DOCUMENT RESUME

ED 396 370 EA 027 590

AUTHOR Haug, Carolyn A.; Marion, Scott F.
TITLE Professional Networks for Educational Change: An Evaluation of the Mathematician and Education Reform Forum.
INSTITUTION American Educational Research Association, Washington, D.C.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE Jan 96
CONTRACT RED925537
NOTE 168p.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160) -- Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC07 Plus Postage.
DESCRIPTORS College Faculty; College Mathematics; Educational Innovation; Elementary School Mathematics; Elementary Secondary Education; Faculty Organizations; Higher Education; *Instructional Innovation; *Mathematics Education; Networks; Professional Associations; *Professional Development; Program Effectiveness; Program Evaluation; Secondary School Mathematics

ABSTRACT

This document contains findings of a year-long evaluation of the Mathematics and Education Reform (MER) Forum, a voluntary association targeting the academic mathematics community in four-year colleges and universities. Specifically, the evaluation sought to assess the extent to which MER influenced its members' involvement in mathematics-education reform at both postsecondary and K-12 levels. Since its inception in 1988, MER has expanded from a network targeted at individuals to include a departmental network directed toward mathematics departments of research universities. Data were obtained through a survey of the entire national population of MER participants (n=730), which elicited a 32 percent response rate, site visits to four university departments, participant observation at MER functions, and interviews with department personnel. Findings indicate that MER provided support to mathematicians interested in improving their own teaching, leadership to mathematics departments, and legitimization of educational interests. MER also facilitated faculty participation in the reform of undergraduate mathematics education and, to a lesser extent, reform of K-12 mathematics education. Although mathematicians generally could not attribute changes in their teaching directly to MER, they attributed at least an indirect effect to MER. Although the majority of MER's impact was at the individual level, the program to some extent also facilitated change at broader levels, particularly within mathematics departments. Suggestions for best portraying MER's program are included. Appendices contain a workshop- evaluation questionnaire and copies of survey instruments. (LMI)

ED 396 370

Professional Networks for Educational Change: An Evaluation of the Mathematician and Education Reform Forum

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
S. Marion
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Carolyn A. Haug & Scott F. Marion
Co-Principal Investigators
University of Colorado - Boulder

January, 1996

This report was prepared with funding from a National Science Foundation grant to the American Educational Research Association (grant # RED 925537). Opinions of the authors in this report do not necessarily reflect the position of AERA or the National Science Foundation. The order of authors is alphabetical; both investigators contributed equally to the evaluation and final report.

4 027 590

BEST COPY AVAILABLE

Table of Contents

Preface

This report presents findings based on our year-long evaluation of the Mathematicians and Education Reform Forum (MER). This report was written with two audiences in mind, the funding agent -- the National Science Foundation -- and the MER co-directors. As such, the report contains more detail than either of the audiences alone might find necessary. We have included this detail to help substantiate our findings and claims.

The introduction (Chapter 1) outlines the research problem and provides a framework for our study, while the second chapter serves to describe the history and mission of the MER Forum. The details of our evaluation methodology are found in Chapter 3. Our general findings -- those that apply to the individual network and to certain aspects of the departmental network -- are discussed in the fourth chapter. We organized this chapter into six themes: (1) the extent to which MER reaches its target audience of research mathematicians; (2) the effectiveness of the Forum's communication activities; (3) the breadth and depth of MER's educational initiatives; (4) the impact of MER's workshops; (5) the extent to which MER meets the needs of mathematicians and mathematics and K-12 educators; and (6) the systemic effects of MER's activities. Within each of these sections, we present the specific problems and summarize our conclusions regarding MER's effectiveness at addressing these concerns. Chapter Five contains our findings about the newly formed departmental network. Because the this network is much newer than the individual network, Chapter Five is somewhat shorter than Chapter Four. Our last chapter contains our overall conclusions regarding the effectiveness of MER, many of which are summarized in the executive summary. In response to the request of the MER co-directors the executive summary contains more detail than would usually be the case so that it can serve as a shorter version of the final report.

The evaluation was conducted by Carolyn Haug and Scott Marion, both of whom are Ph.D. students in the Educational Research and Evaluation Methodology Program at the University of Colorado, Boulder. Ernest House, Ph.D., also of the University of Colorado served as the faculty mentor for this project. This evaluation was conducted as part of the American Educational Research Association (AERA)/National Science Foundation (NSF) Evaluation Internship Program. We are grateful to AERA and NSF for the financial support necessary to complete this study and we acknowledge the guidance and support we have received from Richard Shavelson, John Dossey, and Jeanie Murdock, all from the AERA internship program, and Larry Suter, Program Officer, from the National Science Foundation. Finally, we appreciate the cooperation of MER personnel

and co-directors, especially Naomi Fisher and Bonnie Saunders, without whom we would have been unable to complete this evaluation.

Executive Summary

In this evaluation report we discuss how the Mathematicians and Education Reform Forum (MER), a voluntary association targeting the academic mathematics community in four-year colleges and universities, has influenced its participants to become involved in or deepen their involvement in mathematics education reform at both postsecondary and K-12 levels. It was initiated to provide information to NSF about the quality and sustainability of the MER network and describe how its members benefit from their association with the Forum. This evaluation was conducted to answer questions related to the effectiveness of MER in several areas related to mathematics education reform: K-12 curriculum, undergraduate curriculum for math majors and non-majors, graduate experiences, participation of minority and women students, pre-service teacher preparation, in-service teacher enhancement, involvement with local school districts and participation in statewide initiatives.

MER is dedicated to facilitating the institutionalization of mathematics education reform within the mathematics community. Since its inception in 1988, MER has expanded from the original Network targeted toward individuals to also include a Departmental Network targeted at mathematics departments of research universities. MER's primary activities include hosting participant workshops approximately two times per year (a total of 18 to date), creating and distributing a twice-yearly newsletter, and sponsoring special sessions and a banquet at the Annual Joint Societies Meetings of the AMS and MAA. Presently, there are over 750 people on the MER Newsletter mailing list which, because the original Network does not have a formal membership, is the best indication of its size. A thirteen-member Advisory Committee and an eleven member Task Force work with the four MER co-directors to direct the program.

Methods

To triangulate our findings, we consulted several data sources and employed various data collection and analysis methodologies. Data sources included the NSF Program Officer, MER co-directors, Fall 1994 Baton Rouge Workshop, 1994 Task Force meeting, Winter 1995 Joint Societies Meetings, 1995 Advisory Committee meeting, past and present individual participants, members of the Departmental Network, related documents and pertinent literature. Data collection occurred between November, 1994 and May, 1995 and was framed by Stake's (1995) case study approach. Primary data collection methods were written questionnaires, personal interviews, participant-

observation, direct observation and document review. The majority of our data concerning the individual component of the Forum was gathered via extensive written surveys. We sent questionnaires to the entire national population of MER participants (730 people) and received 230 completed surveys for a response rate of about 32%. The majority of our data concerning the Departmental Network came from site visits to the following four of the thirteen departments: University of Texas-Austin, Pennsylvania State University, Rutgers University and University of California - Santa Barbara. One of us visited each campus once for approximately one week. To analyze our data, we used both qualitative and quantitative methods as appropriate. Coding and domain analyses were the primary tools for interview transcriptions, fieldnotes, and open-ended survey questions and descriptive and inferential statistics were used on the closed-ended survey questions. Data gathering from some of our sources, such as discussions with the MER co-directors and NSF Program Officer and review of literature and documents, was continuous throughout the year of this evaluation. However, other data gathering activities were more discrete and occurred in contexts unique to this evaluation.

Participants reported that MER's primary role is one of facilitator and supporter, rather than an initiator of new ideas. By helping to support mathematicians already involved in educational reform, MER functions by taking people where they are and facilitating their movement toward an increasingly sophisticated perspective on education. We have come to understand that MER functions as a support mechanism for those members of the mathematics community already involved in educational efforts and have incorporated this conception of "effective" into our evaluation. This is not to say that people and institutions have not changed as a result of their experiences with MER, but if we base our evaluation on this criterion of effectiveness it will be too stringent (and unrealistic in many cases) a test for most voluntary networks to meet.

Results and Discussion

Demographics. In general, MER members are tenured faculty members in mathematics departments (77%)[1] who appear to be at a stable point in their careers. Women mathematicians have a slightly higher representation in MER (27%) than they do in the mathematics community generally (20%, Albers, Loftsgaarden, Rung & Watkins, 1992, p. 16). There are relatively few minorities in MER (90% white) which reflects the condition of the mathematics community as a whole. MER has done a good job attracting a large number (approximately 630 mathematicians based on extrapolation of survey results) of mathematicians -- not an easy task considering the demands on academics' time.

[1] In this executive summary, the source for all percentages is the participant questionnaire described previously unless otherwise noted.

In terms of participant credentials, MER is an impressive collection of mathematicians. However, in terms of inclusiveness, MER attracts a relatively narrow slice of the community of mathematicians in the country. One problem we found associated with MER being a relatively small subset of a larger group is that some mathematicians do not perceive MER as a very open organization. Although 15 of the 18 MER workshops to date have been by application and advertised to all mathematics departments, misconceptions about the exclusivity of the organization persist.

Allocation of respondents' time. Most respondents indicated that they spent relatively less time on mathematics research/scholarship than their institution expects for promotion and tenure, but considerably more time on math education reform, service, and administration than their department expects. However, data from our departmental visits and interviews at workshops revealed that many faculty members participating in MER still maintain their research agendas and include some of the most prominent mathematicians in the field. Respondents reported that the amount of time they spent teaching was roughly equivalent to the amount they perceived their department expected. Males indicated they worked approximately four hours more than females (51.3 and 47.1 hours, respectively) on the average week, but there were some interesting differences in the way this time was distributed. Women indicated that they spent significantly more time (42% of their time) on teaching than men (35%) and somewhat more time on mathematical education reform activities (females=20%; males=16%). Whereas men reported spending somewhat more time on both research (females=13%; males=18%) and administration (females=12%; males=15%) than women (see Table 16). Women indicated that, on average, they were expected to spend approximately 44% of their time, compared to 38% for men, related to teaching. These percentages were essentially reversed for perception of time expected for research. On average, women perceived they were expected to spend approximately twice as much time on educational reform activities compared to men's perceptions of their departments' expectations (females=10%; males=5%).

In addition to the characteristics of mathematician participants, we were interested in a description of the math departments in which they worked. In general, it appears that relatively few (less than 20%) faculty members in each of the mathematician respondents' departments were involved in educational activities. For example, only 14% of respondents indicated that more than 60% of the faculty in their department were involved in undergraduate mathematics reform and undergraduate mathematics reform had higher levels of faculty involvement than any of the other educational initiatives. Graduate education (for both mathematics and math-education majors) reform appears to have the fewest number of faculty members involved.

Communication. The way in which the MER network grows and spreads is an important consideration in our evaluation. Because MER expends effort along several avenues of communication in an attempt to attract these volunteers, we wanted to find out which were the most effective. MER uses the following activities to reach current and potential members: workshops, word of mouth, newsletters (and other mailings) and participation at the annual Winter Joint Societies Meetings. Our data indicate that the form of communication over which MER has the least control, word of mouth, is its most effective advertisement. At the present time, word of mouth seems to be the most effective method of spreading the word (reported by 34% of mathematicians, 50% of math educators and 50% of K-12 teachers survey respondents) while some of the more labor-intensive communications (at least for the co-directors), such as the newsletters, are not as effective. MER's newsletters are informative to those already "in the fold" rather than actually serving to attract new members. Additionally, MER has edited four volumes of the Conference Board of the Mathematical Sciences (CBMS) publication regarding educational issues. The primary function of these volumes is to provide a publication vehicle for mathematicians to write about their educational work rather than to promote awareness of MER itself. MER's special sessions and banquet were well received by those survey respondents who attended and significantly increased the amount of focus on educational issues at the Joint Meetings.

This is not to say that MER should eliminate its planned communication avenues because most likely it was one of these that spread the word to the first person in the chain. Instead, MER should examine its focus on various communications in light of their effectiveness and make efforts to capitalize on "word of mouth" to increase its reach and influence. MER might consider expanding its listserver beyond the departmental network or maintaining a separate listserver for individual members. Allowing MER members the opportunity to pass the word about MER by forwarding an electronic mail post to a colleague might create more opportunities for "word of mouth" communication.

The effectiveness of other communication activities are as follows. Thirty-two percent of mathematicians, 20% of mathematics educators and 9% of K-12 teachers found MER special mailings effective. Posted announcements were most effective with the K-12 teachers, more than 25% found them useful, and only slightly valued by mathematicians. Some (10% - 20% of each group) reported they found multiple avenues of MER communication useful including those listed above as well as other conferences, personal invitations from co-directors and Advisory Board members and articles in other publications (such as NCTM). For a few, it was the reputation of the people heavily involved in MER that brought them into the fold.

The MER newsletter is the primary means of communication with participants during the course of the year. It is mailed semi-annually to all workshop alumni and any others who request to be part of the network; there have been 14 newsletters to date. The pattern of topics in the newsletters is similar to that of the MER workshops because quite often the newsletter summarizes what occurred at the most recent workshop. The first several issues were devoted to pre-college education and the need to legitimatize mathematics education activities within the research mathematics community. When MER received its second NSF grant in the Fall 1991 and formally extended its focus from K-12 to K-14 education, the newsletters reflected this change. From 1991 to the present, calculus reform and other undergraduate education topics have garnered increasing amounts of space. The most recent newsletter, Fall 1995, focuses on graduate programs.

The newsletter seems to be more useful for updating those already interested in MER than it is for attracting new participants. Once they were on the MER mailing list -- which includes all workshop and special session participants in addition to others expressing an interest in MER -- three-fourths or more of the respondents, including 80% of the mathematicians said they found the MER newsletter helpful. On the other hand, only seven mathematician respondents (less than 2%) learned of MER by reading its newsletter. The most useful sections are the feature articles regarding new and long-standing programs and essays on the current state and future of mathematics education. Over half of the mathematician and math-educator respondents and 46% of the K-12 respondents also said information on basic MER activities in the newsletters was helpful. Approximately one-third of the respondents from all three groups said information about the Mathematical Sciences Education Board in the newsletter was helpful.

