

## **Change Remains Constant: Faculty Mini-Grants Facilitate Undergraduate-Curricular Reform at Colorado School of Mines**

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### **abstract**

Educational institutions resist change, including those in engineering and science. Elaine Seymour's work on change in Science, Technology, Engineering, and Math (STEM) fields identifies the locus of change as critical to its success; that which emerges both from top down and bottom up is the most lasting and effective.<sup>[1]</sup> Seymour and Hewitt also identify the need for change: without it, engineering and science programs may lose some of their best students to other fields.<sup>[2]</sup>

At Colorado School of Mines (CSM), undergraduate curricular reform emerged from faculty committees and administrative imperatives to improve education, university-wide. Between 1997 and 2001, CSM disseminated faculty mini-grants to enhance classroom innovation and adaptation. Funded proposals focused on curricular reform, better classroom use of technology, and advancing engineering education.

Individual faculty members or teams applied for up to \$5000 to design, develop, and/or deliver courses and materials. A faculty committee granted the awards based on the proposals'

- ◆ educational soundness,
- ◆ meeting essential criteria in CSM's revised curriculum,
- ◆ feasibility for completion within a summer session.

As seed money for change, the program was a good institutional investment because the grants affected the faculty recipients, their colleagues and departments, and students at all levels. Within Seymour's change framework, this program encouraged buy-in for the curricular reform from top-down and bottom-up.<sup>[1]</sup> Every academic program on campus received funding, sparking broad interest in engineering education among disciplinary faculty.

The paper discusses three cases and their roles in changing CSM's engineering-education landscape and explores the mini-grants' long-term effect on the CSM curriculum.

## introduction

In January 1997, Colorado School of Mines received from the National Science Foundation a twenty-four month grant entitled "Programs, Pedagogy, and Process: Institution-Wide Improvement of Undergraduate Education at the Colorado School of Mines." The interdisciplinary faculty research team headed by the Vice-President for Academic Affairs included members from Chemical Engineering, Mathematics and Computer Science, Liberal Arts and International Studies, Chemistry, Geophysics, Geology and Geological Engineering, and Electrical Engineering. The investigators anticipated that each of the 2100 undergraduates at CSM and all of the 180 faculty would be affected by the far-reaching potential of the grant.

The investigators requested funding to continue revision of the entire curriculum at the college, in light of faculty and student evaluations, as well as national calls for reform of engineering education. Having previously developed a revised university mission statement, accompanied by desirable graduate attributes, CSM now sought to continue its reform by incorporating a design-across-the-curriculum program, systems courses, and integrated humanities and social sciences programs. Assessment and continuous improvement of the reforms were to be implemented alongside the new courses and philosophy. Additionally, the research team sought funding to enhance the university's Office of Teaching Effectiveness; in requesting funding for this office, the investigators anticipated exploration of best pedagogical practices to implement with the reformed curriculum.

At its heart, this proposal focused on improving learning by improving teaching, with the intention that reforms at CSM could serve as the model for excellence as institutions across the nation revised their engineering curricula. As the investigators described it, "this project will help continue our transformation from an institution focused on teaching to one **focused on learning** (emphasis original). Our emphasis on pedagogical and process innovations will complement the newly created curricular programs so that our entire academic culture will be transformed to one of continuous improvement of the learning/teaching endeavor." To this end, the grant would help fund development of new texts, laboratory experiments, and both hardcopy and multimedia course materials.

This paper discusses one aspect of the funding: enhancing faculty effectiveness by funding mini-grants to develop, pilot, and implement new materials, procedures, and courses within the overall curriculum reform. During the five-year tenure of the mini-grants, every academic entity on campus received funding at least once. Most frequently, the grants provided summer support for faculty to revise or develop courses to better meet the needs of the new curriculum and better deliver materials to enhance student mastery. In this discussion, we examine the Physics I, Mechanics, and Physics II, Electro-magnetism and Optics, courses, the implementation of Writing Across the Curriculum, and the restructuring of the engineering design courses. In so doing, we

demonstrate that a small amount of grant funding can have a large impact on institutional efforts at change. Summer funding devoted to pedagogy reverses stereotypical research and disciplinary pressures, freeing faculty for creatively responding to challenges to improve engineering education.

