CUR Focus

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Creating and Sustaining a STEM Undergraduate Research Community: The Symposia of the Midstates Consortium for Math and Science

Introduction

Many undergraduates become members of a disciplinary community of scholars through their participation in faculty-mentored research experiences. For most students, the research experience begins with their having only a vague understanding of the process and challenge of original research. In the weeks, months, or years ahead, they mature significantly as they navigate the various pathways of that first and perhaps other projects (Lopatto 2009; Crowe and Brakke 2008). For many students, an oral or poster presentation of their research results to their peers is an important milestone as they enter these communities of scholars.

According to several well-documented studies of undergraduate research experiences, students who present their research in oral or poster symposia gain additional professional confidence and a broader perspective on science (Seymour et al. 2003; Hunter et al. 2006). A November 2009 article in the Journal of Chemical Education presented a comprehensive study of survey responses from about 80 undergraduates who presented their research results at national meetings of the American Chemical Society (Mabouck 2009). Student respondents reported almost unanimously that presenting their results was a vital aspect of the research experience and that participating in a professional meeting positively impacted their decisions about graduate study and future careers in science. For more than two-thirds of the respondents, their participation in a professional meeting motivated them to continue their research project and attend another meeting. For more than 80 percent of the African-American student respondents, their reasons for attending and presenting included honing their presentation skills, developing self-confidence, and meeting potential graduate advisors. Mabrouk, the author of that research, speculates that attending meetings and presenting research can play important roles in retaining members of underrepresented groups in the science pipeline because they experience social and professional acculturation into the scholarly community at these meetings.

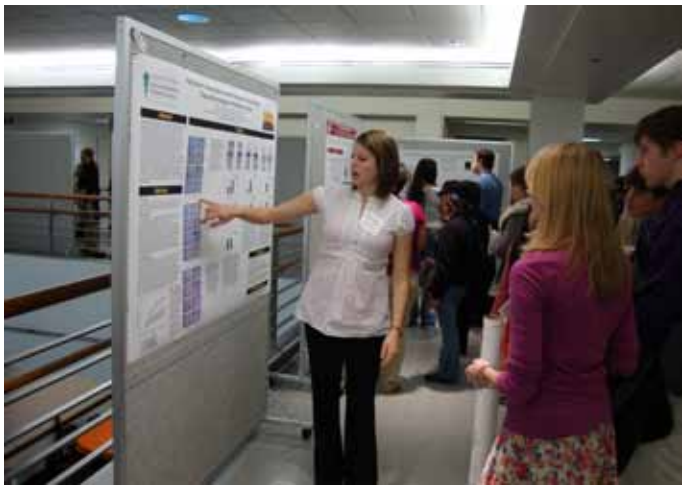
For more than 20 years, the Midstates Consortium for Math and Science (www.mathsciconsortium.org) has hosted annual undergraduate research symposia because the consortium's leadership recognizes the value that these meetings can add to undergraduate research experiences. This article describes these symposia, at which undergraduates present the results of their research to peers and other faculty members within our 13-member campus consortium.

Brief History of the Consortium

The Midstates Consortium for Math and Science (MCMS) originally was called the Pew Midstates Science and Mathematics Consortium because it was founded by a group of ten liberal arts colleges and two research universities through grants from the Pew Charitable Trusts. A $1.4 million grant in 1989, which was renewed for $1.7 million in 1991, enabled the consortium to promote collaboration and professional development opportunities for faculty and students. Since the mid-1990's, the MCMS has been an independently self-funded group of campuses supported by annual dues of $12,000 from each member. The current membership of 13 campuses is listed in Table 1. Each year

Table 1. Current Consortium Member College and Universities

Beloit College, Beloit, WI	Carthage College, Kenosha, WI
Colorado College, Colorado Springs, CO	Grinnell College, Grinnell, IA
Gustavus Adolphus College, St. Peter, MN	Hope College, Holland, MI
Knox College, Galesburg, IL	Lawrence University, Appleton, WI
Luther College, Decorah, IA	Macalester College, St. Paul, MN
St. Olaf College, Northfield, MN	The University of Chicago, Chicago, IL
Washington University in St. Louis, St. Louis, MO	



A student from St. Olaf College presents her poster during one of the poster sessions at the Biological Sciences and Psychology Symposium at the University of Chicago in 2010.

the MCMS offers faculty and students professional-development opportunities that include workshops, undergraduate research symposia, webinars, and funding for collaborations and speaker exchanges.