The American Mathematical Society (AMS) in cooperation with the Mathematical Association America (MAA) has published four (three at the time of this survey) special volumes in the CBMS series on Issues in Mathematics Education. CBMS initiated this series in 1988 to stimulate "cross-fertilization" of educational ideas among mathematicians, mathematics educators and mathematics teachers. When asked if they were aware of these volumes, slightly less than half of the mathematician and math-educator respondents indicated they were aware of these volumes and approximately 40% said they had read at least one of these publications. None of the K-12 respondents were aware of these volumes. When asked if these volumes were useful, approximately one-quarter of mathematician and mathematics-educator respondents said they were extremely or considerably useful; 31% indicated they were a little useful, and 44% of the mathematicians and 22% of the math-educators found these volumes "not at all" useful.

Special Sessions. MER maintains active relationships with the two major mathematics professional societies, the AMS (composed primarily of research mathematicians) and MAA (composed primarily of mathematics instructors from non-research based institutions). In fact, during the past few years MER has held special sessions at the Joint Annual Meeting of AMS and MAA to help increase the presence of educational initiatives among research mathematicians. These two organizations have been co-sponsors of all MER special sessions. Although the MAA offers educational sessions, MER has increased the total number offered and made the unique contribution of some sessions on K-12 mathematics. More than half of the mathematicians, 30% of the math-educators, and less than 20% of the K-12 survey respondents indicated they had attended a special session at the Joint Meeting. A majority of those respondents who attended a special session said that these sessions were useful to them according to the following three general categories: learning new information particularly as it pertains to mathematics education reform, making personal contacts, and finding support for mathematics education activities. Gathering current "eye-opening" information was the most commonly cited benefit of the special sessions. However, most respondents indicated these sessions did not influence their decision to attend the Joint Meeting. Similarly, relatively few survey respondents reported that their attendance at a special session influenced their decision to attend a MER workshop.

MER hosts a banquet at the Joint Meeting to provide a venue for people who are interested in education to gather with like-minded people. Rather than being an effort to explicitly promote initiatives, this is primarily an opportunity to meet others informally. While fewer respondents (35%-mathematicians; 15% math educators; 27%-K-12) attended a banquet than special sessions, a majority (73% of mathematicians, 67% of math educators and 100% of K-12 teachers) of those who attended a banquet indicated they would recommend it to their colleagues.

Workshops. MER is effective at facilitating the work of mathematicians as they engage in educational activities and at promoting new ideas through interactions at their workshops. We categorized all of the topics addressed at MER's first 16 workshops into the following categories: general issues, direct connections with K-12, university issues, K-12 issues, and systemic issues. While this is a rough estimate of the workshop foci on these topics (because we are not considering the quality or length of time of each session), it documents MER's emphasis on undergraduate issues. In fact, undergraduate curriculum/calculus reform (a subtopic within "university issues") has been addressed about as frequently as has the entire topic "direct connections with K-12." In fact, more

than half of the sessions in this category were for K-12 teacher preparation/enhancement activities, which is as much of a university issue as a K-12 issue

Most participants reported that they valued MER workshops and felt these were the mechanism responsible for changing their educational efforts. The workshops bring together mathematicians and mathematics educators with a wide range of experience and knowledge of educational issues. Most of the survey respondents -- 94% of mathematicians, 100% of mathematics educators and 91% or K-12 teachers -- had attended a MER workshop. The survey respondents were about evenly distributed in their reported attendance throughout the various workshops over the course of years.

Workshops are an integral aspect of MER's activities. In order to learn about these meetings first-hand, one of us attended the 1994 "Preparation for Teaching Mathematics: Issues, policies and programs" workshop in Baton Rouge, Louisiana. We surveyed all attendees and the data *in this paragraph* arise from this small-scale survey. For the most part, participants at the Baton Rouge workshop felt that it helped validate many of the ideas they already had and/or that they learned about a few new ideas that they expected to incorporate into their current or future activities. Several indicated that they received information about teaching and curriculum that they can use in their own classes. The participants placed a premium on the opportunities to interact with their colleagues and indicated that the face-to-face exchanges were the most valuable aspects of the workshop.

In summary, most participants indicated that the workshops were valuable experiences. They were particularly appreciative of the opportunities to meet with presenters and other colleagues in informal settings. Many participants indicated a desire to have less traditional forms of pedagogy modeled by workshop presenters, particularly in the afternoon breakout sessions. Perhaps in future workshops the MER co-directors can encourage more modeling of reform-oriented pedagogy at the workshops. We found that much of the information presented at workshops, for example introductions to the NCTM Standards and uses of cooperative learning, was not new in the field of mathematics education. Although this was not "cutting edge" mathematics education, it was new information to many mathematicians and MER was bringing many of these educational ideas into the mathematics world.

MER's focus. MER has broadened its purview from its original focus on K-12 mathematics reform to include undergraduate and, to a lesser extent, graduate mathematics issues. This change of focus has resulted in more emphasis of undergraduate than K-12 educational reform during the past seven years. This is reflected in the quantity of topics addressed in workshops (mentioned previously). The MER co-directors describe the new emphasis on undergraduate issues by stating the "situation is comparable to affirmative

action strategies, i.e.,. to get members from an under-represented group into a program, special recruiting efforts may be necessary" (correspondence, December, 1995). MER hopes that the broadened focus promotes interaction among the different educational levels so that, for example, the topic of teacher preparation could be discussed as an issue that bridges K-12 and undergraduate education.

This also is reflected in reports of how MER participants spend their time. Respondents to our mailed survey were asked to characterize their current involvement in a range of educational activities. At the undergraduate and graduate levels, most of MER's effectiveness has been in facilitating participants' learning about new forms of teaching for their own classrooms, calculus reform issues, and technology in the classroom. Almost three-quarters of the mathematician respondents reported they were considerably or very involved in undergraduate curriculum reform, 60% indicated they were considerably or very involved in calculus reform, and 57% were considerably or very involved in undergraduate programs for mathematics majors. This makes sense in that it appears to us that calculus reform is the most common aspect of undergraduate reform. These were the only three items with a majority of mathematician respondents indicating that they were at least considerably involved in the respective reform effort. Other areas MER encourages participants to pursue include the recruitment and retention of underrepresented minorities and women in mathematics. As might be expected, noticeably more females than males were involved in trying to increase the participation of women (56% females; 39% males).

While the majority of MER participants devote much time and effort to educational initiatives at the undergraduate level, a substantial portion reported spending a considerable amount of time working on K-12 education issues. More than 40% of the mathematician respondents said they were at least considerably involved in: K-12 curriculum reform, undergraduate programs for pre-service teachers, and programs for in-service teachers. In fact, approximately one-quarter of the respondents said they were "very involved" with both K-12 curriculum reform and programs for in-service teachers. Females indicated they were relatively more involved (considerably or very involved) than males in several areas, particularly those related to K-12 education such as undergraduate programs for pre-service teachers (65% females; 39% males), programs for in-service teachers (65% females; 40% males), and K-12 curriculum reform (54% females; 38% males).

Many individual MER participants involved with K-12 education have forged connections with mathematics educators and/or K-12 teachers, but MER, as an organization does not appear to have strong connections to the mathematics education community. Even if MER declared it's focus to be undergraduate education, forging ties with the mathematics education community still seems vital to maximizing potential impact.

Having Advisory Board Members such as Mary Linquist and Thomas Romberg, key figures in the National Council of Teachers of Mathematics (NCTM), is an important step in this direction. We do not mean to diminish the contributions of research mathematicians to mathematics education, many of whom have worked with educators (e.g., Bill Jacobs at UCSB and Phil Wagrich at UIC), but making connections across disciplines can aid the mathematics education reform effort.

Building bridges. Building bridges with the mathematics education community is an important component of having mathematicians participate effectively in educational initiatives. In order to build these bridges, MER needs to help facilitate communication between these two groups; workshops appear to be the perfect settings for this activity. While the MER co-directors clearly state that MER exists to serve the needs of mathematicians involved in educational reform, they also appear interested in working with mathematics educators to help meet this goal. Although MER is targeted at the academic mathematics community, some mathematics educators and K-12 educators see MER as providing the opportunity for them to meet with mathematicians in a way that is not possible through other organizations. Perhaps part of the reason mathematics educators and K-12 teachers are involved with MER is that three workshops (including the two most recent workshops at Southern and Cornell Universities) encouraged interdisciplinary or inter-institutional teams to apply. Although the co-directors treat the participation of non-mathematicians as a side-benefit of the Forum rather than an integral part, we believe that forging connections will make MER stronger and more effective in the long run. In summary, MER is effectively addressing undergraduate mathematics education issues and with more attention to critical partnerships, MER may play an important role in systemic mathematics education reform at the K-12 levels as well.

Benefits to participants. When we asked participants to tell us about the benefits of the Forum, the majority of the benefits affected people on an individual level. First, the most commonly cited benefit of the Forum by survey respondents was, validating personal experiences, the acquisition of a general awareness of educational activities and information which enhanced personal teaching and/or research. Approximately 60% of mathematicians and K-12 educators, and 47% of the math-educators said their association with the MER Forum has been helpful to furthering the goals of their own projects. More than 70% of the mathematicians and K-12 educators and a majority of mathematics educators (over 50%) feel more aware of issues in mathematics education as a result of the Forum. In response to an open-ended question about awareness of educational issues, mathematicians most frequently mentioned heightened awareness of (1) calculus reform and the use of technology (graphing calculators and computers) in the classroom and (2) mathematicians'

involvement in mathematics education reform. These two issues were cited between two and three times more than any other category of response. Other issues for which respondents indicated a raised awareness were: (a) why calculus reform was implemented; (b) how traditional, research-oriented mathematics departments reward faculty for educational endeavors; (c) the tension between the pressure to publish and teach effectively; (d) diversity/minority representation; (e) K-12 teacher preparation; (f) state systemic initiatives and other large-scale collaboration projects; and (g) ways to improve pedagogy in the math classroom. Several respondents indicated that MER opened their eyes to the involvement of research mathematicians in math education issues. Although the responses from math educators were limited (8), they were similar to the mathematics group. More awareness of calculus reform and mathematicians' role in mathematics education reform were the most commonly cited issues. The few K-12 teacher respondents mentioned most frequently increased awareness of calculus reform and use of technology in the math classroom. A major strength of the Forum is the legitimization it provides for mathematics education reform within the mathematics research community.

A second change which participants attributed to the Forum was the creation of a supportive atmosphere for educational reform activities. Perhaps the major function of the MER Forum is to build relationships among mathematicians and others interested in mathematics education reform. More than seventy percent of respondents from all three groups agreed they would feel comfortable contacting or calling MER colleagues about professional matters.

A third individual level change attributed to the MER Forum was that of classroom pedagogy. Almost half of the mathematician respondents agreed that they changed their own teaching as a result of their involvement with the MER Forum. A similar percentage of K-12 educators, but slightly less than one-quarter of the math-educators, reported they changed their teaching as a result of MER. Several mathematicians could not attribute changes in teaching directly to MER, believing that these changes were inevitable, yet still attributed an indirect effect to MER. Cooperative learning is the most popular change in mathematicians' classroom teaching. The second most frequently cited change in pedagogy is the incorporation of technology into the math class, specifically the use of graphing calculators and DERIVE, Mathematica, MAPLE, and other computer software. Other pedagogues that have made their way into the college mathematics classroom include more hands-on activities, more class participation, reformed math curricula such as Harvard Calculus, and new types of assessments.

One of the broader changes reported by survey respondents was more positive departmental attitudes toward educational reform (over 50% felt educational reform was

highly valued and about 75% felt educational reform was as least accepted and supported). While it is difficult to attribute theses attitudinal changes solely to MER because of increased accountability pressures to improve the quality of university teaching, it appears that MER may have helped provide some leadership as mathematics departments have been called upon to address educational issues. We found that the primary indicators of positive departmental attitude change toward mathematics education reform are improvements in curricula, attention to better pedagogy and increased institutional support. Curricular changes primarily involved calculus courses and frequently involved the adoption of a reform (e.g., Harvard) calculus program. At several institutions the curricula were improved in other areas of mathematics as well. Development of more entry level math courses, development of graduate level courses focusing on pedagogical issues, remedial education reform, re-writing pre-service programs for math majors, support for emerging scholars programs and designing a math/science core for undergraduates are some of the other areas of curricular reform in which MER participants and their departments are involved.

Changing institutional beliefs and practices is very difficult. It is the culture of academia to work on your own research, perhaps collaborating with other experts in your specific area but not necessarily with your neighbors next door. Systemic reform will require mathematicians and others to begin to adopt the attitude that changing personal practice is important but is not enough to change the entire system of mathematics education. Although valuable, supporting individuals involved in mathematics education does not "change the culture" of the mathematics community. Recognizing that reform must extend beyond individuals to entire organizations, MER has evolved into a permanent fixture at the January Joint Mathematics Meetings, sponsoring talks and presentations, in an effort to make educational issues a regular feature of what mathematicians conversations. In addition, the new Departmental Network may help fill this need. We support MER in its efforts to bring about systemic change and hope that the organization will put even more effort into changing entire mathematics departments so that they value and reward educational activities of their faculty.

MER's role in departmental education reform

The mathematics departments comprising MER's Departmental Network are engaged in a variety of educational activities, most of which are directed toward undergraduate issues, although there is an increasing emphasis on graduate education reform. For the most part, many of the educational initiatives described in this section of the report were underway prior to the formation of the department network. However, the second departmental workshop (May, 1995) held in Santa Barbara demonstrated the potential for MER's role in facilitating departmental reform. In the following paragraphs we discuss some of the ways that MER has already helped and can continue to help bring about departmental reform. On the other hand, we discuss some of the hurdles to MER's success. We do this with the intent that, if the Departmental Task Force and co-director agree with our findings, these can be addressed so that MER's departmental network may reach its full potential.

By including these thirteen departments as founding members, MER has gotten off to a good start. All of these departments are involved in educational work and almost all have at least one faculty member with strong ties to MER, either as an Advisory Board Member, co-director, or participant in an individual workshop. These ties helped to give MER instant credibility in the department. MER's request that the department chair attend the first meeting was an important strategic move to help increase the likelihood of broad acceptance within the department. At Penn State University, this link was broken when the department chair and MER co-director took a position at another institution. He was the main tie to MER and it will be important for MER to foster that degree of loyalty in the current (interim) chair. Because of the extra work required for the chair and major liaisons, there needs to be a fair amount of trust in MER to help sustain these efforts and believe they will be worthwhile. Penn State appears close to falling into this situation. In fact, they were the only department that did not send a team to the May, 1995 meeting in Santa Barbara.