### **the call to change**

In 1990, Ernest L. Boyer published critical work on the life of the academic, *Scholarship Reconsidered: Priorities of the Professoriate* through the Carnegie Foundation for the Advancement of Teaching. Among Boyer's findings: many faculty chafe under the system of evaluation which emphasizes research over teaching, to the detriment of students, faculty, and the institution. He asserts, "it is unacceptable, we believe, to go on using research and publication as the primary criterion for tenure and promotion when other education obligations are required."<sup>[3:34]</sup> Additionally, Boyer maintains faculty "are often not rewarded for teaching while being penalized if they fail to do research."<sup>[3:33]</sup> Boyer found that "for 70 percent of today's professors, teaching represents their primary interest";<sup>[3:43]</sup> however, faculty are often held to narrow—even constraining—expectations that limit their ability to develop as teachers within their disciplines.<sup>[3:43]</sup>

In engineering education, studies in the 1980's and 1990's indicated the critical need for changes in engineering education. A shrinking pipeline and indicators of student dissatisfaction with Science, Technology, Engineering, and Mathematics (STEM or sometimes SMET) educational practices and offerings<sup>[1:82]</sup> helped to drive reform in many cutting-edge programs across the nation, including—MIT, University of Colorado at Boulder, Rose-Hulman Institute of Technology, and Texas A & M. Nevertheless, nearly twenty years after the first studies began to emerge, engineering education still struggles to revise itself. One of the hazards is failure to retain interested students; a second is failure to attract a broader spectrum of students to engineering as a field of study and employment.

In "The Challenge to Change: On Realizing the New Paradigm for Engineering Education," in *The Journal of Engineering Education*, April 2003, Frank G. Splitt, of Northwestern University's McCormick School of Engineering and Applied Science, observes, "achieving change via engineering education reform presents a formidable challenge."<sup>[4:181]</sup> Boyer found that "at the undergraduate level, and most especially in general education courses, research work often competes with classroom obligations, both in time and content"—leading to time-saving practices, such as reliance on teaching assistants, that are dissatisfying both the faculty and students.<sup>[3:55]</sup> More than fifty percent of respondents in Carnegie research agreed that "the pressure to publish reduces the quality of teaching."<sup>[3:55]</sup> STEM fields are among those most driven for research funding and the associated prestige that comes with large awards.

Although the academy itself holds a "bias toward preservation of the status quo where publications and research funding drive rewards and recognition,"<sup>[4:181]</sup> a feature of the contemporary technical environment counters that conservative tendency. The rapid and widespread change in technology and engineering, as well as the needs of a diverse and

demanding set of stakeholders, insist on agile technical fields.<sup>[4:181]</sup> Without such agility, engineering education is in peril.

Engineering educators are tasked with keeping up with those changes, satisfying multiple and various constituents, and providing sound technical educations in the process. “It seems ironic that those deans and faculty who defend the status quo could be unwittingly undermining the long-term viability of their engineering school in the engineering education marketplace.”<sup>[4:183]</sup> Splitt identifies Colorado School of Mines and others as ““paradigm-shifting”” engineering schools because of efforts to re-make their undergraduate curricula.<sup>[4:183]</sup>

Charles E. Glassick, Mary Taylor Huber, and Gene I. Maeroff, in a 1997 follow-up report to Boyer’s 1990 work, observe that *Scholarship Reconsidered* attempted to move academics beyond the research/teach dichotomy, yet Splitt’s call to action thirteen years later shows that engineering education is still largely caught in that trap.<sup>[5:ix]</sup>

### **a critical need**

Between 1997 and 2001, CSM operated a faculty mini-grant program to foster classroom innovation and adaptation, focusing on curricular reform, improved classroom use of technology, and advancing engineering education. Individual faculty members or teams applied for up to \$5000 to design, develop, and/or deliver courses and materials. No overhead was charged against the grants and frequently departments provided matching funds to meet additional project needs. A faculty committee granted the awards based on the proposals’ educational soundness, meeting essential criteria in CSM’s revised curriculum, and feasibility for completion within a summer session. As one reviewer put it, “good proposals always won out and selfish ones were blown out the water.”

