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Enhancing the Integration of Research and Education Using an Interdisciplinary Undergraduate Research Symposium

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Introduction

In recent years there has been a nationwide emphasis on efforts to integrate research and education in the curriculum at both graduate and primarily undergraduate institutions (NAS, 1996; NSF, 1996). Many colleges and universities now emphasize the role of undergraduate research as part of their overall institutional vision and some of the country's leading science foundations, from the Howard Hughes Medical Institute to the National Science Foundation, have made undergraduate research an important element of their funding strategies (Fortenberry, 1998).

Effectively integrating education and research across an entire campus, however, is a challenge. Different divisions, or even departments and programs within a division, can have different attitudes toward enhancing undergraduate research, or vary in their commitment to this goal. Promoting a culture of research across campus requires some form of institutional consensus and a common focus to help achieve this objective.

Undergraduates who conduct research frequently present the results of their research as part of year-end class projects, in department- or program-specific research or honors presentations, or with their faculty mentors at disciplinary regional or national meetings. Students less frequently have the opportunity to share the results of their research with interdisciplinary audiences or with peers from other departments and programs on their own campus.

To address this need, several organizations and institutions host multi-college research symposia targeted at undergraduates, such as the annual National Conference for Undergraduate Research (NCUR) meetings, the Pew Undergraduate Research Symposia in Mathematics and

the Physical Sciences, and events associated with the Council on Undergraduate Research (CUR) such as Posters on the Hill. A growing number of research universities have developed successful all-campus research events. For example, Carnegie Mellon University holds an annual "Meeting of the Minds" event that provides opportunities for students to share projects through oral, poster, and artistic presentations. A small but growing number of four-year colleges have instituted such events as well.

This paper describes how an undergraduate research symposium was developed and implemented as one component of a multi-year effort to strengthen the research culture at Colby College, a four-year, highly selective, undergraduate liberal arts college in central Maine. This symposium emerged from diverse efforts to encourage the integration of research and education across campus, most recently facilitated by a major grant from the National Science Foundation's Award for the Integration of Research and Education (AIRE) program. We describe the background and goals, the practical problems and pitfalls, and the lessons we learned from implementing this event. We conclude by discussing the role of an undergraduate research symposium as a unique catalyst for promoting a collective vision of undergraduate research across an entire campus, particularly at liberal arts colleges.

Colby College is not the first school to initiate an all-campus undergraduate research symposium. However, we believe our college-wide commitment to enhancing education through research and our experiences developing this celebration of research give us an opportunity to share the lessons we have learned with others who are seeking ways to enhance the integration of research and

education and/or are developing an undergraduate research symposium. We believe a campus-wide research symposium is a valuable way to celebrate research, to promote research activities within and beyond campus, and ultimately to further encourage a culture of research on campus.

Setting the stage

Colby College, like many of its peer institutions, has a long tradition of emphasizing student research. Some individual departments and programs have had annual research symposia for several decades. The Department of Biology has had a special event for student presentations, the Department of Chemistry had held year-end poster presentations, some departments and programs have held special sessions for honors presentations, and individual courses frequently set aside days at the end of the semester for student research presentations. The relatively large number of events, however, did little to focus attention on the broader culture of research across campus and tended to balkanize these events among different disciplines, departments, and programs.

Colby also has a lengthy tradition of student independent study and of recognizing the integration of teaching and research on the part of faculty and students. In the early 1960's the college was the first institution in the United States to introduce the concept of a one-month inter-term between the traditional fall and spring semesters. This 40-year old "January Program of Independent Study," or "JanPlan," provides opportunities for faculty to offer unique courses or intensive research opportunities. Beginning in the early 1990s, the college made a special commitment to enhancing undergraduate research opportunities in the sciences through its "Science Plan for the 1990s," a long-term strategic plan that set out specific goals and objectives for encouraging growth in interdisciplinary learning and whose theme was "education through research." As a result, a current college goal is to spread this theme to other academic disciplines outside of the sciences and to engage as many Colby students as possible in significant research projects that lead to presentation of their results before peers, at professional meetings, and in refereed publications.

One product of this planning effort was the college's success in applying for a National Science Foundation (NSF) Award for the Integration of Research and Education (AIRE) grant in 1998, one of only 10 such awards in the nation (see www.colby.edu/NSF_AIRE). As part of this

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Faculty and students who collaborate on research should look to the . . .



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award, the college brought five post-doctoral fellows to campus, one each in biology, chemistry, environmental science, geology, and physics and astronomy, to help enhance existing courses and to develop new courses and to provide "activation energy" for enhancing undergraduate research opportunities in these areas (Nyhus et al., in review). The authors were instrumental in organizing and implementing this research symposium as part of the goals set forth in the NSF-AIRE proposal.