Generally less than half of faculty members in each of the departments we visited had heard of MER and even fewer (less than one-quarter) understood the implications of their departments' relationship with the MER Forum. More frequently we heard comments such as, "oh that's the organization that Professor X is involved with." The degree of awareness and interest in MER is clearly variable across departments. The level of involvement appears related to the general interest in education throughout the department and the degree to which liaisons have attempted to spread the word throughout their faculty. Some departments specifically invited "cynics" to attend the departmental

workshops to help provide more credibility/evidence for the efficacy of their departments' involvement when reporting back to their colleagues.

In addition to the yearly departmental workshops and MER newsletter, departmental members are all subscribed to an electronic mail listserver. The original plan was to have only a few faculty members subscribed from each department and then these individuals "moderate" the information and decide what to forward to their colleagues. This system has its merits especially because it prevents MER from being seen as too proselytizing and possibly sending too much mail to those not ready to participate. This is consistent with MER's general approach; it does not force educational ideas upon people, rather it serves as a gentle prod to help facilitate reform. However, we think it might be beneficial to open up the listserver to any individual in the departments with an interest in joining instead of limiting it to the appointed liaisons. As far as we can tell, there has not been a lot of traffic on this list (we've been subscribed since the end of 1994), so there does not seem to be too much danger of alienating people by flooding their e-mail boxes. This will also relieve the liaisons with some of the responsibility of having to decide who is interested in each message and forwarding it to them.

One finding from our departmental analysis was particularly striking. Pre-college mathematics educational activities rests on the shoulders of very few faculty members. While some of these departments were engaged in some very impressive K-12 reform efforts, they seemed somewhat precariously supported by a small fraction of the department and not by the departments as a whole. If these faculty members left their departments or decided not to continue with their efforts, these initiatives would likely falter. This scenario actually occurred at Penn State University as a result of the departure of David Bressoud. Whenever we asked about K-12 initiatives, people almost always told us that "David used to do that" and they made it clear that nobody had continued with his efforts. Even at a school such as UCSB where three of 28 faculty members (a relatively high percentage) were responsible for essentially all of the important and impressive K-12 projects, it still seemed somewhat non-institutionalized. Only at the University of Texas-Austin, with a mathematics educator on the faculty, did we feel that there was true institutional support. This is not to detract from the laudatory efforts of the mathematicians working on educational problems, but they are not rewarded nor expected to work on K-12 issues. Without these institutional supports, it is doubtful that these K-12 initiatives can become systemic.

The greatest strength of the departmental network is the quality of the workshops. While most participants were extremely positive about their experiences at individually-oriented workshops, the departmental workshops appear to offer even more opportunities

for facilitating and sustaining educational reform. Department members were extremely positive about their experiences and we witnessed some spontaneous initiatives start as a result of the inter-departmental collaboration.

> *It looks like it [participation in the department network] will lead to graduate student exchanges, ancillary talks by grad students at research meetings, our sharing computer based projects we developed, with a return of others' efforts eventually perhaps (University of Nebraska faculty member, May 6, 1995).*

Simply bringing groups of like-minded mathematicians together might be beneficial, but MER deserves credit for structuring this workshop in a way that maximized the positive outcomes. Having an overarching theme to guide the workshop while scheduling breakout sessions to accommodate specific interests helped faculty members feel like they were gaining insights about topics important to their departments. The following quotes characterize this perspective:

> *As chair, this gives more ammo to get people to move and work so we don't get left in the dust. I am particularly interested in the [mathematics] major now.....*
> *Next step is to get MER "leaders", e.g., Nebraska, out here to meet the Department. Without MER, I wouldn't have a clue about Nebraska, Oklahoma State, and the sort of thing going on there (Mike Crandell, Dept Chair, UCSB, May 6, 1995)*

> *Innumerable instances of 'Oh yes, we have that problem too.' Also a couple of ideas that grew as they bounced (Virginia Warfield, University of Washington, May 6, 1995).*

These types of insights might be able to occur in a non-face-to-face context, but it is unlikely. MER helps people to feel comfortable with one another relatively quickly in a personal setting, in part, because of the informal contact time (e.g., meals) built into the schedule. Several noteworthy developments resulted from these "bouncing ideas" at the Santa Barbara workshop. Graduate and post-doctoral student exchanges and internships was an idea that emerged from this meeting and because so many department chairs were present and agreed with the suggestions, it appears that these ideas will come to fruition. Another idea that was brought to the meeting and was discussed and elaborated in Santa Barbara was a departmental survey to provide comparative information for department chairs and others to use when trying to leverage more resources from the central administration. This could eventually lead to a database to help people find information quickly about specific issues.

For example the concern expressed by the Penn State department chair could be addressed with a MER database:

> *Our math majors dropped in number from 303 in 1988 to 143 in 1994. I'd be real interested to hear how other institutions deal with this.*

Another area of reform that emerged from the departmental workshops (both Austin and Santa Barbara) were several collaborative projects between two or more departments. For example, the Universities of Nebraska and Oklahoma, as a result of their interactions at the first departmental meeting in Austin, collaborated on a planning grant to help infuse mathematical sciences across the undergraduate curriculum. Further, several institutions met at the Santa Barbara workshop to discuss plans for a substantial interdisciplinary initiative. This type of collaboration could occur without MER, but having an organization such as MER to facilitate these types of interactions helps speed the progress toward mathematics education reform.

Overall, MER is successful at facilitating mathematicians' participation in mathematics education reform. We have noted that most individual and departmental MER participants and MER as an organization focuses reform efforts at the postsecondary level, in spite the K-12 emphasis stated in some of the funding proposals. However, this focus on postsecondary mathematics education is the case of MER participants working in areas where they have the most expertise and the most to offer the mathematics education agenda. We think this is a good use of MER members' time. However, improved coordination with mathematics educators and K-12 educational organizations will allow MER to articulate its efforts with those occurring in pre-college mathematics. MER has done a good job of being received into the mathematician community which has not been an easy task. An organization that is too prescriptive might alienate many potentially interested mathematicians, while an effort too *laissez faire* may never accomplish much. MER appears to walk this fine line with a good sense of balance, gently adding new ideas to the education agenda. According to the criteria established earlier -- MER as a support mechanism for those members of the mathematics community already involved in educational efforts -- we believe MER is effectively facilitating mathematics education reform among university mathematicians.

Chapter 1: Introduction

Increasing the participation and capabilities of U.S. citizens in mathematics, science and technology is considered crucial to the national interests of the United States. In fact, Goal 4 of the recently authorized Educate America Act states that: "By the year 2000, the United States students will be first in the world in mathematics and science (Educate America Act, 1994)." Means to these desired ends have taken many forms. One of the most popular is standards-based reform, where content and performance standards are sanctioned by some central authority (e.g., state or Federal) and assessments are designed to measure progress towards these standards. Usually the results are made public in order to increase the "stakes" attached to these assessments, following the assumption that if the stakes are high enough teachers will teach (and students will learn) the specific content standards. While this movement has many influential supporters (e.g., Smith & O'Day, 1991; Resnick & Resnick, 1992), others have been calling for a more decentralized approach to educational reform (e.g., Darling-Hammond, 1994; Lieberman & McLaughlin, 1992).

While much of this debate has been focused on K-12 education, there is interest also in improving the education of postsecondary students in the United States. In 1986, the National Association of Governors cited the quality of higher education as one of its seven priorities for educational areas needing improvement (National Association of Governors, 1988). Unlike the K-12 reforms, however, the push for improvement in higher education was decentralized and allowed each institution to develop their own assessment and accountability plans. It is unlikely that any centralized efforts will be implemented in the near future to improve college education for a variety of reasons, including the relatively high professional status of most university educators, the "academic freedom" of both individual faculty members and university departments, differences in the governance structure of K-12 systems compared to university systems (even public systems), and varied missions across universities.

Networks, or voluntary associations of professionals, have become increasingly important in both K-12 and postsecondary education reform (Mann, 1995). While Lieberman & McLaughlin (1992) studied networks of K-12 teachers, the following statement applies to postsecondary education as well:

> *The experience of diverse networks suggests that policy can lever change more effectively if it takes an indirect approach -- concentrating on the environments available to support and stimulate teachers' professional growth -- than if it directly tackles concerns about teachers' knowledge base*

and classroom competencies. In this period of intensive school reform, when traditional inservice training and staff development have been shown to be inadequate, networks can provide fresh ways of thinking about teacher learning (p. 677).

In this evaluation report we discuss how the Mathematicians and Education Reform Forum (MER or the Forum), a voluntary association of mainly mathematicians and a small portion of mathematics educators and K-12 educators, has affected these several areas of mathematics education reform: K-12 curriculum, undergraduate curriculum for math majors and non-majors, graduate experiences, participation of minority and women students, pre-service teacher preparation, in-service teacher enhancement, involvement with local school districts and participation in statewide systemic initiatives.

This evaluation was initiated to provide information to NSF about the quality and sustainability of the MER network, as well as to help determine the programmatic fit of MER into the overall mission of the Education and Human Resources and other NSF Directorates from which MER receives funds. Further, the MER co-directors are interested in program improvement and look to the results of this evaluation to provide formative feedback. This evaluation was guided by the following general questions (more specific questions are discussed in each chapter of the report):

1. How can we best portray MER's program? (Chapter 2)
2. Is the individual component of the MER Network an effective means of mathematics education reform? (Chapter 4)
3. Is the departmental MER Network an effective vehicle for mathematics reform? (Chapter 5)
4. Is MER an example of systemic reform? (Chapters 4 & 5)

Finally, while there have been many theoretical advances regarding the evaluation of programs, products, and personnel, little has been written about evaluating voluntary networks. It is customary in program evaluation to describe the effects or changes brought about by a particular intervention. In other words, as evaluators we often look for evidence of change in practice (or beliefs or knowledge) to determine whether a program is "effective" or not. However, in this evaluation, trying to determine whether or not change has occurred is difficult, both conceptually and psychometrically. MER is, for the most part, preaching to the converted, i.e., most MER participants were already involved in educational work before joining MER. Therefore, attributing change to MER's influence can be difficult. We have come to understand that MER functions more as a support mechanism for those members of the mathematics community already involved in educational efforts and we have incorporated this conception of "effective" into our

evaluation. This is not to say that people and institutions have not changed as a result of their experiences with MER, but if we base our evaluation on this level of effectiveness it will be too stringent (and unrealistic in many cases) a test for most voluntary networks to meet.

References

Darling-Hammond, L. (1994). National standards and assessments: Will they improve education? *American Journal of Education, 102*, 478-510.

Lieberman, A. & McLaughlin, M. W. (1992). Networks for educational change: Powerful and problematic. *Phi Delta Kappan, 73, 9*, 673-677.

Mann, D. (1995). Can teachers be trusted to improve teaching? *Phi Delta Kappan, 77, 1*, 86-88.

National Association of Governors (1988). Results in Education: 1988. The Governors' 1991 Report of Education. Washington, DC: U.S. Government Printing Office.

Resnick, L. B. & Resnick, D. P. (1992). Assessing the thinking curriculum: New tools for educational reform. In B. R. Gifford & M. C. O' Conner (Eds.), *Changing Assessments: Alternative Views of Aptitude, Achievement and Instruction.* Boston: Kluwer Academic Publishers.

Smith, M. S. & O'Day, J. A. (1991). Systemic school reform. In Fuhrman, S. H. & Malen, B. (Eds.). *The politics of curriculum and testing: 1990 yearbook of the Politics of Education Association.* London: Taylor & Francis.

Stake, Robert E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications.

Chapter 2: Description of MER

The Mathematicians and Education Reform Forum (MER) was organized as the MER Network in the summer 1988 with NSF funding for three years. The beliefs currently driving MER, as stated in their most recently funded proposal, are that

> *[a]s disciplinary experts in the content, methods, and directions of modern mathematics, mathematicians have a great deal to contribute to mathematics education reform; as teachers of mathematics, mathematicians have a great deal to learn from other professionals involved in mathematics education. Further, there is growing awareness that many issues in mathematics education are systemic in nature and must be addressed at all levels and by all constituencies (MER funding proposal, 1993).*

Initially, the MER program concentrated on pre-college education to involve mathematicians in K-12 educational reform. MER has operated by offering workshops to approximately 50 people between one and three times per year. These workshops generally have consisted of mathematicians demonstrating and/or discussing mathematics education efforts. One intent was to include research mathematicians in a network of mathematicians interested in and involved with mathematics educational reform. This was not designed as an electronic or newsletter-type network. Rather, MER's intent was to foster a personal network where colleagues could be supported in their efforts to institute new educational endeavors.

In 1991, when MER was awarded a second NSF grant for two years, the network took on a slightly different focus. The co-directors found that the level of participant interest in undergraduate education had increased. Although the intent was for the main focus of MER to remain pre-college, MER now included the first two years of undergraduate education and became a K-14 program.

For the past two years (1993 & 1994), MER has been awarded one-year NSF grants, subject to yearly renewal. The focus of the current grant, bearing the name of Mathematicians and Education Reform Forum, is on continuing the individual MER networking effort, as well as involving mathematics departments in their own network. The new MER Forum mission is "to facilitate the institutionalization of mathematics education reform within the mathematics community" (MER funding proposal, 1993). It is important to note that the original individual component of the network will continue to meet at least yearly. According to the co-directors, the new name was selected to embrace both MER's ongoing activities directed at the mathematics community in general and its new program, the Departmental Network. Forging a relationship between the mathematics and education cultures was not an intentional part of the new mission. However, an article in the Spring 1994 MER Newsletter proposed a different rationale for the name change,

that MER wanted to emphasize that two cultures "not disjoint but containing non-empty relative complements" (D. Hurwitz, MER Newsletter, Spring 1994) were being joined -- that of mathematicians and educators.