As seed money for change, the program was a good institutional investment because the grants affected the faculty recipients, their colleagues and departments, and students at all levels. While there was no specific trigger mechanism for a type of proposal to fund, one fundamental element was that large numbers of students would benefit from the work the faculty hoped to conduct. Within Seymour’s change framework, this program encouraged buy-in for the curricular reform from top-down and bottom-up.<sup>[1]</sup> Faculty were excited about the reforms, and grants stimulated thought about and implementation of engineering education research and theory into course revisions.

The work of Boyer, as well as Glassick, Huber, and Maeroff, indicates that academics have come to recognize the place of teaching in research institutions. The 1997 report *Scholarship Assessed: Evaluation of the Professoriate* finds that sixty-eight percent of research and eighty-three percent of doctoral-granting institutions provide grants for course development. Seventy-five percent of research and seventy-three percent of doctoral-granting institutions provide release time for course development.<sup>[5:Table 43]</sup> The CSM Faculty Mini-Grant program supported faculty time devoted to retooling a classroom or program. Nevertheless, a sharp disconnect remains: *Scholarship Assessed* indicates that only twenty-one percent of research and twenty-six percent of doctoral-

granting institutions report that there is a direct relationship between applications of faculty scholarship and teaching. <sup>[5:Table 32]</sup> The disciplines continue to win out.

This suggests that other areas of faculty effort are of more importance for career advancement, research and publication being obvious examples.

It is difficult for some deans and faculty to address the compelling need to educate their students in accordance with the new paradigm when their ‘benefits,’ new research funding and derivative prestige, faculty promotion, tenure, honors and corresponding high external rankings, by such as *U.S. News & World Report*, depend on an infrastructure in which ‘grantsmanship’ is valued over the ability to educate undergraduates. <sup>[4:183]</sup>

Additionally, the engineering-education community is relatively small and conservative. As one member of the CSM administration put it “no university wants to be the first” to change the reward structure by which hiring, tenure, and promotion are granted, because the risks are too great. “Changing the criteria for departmental rewards... require[s] leadership. Leverage exercised by powerful groups will be required to even the imbalance between rewards for teaching and education scholarship, on the one hand, and for discipline-focused research on the other.” <sup>[1:97]</sup> Encouraging widespread faculty participation in engineering-education reform and encouraging professors and administrators to see the correlation between pedagogy and disciplinary knowledge is a vehicle for this change.

The shift from research to guiding education, from teaching to learning is neither intuitive nor obvious. Among the requisites: classroom focus on student acquisition and application of knowledge; focus and alignment of student learning with classroom objectives; and matching assessments to student engagement and faculty effectiveness. <sup>[1:85]</sup> Within STEM education, these requirements evolve further. Teaching and pedagogy must become inherent within the reward structure; relationships among departments and programs as well as among universities and K-12 programs must be developed, enhanced, and maintained; professional development at all levels must be reviewed and revised; and the STEM classroom must be overhauled to become learner, rather than lecture, friendly. <sup>[1:86]</sup> Disciplinary attitudes must also be adjusted; faculty have been demonstrated to respond less favorably to reports of pedagogical breakthroughs than to research reports of findings within their disciplines. <sup>[1:92]</sup> Furthermore, faculty tend to be more favorably impressed if an educational researcher comes from a prestigious institution than if the recommended innovation has positive student feedback and is also practical. <sup>[1:92]</sup> Thus, we see that faculty simply transfer the hierarchy of the research model into the pedagogical platform.

Despite that somewhat disheartening—if entirely predictable—finding, unless change in STEM education is paired with successful methodology backed by research, any change will find inconsistent results, difficulty in dissemination, and the tendency to regress into the “good-old days.” <sup>[1:93]</sup>

Throughout the Mini-Grant program, funding largely went for faculty summer salary, although some funds went to program support materials, supplies, and stipends for workshop participants. By rewarding and encouraging faculty innovation in the classroom through small grants, CSM created an environment for its faculty that enables good teaching to flourish within disciplines without making changes that would threaten the fabric of the research/publish reward system.