Goals

The Colby Undergraduate Research Symposium is intended to give greater recognition on- and off-campus to student research, to provide incentives for high quality work, to encourage a higher level of participation in research among the student body, and to draw external attention to Colby's experience in providing undergraduate research opportunities. The event is intended also to encourage the development of more courses with project-based learning components. In the longterm, it is hoped this new tradition will foster further efforts to integrate research and education across campus in disciplines outside of the sciences, to develop a culture of research and scholarly exchange among students in different departments, and to provide a visible forum to celebrate research on campus. The symposium is designed to offer opportunities to students across the campus to present papers, posters, and exhibits.

Student participation

We experienced considerable growth in the number of departments and programs as well as the number of students participating over the two years this event has been held (Table 1). To put these numbers in perspective, the college currently has 35 different departments and programs and a student body of approximately 1,800 students. In 2001, 60 percent of all departments and programs participated and approximately one-fifth of junior and senior students presented results of their research at this event. In the first year, there were 59% presenters were from the natural sciences, 34% from interdisciplinary studies, 5% from social sciences, and no participants from the humanities. In the second year, 46% of presenters were from the natural sciences, 42% from interdisciplinary studies, 8% from social sciences, and 4% from the humanities. Many more students came to hear and view these presentations. This high and increasing level of participation indicates considerable interest in this event on campus. Given the number of presentations that could still be added and the low participation from certain segments of campus (e.g., social sciences, the performing

arts), we have little doubt this event still has considerable growth potential. Additional information and a copy of student titles and abstracts from both years can be found at the web site developed for the research symposium: www.colby.edu/sturesearch/ressymposium.

The event's emphasis on research, the limited involvement of the performing arts, and the large number of presentations from the natural sciences was driven in part by the research-oriented goals of the AIRE award, the history of research presentations in the departments of the Natural Science Division, and the disciplinary makeup of the organizing committee. To increase the participation of students in the performing arts and humanities, students are now invited and encouraged to participate with "non-research" exhibitions, such as poetry readings, art exhibits, and musical performances.

Planning considerations

We provide the following discussion of our experiences and lessons learned as a starting point to stimulate ideas and discussion concerning how undergraduate research symposia can help to expand the integration of research and education, and to serve as a guide for other schools who are considering initiating or expanding their own undergraduate research symposia.

Organizing committee and allocation of resources

The ad hoc organizing committee for this event evolved from the NSF-AIRE grant steering committee. The original AIRE proposal identified the fellows as important elements in the development and organization of this event. In the first year, NSF-AIRE fellows, an AIRE faculty member, and the Dean of the Faculty were the principal organizers. By the second year, a second AIRE faculty member was added to the core organizing committee, with nominal assistance from the division chairs. Departmental chairs and program directors provided additional support by encouraging faculty and students to participate, but no formal campus-wide meetings were convened. Discussions are underway to formalize this process to ensure broad support from across the campus, and to ensure participation by all divisions on the organizing committee.

In the first two years, no formal allocation of staff support was requested or made. Nevertheless, departmental secretaries and student research assistants on an as-needed and as-available status provided considerable assistance. The time commitment of the core organizers was

	2000		2001	
	No.	Total student authors and co-authors	No.	Total student authors and co-authors
Departments and programs	9	na	21	na
Student presentations				
Oral	23	32	43	53
Poster	15	21	19	27
Associated	8	22	91	191
Total student presentations	46	75	153	271

Table 1. Number of departments, programs, and students participating in the 2000 and 2001 Colby Undergraduate Research Symposia.

substantial, with two people allocating close to 50% of their time to this event in the weeks preceding the event. As this event expands, additional support is coming from various areas of the campus. For example, the college has allocated staff time for web development from its technology support office to develop a web site for electronic submission of papers by students that will automate much of the process. Not only will the submission process be made more efficient, updating of the web site pages will be automated and the need for tedious reformatting of submissions to produce the symposium program will be reduced considerably. To ensure the sustainability of this annual event after completion of the AIRE grant, the Dean of Faculty has allocated stipend support for the lead faculty organizer.

Institutional support and participation

Support from the college administration has been central to the success of the symposium. Early in the process, meetings were held and support received from the Dean of Faculty and division chairs. Important announcements were sent to faculty under the aegis of the Dean of Faculty. Announcements to students came from the Dean of Students and chairs of their major department or program. Advertising also played a major role in encouraging student and faculty participation. In both years, campus-wide announcements were sent by electronic mail. In the first year, these were limited to department/program heads and faculty; in the second, this was expanded to all students and a symposium web site was

developed. Posters, printed professionally the second year, were published and placed strategically around campus to encourage submissions and then to advertise the event itself. Regular announcements appeared also on Colby's campus-only and public web sites and press releases were distributed. As the event approached, a number of individual faculty who had sponsored student research projects or who had taught project-based classes, as well as department the organizers contacted heads, individually. This personal contact contributed to the almost doubling of student participation between the first and second years.