The application process for the individual workshops also involves the individual mathematician's department via the requirement of a letter of support from the chair or dean. This requirement is an up-front assurance that the applicants' department is supportive of mathematics education, furthering MER's pursuit of systemic change. Naomi Fisher told us that the application process, because of all its requirements, serves to screen candidates.

The Department Network officially began with the first invitational workshop held at the University of Texas-Austin in May 1994 with departments who were considered outstanding research departments supportive of educational reform efforts. MER restricted participation to research universities because it believes these function as role models for smaller institutions and, if research universities "buy into this", then other institutions will as well. MER required that several faculty and administrators from each mathematics department be supportive of math education reform for participation in the departmental network. In essence, MER intends the Forum to have systemic effects.

The Departmental Network Task Force (consisting of the four co-directors and seven outside people) selected institutions for the new network based on their knowledge of which mathematics departments are at the forefront of mathematics education concerns. They invited members of the MER Advisory Committee to consider having their departments join, which many did. Information about other institutions came from the co-directors' first-hand knowledge of what was going on at other institutions through participation in the individual component of the MER network. One institution, Howard University, had a few members who had attended a MER workshop previously and was selected in part because it serves a predominantly African-American population.

These thirteen departments have made a three year commitment to the department network: University of Arizona, Howard University, University of California-Santa Barbara, University of Illinois-Chicago, University of Maryland, University of Michigan, University of Minnesota, University of Nebraska, Oklahoma State University, Penn State University, Rutgers University, University of Texas-Austin and University of Washington. This commitment is operationalized by sending a team of faculty and/or administrators to the yearly departmental workshops, maintaining communication with other departments through the MER Departmental E-Mail Network, and trying to spread the word within their departments to involve more faculty in educational endeavors.

Chapter 3: Evaluation Methodology

In this section we specify our data sources and describe our data collection and analysis methodologies. To triangulate our findings, we consulted several data sources and employed various data collection and analysis methodologies. Data sources included the NSF Program Officer, MER co-directors, Fall 1994 Baton Rouge Workshop, 1994 Task Force meeting, Winter 1995 Joint Societies Meetings, 1995 Advisory Committee meeting, past and present individual participants, members of the Departmental Network, related documents and pertinent literature. The case study approach (Stake, 1995) provided a framework for our data collection. Primary data collection methods were written questionnaires, personal interviews, participant-observation, direct observation and document review. To analyze our data, we used both qualitative and quantitative methods as appropriate. Coding and domain analyses were the primary tools for interview transcriptions, fieldnotes, and open-ended survey questions and descriptive and inferential statistics were used on the closed-ended survey questions. Data gathering from some of our sources, such as discussions with the MER co-directors and NSF Program Officer and review of literature and documents, was continuous throughout the year of this evaluation. However, other data gathering activities were more discrete and occurred in contexts unique to this evaluation. We elaborate on our primary data collection methods in the sections to follow.

Participant Observation

As previously explained, we organized our evaluation to address both the individual component and the newly formed departmental component of the Forum. Due to limited travel resources, Scott and Carolyn alternately attended the meetings and conferences where data collection took place, with the exception of the Departmental Workshop in Santa Barbara. This conference served as follow-up to our case study site visits and both evaluators attended. The conferences and meetings at which we collected data included the Baton Rouge Teacher Preparation Workshop (11/94), MER's Task Force Meeting (12/94), MER's Advisory Board Meeting (1/95), MER's Special Sessions at the Joint Annual Meeting of AMS and MAA (1/95) and MER's Departmental Network Workshop (5/95).

Baton Rouge Workshop In November 1994, one of us acted as participant-observer at the Teacher Preparation Workshop. In addition to observing the sessions and interviewing participants, we surveyed workshop participants by distributing questionnaires on the final morning of the workshop. This survey was designed to provide us with descriptive information about the types of people participating in the workshop, their current educational (specifically, teacher education) activities, and the institutional support available to facilitate mathematics teacher education reform at their university.

Several questions were included to gather informants perceptions about the quality and usefulness of this particular workshop (see Appendix A).

MER Task Force Meeting In December 1994, one of us attended the annual meeting of the Task Force which oversees operations of the Departmental Network. The meeting spanned two half days (Saturday afternoon through Sunday morning) and was held in Chicago. Direct observation of the Task Force was the primary objective; we used a limited amount of time to explain the purpose and focus of this evaluation.

AMS & MAA *Joint Societies Meeting.* In January 1995 one of us observed MER's participation in the Winter Joint Societies Meetings of the AMS and MAA which was held in San Francisco. This activity included observing MER's special sessions at this major professional conference, participating in the banquet MER hosts for interested conference attendees and informally interviewing attendees.

MER Advisory Committee Meeting In January 1995 we also attended MER's Advisory Committee meeting which was held concurrently with the Joint Societies Meetings. Participation at the Advisory Committee meeting included leading a discussion of this evaluation and our survey instruments.

MER Departmental Network Workshop. In May 1995, both of us attended the Departmental Workshop held in Santa Barbara. Our participant-observation consisted of observing all workshop sessions and participating in social activities and informal discussions with members of our case study departments for follow-up information.

Case Study Site Visits

To help us describe and evaluate the departmental network and provide us with more information about the culture of mathematics departments, we made site visits to the following four of the thirteen departmental members: University of Texas-Austin, Pennsylvania State University, Rutgers University and the University of California at Santa Barbara. We were concerned that using a random selection to decide on cases might prevent us from learning as much as possible about this network. Therefore, we selected institutions where we expected to find a best-case-scenario of active educational agendas. Since several departments fit this criteria, we selected our cases to provide both geographic and programmatic representation. All the institutions in the network, with the exception of Howard University, are large state universities. We selected one school from the Mid-Atlantic region, one from the East Coast, one from the Southwest, and one from the West Coast. One of us spent approximately one week at each of these four departments.

The evaluation theory guiding our site visits came from a mixture of responsive and pre-ordinate literature. The pre-ordinate aspect of the case studies included a checklist of documents we wanted to review and activities we wanted to accomplish, e.g.,

interviewing the department chair, meeting with graduate students, talking with those "pro-MER," "neutral-toward-MER" and "anti-MER", and attending at least one "reformed" mathematics class. The responsive aspects of the case studies were that we carried out these agenda items in ways we felt were most appropriate for the structure of each department and university, and we allowed our activities to be guided by themes salient to each site related to mathematics education reform. By using the combination of our *a priori* checklist and flexible approach to actually conducting the visit, we hoped to maintain balance between pre-ordinate and responsive case studies.

Written Surveys

The bulk of our data concerning the individual component of the Forum was gathered via extensive written surveys. The target population for the survey consisted of 730 past and current participants in the MER Forum individual and departmental networks. All these people have participated in one or more aspects of this project including serving on the Advisory Committee or Task Force, having attended a MER workshop or belonging to mathematics departments which are in the MER Departmental Network. A small minority of people on the mailing list were added because they expressed interest in MER by responding to a mailing or through some other means.

We chose to survey the entire population of participants rather than to sample from it. We discovered that there are at least three professional community subgroups in this population: 1) mathematicians, mathematical scientists, and mathematics educators working in departments of mathematics, applied mathematics, statistics and computer science; 2) mathematics educators working in departments of education; and 3) K-12 teachers. However, due to a lack of descriptive information identifying to which group individuals belonged[2], it was impossible to bound the subpopulations of interest. This prohibited us from using multi-stage sampling techniques, specifically stratifying the population based on affiliation with various professional communities. While random sampling theoretically would have yielded proportions of these groups that are representative of the target population, we felt it was more appropriate to survey each member of the population rather than use probabilistic sampling. The co-directors informed us that the K-12 and mathematics educators professional communities involved in MER are much smaller than that of mathematicians. To maximize the chances of including these groups in the response (and because we could not over-sample from these groups since we could not identify them), we surveyed the entire population. In this way we

[2] Although a 1992 MER survey collected some demographic data such as participants' gender, highest degree obtained and type of institution where employed, it did not identify participants according to professional community.

saturated our targeted "sample" with respondents from each group in hopes of improving the sheer numbers of responses from K-12 teachers and mathematics educators. MER's impact on mathematics educators and K-12 teachers is important and, regardless of their relatively low numbers, we need to be able to hear their voices.

Pilot Testing the Instruments An interpretive approach was used during the instrument development stage by active collaboration with the co-directors, advisory committee and task force members. Two of the four MER co-directors (Naomi Fisher and Harvey Keynes) were particularly helpful, commenting on each draft of the questionnaire and providing direction for it. Our objective during this period was to "learn the language" of the MER Forum participants so that we could ask pertinent questions in terms that would be mutually understood by both participants and the evaluation team.

A literature search and review of the 1992 MER survey provided insight useful for instrument development. The literature search, directed toward post-secondary institutions' departmental cultures, revealed one particularly helpful instrument, "Faculty at Work: A Survey of Motivations, Expectations, and Satisfactions." In addition to the literature search, we consulted the 1992 MER Forum survey (the "Berger survey"). A combination of the Berger and Faculty at Work surveys, feedback from MER representatives, and discussions among the evaluation team served as the basis for the development of the initial version of the survey.

The instruments were pilot tested three times, at the MER Forum workshop in Baton Rouge, at the December 1994 Departmental Task Force meeting in Chicago, and at the January 1995 MER Advisory Committee meeting. As a result of these initial trials, decided upon a final approach. We mailed each person in our population three separate surveys and ask them to complete the one for the professional community to which they belong. Although this was more expensive in terms of photocopying and mailing, this eliminated complicated skipping patterns which, we hope, improved our response rate. The final version contains three separate questionnaires and encourages return of even partially completed surveys (see Appendix B). The pertinent section of the cover letter reads as follows

> *Much consideration went into deciding to develop three separate forms of the survey. We have enclosed three clearly labeled forms, one for each of the following three groups of professionals: 1) mathematicians, mathematical scientists, and mathematics educators in departments of mathematics, applied mathematics, statistics and computer science (white); 2) mathematics educators in departments of education (blue); and 3) K-12 teachers (yellow). Please decide to which professional community you belong and then complete only the appropriate form. Note that you should complete and return only one survey! We anticipate that this should take about 20-25 minutes of your time despite the apparent length. We ask that if you can not spare that much time you at least complete the demographic*

information and close[d] ended questions and return the survey. However, the examples and elaboration you provide will enrich our understanding of the MER Forum. Therefore, we request that you complete the entire questionnaire if at all possible.

Lastly, we consulted a University of Colorado-Boulder faculty member specializing in research design to review the instrument and suggest possible ways to boost the response rate. The idea for a $2 MER coupon for the 1996 MER banquet at the Joint Societies Meeting came out of this process.[3] We mailed a follow-up postcard approximately two weeks after the survey mailing to remind and encourage participants to return their completed surveys.

Devising a good survey would have been an impossible task without the cooperation of MER representatives. Repeated pilot tests provided invaluable information that certainly improved both the quality of information we received and the response rate.

Response Rate Two-hundred and thirty usable questionnaires were returned yielding a response rate of 32%. Of these respondents, 199 identified themselves as being from mathematics, computer science, and/or engineering departments, 20 were from education departments, and 11 were from K-12 or other institutional settings. As mentioned in the methods section, we identified 430 individuals from the MER mailing list as affiliated with mathematics, computer science, and/or engineering departments. Therefore, we sent only questionnaires designed for mathematicians. We sent all three questionnaires to the other 290 recipients because we could not positively identify their primary group. As a result of using this system (which we felt was the best possible given the circumstances) we are unable to calculate precisely the response rate for the various subgroups of respondents. It does appear, however, that the response rate for mathematicians (199 out of at least 430 -- 46.3%) was considerably higher than the response rate for the other two groups. Perhaps the response rates were lower for mathematics educators and K-12 teachers because MER has not been not targeted toward them and, although they have attended workshops and/or expressed interest in the Forum, they do not feel the same allegiance toward the Forum mathematicians (verbatim survey responses are available upon request).

References

Stake, Robert E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage.

[3] We realize that the $2 off coupon for the 1996 MER Banquet at the AMS/MAA Joint Societies Meeting was attractive only to those respondents who are supportive of MER and would be interested in attending the Banquet. It might have been better in terms of enticing a wider range of respondents to include a dollar or two and invite them to have a cup of coffee on us while they complete the survey but we did not have the funds for this.

Chapter 4: General Findings

In this chapter we present our general evaluation findings which pertain to the Forum's individual level and certain aspects of the departmental level; findings unique to the departmental component are reserved for the next chapter. Since this section of the report is fairly long, we feel it necessary to provide an "advanced organizer" for the pages to come. We have separated aspects of MER's functions which contribute to its effectiveness into themes which emerged from our data analyses: (1) the extent to which MER reaches its target audience of research mathematicians; (2) the effectiveness of the Forum's communication activities; (3) the breadth and depth of MER's educational initiatives; (4) the impact of MER's workshops; (5) the extent to which MER meets the needs of mathematicians and mathematics and K-12 educators; and (6) the systemic effects of MER's activities.

The Forum as a subset of the community of mathematicians

Naomi Fisher clearly states that the target audience for MER does not include all mathematicians.

> *The workshops, which are advertised throughout the mathematics community, are aimed at mathematicians who want to work in education. Applicants are required to show evidence of a commitment to sustained work and to give details of their present activities and their future plans."*
> *(Fisher, 1990, p. 4)*

Some people in mathematics departments become involved in education because of a personal commitment to education, while others, with less active research agendas due to their own interest or institutional expectations, are urged to become more involved in educational issues. There may be other issues at work in the definition of MER's target audience. We have no way of assessing the size of this subset of mathematicians who also are interested in educational issues, and neither does MER. As a result, we examine the extent to which MER influences the entire community of mathematicians. This is not unfair because MER's claim to systemic reform necessarily implies reaching those in the community who may not be already interested in educational issues. In addition, those not involved in education may influence those who are involved through the university reward structure.

Slightly more than eighty-six percent (86.52%) of our survey respondents indicated they are mathematicians. Generalizing to the entire population (N=730; we did not mail to

the co-directors and international members) represented by the MER mailing list[4] we assume that 632 people are mathematicians. Trying to determine what portion of the mathematics community this 632 mathematicians represents is difficult. Following, we explain our logic for determining the portion of the mathematics community involved in MER; then we present arguments why these different percentages might be considered meaningful. Interpreting these numbers is ultimately up to the MER co-directors and the NSF Program Officers.

