important or need to be made quickly. The function of the STEM Leadership Team is to advocate, plan for, and undertake bold and synergistic efforts to support the UNO STEM priority and to work closely with UNO colleagues and community partners to advance STEM Education at UNO, in the metropolitan Omaha area, in Nebraska, and across the nation.

Table 1. Members of the UNO STEM Leadership Team

Member	UNO Position	Collegea	Committee Role
Neal Grandgenett	Community Chair of STEM Education Core Leadership	COE	Lead Chair,
Neal Topp	Professor, UNO Academic Affairs	COE	Co-Chair, Core Leadership
Angie Hodge	Community Chair of Mathematics	A&S	Asst. Chair, Core Leadership
Brian Dorn	Community Chair of Computer Science	IS&T	Asst. Chair, Core Leadership
Christine Cutucahe	Community Chair of Science	A&S	Asst. Chair, Core Leadership
Bob Shuster	Department Chair of Geology/ Geography	A&S	Core Leadership
Mark Pauley	Senior Research Fellow, Bioinformatics	IS&T	Core Leadership
Scott Tarry	Professor, Aviation Institute	CPACS	Core Leadership
Dana Richter-Egger	Director MSLCb, Assistant Professor Chemistry	A&S	Core Leadership
Vicki Lentfer	Instructor, STEM Education	COE	Member
Lulia Podariu	Associate Professor, Physics	A&S	Member
Sandy Vlasnik	Lecturer, Info. Systems/ Quantitative Analysis	IS&T	Member
Scott Vlasek	Director, Aviation Institute	CPACS	Member
Michael O'Hara	Professor, Finance and Banking	CBA	Member
Carol Mitchell	Professor, Science Education	COE	Member
Amelia Squires	UNO STEM Outreach Coordinator	COE	Member
Rose Strasser	Associate Professor, Psychology	A&S	Member
Kris VanWyngarden	Graduate Assistant	COE	Student Member

Note: **Administrative oversight and various approvals (such as budgetary expenditures) are provided by the deans in the Colleges of Education, Arts and Sciences, and Information Science and Technology and, in some cases, by the Associate Vice Chancellor of Research.**

a A&S = College of Arts and Sciences; CBA = College of Business Administration; COE = College of Education; CPACS = College of Public Affairs and Community Service; IS&T = College of Information Science and Technology

b MSLC = Math-Science Learning Center

In addition to the STEM Leadership Team at UNO, there is also a group of about fifty faculty members across campus that collaborate regularly with the team on various efforts, such as grant proposals, outreach events, and various "STEMinars," in which faculty with areas of particular expertise—such as inquiry-based teaching strategies, discipline-based education research, or STEM outreach—deliver presentations to the UNO STEM community.

Selected Collaborative Accomplishments of the Community Chairs

As mentioned previously, once appointed, each of the four community chairs worked quickly and collaboratively to plan, organize, and provide leadership for the evolving STEM priority on campus. For almost all initiatives, subgroups of the STEM Leadership Team also contributed significantly and often shared leadership on particular objectives. Some of the key accomplishments of the community chairs and the STEM Leadership Team are described below.

STEM Strategic Plan

One of the most important accomplishments of the community chairs and the STEM Leadership Team, was the STEM Strategic Plan. This plan includes four goals, associated with efforts in teaching, research, service, and structures, that focus directly on the planning for an interdisciplinary STEM context that has been shown to be critical for STEM pathways in universities and within the context of the communities that universities serve (Lansiquot et al. 2011; Singer 2011). The goals associated with such pathway building and context were particularly structured in the plan to align well with faculty annual review categories (teaching, research, and service) as well as the need to build a STEM priority collaborative base (infrastructures), which included various targeted strategies to work together better (such as the need for a STEM Outreach Coordinator). Each of the goals had a series of specific objectives as well as tables that include current status, indicators, and targeted benchmarks. The plan was completed in September of 2013 and took about eighteen months to put into place. It was the result of focused dialogue, as facilitated by an outside strategic planning expert and with assistance in the writing process from a technical writing consultant. The plan is now routinely referenced at STEM Leadership Team meetings and is frequently used as the foundation for deciding which initiatives to move forward with and whether newly proposed initiatives align with that plan. It has also been a fundamental element in grant proposal submission and has been referenced in various grant proposals, as

well as by faculty members in their annual reviews. The STEM Strategic Plan can be accessed at: http://www.unomaha.edu/stem/STEM_Strategic_Plan.pdf.