### **success stories**

The case studies in this paper examine three different programs within the revised CSM curriculum. Every student who graduates from CSM takes each of these courses. Each of the programs requested and received funding four of the five years the Mini-Grant program operated.

### **writing across the curriculum**

The first program we examine is located in the Liberal Arts and International Studies Division of the Colorado School of Mines. The Writing Program was created in 1997 in response to campus needs to improve the quality of written communication for CSM graduates. An Alumni survey conducted in 1994 and a faculty survey conducted in 1996 yielded virtually the same findings: CSM students and graduates needed more experience with technical writing. A Writing Across the Curriculum (WAC) committee was recommended to the Curriculum Reform committee and the Writing Program was one of the developments from the committee's work. The program comprises several components.

First is a course divided into two parts: a recitation portion partnered with lectures in engineering ethics. The recitation employs readings in literature, history, and ethics as the vehicle for background content in critical issues in engineering and scientific fields. Students write a series of technical reports based on reading, interpreting, and creating a persuasive argument.

A second aspect of the Writing Program is a tutoring center offered free of charge to CSM students. With an appointment, students can spend up to one hour meeting with Writing Center faculty, consulting on the content (as possible) and quality of their written work. This one-to-one context provides a valuable campus resource to all CSM students, whether they are working on undergraduate reports or graduate theses. Faculty and staff of CSM are also invited to use Writing Center services.

In addition, CSM's Writing Program works with departments across campus to incorporate writing into the technical, engineering, and hard sciences courses. As a part of the curriculum reform project, divisions and departments designated certain courses as "writing intensive," particularly in the junior and senior years of study. Students in their disciplines are expected to write 15,000 words—50 pages at 300 words per single-spaced page—as a part of their advanced studies toward their degrees. Across the CSM curriculum, certain courses were also designated as part of the "Writing Across the

Curriculum” (WAC) initiative, which meant that each department or division was responsible for selecting courses that incorporated writing integrally to their major offerings. Faculty in these courses were then responsible for providing critical feedback on both the content of the students’ work, as well as the quality of the written communication.

So as to prepare faculty, who had been trained in the sciences or engineering, to be comfortable and equipped to conduct WAC courses, Jon Leydens, the director of the Writing Program developed a series of faculty workshops. These workshops were principally funded by the Faculty Mini-Grant program, and were delivered in August and January. The Writing Program requested and received funding for four of the five years of the Faculty Mini-Grant program. Largely, this funding provided stipends for faculty participants to attend workshops to plan strategies and develop methods for incorporating writing assignments into courses in their disciplines.

The workshops were enthusiastically received. As one reviewer in 1998 noted, funding this project is “an essential investment in implementing the WAC program.” From 1998 through the Mini-Grant’s final year in 2001, forty faculty members participated in workshops. In an evaluation, a participant in a 2000 workshop reflected, “time well spent; I believe all instructors would benefit by learning more about WAC and how they can help students become better writers.”

## **physics i and ii**

The Physics courses, unlike the Writing Program, already existed in the CSM curriculum, and were required of each CSM student. As a general requirement, the existing course, largely lecture or other passive forms of content delivery was plagued with low evaluations, student dissatisfaction, and high rates of failing grades. This course needed a makeover, and the Faculty Mini-Grant program helped to provide the means. As Dr. Thomas Furtak, the principal developer of the Physics I course describes it, “we had arrived at a point where I needed time to renovate the curriculum; the Faculty Mini-Grant had a big impact on Physics Studio I, because it paid my salary to do the work necessary to revise the course.”<sup>[6]</sup> In addition, outside support came from NSF in a CCLI award to renovate classrooms in the existing Physics building, and institutional support came from a grant from the CSM Board of Trustees and a student technology fee to provide hardware for the course.

The proposal, in April of 1998, describes the course as an “activity-based, computer-assisted learning laboratory developed for introductory Physics in the new Colorado School of Mines’ curriculum.” One of the reviewers, in giving the proposal a 9.5/10 recommendation for funding, noted, “this course is emerging as one of the CSM showcases in curriculum reform. Furtak is right on target with his efforts, his development of methodology to date, his plans for the future, and long-term funding and institutionalization.” The Studio Physics Laboratory used the Faculty Mini-Grant program to fund faculty summer support, to refine student materials, including the

website, to implement interactive materials, including hardware, and to develop faculty/teaching assistant manuals.