It is a challenge at first to get students to participate as presenters as well as to attend these sessions as audience members. We found the battle was only half over when students signed up as presenters because we also wanted to reach out to students who were not involved in research being presented. In addition to print and electronic advertising, some faculty encouraged their students to attend sessions and the keynote address as part of their classes. This encouragement almost certainly inspired — or at least compelled — some students to attend who may not have otherwise done so. We feel it is particularly important to target first-year and sophomore students to attend in order to develop their interest in participating in research and in the symposium in future years.

Some faculty initially felt that the new symposium might threaten long-standing departmental or program events.

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This led us to clarify that the event was not intended to supersede existing programs but to strengthen them by providing a larger forum for students to share their research experiences in front of their peers. The all-campus symposium has enabled disparate events to be advertised under a single umbrella, titles and abstracts to be published in a single document, and has provided a central venue for "independent" talks and posters. For example, in the Department of Biology a "Biology Undergraduate Research Symposium" held annually for years was initially organized and advertised as a separate event. By the second year, this dual advertising was eliminated and the department's presentations are now an integral session within the all-campus symposium.

To provide flexibility for students who had scheduled their own research talks, faculty who had scheduled course presentations, and departments that had scheduled honors presentations before they were aware of the research symposium, the opportunity was provided to include their titles and/or abstracts as "associated presentations." These associated presentations were listed in the proceedings and students could submit abstracts, but the talks were given on dates outside of the formal two-day symposium. Some of the associated presentations would have occurred without the research symposium as part of existing course or departmental or program requirements (e.g., final presentations in research courses or honors theses), but these presentations gained campus-wide exposure and a chance to have a published abstract for those who submitted them. In addition, by compiling this list, we hoped to encourage faculty to include project-based components in their courses. Since the symposium was initiated two years ago, there has been an increase in the number of courses across campus with project-based or research-based components. In large part this category simply reflected our interest in being as inclusive as possible and the acknowledgement that some faculty and programs had already established dates for these events that did not coincide with the formal two-day event. We expect that in future years the number of associated presentations will decrease as awareness of the event increases, the dates become institutionalized, faculty begin to include this event in their class syllabi, and departments and programs plan their honors presentations and senior theses around this event.

What did we learn?

Involve a broad range of people and programs: Building a clear communication system among organizers, deans, department and program chairs, faculty, and ultimately students is important to encourage participation and to

facilitate planning. We have recognized the need to assemble an organizing committee representative of the entire campus, with support from the Dean of Faculty and Dean of Students, to encourage planning and discussion among different segments of the campus community. Students could play a larger role in managing numerous aspects of the event, such as preparing the proceedings, advertising, and setting up.

Consolidate events: Having many different events at the end of the semester spread among many different departments and programs crowds the calendar and almost guarantees that few faculty or students from other disciplines will attend each event. By providing a single program and abstracts, a central location, and a focused time schedule, students who might normally have had only a handful of people in the audience were standing before dozens of other students, faculty, staff, and visitors. At the 2001 event, every room had standing room only audiences for at least part of each of the two days. Convening as many sessions as possible in one location increases opportunities for people to visit multiple sessions, facilitates organization, and increases multi-disciplinary gatherings.

Encourage participation from students who receive college research funding: In the first two years, no students were obligated to participate. In future years, students who receive funding from the college will be expected to present the results of their research at the all-college symposium.

Encourage participation from students who enroll in project-based courses: Participation from students in project-based courses would offer an opportunity for faculty to encourage additional student involvement and possibly further motivate students to enroll in project-based courses.

Use the Dean of Faculty and Dean of Students office: We found that messages that came from the Dean of Faculty and Dean of Students carried more weight and were more likely to be read than messages tucked away in more general campus announcement email lists from a faculty member with a disciplinary home.

Introduce students early: In the long-term, the Admissions Office could play a role in disseminating information about the event and adding this to tour and information sessions. This would help to build an awareness of the research culture among prospective students starting with their first contacts with the campus.

Encourage diverse formats: Research presentations in the sciences often rely on talk or poster formats. We found that students who presented using other formats (e.g., music students using stereo equipment as part of their talks) helped to broaden the interest in the presentations. In coming years, we plan to expand the interdisciplinary nature of the event by including additional components not well represented in past symposia, such as the student art show, the senior art show, and the senior recital. In addition, we plan more inclusive coverage of department and program honors programs and hope to add additional courses to the list of courses already associated with the symposium.