STEM Teaching Pathways

Trying to do our part to ramp up the production of high quality teachers in the STEM disciplines, the community chairs and STEM Leadership Team worked on program pathways that would allow UNO to graduate high school teachers that had a discipline-based degree in the content area and were still qualified to become a certified teacher. Until this initiative, all teacher education degrees were exclusively from the College of Education, regardless of the discipline. The new parallel pathways allow a student to graduate with a degree from the college of Arts and Sciences and to take each of the required teacher certification courses from the College of Education within a specialized area of emphasis or minor. The new parallel pathways, when investigated, made quite a bit of sense for bringing in new students, without reducing the number of students in the College of Education. In fact, as the courses were closely aligned, the majority of students are now able to easily get a double major. The parallel pathway for mathematics was the first program of this type; it has been very successful, graduating eight students over the two years since it was first approved, with nineteen students in the current pipeline (sixteen of whom will graduate with a double major). We have recently successfully added similar pathways in physics and chemistry, and we are now working on establishing similar pathways in biology and geology (Earth system science). The mathematics program has been seen as quite innovative nationally, and an article describing the program was recently accepted for publication in the internally distributed *Mathematics and Computer Education Journal* (Grandgenett, Matthews, and Adcock, forthcoming).

Supplemental Endorsement in Computer Science and Related Coursework

There is a well-documented critical shortage of computer science teachers (see Astrachan et al. 2011). In addition, P-12 students typically lack access to educational experiences that expose them to both core concepts and career opportunities related to computer science (eg., coding, computational thinking) and this situation has received considerable nationwide attention among the academic community (CSTA Certification Committee 2013; Wilson et al. 2010) and IT industry professionals (http://www.code.org).

As lead by the new Community Chair in Computer Science, UNO is working to meet this challenge by developing multiple pathways to earn a state-recognized supplemental teaching endorsement for computer science and information technology. The first of these is an eighteen-credit-hour undergraduate program integrating fifteen credits of computing coursework plus a disciplinary teaching methods capstone course offered through the Department of Teacher Education. This undergraduate pathway was

approved by the Nebraska Department of Education and became official as of the fall 2014 academic term.

Concurrently, we are developing a graduate endorsement pathway and a new master's degree in Computer Science Education specifically targeting in-service teachers seeking to retrain or improve their foundations in computing. This effort requires new courses to be developed and proposed in the Computer Science Department and some significant assistance and the refinement of a STEM education methods course in the Department of Teacher Education. We were recently awarded an internal University of Nebraska System grant ($35,000) that will help plan for some of the courses to be offered online and to strategically plan additional graduate offerings for mathematics, science, and business teachers who want to cross-certify in computer science/information technology.

NSF STEM Grants

One of the more recent and exciting accomplishments of the community chairs and STEM Leadership Team is newfound success in NSF grants related to the STEM efforts and strategically planned initiatives for the STEM priority. All of the community chairs are experienced grant writers, and when a faculty member begins to conceptualize a grant proposal to NSF related to STEM, a community chair is quickly assigned to help mentor the faculty member and potentially to be on the senior-personnel team. This has resulted in the award of three recent NSF grants that grew directly out of strategically planned STEM initiatives. For example, UNO received in 2014 a $1.2 million student scholarship grant from the NSF's Noyce program that will now pay for 27 four-year scholarships for mathematics majors entering the program starting in the Fall of 2014. UNO's computer science education team was also recently awarded a $1.1 million dollar grant from NSF's Innovative Technology Experiences for Students and Teachers (ITEST) program to collaboratively train middle school teachers and develop interdisciplinary lessons that integrate core computing concepts into existing middle school curricula. Finally, UNO is sharing another $900,000 ITEST grant with the University of Nebraska at Lincoln related to helping middle school teachers and informal educators (in after school programs) to teach STEM topics using wearable technologies. In a climate of increasing competitiveness for securing federal grant funding, we feel these recent successes highlight the impact that a team/community-based approach can have on an institution.