For more than 20 years, the MCMS has hosted two annual symposia, at Washington University in St. Louis and the University of Chicago, at which undergraduates present the results of their research projects to their peers (Parson 1990). For size reasons, the two meetings have been divided by topics into (1) the biological sciences and psychology and (2) the physical sciences, mathematics, and computer science. The two campuses alternate hosting the two meetings each fall. In even years the University of Chicago hosts the Biological Sciences and Psychology Undergraduate Research Symposium and Washington University hosts the Physical Sciences, Mathematics and Computer Science Undergraduate Research Symposium; in odd years, the meetings switch host campuses.

Students present their work at both oral and poster sessions and participate in panel discussions about graduate school and science-related careers. In addition to student presentations, one or two plenary talks are given by faculty from the host institution and/or from another MCMS campus. Since 2008, one of the plenary lectures at each symposium has been reserved for the faculty member who has won the Janet Andersen Award, named after the Hope College mathematics professor and MCMS director who was killed in an automobile accident in 2005. (For more information about this award, visit www. mathsciconsortium.org/ janet-andersen-award.html.)

For many years, each symposium has attracted from 60 to 90 undergraduate participants and 15 to 30 faculty members. In both 2010 and 2011, the meetings had more than 130 student and faculty participants each, which is at or near the upper limit for the facilities we typically use, including campus classrooms, hotel space, and banquet facilities. Since 2000, the registration and abstract-submission processes have been handled online at www.mathsciconsortium.org.

Current Symposia Details

Goals. The primary goals of the symposia are to provide undergraduates with a professional venue to present their research results to peers and faculty, to provide opportunities for students to interact with other STEM (science, technology, engineering, and mathematics) students and faculty from a range of Midwestern campuses, and to encourage students to consider graduate school in STEM fields. In addition, these meetings have often provided opportunities for students and faculty to see research and teaching facilities at major research institutions and for faculty to network with colleagues from other campuses.

Timing. The events have always been held in the fall, in late October or early November, which allows students to present on research they have carried out during the summer or the previous academic year. We recognize that for students in disciplines or at colleges where academic-year research is more common than summer research, this timing may make it difficult or even impossible for them to participate, but this is certainly not the case for the majority of the students. Fall is also a good time for juniors and seniors who are considering graduate school to attend the panel discussions by current graduate students at the two host campuses. Fall meetings also have fewer conflicts with other scholarly meetings that are typically held in the spring. Most importantly, the fact that our fall meetings have been held for more than 20 years means that they have become part of the culture on many campuses and in many research groups. Students and faculty know when these meetings occur in the rhythm of the academic year, making it possible to plan well in advance when students will present their research results.

Promoting the symposia. Each of the 13 campuses has a faculty member who serves as a representative on the consortium's leadership committee and is the communications conduit for the symposia for students, faculty, staff, and administrators on their campus. We ask these representatives to distribute posters and flyers and send email invitations to faculty and students promoting these meetings each fall. We also promote the meetings in our electronic newsletter, Consortium Connections, which is distributed several times

Table 2. Cost Ranges for the Undergraduate Research Symposia for 2005 to 2010

Expense Category	Description	Cost ranges for 2005-2010
Lodging	Hotel rooms with occupancy of three to four students and double occupancy for faculty	$8,000 – $12,000
Travel	Transportation to the meeting, including airfare, van, bus, or car rental, train fare, and personal vehicle mileage.	$10,000 –$17,000
Meals	Two breakfasts, two lunches, two dinners, and breaks	$6,500 - $8,500
Logistics for the meeting	Bus rental for transportation to and from the hotel and meeting venues, stipends for technical support staff	$1,200 - $2,000
Additional expenses	Room rental, printing, nametags, and other supplies	$1,000 - $1,500

each semester. Campus representatives make sure to inform new faculty about the meetings, especially faculty who mentored research students during their first year or summer of teaching at a consortium member campus.