The Physics I Studio Course was redeveloped into an active learning format and, in 2001, became a beneficiary of a new campus building dedicated to using cutting-edge technology in the delivery of engineering, technical, and science content. Dr. Furtak notes that, “without the new Center for Technology and Learning Media, none of this could have happened.”<sup>[6]</sup> The classroom provides students the opportunity to explore the Physics principles immediately after being exposed to them in lecture. The technological capacity of the website, activities, and exercises engages students in a learner-centered environment. Furthermore, the laboratory instructors are widely available in the classroom, during office hours, and one-on-one instructional sessions.

This framework, developed in large part with funding from a Faculty Mini-Grant, has become “among the crown jewels of CSM’s teaching capability,” Dr. Furtak reports.<sup>[6]</sup> The American Association of Physics Teachers meeting in Washington, D.C., in October 2003, focused chiefly on pedagogy, methodology, student learning, and curricular design. Dr. Furtak describes that CSM is far ahead of other institutions in how it teaches physics. “During the sessions, we found that we weren’t asking many questions, but spent lots of time answering questions about how we do things here.”<sup>[6]</sup>

In comparison, the Physics II course, itself a beneficiary of three Faculty Mini-Grant awards has not had the benefit of a new physical setting and has had to rely on the standard mode of lecture, demonstration, recitation, and laboratory to deliver its content. Within this more traditional format, course designer, Dr. James McNeil, sought to implement a learner-centered experience delivered within the existing physical space but without significantly increasing staffing. He believes the Faculty Mini-Grants were essential to his ability to meet the challenge of the Curriculum Reform.

The summer funding he received through the Faculty Mini-Grant program,

“primed the pump for me, allowing me to attend a conference, do research, and network. I became familiar with Cal Tech’s ZAP program and its director, Jerome Pine. I took what I learned from this summer research and made it my own, creating a tightly integrated, orchestrated course in which students see the same thing in different contexts: in the lecture, the lab.”<sup>[7]</sup>

The careful integration through each segment of the Physics II course is one of its pedagogical hallmarks.

Dr. McNeil’s goal is to assist his students construct a framework of knowledge through which they can solve physics problems in the classroom and in their engineering courses. Relevance is a critical design component running through the course. “This is not a cookbook class; we design stuff here with a purpose.”<sup>[7]</sup> Students learn electromagnetism by applying it in an engineering context; they experience the practical and social application of their studies by constructing devices, such as a metal detector.

Students see concepts integrated from beginning to end of the Physics II course, making the highly theoretical content become more tangible and real.

Among the benefits of the revised Physics courses are significantly reduced numbers of repeaters, improved student satisfaction, higher course evaluations, and a larger number of students who declare Physics as their major.

### **engineering design i and ii: epics**

First- and second-year engineering design at CSM was first piloted as an interdisciplinary, eleven-credit-hour, four-semester course in the early 1980's. Engineering Practices Introductory Sequence is known as EPICS. The course emphasized engineering design in a team setting, alongside activities in oral and written communication, engineering drafting, and computer software related to engineering practice, including AutoCAD. Curriculum reform streamlined the EPICS program; in its present form, the course covers two semesters, one during the first year, one during the second; students earn three credits each semester.

EPICS requested and received funding for four of the five years of operation of the Faculty Mini-Grant program. A principal objective in seeking Mini-Grant funding was to provide faculty salaries for program development during the summer. Each of the Mini-Grants awarded to EPICS went to funding course revision, materials and course development, and assessment strategies that would make the course more uniform across the sections.

In 2001, the Faculty Mini-Grant supported faculty salary to create a week-long seminar on various aspects of trainer-training and materials development. Each of the topics had arisen in faculty meetings the prior year as areas of classroom concern. Because the course is taught by adjuncts and/or faculty on loan from other departments, consistency across sections proves to be challenging. Furthermore, because most disciplinary faculty have not had extensive experience in addressing issues of teamwork, frequently, difficulties in teaching the course arise from management rather than technical concerns.