Inquiry-Based Courses in STEM Disciplines

STEM courses are notorious, unfortunately, for problems with retention, as mentioned earlier. Inquiry-based learning (IBL) strategies have been identified as a possible way to deepen content understanding, while building student retention in STEM content courses (McLoughlin 2008; Zitarelli 2004). IBL is a teaching method that engages students in sense-making activities. Students are given tasks requiring them to solve problems, conjecture, experiment, explore, create, and communicate, which are skills STEM professionals engage in regularly (Dostis 2013; Hoachlander and Yanofsky

2011). One challenging and key STEM course on the UNO campus, as on many campuses, is introductory calculus. As lead by the Community Chair in Mathematics, the effort to revamp calculus courses was undertaken both aggressively and systematically. We are now offering several new sections that include a foundational inquiry-based approach, where students discuss the bigger concepts of calculus, engage in thoughtful questions and computations, and make presentations in class, rather than just sitting in a traditional lecture. These sections have been very successful and have modeled the following improvements and benefits, many of which are also now being integrated into the planning for Inquiry-Based Teaching courses:

- 42.2 percent of students in non-IBL calculus received grades of D/F/W versus 20.3 percent in IBL calculus.

- Students who have been in IBL calculus are doing generally better in Calculus II.

- Daily presentations give students a chance to teach each other.

- Several classrooms have been renovated to include tables for group seating and white boards.

- Undergraduate Learning Assistants have been added to the IBL calculus classrooms.

- Mathematics faculty conduct regular meetings with other UNO faculty about IBL techniques.

- Three UNO instructors are attending national IBL teaching workshops.

- A partnership has been established with the University of Nebraska-Lincoln, the University of Colorado -Boulder and the University of Georgia to evaluate success of IBL.

- UNO faculty have had leadership roles at two national IBL workshops in the summer of 2014.

- The description of IBL calculus sections has been modified to highlight active learning.

The next inquiry-based learning course newly approved and underway is "Inquiry-Based Thinking in STEM" for pre-service elementary teachers. This new course is approved as a general education science course and is offered at UNO's Glacier Creek Preserve. In this important course, students engage in inquiry-based thinking to examine STEM concepts related to prairie ecosystems, which is a major elementary-science focus in schools in the Omaha area. The course has nineteen students in this first offering and is going very well, with pre-service teachers conducting inquiry-based earth system science activities that align directly with the science concepts that they will be teaching in the elementary schools. This approach directly confronts the national problem of elementary teachers being less interested in science than in other

areas of the curriculum, which is an attitude that is often passed inadvertently to their students (Brown et al. 2011; National Governors Association 2011). The STEM team working with the course is investigating the evolution of the science attitudes of the pre-service teachers in the course to see if there are any changes.

STEM Learning Inventories

In order to help STEM departments plan instructional reforms to improve STEM pipelines, the newest community chair (Science) has initiated a process to help guide the conversation within a particular department, starting with the Department of Biology. This process is described as a "Learning Inventory" in the STEM Strategic Plan. In brief, the objective is to initiate a guided reflection and discussion amongst faculty on how students are doing within the coursework and to identify clear objectives for students to meet across all courses, to take an inventory of current practices across courses, and to target practices for improvement. This process includes: 1) review of enrollment, retention, and graduation data; 2) a review of space utilization and infrastructure needs; 3) a self-reflection by faculty using a guided rubric; 4) a review of syllabi; 5) discussion meetings with all faculty; and 6) input from an external consultant from the discipline who has implemented this process at an institution of similar size, enrollment, etc. In biology, it is an excellent opportunity to use a new educational reform report, called *Vision and Change in Undergraduate Biology Education: A Call to Action*, which was produced by the American Association for the Advancement of Science (2011). Quite a few follow-up materials to the Vision and Change report have been designed for use by biology departments in reflecting upon needed reforms, such as a set of rubrics designed by the Partnership for Undergraduate Life Sciences Education that can be used by departments to step through a reflective process on potential educational reforms that align with Vision and Change (Aguirre et al. 2013). These materials are currently being discussed with leadership from the Community Chair of Science, with full support from the lead Community Chair in Science Education, and with administrative support. The experienced faculty members engaged in educational reforms at other institutions are also making themselves available for conversations, and one of these external experts will soon be coming to UNO to help to further reflect on the learning inventory process.

The learning inventory effort has started very well in biology, and some of the materials are now also being shared with the UNO Department of Chemistry, which has expressed interest in a similar reflection process and has formed a UNO Community of Practice around chemistry education and supporting student success in introductory chemistry classes. The Community of Practice is a new faculty collaboration structure at UNO, where faculty members meet monthly around a common theme and try to help each other to be more effective in university teaching, research, and service. Another similar effort is being undertaken in computer science. The community chairs are well represented in several of these new campus communities of practice.