In 1990 there were 19, 441 total faculty members in departments of mathematics at four-year institutions (Albers, Loftsgaarden, Rung, & Watkins, 1992). We realize that MER intends also to target mathematicians at two-year institutions so the number 19,441 is actually an underestimate. These data indicate that MER attracts less than 1% of its target population. Less than one in one hundred mathematicians actively involved in MER shows a limited impact.

In a few ways MER mathematicians are representative of the larger mathematics community (such as in the level of minority participation) but in many ways they are unusual. In general, MER participants includes more women, are more stable in careers, and are more involved in educational activities than the mathematics community as a whole. As noted previously, the number of mathematics educators and K-12 teachers in our sample is low and we cannot make claims about the representativeness of this portion of our sample. The next few pages present the mathematician-respondent characteristics in considerably more detail below.

Minority groups are severely underrepresented in the mathematics community and the respondents to this survey reflected this underrepresentation (Albers, et al., 1992). More than 90% of the respondents from both the mathematician and math-educator groups and over 80% of the K-12 group identified themselves as White, 10 respondents (across all 3 groups) were African American, 4 were Asian, 3 were Hispanic, and one was Native American (see Table 1). With such a small pool of minority mathematicians from which to attract members, MER can not be faulted for its low numbers of minorities.

Another similarity between participants and the mathematics community are the non-MER organizational affiliations. Not surprisingly, non-MER organizational affiliations varied according to respondent group. The organizational affiliation most common among all three groups is the Mathematical Association of America (MAA) with

[4] We recognize that MER impacts a larger group than those who attend the workshops (as discussed in the departmental component) and in trying to estimate the breadth of MER's impact, we suspect that we are providing slight underestimates. Further, it is important to note that respondents to the mailed survey were self-selected (i.e. volunteers), therefore it is impossible to accurately generalize to the target population of MER members.

over 80% of mathematicians, 60% of math educators, and 36% of K-12 respondents indicating membership. Seventy percent of the mathematician respondents were members of the American Mathematical Society (AMS), but less than 20% of respondents from the other two groups were members of this organization. The group with the largest representation in the American Educational Research Association (AERA) was mathematics educators (55% belonged) and that of the National Council of the Teachers of Mathematics (NCTM) was K-12 educators (91% belonged). In the category marked "other" the most commonly additions were specific mathematics organizations (such as the Association for Symbolic Logic and the American Statistical Association), associations devoted to women's issues (such as American Association of University Women) and management-type organizations (such as National Council of Supervisors of Mathematics and Association of State Supervisors of Mathematics).

Gender representation of respondents differed among groups. Of the mathematician respondents, 27% were women and 73% were men, whereas approximately 65% of the respondents from each of the other two groups were women. If, in fact, the 27% female mathematician response rate generalizes to the population of MER mathematicians, it is a higher percentage of women than in mathematics departments as a whole which has been recently estimated at 20% (Albers, Loftsgaarden, Rung, & Watkins, 1992, p. 16). These data, when interpreted one way, show that MER is attracting women at a higher rate than is the mathematics profession in general and, thus, moving in a desirable direction. Looked at another way, however, one might infer that female mathematicians are being shepherded into areas (e.g., teaching) traditionally considered to be "women's work." We are not sure if this pattern is typical of mathematics departments, although gender equity researchers (e.g., Hall & Sandler, 1986) have suggest this might be more prevalent than most people would like to believe

As indicators of stability, we considered the academic rank, length of time at institution and age of the respondents. The majority (57.5%) of mathematician respondents were full professors and an additional 8.8% indicated they were department chairs, deans, or program directors. Approximately 20% of the mathematicians indicated they were associate professors, approximately 10% were assistant professors, and less than 5% reported they were non-tenure track faculty and/or graduate students. If we assume that both associate and full professors are tenured faculty, then the total percentage of tenured faculty involved with MER is 77.2%, which is considerably higher than the national average (65%) of tenured faculty in mathematics departments (Albers et al., 1992, p. 36). In fact, if we assume that the majority of chairs and deans still hold faculty lines, the

percentage of tenured faculty members involved in MER is probably over 80% (see Table 1).

The age distribution of MER respondents is consistent with the distribution of academic rank (see Table 1). Approximately 10% of the mathematician respondents were younger than 40 years of age, 20% were between 40 and 49 years, 54% were between 50 and 59 years, and 15% were 60 years old or older. Thus, 69% of respondents were older than 49 years, whereas nationally, only 36% of full time faculty in mathematics departments were in the same age group (Albers, Loftsgaarden, Rung, & Watkins, 1992, p. 38). We cannot say for sure that MER participants are older and more advanced in their careers than the general population of mathematics faculty because this may be an artifact of self-selection of respondents to this survey. However, our impression from being at two workshops and visiting four departments is that MER tends to attract faculty more secure in their mathematics career. In fact, one faculty member said, "I hate to see young people at these workshops, they should be concentrating on their mathematics research."

A final sign of stability was the length of time spent as faculty at the participants' institutions. The majority of respondents have been at their current institution for more than 10 years, and the majority have been employed at other schools for 5 years or less. These demographic characteristics (age, rank, length of employment) paint the picture of MER participants as being relatively established members of the mathematics profession.

Examining the interaction of gender and academic rank revealed an interesting picture. While 65% of the male mathematics faculty were full professors and 20% were associates, only 38% and 19%, respectively, of female faculty held these ranks (see Table 2). Likewise, almost 23% of female mathematics faculty compared with 5% of the male faculty were assistant professors and 9% of females were not in a tenure-track position compared with only 2% of the male respondents. In spite of their generally lower ranks, female mathematician respondents were similar in age to their male counterparts. The average age of male mathematician respondents was 52.4 years (Std. deviation. = 7.7 years) and females averaged 50.6 years (Std. deviation. = 9.4 years). Perhaps females either are persuaded to or freely choose educational orientations earlier in their careers which, in turn, negatively affects their chances for promotion and tenure. Another possibility is that females take time off from their careers to tend to family responsibilities which would also account for their relatively lower average rank. The slight age difference does not appear to explain the noticeable difference in average rank. We do not know if this situation is characteristic of mathematicians.

Table 1.
Demographic characteristics of survey respondents.

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
Gender						
Male	145	72.9	7	35.0	4	36.4
Female	54	27.1	13	65.0	7	63.6
Race/Ethnicity						
American Indian/Alaska native	1	0.5	0	0.0	0	0.0
Asian/Pacific Islander	3	1.5	1	5.0	0	0.0
White (Not Hispanic)	184	92.9	18	90.0	9	81.8
Black (Not Hispanic)	7	3.5	1	5.0	2	18.2
Hispanic	3	1.5	0	0.0	0	0.0
Current Academic Rank						
Graduate student	3	1.6	1	5.6	N/A	N/A
Instructor	3	1.6	0	0.0	N/A	N/A
Lecturer	1	0.5	0	0.0	N/A	N/A
Senior Lecturer	1	0.5	1	5.6	N/A	N/A
Assistant Professor	19	9.8	4	22.2	N/A	N/A
Associate Professor	38	19.7	2	11.1	N/A	N/A
Professor	111	57.5	7	38.9	N/A	N/A
Other	17	8.8	3	16.7	N/A	N/A
Age Group						
< 30 yrs old	2	1.0	0	0.0	0	0.0
30-39 yrs	18	9.2	2	10.0	1	9.1
40-49 yrs	40	20.4	8	40.0	5	45.5
50-59 yrs	106	54.1	8	40.0	4	36.4
60-69 yrs	28	14.3	2	10.0	1	9.1
70+ yrs	2	1.0	0	0.0	0	0.0
Highest Educational Degree						
Bachelor's	0	0.0	0	0.0	1	9.1
Master's	13	6.6	3	15.0	8	72.7
Ph.D. in Mathematics	155	79.1	2	10.0	1	9.1
Ph.D. in Math Education	18	9.2	11	55.0	1	9.1
Ph.D. in another field	4	2.0	1	5.0	0	0.0
Ed.D	4	2.0	3	15.0	0	0.0
Other	2	1.0	0	0.0	0	0.0

Table 1 (continued)

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
Organizations/Affiliations						
AMS	138	70.1	3	15.0	2	18.2
MAA	164	83.2	12	60.0	4	36.4
SIAM	21	10.7	1	5.0	0	0.0
AWM	47	23.9	3	15.0	0	0.0
NCTM	99	50.3	15	75.0	10	90.9
AMATYC	13	6.6	1	5.0	0	0.0
AERA	11	5.6	11	55.0	0	0.0
Other	47	23.9	8	40.0	5	45.5
Number of years as a faculty member at present school.						
0 yrs	2	1.0	2	10.0	0	0.0
1-5 yrs	31	15.6	5	25.0	1	9.1
6-10 yrs	25	12.6	2	10.0	3	27.3
11-20 yrs	49	24.6	3	15.0	3	27.3
20+ years	92	46.2	8	40.0	4	36.4
Number of years as a faculty member at other schools.						
0 yrs	74	37.2	7	35.0	1	9.1
1-5 yrs	59	29.6	9	45.0	5	45.5
6-10 yrs	22	11.1	2	10.0	2	18.2
11-20 yrs	26	13.1	1	5.0	2	18.2
20+ years	18	9.0	1	5.0	1	9.1

Table 2.

Rank by gender of respondents from mathematics departments.

	Male		Female	
Current Academic Rank	Frequency	Valid %	Frequency	Valid %
Non-tenure track	3	2.1	5	9.4
Assistant Professor	7	5.0	12	22.6
Associate Professor	28	20.0	10	18.9
Professor	91	65.0	20	37.7
Administrator	11	7.9	6	11.3

Looked at in terms of sheer numbers, MER has done a good job of attracting a large group of its target audience -- not an easy task considering the demands on academics' time. The men and women who participate in MER by and large still maintain their research agendas and include some of the most prominent mathematicians in the field. In terms of participant credentials, MER is an impressive collection of mathematicians. However, in terms of inclusiveness, MER attracts a small fraction of the community of research mathematicians in the country. One of the problems we found associated with MER being a relatively small subset of a larger group is that some people perceive it as an elitist organization. We found that several mathematicians (who are considered participants) held this view and received these comments on surveys: "Make it less elitist and open to mathematicians from a wide variety of institutions, not just researchers." "Open up the meetings! Why all the secrecy and invites only?" "Involve participants more; make conferences more egalitarian." Perhaps if mathematicians sensed that MER was open to all members of the mathematics community, they would reach a larger portion of their target population. On the other hand, we recognize that MER needs to attract research mathematicians as part of its mission and making MER less special might alienate those they were originally trying serve. Again, MER is placed in the position of walking a fine line, but we think that opening up the organization gradually would serve their mission in the long run.

Effectiveness of outreach activities

The way in which the MER network grows and spreads is an important consideration in our evaluation. Because MER expends effort along several avenues of communication in an attempt to attract these volunteers, we wanted to find out which were the most and least effective. MER uses the following variety of activities to reach current and potential members: word of mouth, newsletters (and other mailings), participation at the annual Winter Joint Societies Meetings and workshops. Additionally, MER has edited four volumes of the Conference Board of the Mathematical Sciences (CBMS) publication regarding educational issues. Although the primary function of these volumes is to provide a publication vehicle for mathematicians to write about their educational work rather than to promote awareness of MER, at the request of the co-directors we included questions pertaining to these volumes in our participant survey. In short, we found the following which we elaborate upon in the remaining pages of this section: the form of communication over which MER has the least control, word of mouth, is its most effective advertisement; MER's newsletters are informative to those already "in the fold" rather than actually serving to attract new members; workshops are valued by those who have

attended; MER participants who have attended the special sessions and banquet at the Annual Meeting feel these are useful activities; and the CBMS volumes are not read by this audience.

Avenues of communication

Word of mouth from colleagues was the most effective source of information about MER according to each group (34% of mathematicians, 50% of math educators and 50% of K-12 teachers). Thirty-two percent of mathematicians found MER special mailings effective. Similarly, 20% of math-educators and 9% of K-12 teachers valued special mailings. Posted announcements were most effective with the K-12 teachers, more than 25% found them useful, and only slightly valued by mathematicians. Rather large percentages of each group (from 10% - 20%) reported that they used multiple avenues of MER communication including those listed above as well as other conferences, personal invitations from co-directors and Advisory Board members and articles in other publications (such as NCTM, see Table 3). For a few, it was the reputation of the people heavily involved in MER that brought them into the fold. One respondent wrote, *"I have great professional respect for many people involved with MER -- e.g., Harvey Keynes & Phil Wagreich."*

The MER newsletter is the primary means of communication with participants during the course of the year. Twice a year it is mailed to all workshop alumni and any others who request to be part of the network. Similar to the pattern of workshop topics, the early newsletter articles addressed sensitizing mathematicians to the differences in perspective between pre-college education and undergraduate education and promotion of the NCTM standards. In 1990, the newsletters voiced concern about the need to legitimatize mathematics education the mathematics research community. From 1991 to the present, calculus reform and other undergraduate education topics have garnered more space and K-12 has garnered less.

The newsletter seems to be more useful for updating those already interested in MER than it is for attracting new participants. Once they were on the MER mailing list -- which includes all workshop and special session participants in addition to others expressing an interest in MER -- three-fourths or more of the respondents, including 80% of the mathematicians, in all three groups said they found the MER newsletter helpful. However, only seven mathematician respondents (less than 2%) learned of MER by reading its newsletter. The most useful sections are the feature articles regarding new and long-standing programs and essays on the current state and future of mathematics education. A majority of mathematician and math-educator respondents and 46% of the K-12 respondents also said information on basic MER activities in the newsletters was

helpful. Approximately one-third of the respondents from all three groups said information about MSEB in the newsletter was helpful (see Table 3).