Keynote speaker

The keynote speaker played a prominent role in both years' events. Inviting a prominent, nationally-recognized keynote speaker helped to promote and to provide a larger context for the research symposium. We sought someone with a strong professional reputation who was nationally-known, broadly interdisciplinary, could appeal to a broad spectrum of students, involved directly or indirectly with student research, an effective and motivational speaker, and who could also participate in classes or provide information on graduate school (or other related information) to students. Funding for an honorarium and travel expenses for the speaker came from a campus-wide, endowed lecture fund. Miscellaneous additional expenses were met by the Dean of Faculty. Total expenditures for the annual research symposium have been \$4,000 to \$5,000.

In last year's event, the speaker talked to two different classes about his research and met with several groups of interested students regarding graduate school opportunities and campus greening issues. Students were enthusiastic about his presentations and this helped to build attendance and to further advertise the research symposium itself.

What did we learn?

Pick a strong keynote speaker: Picking the right speaker for the keynote address who can also talk with students about research and graduate opportunities can help to build positive momentum for the symposium.

Combine speakers and funding sources: Rather than finding funds for a speaker unique to this one event, it would be helpful for departments and programs with designated speaker funds to co-sponsor a prominent

speaker as part of this event. Alternatively, having speakers from different divisions on campus for any given year would also help to draw attention to the event from all corners of campus and hopefully increase participation from these divisions.

Coordinate major events on campus to avoid conflicts with the keynote address: This year we are working with the Dean of Students Office to schedule the presentation by the college teaching award winner to occur as part of the symposium activities, giving greater visibility to both events.

Planning and scheduling

The event's location was an important consideration and scheduling was a major part of setting up this event. After the inaugural event, at which talks and presentations were scheduled in two different buildings, we realized the value of having a central location as a unifying element. The second year, presentation rooms were reserved well in advance and located adjacent to one another. One large room was set up for poster presentations. Three adjacent rooms were set up for talks. This format allowed people to attend multiple sessions and virtually everyone to view the poster presentations set up nearby.

Classes were not formally cancelled for this event, although some faculty with project-based courses used their class time to enable students to present papers and others encouraged students to attend the event. Non-presenters were not required to attend, although many faculty and departments encouraged attendance by their majors.

What did we learn?

Start early: With an event of this magnitude, planning is everything. Despite setting aside rooms almost one year in advance, much of the actual organization for the event was still carried out within the last two months. A year-long schedule and timeline would help to reduce the number of "crisis" days just before the event, even though inevitably there will be a busy period after students finally submit their titles and abstracts. As this tradition develops, faculty and students alike will be able to plan for the event earlier in the year. This is important for research-based courses and seminars so that student presentations can be scheduled appropriately.

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Coordinate scheduling and support: Considerable time and effort went into making sure that facilities were organized (including rooms, room set-up, and refreshments) and that the students' audiovisual (AV) needs were met. Having an early estimate of the number of students likely to participate facilitates room scheduling and planning. Students had different AV needs. We requested that all students submit this information when they submitted their abstract. This decision allowed the AV staff to ensure that each room was equipped with the necessary projectors, computers, and other presentation equipment. A separate room was set up with similar AV equipment so students could test their electronic presentations beforehand. Using a web submission system this year will simplify scheduling of presentations as well as facilitate meeting audiovisual needs of the speakers.

Encourage faculty to plan for the event: Early notification and repeated announcements in the fall and early in the spring semesters would undoubtedly help to ensure that faculty were aware of the event and help to eliminate scheduling conflicts. For example, a talk by the recipient of a prestigious teaching award was scheduled late and conflicted with the symposium keynote speaker, possibly reducing attendance at both talks. Additional publicity could help to encourage faculty with research students, advisees, or project-based courses to include this symposium in their schedules and syllabi.

Use session chairs: Session chairs were identified before the event and their names were included in the symposium program. These chairs were responsible for introducing speakers and ensuring the talks remained on time and for helping to troubleshoot problems with audiovisual equipment. Last year faculty served as session chairs, but in the past students have served effectively in this role at department- and program-specific symposia.

Keep concurrent sessions synchronized: Speaking schedules and breaks among different sessions were initially scheduled to be at the same time. Last-minute scheduling changes altered this. In future years, greater effort will be made to synchronize these to reduce noise and to facilitate movement of people among sessions.