STEM Outreach Efforts

As mentioned previously, bringing young people into STEM pathways is critical for the health of the country (Gentile 2011; National Science Board 2010). So part of the STEM initiative at UNO has been to work closely with the community and to participate aggressively in bringing youth into STEM pathways, by contributing to both on-campus and off-campus STEM outreach efforts and by making STEM more "real" for students, which has been shown to be critical to students entering the STEM pathways (Hoachlander and Yanofsky 2011) and for helping students become comfortable with STEM content learning (Brown et al. 2011). The initiatives associated with STEM outreach are quite numerous, are led by various faculty teams, and are now coordinated by a new STEM Outreach Coordinator. Outreach events have included activities such as a four-week Girls Inc. Eureka STEM Camp, where 60 middle school girls, mostly from minority and low socioeconomic families, participate in some exciting STEM activities, including robotics, high-altitude ballooning, and digital media work. In addition, events and institutes have also been undertaken for P-12 teachers, such as the Kiewit Engineering Day, where 40 teachers who teach engineering in the local schools joined 40 Kiewit engineers as colleagues in professional development related to engineering instruction and outreach. In many ways, such outreach builds community partnerships, since the community often tends to synergize contributions around informal educational environments more easily than formal ones (Jehl, Blank, and McCloud 2001). UNO also has participated in many different city- and state-wide events, such as the Nebraska Science Festival, where nearly 600 students (including boy scouts and girl scouts) came to campus for a day of STEM mini-courses and field based activities; or the statewide River City Rodeo, where 300 students and teachers undertook rodeo themed robotics challenges; or the Lights On after School event, which involved 1,500 students in the after school programs with access to twenty tables of interactive STEM activities run by UNO faculty and students.

The Challenges of Establishing a Community Chair at a University

In addition to the benefits related to establishing a community-chair-led effort for building the STEM initiatives or other priorities on a university campus, there are also typically some challenges. First and foremost, there is the need to fund the community chair position or to modify an existing position to have the operational level and resources needed for establishing an effective community chair. At UNO, we had the significant benefit of the vision and generosity of a major benefactor, Dr. Haddix, who helped us to start the program and then to use it as a match for further community chair positions. The yearly stipend, operational budget, and reduced teaching load are all real costs to an institution, to be either covered internally by the college or university or externally by a foundation or private donor. At UNO, we had a mix of such contributions both externally and internally. As with any leader on a campus, it's essential that community chairs have the operational budget they need to implement their vision and related efforts to best serve campus priorities.

Additional challenges are related to identifying and hiring the correct faculty member for the position, either through an internal or external search. The person really needs to be a strong communicator, leader, and team builder who can have candid conversations with colleagues based on their own expertise. Such expertise needs to be relatively broad and should include accomplishments in each of the three areas of teaching, research, and service. Further, community chairs in many ways need to have both content (i.e., in-discipline) and pedagogical expertise, since their leadership may well be based in a specific content department, but they also will need to plan and build initiatives on new ways of teaching and learning in STEM courses. As with any faculty position, these leaders must remain aggressive in their performance in teaching, research, and service, so the candidate that can best balance these needs while helping faculty to achieve their goals is necessary.

Moreover, there is a challenge with the sheer quantity of contacts and communications that need to flow through a community chair. Those contacts, including e-mail, phone, and office visits, can be overwhelming, particularly for new faculty members, and colleagues need to assist that person by being fully aware of the challenges associated with leading initiatives that cross departments, colleges, and community partners. Everyone needs to help the community chair to build the team they need and to undertake true reforms. The community chair must balance a traditional faculty profile but also serve as a major leader—it's a balancing act. In addition, untenured community chairs may need to be helped to ensure that the initiatives that they choose to undertake will also help to steadily move them toward a tenure status.

Finally, the dean and department chairs working with the community chair need to support the chair's leadership with periodic help in providing additional resources when needed, including help from consultants such as technical writers, grant development specialists, and community outreach coordination. For example, the awareness of the expertise and talents in the area of STEM have resulted in UNO becoming the "go to" institution for community events. The ability to create awareness, engagement, and action around STEM initiatives has created tremendous momentum and activity in the Omaha community, which is certainly aligned with our strategic goals. This has resulted in extraordinary opportunities for faculty and students; however, the demands on faculty time became increasingly challenging. Therefore, UNO administration partnered with a community agency to fund a STEM Outreach Coordinator position.