Finances. As noted earlier, the consortium is funded through annual dues from each member institution; we use those resources to provide programming to students, faculty, and staff at our member campuses at no additional cost. Each campus is invited to send eight students and two faculty members to both of the fall symposia, with all of their expenses covered. Additional students and faculty are accommodated if space is available, and if funding is available to support their travel, lodging, and meals. At a combined cost of about $75,000 per year, these two meetings represent the largest annual expenses of the consortium. Over the last four years, the average cost per participant at the University of Chicago meetings has been $400 and at the meetings at Washington University, $460. Between 2007 and 2010, with 75 to 100 participants at each meeting, the total costs have ranged from $33,000 to $41,000 per meeting. Table 2 breaks that total cost into more detail.

Participants' registration. The online registration, including abstract submission, is available on our website in early September for both meetings. The registration deadline is usually dictated by the hotel deadlines for room and banquet reservations and is usually three to four weeks prior to the meeting. Participants receive a confirmation email once their registration is complete, with additional information about making travel arrangements and other meeting logistics.

Program Frameworks

Since the primary goal of these meetings is to provide venues for students to present their research results to their peers, we begin creating the weekend's program by scheduling the oral and poster sessions. On their registration form students indicate a preference for a poster or a 15-minute oral presentation, and we are almost always able to accommodate their preferences. Once we have the complete registration list, we begin trying to cluster talks according to similar topics. In some cases we begin the meeting with a poster session on Friday evening after the opening dinner, but it is more common for the student presentations to begin Saturday morning. Faculty members attending the meetings are invited to be facilitators at the oral presentations. Based on the number of students presenting posters and the capacity of the space for the poster sessions, there are usually two or three 60- to 90-minute poster sessions during the weekend. A printed symposium program including a detailed schedule of the oral and poster sessions, all of the presentation abstracts, and a contact list of participants' names and email addresses is prepared and distributed to all participants.

As noted earlier, the two Janet Andersen Lecture Award winners are each invited to present a seminar at one of the meetings. In addition, a faculty member from each of the host universities is usually invited to present to the full group. A panel discussion with current graduate students, often including alumni from member colleges, is always offered, along with a session on careers in STEM fields presented by faculty and consortium alumni working in STEM careers in the Chicago and St. Louis areas. These presentations are usu-

Undergraduate Research Symposium
Physical Sciences, Mathematics and Computer Science
The University of Chicago

Program Schedule

Friday, November 6, 2009

5:00 – 6:30 p.m.	Registration	Holiday Inn Hotel
6:30 – 7:30 p.m.	Dinner Buffet	Holiday Inn Hotel
7:30 p.m.	Greetings Professor John Frederick, Symposium Organizer, The University of Chicago and Karen Nordell Pearson,Director Midstates Consortium, Hope College	Holiday Inn Hotel
7:45 – 9:00 p.m.	2009 Janet Andersen Award Lecture *Climate Change in the Polar Regions* Professor Robert Jacobel Physics Department St. Olaf College	Holiday Inn Hotel

Saturday, November 7, 2009

7:45am	Load the buses outside the hotel	
8:00 am	Transportation to University of Chicago Campus	
8:30 - 9:10am	Breakfast at The University of Chicago Kersten Physics Teaching Center	KPTC-206
9:15 - 10:30am	Oral Presentations of Student Papers Session 1: Chemistry Session 2: Mathematics and Computer Science	KPTC-120 - Session 1 KPTC-103 - Session 2
10:30 – 10:45am	Break	KPTC-206
10:45-12:15 am	Oral Presentations of Student Papers Session 3: Chemistry Session 4: Physics	KPTC-120 - Session 3 KPTC-103 - Session 4
12:30 – 1:30 pm	Lunch and Discussions	KPTC-206