AMS, in cooperation with MAA, has published four (three at the time of this survey) special volumes in the CBMS series on Issues in Mathematics Education. CBMS initiated this series in 1988 to stimulate "cross-fertilization" of ideas among mathematicians, mathematics educators and mathematics teachers. The articles center around a specific issue in mathematics education and the articles are usually written by MER co-directors, Advisory Board members, or MER participants. Although the volumes are not an avenue the co-directors rely on to inform mathematicians about MER, they wanted to find out whether MER participants read these articles and we included questions about this on our survey. When asked if they were aware of these volumes, slightly less than half of the mathematician and math-educator respondents indicated they were aware of these volumes and approximately 40% said they had read at least one of these publications. The K-12 respondents were not aware of any of these volumes. When asked if these volumes were useful, approximately one-quarter of mathematician and mathematics-educator respondents said they were extremely or considerably useful; 31% indicated they were a little useful, and 44% of the mathematicians and 22% of the math-educators found these volumes "not at all" useful (see Table 3).

Table 3.
Avenues of communication within the MER Forum.

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
How did you find out about MER?						
mailing from MER	63	32.0	4	20.0	1	9.1
informed by colleagues	66	33.5	10	50.0	5	45.5
MER newsletters	7	3.6	0	0.0	0	0.0
posted announcements	19	9.6	1	5.0	3	27.3
other	23	11.7	3	15.0	1	9.1
multiple sources	19	9.6	2	10.0	1	9.1
Is the MER Forum newsletter helpful to you?						
Yes	156	80.4	17	94.4	8	72.7
No	36	18.6	1	5.6	3	27.3
Sometimes*	2	1.0	0	0.0	0	0.0
Which of the following sections of the MER newsletter do you find helpful?**						
information on basic MER activities	107	55.4	12	66.7	5	45.5
feature articles regarding new and longstanding programs and projects	128	66.3	13	72.2	8	72.7
essays on the current state and future of mathematics education	139	72.0	15	83.3	6	54.5
information on MSEB	59	30.6	7	38.9	4	36.4
other	3	1.6	0	0.0	0	0.0
Are you aware of the MER publications in the CBMS Issues in Mathematics Education volumes?						
Yes	86	43.9	9	45.0	0	0.0
No	110	56.1	11	55.0	11	100.0
Have you read any of these CBMS publications?						
Yes	70	36.1	8	40.0	0	0.0
No	124	63.9	12	60.0	10	100.0

Table 3 (continued).

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
To what extent are the CBMS Issues in Mathematics Education volumes useful to you?						
Not at all	53	44.2	2	22.2	3	100.0
A little	37	30.8	4	44.4	0	0.0
Considerably	28	23.3	2	22.2	0	0.0
Extremely	2	1.7	1	11.1	0	0.0

* Respondent-added category

** Total is more than 100% because respondents were free to provide more than one answer.

In summary, word of mouth and special mailings (for mathematicians) are the most effective ways of attracting new members into the MER network. Once participants become part of the MER network, newsletters serve to provide useful information to members. Survey respondents valued the newsletter and were very appreciative of many aspects of this periodical. The CBMS volumes, on the other hand, were rarely read by MER participants and would not be an effective mode of communication for MER.

Joint Society Meetings

MER maintains active relationships with the two major mathematics professional societies, the AMS (comprised primarily of research mathematicians) and MAA (comprised primarily of mathematics instructors from non-research based institutions). In fact, during the past few years MER has held special sessions at the Joint Annual Meeting of AMS and MAA to help increase the presence of educational initiatives among research mathematicians. These two organizations have been co-sponsors of all MER special sessions. This conference, held in San Francisco in 1995, is the major yearly general professional meeting of mathematicians (equivalent to the annual AERA meeting for educators) and attracts approximately 4000 people. In the following pages we describe the special sessions and banquet in detail. We feel that these activities deserve elaboration because they are an opportunity for MER to show-case itself to the larger community of mathematicians and recruit members.

Special Sessions. Overall, the special sessions at the meetings were well-attended and interesting. AMS makes all room arrangements and tries to anticipate the size of the audience in advance. As a result, all MER sessions were held in a mid-sized hotel hall with seating for about 200 people. Despite the large size, the room was often nearly full and a few sessions were so crowded that there was standing room only for late-comers, an indication that these talks were popular. A few presentations did not draw a large crowd, perhaps due to the particular topic (e.g., a talk on constructivism in education) or time of day. Good pedagogy was modeled in most of the MER sessions attended. In fact, the combination of good pedagogy and interesting topics led to a couple of the MER presenters being able to engage the audience in lengthy discussions.

MER's special sessions were listed in the conference program and spanned the majority of the first two of the three and one-half day meeting. MER's sessions centered around mathematics education reform and offered presentations such as "Portfolios and interactive questionnaires", "Introductory college mathematics: The critical filter for the majority", and "Trigonometry on the Ferris wheel: A constructivist approach to the circular functions." One of the most attended presentations was "Introductory college mathematics:

Critical filter for the majority." The presenter stressed that mathematicians must address the needs of students who will never need calculus but still need math skills. She urged math instructors to rethink their teaching methods and use hands-on laboratory components in the spirit of the NCTM Standards. In addition, the presentation was conducted in good pedagogical style.

At these sessions, MER provides a forum for discussing a range of views on educational reform. Views presented are not necessarily endorsed by the co-directors. One of the best discussions emerged from a highly controversial presentation entitled "What about the top 20%?". The presenter espoused that the NCTM Standards "dumb down" the math curriculum at the expense of the highest achieving students. By emphasizing "the why" instead of "the how" of mathematics, this mathematician feared that the students would miss both "the why" and "the how." At least, his argument continues, when students learn rote algorithms they grasp how to do some math even if they do not understand it. He claims the NCTM Standards are flawed in that they de-emphasis drills and that by trying to teach to the majority of the students the top achievers do not get what they need. These views sparked a lively discussion and the audience, for the most part, disagreed with them. The audience voiced the opinion that math teachers have been teaching to the top echelon of students for too long. Contributing members of the audience felt that math teachers should teach to the level of the largest portion of their class, the middle 50%, rather than those in the top 25% of the class (or the bottom 25%). The rationale was that these are tomorrow's leaders and it is more important that they all understand math at an adequate level than that a few excel.

Such an education reform-oriented presentation was particularly powerful because it drew a standing-room-only crowd at the Joint Mathematics Meetings. Bonnie Saunders, MER Assistant to the co-directors, said later that MER hoped to invoke such discussion of the NCTM Standards by inviting this mathematician to present his controversial views. The negative attitude of the crowd to these views testifies to the awareness of and interest in education reform among some mathematicians.

At the Joint Meetings the MAA also sponsored numerous sessions on mathematics education. In fact, the MAA's sessions were so closely aligned with MER's that one could not distinguish them. For example, MAA supported presentations such as "Learning styles approach to mathematics instruction", "Students should be partners, not merely observers", "Portfolios in mathematics", "Standards for teaching college math?" and "The new GRE." One exception is that MER addressed math education topics in elementary and secondary schools whereas MAA limited its involvement to post-secondary education (including community colleges). While we perceive this as an overlap between the organizations, the

co-directors do not. They believe that MER is distinct in that it addresses more controversial educational issues than does the MAA and that MER has this "luxury" because, unlike the MAA, MER does not have a membership to which it must be responsive.

One should not be surprised to find that the AMS did not support many such sessions. The vast majority of AMS sessions presented mathematics research. However, at least one AMS session dealt with educational topics including "Written dialogue as a tool for conceptual understanding" and "Nurturing students' mathematical creativity through student-constructed examples". These are topics indistinguishable from MER's and MAA's but this appeared to be the only AMS effort at educational issues. Other groups, such as NCTM, SUMMA and SIAM each supported one or two sessions focused on mathematics educational issues also.

In summary, the MER special sessions were well-received in the community of mathematicians. The co-directors report that these sessions are "regarded as a significant innovation in the program of the Joint Mathematics Meetings. The first MER special session broke new ground in the general programming, since heretofore special sessions were devoted to mathematics research topics" (correspondence, 12/95). Although the MAA offered educational sessions also, MER greatly increased the total number offered and made the unique contribution of some sessions on K-12 mathematics. More than half of the mathematicians, 30% of the math-educators, and less than 20% of the K-12 survey respondents indicated they had attended a special session at the Joint Meeting (see Table 4). Most survey respondents who attended a special session, however, indicated that these sessions did not influence their decision to attend the Joint Meeting. Similarly, relatively few survey respondents reported that their attendance at a special session influenced their decision to attend a MER workshop. On the other hand, a majority of those respondents who attended a special session said that these sessions were useful to them (see Table 4). Responses about the usefulness of the Special Sessions at the Joint Societies Meetings fall into the following three general categories: learning new information particularly as it pertains to mathematics education reform, making personal contacts, and finding support for mathematics education activities. Gathering current "eye-opening" information was the most commonly cited benefit of the special sessions. *"Waiting for publication is not good so the special sessions are good to keep me up to date."* Networking opportunities such as meeting new people, maintaining relationships or re-establishing old contacts was the second most commonly cited benefit and was described as *"rejuvenating"*. A few reported that the Special Sessions provided them with emotional support in their educational endeavors. One commented that *"Seeing faculty in departments of mathematics pay*

attention to teaching and educational research gave me hope in the future of undergraduate education." Another wrote, *"Its a rare opportunity to hear major figures in mathematics talk about serious issues in mathematics education."*

Banquet. MER hosts a banquet at the Joint Meeting to provide a venue for people who are interested in education to gather with like-minded people. Rather than being an effort to explicitly promote initiatives, this is primarily an opportunity to meet others informally. Despite competition among social events for the evening, at least 70 people were present at the MER Banquet on Thursday evening. (MER reports that ticket sales were higher.) Attendees were mostly professors and administrators. The $45 banquet fee was probably too expensive for graduate students, although a few were present at the cocktail hour, presumably to network with prospective employers. Typical of many group dinners, people mingled during the cocktail hour and then were seated for dinner. Dinner seating was arranged to facilitate small group discussion with several round tables, each seating eight people. Since there were no after dinner speakers or themes for the evening, the small groups had the entire evening for discussion -- a format that has evolved in response to feedback from attendees. The co-directors cite continued ticket sales as evidence that this format meets the audience's needs.

The banquet served as a good forum for mathematicians to interact about educational issues with which they were currently concerned. Again, one of us acted as participant-observer during the dinner. Attendees at the observer's table talked about problems such as the lack of jobs for new math Ph.D.s and poorly motivated undergraduate students. The difference in lifestyles between today's students and previous generations and how this may impact students' ability and/or desire to concentrate on math and other subjects was discussed. It was only when the participant-observer initiated a discussion of MER by asking how individuals became involved with it that MER came up at the table. In general, most felt that the forum MER provides for discussing educational issues is very important. While most people did not have much else to say about MER, the chair of the math department at one of the 13 universities in the departmental network was at this table and seemed eager to discuss MER. This mathematician felt very strongly about the support provided by MER in terms of facilitating a professional and personal conversation among people with similar interests. He felt that, without MER, many mathematicians who are interested in improving education would not pursue these interests very far, if at all.

While fewer respondents (35%-mathematicians; 15% math educators; 27%-K-12) compared to those who attended special sessions had attended a banquet, a majority (73%

of mathematicians, 67% of math educators and 100% of K-12 teachers) of those who attended a banquet indicated they would recommend it to their colleagues (see Table 4).

The total number and types of people involved with MER is related to the way in which MER "spreads the word." Some of MER's avenues of communication are effective and several others are only marginally so. At the present time, word of mouth seems to be the most effective method of spreading the word while some of the more labor-intensive communications (at least for the co-directors), such as the newsletters, are more effective at maintaining communications rather than initiating them. We are not sure how MER can capitalize on "word of mouth" to increase its reach and influence. In these days of electronic communication, MER might consider either expanding its listserver beyond the departmental network or maintaining a separate listserver for the individual network to help extend this "word of month." Allowing MER members the opportunity to electronically pass the word about MER by forwarding an electronic mail post to a colleague might create more opportunities for "word of mouth" to work.

Table 4.
Attendance at workshops, special sessions, and MER banquets.

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
Have you attended the MER special sessions at the Joint Mathematics Meetings?						
Yes	111	56.3	6	30.0	2	18.2
No	86	43.7	14	70.0	9	81.8
To what extent did the existence of the MER special sessions at the Joint Mathematics Meetings influence your decision to attend the Meetings?*						
Not at all	55	50.0	4	66.7	1	50.0
A little	29	26.4	2	33.3	1	50.0
Considerably	16	14.5	0	0.0	0	0.0
Very Much	10	9.1	0	0.0	0	0.0
To what extent did these MER special sessions influence your decision to attend a MER workshop?*						
Not at all	69	66.3	4	66.7	2	100.0
A little	20	19.2	1	16.7	0	0.0
Considerably	13	12.5	1	16.7	0	0.0
Very Much	2	1.9	0	0.0	0	0.0
To what extent were these special sessions useful to you?*						
Not at all	5	4.9	1	20.0	1	50.0
A little	43	41.7	1	20.0	0	0.0
Considerably	37	35.9	3	60.0	1	50.0
Very Much	18	17.5	0	0.0	0	0.0
Have you attended a MER banquet at the Joint Mathematics Meetings?						
Yes	70	35.4	3	15.0	3	27.3
No	128	64.6	17	85.0	8	72.7
If yes, would you recommend the banquet to your colleagues?						
Yes	48	72.7	2	66.7	3	100.0
No	16	24.2	1	33.3	0	0.0
Maybe**	2	3.0	0	0.0	0	0.0

Table 4 (continued).

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
Have you attended a MER workshop?						
Yes	185	93.9	20	100.0	10	90.9
No	12	6.1	0	0.0	1	9.1
Which of the following MER workshops have you attended?						
7/88 at the U. of IL	12	6.5	1	5.3	0	0.0
5/89 at UC Berkeley	25	13.6	1	5.3	0	0.0
7/89 at the U of Minnesota	8	4.3	1	5.3	1	10.0
3/90 at Ohio State	12	6.5	2	10.5	0	0.0
6/90 at Harvard	15	8.2	0	0.0	0	0.0
3/91 at U of AZ	21	11.4	0	0.0	0	0.0
5-6/91 at U of Washington	19	10.3	0	0.0	0	0.0
3/92 at UC Berkeley	16	8.7	2	10.5	0	0.0
7-8/92 at Bowdoin College	18	9.8	1	5.3	4	40.0
11/92 at Rutgers	13	7.1	0	0.0	0	0.0
3/93 at UC Berkeley	14	7.6	1	5.3	0	0.0
7-8/93 at the U of Michigan	21	11.4	1	5.3	0	0.0
11/93 at RPI	19	10.3	6	31.6	2	20.0
5/94 at the U of Texas	27	14.7	0	0.0	0	0.0
11/94 at Southern U.	15	8.2	6	31.6	4	40.0
Why did you attend?						
Colleague recommended I attend.	54	27.1	7	35.0	5	45.5
Dept. chair recommended I attend.	51	25.6	5	25.0	3	27.3
Invited speaker on program.	29	14.6	8	40.0	0	0.0
Invited to make a small group presentation.	23	11.6	4	20.0	4	36.4
Wanted to meet people who share interests in math-ed reform.	161	80.9	17	85.0	10	90.9
Wanted to meet people who share interests in mathematics research.	23	11.6	2	10.0	2	18.2
I did not have to pay for the trip.	73	36.7	6	30.0	7	63.6
Wanted to visit the city where the workshop was held.	24	12.1	0	0.0	3	27.3
Wanted to meet the MER Co-directors and other leaders.	60	30.2	3	15.0	3	27.3

Table 4 (continued).