The Next Steps for the STEM Community Chairs at UNO

The next steps for the STEM community chairs, as the academic year moves into 2015, is to support faculty members interested in undertaking efforts as aligned with the STEM strategic plan. STEM-related grants are particularly becoming of interest to other faculty members, and the community chairs are looking for ways to mentor new faculty in STEM-education-related grant writing. Often, discipline-based faculty need

some mentoring to be able to submit STEM-education-oriented grants and to work through needed considerations, such as formal approvals by the Institutional Review Board for the protection of human subjects. The community chairs are already doing quite a bit of grant-related mentoring, and this will no doubt continue to increase as faculty become more interested and the campus becomes more experienced.

A major new priority for the STEM community chairs, thanks to the hires of the Community Chair of Computer Science and the Community Chair of Science, is to support efforts for discipline-based education research (DBER). Many faculty show interest in DBER, as it's a way for them to study their own best practices and to identify creative ways to best engage their students in the classroom. Some example efforts include faculty investigating innovation in the instructional environment or curriculum of their department or discipline or investigating different types of pedagogical interventions and research-based course structures (National Research Council 2012). To complement the ongoing fostering of these initiatives, the community chairs are striving to help departmental reappointment promotion and tenure committees to realize how valuable this type of research is both locally and nationally. Often this support includes a letter signed by the four community chairs to the faculty member acknowledging how critical improving STEM education is for our country and the important role that DBER is playing. It is becoming increasingly identified in the literature that DBER can help to change the culture of STEM departments to be more learning and student-success focused (Anderson et al. 2011), thanks to visionary leaders across the nation who devote their work to DBER.

In addition, the STEM community chairs are looking closely at campus outreach in STEM and trying to help the university outreach organizations to undertake their own strategic planning efforts. For example, UNO's Aim for the Stars program, based in the Department of Physics, is hosting nearly eighty week-long middle school camps on STEM topics and is now engaged with several of the community chairs to strategically plan for the future and to maximize the effectiveness of the curriculum for not only building student STEM interest and content knowledge but also for encouraging students to consider UNO as their institution of choice for later college enrollment.

As the STEM Leadership Team continues to expand its STEM leadership efforts and as other faculty step forward to conceptualize and lead initiatives, coordination by the community chairs and the active support of their deans and department chairs is becoming increasingly important. This support will be aided by a new effort being undertaken to create a short report template that can be used to periodically report on the progress in the STEM Strategic Plan and that can be shared with stakeholders in both UNO and the surrounding community.

Conclusion

The momentum and support for UNO STEM initiatives has continued to accelerate at a pace that has exceeded the expectations of all involved. The community chairs have been the key catalyst to this success. The development, implementation, and ongoing

refinement of the strategic plan has resulted in varied collaborations, from simple to complex, that have engaged an extraordinary number of faculty, university administrators, community leaders, and philanthropists. Such collaborative efforts have helped to support evolving conversations about the potential for a new STEM building at UNO that would include innovative instructional facilities to help further support the evolution of STEM education at UNO and throughout our community.

The community chair concept is perhaps not new to institutions, but it may well be a new approach for focused leadership at an institution for expanding the STEM pipelines. Our experience supports the notion that this challenging task depends upon a close collaborative and interdisciplinary effort, which fully engages community partners. The community chair allows the university to provide STEM pipeline leadership and be in a position to build strong partnerships with local school districts, business and industry, the chamber of commerce, and the philanthropic community to accomplish what could not be accomplished without collaboration. Such strategic collaborations certainly take a much more flexible form of faculty-level leadership than what is often seen at universities. The ability to transcend the various institutional challenges and silos that have been embedded in the STEM educational pathways combined with community partnerships is a powerful recipe for transformational change. The opportunity to connect various units on campus has assisted us in attracting, supporting, challenging, and retaining students who are seeking an innovative educational model that offers various pathways to career opportunities.

Finally, at UNO, we have been fortunate to be able to steadily establish a focused team for leading the campus STEM priority that includes the four community chair positions, the seventeen-member STEM Leadership Team of faculty members, three lead deans, and the many other engaged faculty, staff, and department chairs that have been so supportive of these many different efforts. The STEM journey continues for us, and we are increasingly going together.

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