1:45- 2:15 pm	Oral Presentations of Student Papers Session 5: Engineering and Radiology	KPTC-120
2:30 pm	Load buses at Kersten for Shedd Aquarium, Field Museum of Natural History and Museum of Science and Industry	
5:00 pm	Load Buses at Museums and Aquarium to return to campus/Kersten	
5:30 - 7:00 pm	Dinner and Poster Session 1	KPTC-206 and KPTC-2nd floor Hallway
7:15 pm	Buses leave for the Holiday Inn Hotel	

Sunday, November 8, 2009

8:00am	7:45am Load the buses or campus vans and cars to drive to The University of Chicago; park in free Ellis Ave. Parking Structure*, 5525 S. Ellis Avenue	
8:30 - 9:10am	Breakfast at The University of Chicago Kersten Building Poster Set-up	KPTC-206
9:15 - 10:00am	Pamela Martin Assistant Professor Geophysical Sciences Department University of Chicago Lecture	KPTC-120
10:00 – 11:15 am	Poster Session 2	KPTC-2nd floor Hallway
11:30am	Complete Meeting Evaluations Final Remarks	
11:45am	Box Lunches Available	KPTC-206
12:00pm	Transportation to O'Hare airport	

*N.B. There is no longer any free street parking in Chicago; it has become very expensive, and it is now 7 days a week. There are pay boxes on Ellis Ave. that take credit cards! I would recommend our Symposium Participants who drive either day use the Ellis Avenue Parking garage at 5525 S. Ellis. Although free, drivers should take a ticket when entering. When they return to their cars, they should first stop by the payment machine to have their ticket "validated"— should be free.
And needless to say in any city, participants should never leave luggage, laptops or valuables visible in parked cars because of possible break-ins.

ally offered as parallel sessions over lunch on Saturday. Meals and breaks provide important networking time for students and faculty to interact informally. A sample schedule for the 2009 meeting in Chicago follows.

[[see PDF attachment entitled "Symposium Program"—include at this point]]

Participation and Evaluation

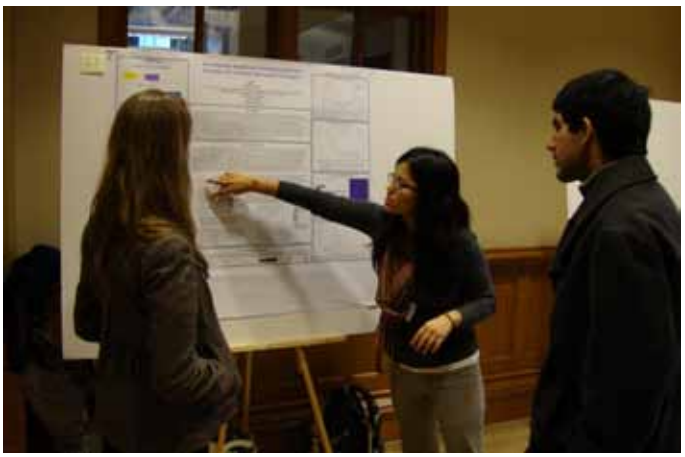
Over the years, as opportunities for undergraduates to present their research have proliferated, the consortium's leaders have discussed the value of continuing our symposium. Based on feedback we get from the students and faculty, however, these meetings remain an important offering for students as they develop and mature as scholars, for three main reasons. First, about half of the students who come to these meetings are presenting their research in a professional setting, off-campus, for the first time. Our symposia are less intimidating venues for presentation than larger, disciplinary regional or national meetings that may have hundreds or thousands of professionals in attendance. Many faculty members encourage their younger and less-experienced students to present at this meeting, with the understanding that should they persist in their research programs, they will have the opportunity to present at a larger research conference in subsequent years. Second, students and faculty enjoy the opportunity to network with other students from fairly similar Midwestern colleges. Students make clear on the evaluations that they consider the opportunity to meet and "talk shop" with other students who are serious about science and research to be a highlight of the weekend. Third, students and faculty attend because of the strong international reputations of the two host institutions. For students beginning to think about graduate school and other post-baccalaureate opportunities, visiting the University of Chicago and Washington University in St. Louis and hearing from current graduate students can be eye-opening. The universities, in turn, have found these events to be of value in recruiting highly capable graduate students from the pool of attendees.