	Mathematician Frequency	Mathematician Valid %	Math-Educator Frequency	Math-Educator Valid %	K-12 Frequency	K-12 Valid %
Wanted to exchange ideas with professional peers.	140	70.4	16	80.0	8	72.7
Was particularly interested in the theme of the workshop.	108	54.3	11	55.0	7	63.6
Other	6	3.0	2	10.0	3	27.3
Would you attend another MER Forum workshop if the topic were of interest to you and:						
All expenses were paid?						
Yes	179	92.3	18	94.7	9	90.0
No	10	5.2	1	5.3	1	10.0
Maybe	5	2.6	0	0.0	0	0.0
You had to pay for your own transportation and conference fee?						
Yes	92	48.4	10	52.6	3	30.0
No	78	41.1	8	42.1	6	60.0
Maybe	20	10.5	1	5.3	1	10.0
You had to pay for all of your own expenses, including room and board?						
Yes	38	20.1	5	26.3	1	10.0
No	132	69.8	12	63.2	9	90.0
Maybe	19	10.1	2	10.5	0	0.0

* Includes only those respondents who had attended a Special Session.
** Respondent-added category.

Table 5.
Attendance at workshops and special sessions by gender of respondent
(mathematics department respondents only).

	Male		Female	
	Frequency	Valid %	Frequency	Valid %
Have you attended the MER special sessions at the Joint Mathematics Meetings?				
Yes	82	57.3	29	53.7
No	61	42.7	25	46.3
To what extent did the existence of the MER special sessions at the Joint Mathematics Meetings influence your decision to attend the Meetings?				
Not at all	81	64.8	26	65.0
A little	25	20.0	7	17.5
Considerably	12	9.6	4	10.0
Very Much	7	5.6	3	7.5
To what extent did these MER special sessions influence your decision to attend a MER workshop?				
Not at all	88	75.2	29	76.3
A little	16	13.7	5	13.2
Considerably	11	9.4	3	7.9
Very Much	2	1.7	1	2.6
To what extent were these special sessions useful to you?*				
Not at all	3	3.9	2	7.7
A little	32	41.6	11	42.3
Considerably	29	37.7	8	30.8
Very Much	13	16.9	5	19.2
Have you attended a MER workshop?				
Yes	134	93.7	51	94.4
No	9	6.3	3	5.6

* Includes only those participants who attended a Special Session

Table 5 (continued).

	Male		Female	
	Frequency	Valid %	Frequency	Valid %
Which of the following MER workshops have you attended?				
7/88 at the U. of IL	10	7.5	2	3.9
5/89 at UC Berkeley	19	14.3	6	11.8
7/89 at the U of Minnesota	6	4.5	2	3.9
3/90 at Ohio State	9	6.8	3	5.9
6/90 at Harvard	12	9.0	3	5.9
3/91 at U of AZ	15	11.3	6	11.8
5-6/91 at U of Washington	10	7.5	9	17.6
3/92 at UC Berkeley	10	7.5	6	11.8
7-8/92 at Bowdoin College	13	9.8	5	9.8
11/92 at Rutgers	10	7.5	3	5.9
3/93 at UC Berkeley	14	10.5	0	0.0
7-8/93 at the U of Michigan	16	12.0	5	9.8
11/93 at RPI	8	6.0	11	21.6
5/94 at the U of Texas	23	17.3	4	7.8
11/94 at Southern U.	6	4.5	9	17.6

Table 5 (continued).

Why did you attend?	Male Frequency	Male Valid %	Female Frequency	Female Valid %
Colleague recommended I attend.	37	25.5	17	31.5
Dept. chair recommended I attend.	41	28.3	10	18.5
Invited speaker on program.	22	15.2	7	13.0
Invited to make a small group presentation.	17	11.7	6	11.1
Wanted to meet people who share interests in math-ed reform.	112	77.2	49	90.7
Wanted to meet people who share interests in mathematics research.	12	8.3	11	20.4
I did not have to pay for the trip.	52	35.9	21	38.9
Wanted to visit the city where the workshop was held.	18	12.4	6	11.1
Wanted to meet the MER Co-directors and other leaders.	42	29.0	18	33.3
Wanted to exchange ideas with professional peers.	91	62.8	49	90.7
Was particularly interested in the theme of the workshop.	74	51.0	34	63.0
Other	5	3.4	1	1.9

The MER Forum Workshops and their Effects

MER's primary mechanisms for promoting educational efforts are yearly (usually, twice-yearly) workshops. Having learned about MER's intentions and beliefs, we needed to ascertain what MER does in its workshops and how it facilitates networking of mathematicians for the purpose of improving mathematics education. In this section we first present a general overview of our findings related to MER workshops. Next we describe the patterns of workshop foci and attendance, followed by a presentation of an in-depth description of the Baton Rouge Teacher Preparation workshop including participants' perceptions of the workshop format and content.

Briefly, a majority of respondents to both the mailed survey and participants in the Baton Rouge workshop perceived MER workshops as being valuable experiences and MER workshops appear to be an effective means of sharing mathematics education information. Participants enjoy the interactions with their colleagues and feel like they benefit professionally from these meetings. The workshops have been particularly effective at helping individuals improve their own classroom instruction, both by providing new information and by having participants' own ideas "validated." This focus on supporting individuals involved in mathematics education, while valuable, does not seem to be "changing the culture" of the mathematics community, although the new departmental Network (discussed later) may help fill this niche. We found MER workshops interesting in that much of the information presented was not new educational research, but was new to many of the mathematicians participants. Similarly, the pedagogy used by workshop participants was lecture-oriented and many participants indicated a desire to have less traditional forms of pedagogy modeled by workshop presenters, particularly in the afternoon breakout sessions. In the following pages we present the findings that led to these summary opinions.

Most of the survey respondents -- 94% of the mathematicians, 100% of the math-educators, and 91% of the K-12 respondents -- indicated they had attended a MER workshop. The survey respondents were fairly evenly distributed in their reported attendance throughout the various workshops over the course of years. When asked why they attended the workshop, most of the respondents reported they wanted to *"meet people who share interests in mathematics education reform"* and they wanted *to "exchange ideas with professional peers."* A majority indicated they chose to attend a particular workshop because they were interested in that workshop's theme. For each of the following reasons, approximately one-quarter of the respondents indicated that these influenced their decision to attend a workshop: *"colleague recommended I attend," "department chair recommended I attend," they did not have to personally pay for the trip, and they wanted to "meet the MER*

co-directors and other leaders (see Table 4)." Other responses ranged from *"I was on leave so I had the time"* and *"[I] couldn't get into [other] workshops that summer"* to *"I wanted to find out what other institutions are doing with regard to engineering, science, and mathematics with underrepresented minorities"* and *"because Naomi Fisher was attending and I like to discuss ideas with her."*

There were few gender differences in opinions of the special sessions and for the pattern of workshop attendance (see Table 5). One interesting gender difference in the pattern of workshop attendance was the relative over-representation of females at the two teacher preparation workshops (11/93 at RPI, 11/94 at Southern University). For the most part, males and females gave similar reasons for attending workshops, although a higher percentage of males said they attended because their "department chair recommended I attend," while a higher percentage of females said they wanted to meet people who share their interests in mathematics education reform and they wanted to exchange ideas with professional peers. Perhaps as a result of typical mathematics department demographics and/or due to their interests in mathematics education, females may look to MER to help form connections with professional colleagues more often than their male counterparts (see Table 5).

To gain a more specific understanding of MER's activities we examined the workshops from both a course- and fine- grained perspective. First, we analyzed all of the topics addressed in the sixteen workshops held since MER's 1988 inception. These were then categorized into the following domains: general issues, direct connections with K-12, university issues, K-12 issues, and systemic issues. The following matrix presents the results of this analysis. Clearly, MER has shifted its focus away from K-12 and toward undergraduate issues over the past seven years. In fact, undergraduate curriculum/calculus reform (a subtopic within "university issues") has been addressed about as frequently as has the entire topic "direct connections with K-12." While this is a rough estimate of the workshop foci on these topics (because we are not considering the quality or the length of time of each session), it documents the shift in MER's emphasis toward undergraduate issues (see Table 6).

Table 8
An Overview of MER Workshops and topics addressed.

Workshop Date	88-1	89-1	89-2	90-1	90-2	91-1	91-2	92-1	92-2	92-3	93-1	93-2	93-3	94-1	95-1	95-2	Total
N Participants	50	54	41	44	43	64	57	53	45	53	73	69	93	55	77	55	926
General Issues	**3**	**4**	**1**	**3**	**4**	**7**	**3**	**1**	**1**	**3**	**1**	**0**	**7**	**1**			**39**
Enhancing Minorities/women	2	3		1	1	1	2						2	1			13
G & T Youth Programs		1		2		3		1		1							8
Assessment Issues										1							1
Technology Ed.			1			1											2
Linking Math Ed.-Math Res.	1				3	2	1		1	1	1		5				15
Direct Connections- K-12	**2**	**3**	**4**	**3**	**3**	**3**	**3**	**4**	**0**	**2**	**3**	**2**	**15**	**1**			**48**
School-Univ. Collaborations	1	2	1	2	1	2	1	2			2	1					15
K-12 Teacher Prep./Enhance.			2	1	1	1	2	2		2			15	1			27
Issues in Math Education	1	1	1		1						1	1					6
University Issues	**1**	**1**	**1**	**0**	**1**	**2**	**6**	**9**	**21**	**4**	**10**	**16**	**1**	**17**			**90**
Inst. Change @ Res. Univ.		1					3	3	1	1	5	1		2			17
Department Reports							2				1			10			13
University Teaching	1							1						2			4
Preparing Grads-Teaching													1	1			2
The Math Major									1					1			2
12-14 Curric. Reform					1	2	1	5	19	3	2	14		1			48
Misc. Role of Mathematians			1								2	1					4
K-12 Issues	**1**	**1**	**2**	**3**	**1**	**3**	**6**	**0**	**0**	**1**	**1**	**0**	**2**	**2**			**23**
Integrated Math/Science K-12	1	1		1	1	1											5
Integrated Math/Science K-16							1			1							2
K-12 Curriculum Reform			1	1			3						2				7
K-12 Outreach efforts			1			2	2							2			7
Teachers' views of Math Ed.				1							1						2
Systemic Issues	**5**	**2**	**2**	**2**	**0**	**0**	**3**	**1**	**0**	**3**	**2**	**1**	**0**	**2**			**23**
NSF / Funding Isssues	2		1	1				1									5
MER Issues	2	2					3							2			9
State-wide/federal issues	1		1	1						3	2	1					9
misc					1	1											2

The Baton Rouge/Southern University Teacher Preparation Workshop. Because workshops are such an integral aspect of MER and we wanted to learn about these meetings first-hand, therefore one of us served as a participant observer at the November 17-20, 1994 Baton Rouge workshop. MER's 15th workshop for "individual" network members was held November 17-20, 1994 in Baton Rouge, LA on the campus of Southern University. The stated focus of this workshop was the "Preparation for Teaching Mathematics: Issues, Policies and Programs," the second such workshop held by The MER Forum.

As expected, most of the 76 participants (including speakers) were affiliated with university mathematics departments (60.5%), yet almost one-quarter (22.3%) were K-12 educators (this included teachers on leave to work on university-school partnership/collaborative). Seven (9.2%) of the participants were from university departments/divisions of education, four were from state or federal agencies (5.3%), and we were unable to classify two participants (2.6%). Naomi Fisher explained that the relatively large number of K-12 educators was the result of two State Systemic Initiatives (Connecticut and Louisiana) including several teachers in their respective groups of participants.

The workshop followed the "standard" MER pattern. This included a reception and keynote address on Thursday evening, two panel sessions each on Friday and Saturday mornings followed by concurrent afternoon breakout sessions. The Sunday morning panel discussions were designed to reflect on the past two days' activities and to set the agenda for future MER "teacher preparation" workshops.

The morning panel sessions, lasting 90 minutes each, included 2-4 speakers who presented their ideas and experiences related to mathematics departments' roles in teacher preparation: the mathematics content for preservice teachers, curriculum development and other innovations, collaborative such as State Systemic Initiatives, and the professionalization of the teaching of mathematics at all levels. These panel sessions, for the most part, appeared effective at sharing a lot of information in a fairly condensed time frame. Most of the individual presentations were fairly well articulated with the rest of their respective panels and the set of panelists represented a range of experiences and knowledge about their particular topics.

The afternoon breakout sessions were organized into two sets of concurrent sessions on Friday and Saturday, each session lasting 90 minutes. Participants were able to choose from six sessions during each of the four time periods. Many of the morning panelists conducted afternoon workshop sessions that appeared to build on their previous

presentations, while other sessions were conducted by participants who were not part of the morning panels, although their sessions, generally, appeared tied to the overarching themes laid out by the morning panels. The afternoon sessions were generally limited to 15 participants each (controlled by a sign-up form) and were designed to facilitate more interaction among participants than was possible at the morning sessions.

In addition to collecting evaluation data using participant observer methods, we surveyed workshop participants by distributing questionnaires on the final morning of the workshop (see Appendix A for a copy of the survey). Twenty-seven of the 57 participants who received a survey (several people had left by the time surveys were distributed) completed and returned their surveys yielding a response rate of 47.4%. We summarize several key aspects of these survey results below.