To meet faculty concerns, the 2001 seminars addressed topics such as conflict resolution, mentoring, learning styles, visualization, classroom management in a process course, and fairly evaluating team and individual efforts. Faculty were also introduced to new classroom support materials on technical communications. Additionally, in Fall 2001, the program was entirely relocated into new facilities; faculty received training on using the technology-equipped classrooms to better enable their move into the state-of-the art Center for Technology and Learning Media building. Finally, faculty were guided through a short session using the same methodology students in the course experience; this exposure to a process course was the first time many faculty had solved technical problems in a team-based, interdisciplinary setting. Feedback indicates that the process was valuable in revising faculty expectations of how the course is and should be delivered.

In addition to teaching faculty within EPICS, members of the campus community responsible for delivering design in the disciplines were invited to join the entire session or individual meetings. This outreach function allowed disciplinary faculty to learn more about the design program and encourage interdisciplinary engagement.

Without summer funding from the Mini-Grants, the ongoing revision of the EPICS program would have been virtually impossible. As a service course with a highly mobile faculty population, the class requires a great deal of time simply maintaining the status quo; program reform and development of new materials are a luxury. Nevertheless, in a course delivered to every student on the CSM campus, it is essential to revise continually so as to keep from becoming rote and stale. The faculty Mini-Grant program allowed EPICS to ensure continuous improvement and maintain high standards within the larger CSM curriculum reform process.

### **evaluating the mini-grant program: lows and highs**

From 1997 to 2001, the CSM Vice President for Academic Affairs' office received one-hundred-one applications for Mini-Grants from faculty in all academic areas. Of these, forty-seven were funded. Over the five-year period, faculty received nearly \$240,000 in Mini-Grant funding; fifty percent of the funds came from the NSF grant, fifty percent from the Vice-President of Academic Affairs' office. Every academic unit on campus received funding at least once. The CSM Faculty Mini-Grant program was successful in funding curricular reform and in distributing funding to programs that would ensure that monies went to disseminating change to the greatest number of students possible.

Nevertheless, the grants did not operate without some problems. Although recipients were required to submit follow-up reports to the Vice-President for Academic Affairs office upon completion of the project or research, many failed to do so. Archival research reveals that only thirty-four percent of awarded grants show documentation of how the project proceeded and the results of the investigator's inquiry. One means of addressing this non-compliance was to automatically disqualify from future Mini-Grants anyone who failed to submit a follow-up report. Should the program be reinstated, a follow-up mechanism to ensure greater compliance and documentation of activities conducted with Mini-Grant funding would be essential. The absence of this documentation provides one challenge to assessing the effectiveness of the program.

A second area of concern is the general lack of wide-scale dissemination beyond the institution. Although faculty in Mathematics and Computer Science are general exceptions to this rule, the Faculty Mini-Grant program did not generate a great deal of follow up grants, conference papers, or presentations. In part, this may be a failure of expectations; the Request for Proposals did not specify dissemination as a deliverable. In part, this may also be indicative of the uncertain relationship between engineering pedagogy and engineering disciplinary work. Because faculty tend to default to their disciplines, new research and funding may have evolved within particular scientific, engineering, and technical fields as a result of the grants and reformed curriculum that do not have immediately identifiable traces, yet that would not have occurred without the

grant. Further follow-up work with the campus office of research and individual faculty will be necessary to quantify the role of mini-grants in external funding applications.

On the flip side, the Faculty Mini-Grant program was remarkably successful in spurring interest in the Curriculum Reform, which led to widespread buy-in of that reform. The Mini-Grants, thus, energized the faculty to be creative and engaged, two hallmarks of good teaching. Courses were revised to be learner centered, and disciplinary faculty became enthusiastic about engineering education on the CSM campus. For some, this has spurred a revised understanding of what being a faculty member means.

