

Executive Summary of the Evaluation of the Manufacturing Engineering Education for the Future Program

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Prepared for
Mike Corradini, Associate Dean, College of Engineering

By
Baine B. Alexander, Susan Millar, Debby Penberthy, Ramona Gunter

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Executive Summary

The three-year (1994-97) Advanced Research Projects Agency-Technology Reinvestment Project (ARPA-TRP) grant "Diversity and Cultural Change: Manufacturing Engineering Education for the Future" (MEEF) to the University of Wisconsin's-Engineering Research Center for Plasma-Aided Manufacturing, was launched in spring of 1994 in a "reform ready" context that was prepared by the College of Engineering's Ad Hoc Curriculum Committee and Teaching Improvement Program. The ARPA MEEF program goals were congruent with goals of a substantial set of faculty leaders in COE, and were supported by campus administrators, as indicated by the grant "match" provided by College of Engineering, the College of Letters and Science, and the Graduate School. The ARPA MEEF programs and courses were designed to address retention issues by emphasizing improvements in the pre-engineering experience, and to create a more student-centered curriculum with emphasis on connections to manufacturing throughout the four years of the major. As stated in the proposal, the principal investigators of the grant were interested in fostering cultural change at UW-Madison, not just funding isolated programs or courses.

Evaluations conducted by researchers from the LEAD Center and other organizations show that the intended outcomes for students were achieved. The intended outcomes were: increased retention rates in engineering, particularly among underrepresented groups; improved student learning through shifts toward collaborative, hands-on assignments that emphasize critical thinking, teamwork, and communication skills; and improved student attitudes through increased understanding of the engineering profession and a broadening of perspective about the type of people who succeed in engineering. We found that the MEEF-funded initiatives encouraged important and significant improvements in student learning, and improved students' abilities to transfer that learning to real-world problems. Our data also show that EPD-160 significantly boosted the retention rates of female engineering students, and that the Summer Internships in Manufacturing Technology successfully encouraged participants to go on to graduate school. We found that that participants in the Wisconsin Emerging Scholars calculus program (comprising 40% minority students and 50% women) performed, on average, statistically better than comparable students not in the program, but were retained in engineering only at rates statistically comparable to those of students who did not participate in the program. Desired learning outcomes were found for other MEEF-sponsored programs and courses, but retention to major data associated with these activities are not yet available.

We conclude from these findings that obtaining higher engineering retention rates may involve more than just providing students a more collaborative and supportive learning environment in one or two of their prerequisite courses. We suggest that to achieve higher retention rates, particularly for women and underrepresented ethnic groups, it may be necessary to both (1) provide a critical mass of courses using active learning strategies like those used in WES and Chem 110, and also (2) provide students opportunities (like EPD 160 and the Summer Internships) that help them determine if there is a "good match" between a student's interests and the career opportunities available with an engineering degree.

LEAD Center evaluators also determined that two of the intended outcomes for the COE--the institutionalization of successful MEEF-funded reforms at both the course and program level, and a change in faculty culture that would support and encourage collaborative learning and other reforms in engineering education—were achieved at a high level, and that significant improvement was made with respect to the third goal for the COE-- enhancement of the role of industry in engineering education. For the most part, initiatives funded by the grant have made the difficult transition from soft to hard money, although a few have yet to secure permanent funding. Cultural changes within the college which can be attributed to the ARPA MEEF grant include the creation of a more student-centered learning environment, the development of forums in which instructors can focus on pedagogy, the establishment of lasting cross-departmental and cross-college connections, and increased collaboration with industry on educational initiatives. In addition, the pedagogical and curricular components of the MEEF-sponsored initiatives have been adapted by others on a local and national level. UW-Madison faculty from the COE and other colleges have had the opportunity to learn about the reform efforts and in some cases have incorporated aspects of the MEEF initiatives into their own courses. On the national level, faculty and evaluators have produced numerous articles, reports and conference presentations on the MEEF initiatives.

With respect to the implementation and institutionalization of the MEEF-funded reforms, we found that certain strategies were essential. First, a match between the vision and programmatic efforts of the ARPA MEEF grant and the mission and priorities of the College of Engineering was essential in encouraging the participation and support of faculty and administrators in grant-sponsored initiatives. Second, the successful implementation and institutionalization of many of the grant-sponsored initiatives required the ownership and the commitment of faculty, who were needed to play the primary role in designing and implementing initiatives. Other players whose commitment and skill was essential include: the paid program coordinators, who did most of the networking and handled important logistical matters; trained TAs and SAs, who played critical roles in facilitating collaborative group work; and supportive administrators like COE Dean John Bollinger and Associate Dean Mike Corradini, who found continued funding and administrative “homes” for successful initiatives. The utilization of formative and summative evaluation data to “fine-tune” initiatives and to gain support for their dissemination was also essential to their success.

In sum, the ARPA MEEF grant was successful in encouraging the development, implementation, and institutionalization of collaborative learning approaches for students and in fostering desired cultural change in the College of Engineering and at the UW-Madison more generally.