Schedule mixed sessions: Some sessions were thematic; other sessions were interdisciplinary. We found advantages with both formats. In the former, such as a session with mostly biology students, it was possible for interested faculty and students from those departments and

programs to hear talks by people they knew and topics they were familiar with all at one time. For some sessions, however, this meant that turnout was rather low. In the latter, turnout tended almost always to be high and there tended to be a more formal atmosphere as students faced a large group of people they often did not know.

Provide refreshments: We found that having refreshments available during session breaks and between sessions was a successful strategy that provided faculty and students an opportunity to discuss recent talks. We set up the poster sessions adjacent to this area to encourage people to walk through this area during these breaks. In hindsight, this addition appeared to be an effective tool to encourage conversation about the talks and posters and to keep visitors from leaving immediately after a session they had attended.

Web site and proceedings

Students were given specific deadlines for submitting proposed titles and final titles and abstracts. These on-line submissions were organized into a final program and abstract document. This document served a valuable role in highlighting the interdisciplinary nature of the event, giving students a hardcopy and an electronic document they could cite in their resumes, and serving as a tool to advertise the event to people not yet involved.

A symposium web site, www.colby.edu/sturesearch/ressymposium/, was developed the second year. This site provided information about calls for papers and posters, including deadlines, formats, and regular updates; information about the keynote speaker; a list of participating departments and programs; and tips about giving talks and poster presentations. After abstracts were submitted, the site also displayed the schedule and abstracts.

What did we learn?

Automate submissions: A major time consideration for the organizers was sending out and addressing email queries, submissions, and changes. A web-based submission process would reduce significantly the amount of time needed to do this and would enable students to update and edit their submissions on their own. This year we will be automating this process and allowing students to submit and to access their material on-line. This will reduce the time spent organizing this information

and will hopefully reduce errors as well.

Conclusion

We are confident that this annual event has had a positive influence on Colby's efforts to encourage undergraduate research on campus. From the enthusiastic response of students and faculty we believe this interdisciplinary symposium has already become a key component and a very visible manifestation of the college's efforts to build a strong research culture on campus, to encourage the integration of research and education, and to celebrate student research.

Students benefit by gaining an outlet to share the results of their hard work with a larger and more diverse group of their peers. They develop skills necessary to present their research results effectively, receive feedback on their work, and gain a published abstract for their resumes. It also encourages students to consider graduate study or employment in research-oriented fields. Younger students are exposed to the many opportunities available for research on campus.

Faculty benefit by showcasing their students' research, whether based on the faculty member's own research, a student independent or honors research project, or as part of a research-based course. The visibility of the event may help to build momentum and to encourage faculty to add project-based learning components to their courses and to encourage other students to undertake research projects.

The college benefits from the opportunity to highlight its commitment to undergraduate research as an admissions, recruiting, and fund-raising tool. It benefits by gaining an additional event to show prospective students, donors, and alumni that many students are involved in numerous, diverse, exciting, and vigorous research programs across many disciplines on campus.

Ultimately, an all-college undergraduate research symposium is both a practical forum and a symbolic event that serves as an umbrella for student research presentations. A multi- and inter-disciplinary symposium both highlights and enhances the integration of research and education by helping to build a culture of research across campus. Over time, we believe this event can have an impact on the curriculum by encouraging more faculty to develop hands-on, research-based learning in their courses. Additionally, we believe that this event can serve as a catalyst for encouraging additional undergraduate research opportunities on our campus and suggests a

model for other undergraduate institutions attempting to enhance the integration of research and education.

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Philip Nyhus recently completed two years as a National Science Foundation Award for the Integration of Research and Education (NSF-AIRE) postdoctoral fellow in Environmental Science at Colby College. He will be applying his experiences to his new position as assistant professor in the Department of Geosciences and the Environmental Studies Program at Franklin and Marshall College in Lancaster, Pennsylvania.

F. Russell Cole, Oak Professor of Biological Sciences, is a member of the Department of Biology and the Advisory Committee for the Environmental Studies Program at Colby College. He has served as chair of the Department of Biology and the Division of Natural Sciences. He is currently the Project Director for Colby's NSF-AIRE grant.

David H. Firmage, Clara C. Piper Professor of Environmental Studies, is a member of the Department of Biology and is affiliated with the Environmental Studies Program at Colby College. He has served as the chair of the Department of Biology, as the Director of the Environmental Studies Program, as the chair of the Interdisciplinary Studies and Natural Science Divisions.

Ed Yeterian serves as Vice President for Academic Affairs and Dean of Faculty at Colby College. He has been a member of the Department of Psychology since 1978 and has been involved in Colby's education through research efforts for several years. He is currently Principal Investigator for Colby's NSF-AIRE grant.

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