For example, Tom Furtak, in his 2001 Faculty Senate Distinguished Lecture, “It’s Time for a Change to a More Effective Paradigm in College Teaching,” asserts,

“The fundamental problem with the lecture method of teaching is that it is based on incorrect ideas about learning. The assumption goes like this: If I know something, then the way to teach it to you is to tell you about it. Your mind is an empty container in which I deposit my knowledge. If you can’t understand it this way, then I’ll re-explain it in a different way. This is supposed to go on until you get it. But that’s not the way learning works.” [8]

Jim McNeil of the Physics department cites the influence of Russian educational theorist Lev Semenovich Vygotsky on his decisions in revising Physics II. Prior to the curriculum reform, cognitive psychology and learning theory played a much less important role in Dr. McNeil’s daily approach to teaching physics. [7] Engineering-education reform occurs one faculty member, one course, and one university at a time.

The fact that disciplinary faculty developed interests in engineering educational practices in part because of their participation in the Faculty Mini-Grant program is indicative of the influence even small grants can have on faculty thinking and practices. In this light, the CSM Faculty Mini-Grants were a great success.

Furthermore, operating on generalized enrollment figures, assuming a total undergraduate enrollment of 2,100 in 1997 and adding 700 students per year for each incoming first-year class through the 2003-2004 academic year, approximately 6,300 students have been affected by the Mini-Grants and Curriculum Reform project. These grants as seed for change have been enormously powerful in affecting education at the Colorado School of Mines. In this arena, dissemination has been a success.

### **gazing into the crystal ball: the future of mini-grants at csm**

Faculty members received the last awards in the Faculty Mini-Grant program in Spring/Summer 2001. The grants’ funding fell victim to budget cuts within the State of Colorado, as amendments to the state constitution have caused higher education to bear a significant portion of service reductions caused by the recession of the early 2000’s.

The Vice-President for Academic Affairs' office views the program as one which will be fast-tracked for renewed funding when the fiscal picture is less grim. Although the award amounts would remain small, for the administration to prioritize funding engineering-educational efforts indicates how highly the CSM administration values such efforts.

Furthermore, on September 18, 2002, President John U. Trefny and Sharon L. Trefny, his wife, pledged \$100,000, to the CSM Center for Engineering Education (CEE) as an endowment and seed money for future mini-grants. The John U. and Sharon L. Trefny Endowment for Curriculum Advancement is designed so that income from the gift will provide funding for a renewed mini-grant program. The CEE is presently collaborating with the campus Office of Institutional Advancement to seek additional endowment funds as a way to revive the program beyond the vagaries of the economic cycle.

Given widespread faculty interest, across-the-board effects on the undergraduate curriculum, and a relatively small amount of financial investment, the Mini-Grant program was a powerful agent for change at CSM. Given strong administrative backing, an endowment for funding, enhanced faculty interest in engineering education, and discussions of a new curriculum reform, the future of a mini-grant program at Colorado School of Mines looks bright. The potential is too great to be missed.

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#### Biographies

HEIDI G. LOSHBAUGH is a Research Associate for the Center for the Advancement of Engineering Education at CSM. She has taught in CSM's Engineering Design program, for which she developed extensive course and faculty-support materials, and implemented a leadership course. She also has experience in international education, corporate training and coaching, and academic editing.

RUTH A. STREVELER directs CSM's Center for Engineering Education is a co-principal investigator for the Center for the Advancement of Engineering Education, and co-directs an NSF-funded grant to develop assessment to identify engineering students' misconceptions. Her paper, "Investigating Student Misconceptions in the Design Process," was a 2001 best-paper finalist for ERM at the ASEE national conference.

BARBARA M. OLDS is Professor of Liberal Arts and International Studies at CSM. She has participated in many curriculum innovation projects and been active in the engineering education and assessment communities. She was a Fulbright lecturer/researcher in Sweden in 1999. Dr. Olds is presently serving as Director of the Division of Research, Evaluation and Communication in the EHR Directorate of the NSF.

NIGEL T. MIDDLETON, V.P. for Academic Affairs and Dean of Faculty at CSM, has numerous responsibilities in the institution's academic and research programs. A Professor of Engineering, Dr. Middleton has been involved in engineering curriculum design at all levels, innovative approaches to engineering education, research in applied signal-processing, and experience in industrial R & D.