Participants complete an evaluation form at the end of each meeting, and we have compiled hundreds of comments from participants demonstrating the overwhelmingly positive experience most students and faculty have at the meetings. Responses from students and faculty demonstrate the ways in which the goals of the symposia are being met for the vast majority of participants. According to student responses, the most valuable parts of the meetings are presenting their research, fielding questions about their projects, meeting other students and faculty, and learning about graduate school. Table 3 gives some examples of the most consistent responses of students and faculty to open-ended questions about the symposia. These responses are similar to those found by Seymour et al. (2003), Hunter et al. (2006) and Mabrouk (2009) in their studies.

Table 3. Representative Comments from Participants to Open-Ended Questions on Post-Symposia Evaluations

What were the most enjoyable and useful aspects of the symposium?
• The poster presentations and lunch time workshop. I loved being able to ask questions of the graduate students. (student, 2007) • Presenting my research. I feel that it is important to continue to learn now to present effectively. (student, 2009) • [The] poster presentation [was] good practice and motivated me to think deeper about the project. (student, 2009) • Seeing my students' field questions about their posters in a non-threatening environment. (faculty member, 2009) • The most enjoyable [parts were] interacting with other students and seeing the city. Most useful was presenting and listening to other students. (student, 2010)
What is your overall assessment of the Symposium?
• It was great. I was excited to be able to attend, and I think it's been an important experience for me as a future graduate student. Being able to share your work is exciting and fun. (student, 2007) • Very good. The quality of the presentation was a lot higher than that of any undergraduate conference I had previously attended. (faculty member, 2007) • The Symposium was both very interesting in all the research presented and a very fun way to meet new people. (student, 2009)

When asked if they would recommend this meeting to other students, the answers are overwhelmingly "yes!" When asked for constructive feedback about ways to improve the meetings, student and faculty comments usually say that: (1) the weekends are too packed with activities and presentations, (2) participants need more time for touring departments and labs on the host campuses, and (3) participants would like a more even distribution of disciplinary participation, especially more presentations in psychology and computer science (which is, of course, dependent on applications received).



A student from Hope College discusses her research with other participants at the Physical Sciences, Mathematics and Computer Science Symposium at Washington University in 2010.

We have not gathered data on how many students go on to present at other regional and national meetings, nor do we have data on the numbers of our student presenters who pursue graduate study. However, anecdotal evidence gathered through conversations with both students and faculty indicates that significant numbers of students who have attended these meetings go on to present at other meetings and attend graduate school.

The leaders of the consortium routinely engage in lively conversations about how to continue to make our symposia enjoyable and valuable to students. Recently, we have heard from participants that it is becoming harder to be away from campus for such a long weekend. The symposia begin on Friday evening and conclude about noon on Sunday. With the travel time factored in, participants make a three-day commitment to attend these meetings. Based on that feedback, in 2011 we hosted symposia with condensed schedules; they began on Friday evening and concluded on Saturday evening after dinner.

Conclusions

Well over 3,000 students and faculty have participated in the undergraduate research symposia hosted by the Midstates Consortium for Math and Science over the past two decades. These symposia, held annually in the fall at two private research universities for participants from 13 member colleges in the upper Midwest, have contributed to creating and sustaining a STEM undergraduate research community for consortium faculty and their students. This successful program might serve as a template for others who wish to establish a similar undergraduate symposium series.

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