When asked about things they learned at the workshop, participants, for the most part, said that the workshop helped "validate" many of the ideas they already had and/or that they learned about a few new ideas that they expected to incorporate into their current or future activities. For example, one participant who is the committee chair responsible for teacher education as part of his state's SSI wrote,

> *I have received a lot of information which I can share with colleagues throughout the State. In addition, we have learned from specific experiences of MD [Maryland], Montana, LA [Louisiana], etc. [about] ideas that can help us plan in strategic terms for systemic change.*

While not as large of a scale, yet still important, many others indicated that they received information about teaching and curriculum that they can use in their own classes.

MER participants placed a premium on the opportunities to interact with their colleague and we were curious whether or not the beneficial aspects of the workshop could only be obtained by being physically present. Overwhelmingly, participants indicated that the impact of hearing about these ideas in a face-to-face forum and providing the opportunity for extended interaction with presenters especially in informal gatherings (e.g., during meals) were the most valuable aspects of the workshop. An example of this sentiment follows:

> *Face to face meeting with Resek, Trafton, Phillips -- [was] really important to me. I learned most in informal settings, especially during dinner conversations. Also, information took on life -- reports that in print (or on-screen) might have put me to sleep were lively [and gave me] a chance to ask questions.*

Workshop participants, for the most part, indicated that they would take information from the workshop and incorporate it into their current teacher preparation activities, whether that meant changing what they were currently doing or continuing with their current activities that they felt were validated at the workshop. Several of the

participants indicated that, in addition to incorporating MER information in their own classes, they might try to influence their departments' and universities' mathematics teacher education activities. However, several participants recognized that the ideas being discussed at the workshop, while important, would not necessarily be received warmly in their home departments. Nevertheless, many participants indicated that they intended to try to have these views become part of their teacher preparation and educational activities. To this end, many participants indicated that they planned to share the information from the workshop with their colleagues and administrators either informally or through more structured means such as colloquia or special meetings.

We were interested in investigating the types of pedagogy modeled by workshop presenters. Except for a few of the afternoon sessions, the panel and afternoon presentations were fairly didactic, though they generally included time for questions and discussions. The afternoon sessions were often "more" interactive than the morning panels, but in many cases we would be hard-pressed to refer to these sessions as anything other than fairly traditional "whole-class" format and were not as interactive as they might have been with a less lecture-oriented (e.g., seminar style, cooperative groups) presentation. Only one of the four afternoon sessions we attended used a hands-on, interactive style. While several participants indicated that at least a few other sessions were student-centered, comments from many of the participants indicated that the format we observed could be generalized to most of the afternoon sessions.

While the survey responses indicated general agreement with this perception, these responses captured more of the complexity of this issue. The following quote is representative of the majority view about the amount of lecturing, but it is especially characteristic of the non-research mathematician contingent:

> *There was a lot of 'talking to' us broken by examples of activities, but very little interactive discussion. Ideally, these three activities should balance....In general, the presenters 'presented' [and] did not model good pedagogy. Activities were not followed up by good 'reflection' discussion. The information was passed along in lecture mode with only occasional interaction.*

While many people supported this view, at least one-quarter of the respondents offered a different view. They agreed that the workshop was very lecture oriented, but they indicated that this lecture-discussion style was perhaps the most efficient way to share information in the relatively short time frame of the workshop. The following two quotes illustrate this point; in particular the quote from the second respondent indicates that he understood that good pedagogical techniques were not being modeled, but clearly felt that

using time for cooperative learning activities or other forms of non-lecture teaching modes might not be very efficient considering the limited time frame of these workshops.

> *I think it's difficult to expect presenters to exhibit good pedagogy in a forum format. The two breakout session [that this respondent attended] came closer to modeling good pedagogy. One presenter posed excellent questions for discussion. The other presenter used a video tape to share a teacher modeling principles of classroom discourse.*
>
> *Poor pedagogy: Presenter lectured on his/her program--very useful and a good use of my time;*
> *Good pedagogy: We were broken down into small groups. Not useful for this forum--[a] waste of our time.*

These varying perspectives raise a few interesting issue for MER program developers. Clearly many people are comfortable with lecture formats -- their success as mathematicians is evidence of their acceptance of this format -- and favor gathering as much information as possible in the short time span of the conference, while others would like to see modeling of good classroom techniques. Several participants suggested a form of pedagogy that might help bridge these positions. Having a short presentation followed by a structured discussion where participants could grapple with real problems and issues might be a method to engage participants while modeling some effective classroom pedagogy.

When asked if they would attend another workshop if all expenses were paid (as is often the case), almost all respondents said yes, but these are very busy people and while they do not have to pay out-of-pocket expenses, time can be a more important resource than money. However when asked if they would attend if they had to pay for their own transportation and conference fee, this number dropped to slightly less than half and only 25-35% said they would or might attend a workshop if they had to pay all expenses (see Table 4).

In summary, most participants indicated that the workshops were valuable experiences. They were particularly appreciative of the opportunities to meet with presenters and other colleagues in informal settings. The workshops bring together mathematicians and mathematics educators with a wide range of experience and knowledge of educational issues. Many of the participants and presenters felt like they learned new information at the workshops, but perhaps most importantly, participants reported that the workshop helped validate many of their own educational notions and practices. By helping to support mathematicians already involved in educational reform, MER functions by taking people where they are and facilitating their movement toward an increasingly sophisticated perspective on education. As mentioned earlier, we found that much of the information presented was <u>not</u> new mathematics education (e.g., uses of cooperative

learning, teaching problem-solving skills), but was new to many of the mathematician participants. Our first reaction was that this was not "cutting edge" mathematics education, but after more experience with the mathematics community we realized that MER was effectively bringing many of these "educational" ideas into the mathematics world.

Similarly, many participants indicated a desire to have less traditional forms of pedagogy modeled by workshop presenters, particularly in the afternoon breakout sessions. However, this issue, too, was more complex after time for reflection. Mathematicians are used to didactic classroom approaches and most of the participants wanted to get as much information as possible in this short 3-day workshop. Perhaps, in future workshops the MER co-directors can encourage more modeling of reform-oriented pedagogy in the afternoon breakout.

Advisory Committee meeting

The MER Advisory Committee exists to advise the co-directors on all MER activities and does not act in a policy setting capacity. Members of the Committee are chosen based on their experience in education activities, leadership positions in the mathematics community, the K-12 mathematics community and professional societies. They bring their own perspectives to the Advisory Committee meetings, rather than being charged with gathering information from others in the community. The Advisory Committee has grown from 10 members at its inception in 1988 to 27 members in 1995. (In addition, MER plans on forming a Steering Committee to oversee and coordinate operations but, to date, has not established it.) In the paragraphs that follow we present an extensive description of an Advisory Committee meeting to provide insight into how outreach activities are planned, and then discuss the relative effectiveness of MER's forms of communication.

The annual Advisory Committee meeting is coordinated with the Winter Joint Societies Meetings. In past years, this Committee has provided services such as forming a long-range planning committee, examining alternative sources of funding and searching for a "home" for MER among existing mathematical organizations (Advisory Committee 1992 minutes). Since this yearly meeting is one of the major planning and goal-setting meetings for MER, we attended it in 1995 and assumed the role of participant observer.

The short (1 1/2 hour) meeting was quite productive. This group meets formally only once per year despite it's responsibility for advising the co-directors concerning the general focus of upcoming workshops and special sessions. While the formal gathering was rather brief, we recognize that much informal dialogue among these Members occurs at other MER events and over the Internet throughout the year. Nevertheless, their limited

face-to-face time together as a group is scarce and should be spent as productively as possible. At the January 1995 meeting, the Committee discussed these three general topics (described in more detail in the pages that follow): (1) MER's departmental network, (2) this evaluation and (3) future activities and directions of MER. Most Advisory Committee members and three guests were present.

First, the co-directors briefly described the departmental network and updated the group about its current focus on graduate education. "Soul searching" is how the co-directors described the current departmental activities -- soul-searching in terms of looking at how well they are preparing doctoral students to enter the job market. The group raised questions about the departmental network's plans for disseminating information and generally agreed that plans should begin now for *what* and *how* information will be disseminated. Committee members commented,

> *We need to prepare for how we are going to use information in the future, the next generation of math departments*
>
> *This requires some design work by MER. It is critical to think about what we are going to disseminate. Some partnerships occur because of personal chemistry...*

Concerning *how* dissemination should occur, the group felt it appropriate for, and perhaps the responsibility of, the major professional organizations (AMS & MAA) to publicize MER ideas. The issue of *what* to disseminate took much longer to debate as advisory committee members struggled with the fundamental purposes of the departmental network. One member described his perception of the purpose as

> *...to promote educational reform that respects the integrity of the mathematics. Making the departmental network public by talking about it is only a prerequisite to what we want to happen. Hopefully, folks will make joint [interdisciplinary] proposals. We need to look at how we use the MER departmental network to promote educational reform.*

Dissemination methods depend on the intentions of the network, according to one member who said, *"There are two ways networks function: (1) as a conduit from which you can push or (2) as a conduit from which individuals out there can pull."* In his view, newsletters push information onto readers but descriptions and statistics allow readers to pull pertinent data and thus disseminate successful programs.

Another member felt that the act of discussing the network changes how people view their own departments. *"It lets people know what they thought was impossible is being done elsewhere, at similar institutions."* Although the issue of what and how to inform others was not resolved, it is noteworthy that the Advisory Committee, designed to

oversee the individual component of the network, spent so much time ensuring that the departmental network gets off to a good start.

The Advisory Committee also was concerned with this evaluation, however a few members did not know much about it. Although this was the first advisory committee contact from the evaluation team, we assumed that the co-directors had fully informed members earlier. At this meeting, the evaluation team solicited feedback from the Committee on the survey instruments we intended to use and received constructive and thoughtful comments. The instruments were better ones because of their input.

Also, the Committee addressed the invitations of two other organizations to participate in/endorse their activities. First, AMATYC (American Mathematical Association of Two Year Colleges) invited MER to endorse its newly developed Standards for College Mathematics. The committee decided that it is more appropriate for MER representatives to write a critique of the Standards than simply to endorse them. Second, CRAFTY (a committee of the MAA) requested MER to cooperatively organize a special session at the 1996 Joint Society Meetings celebrating the 10th anniversary of the calculus reform movement. It is noteworthy that large associations such as AMATYC and the MAA (via CRAFTY) recognize MER as an appropriate body to support educational reform endeavors.

This Advisory Committee meeting covered a lot of territory and provided a great deal of information to committee members. There is communication between the co-directors and individual Advisory Committee members throughout the year, but we question whether there is enough time for the entire committee to meet and deliberate over policy issues. In combination with the fact that the co-directors do not have a systematic avenue for gathering the feedback of their constituency, it seems the co-directors must rely on questionable sources (e.g., the most vocal people or those they happen to encounter) for analyzing the needs of its participants to direct this network.

The focus of MER's educational initiatives

MER has shifted its emphasis from K-12 mathematics reform at its inception to an organization primarily addressing the needs of mathematicians as they engage in undergraduate curriculum reform. This is reflected in the quantity of topics addressed in workshops and reports of how MER participants spend their time. Nevertheless, approximately one-quarter of MER participants still spend a considerable amount of time focusing on K-12 issues, and feel supported by MER in these efforts. In fact, Forum members reported that MER's primary role is one of a facilitator and supporter, rather than an initiator of new ideas. In other words, most participants felt as if MER and the colleagues they interacted with at MER workshops validated and supported them in their

own educational endeavors. The "learning" of new information about pedagogy, curriculum, and/or policy occurred largely through their interactions with colleagues at MER workshops. In short, MER is effective at facilitating the work of some mathematicians as they engage in educational activities and at promoting new ideas through interactions at their workshops. We explain these ideas and findings in the following section.

Initially, MER concentrated on trying to involve mathematicians in K-12 educational reform. Fisher (1990a) indicates the motivation for the network originally focusing on K-12 math education as follows

> *The network has emphasized primary and secondary education because of the relative neglect within the mathematics community of these levels of education. Education is a continuum and what happens in pre-college education has tremendous impact on college mathematics. Poor pre-college mathematics education shifts the burden of remedial work onto the colleges and universities. Not only are resources diverted from the undergraduate program but the prevailing pattern is that students who enter college in need of remedial work are unlikely to pursue majors that require a mathematics background. In other words, they enter college with a restricted set of options as though part of the institution did not exist. On the other hand, if the mathematics faculty could be assured that entering students were well prepared in mathematics, the undergraduate curriculum could be revitalized and courses could be upgraded. (p. 5)*

In addition, beliefs driving MER include

> *Immersion in one aspect of education yields unexpected insights and opportunities for improving other parts of the educational picture...What may be most novel about the experience of educational work is the recognition that college and university mathematics faculty are part of a much larger community of professional educators and teachers of mathematics. (Fisher, 1991, p. vii)*

In 1991, when MER was awarded a second NSF grant for two years, the network took on a slightly different focus. The co-directors found that the level of participant interest in undergraduate education had increased. Although the intent was for the main focus of MER to remain pre-college, MER now included the first two years of undergraduate education and became a K-14 program. With the addition of the Departmental Network, MER's focus has shifted and now includes graduate mathematics educaion as well. For example, this year's (1995) departmental conference focused on issues related to graduate education. With this shift toward undergraduate and graduate education issues, it appears that MER's emphasis on K-12 educational efforts has diminished. In this section we explore the effectiveness of MER in supporting and

BEST COPY AVAILABLE

facilitating participants as they engage in classroom, outreach, curriculum/staff development, and/or research behaviors which are aligned with MER's vision for mathematics education. Specifically, we examine MER's success as it related to three levels of educational activities (K-12, undergraduate, and graduate education) and as it related to mathematics education research.

To evaluate the "effectiveness" of MER in supporting or facilitating educational reform efforts we need to specify our criteria and standards for determining whether MER is effective. If MER, in terms of structural supports, was effectively supporting or facilitating educational reform in any of these arenas, we should expect to see workshops or newsletters focused on these topics. Beyond these structural mechanisms, MER participants should indicate that they spend their time engaged in these educational initiatives and further, that they value MER's role in helping them with their work.

To trace MER's organizational emphasis, we analyzed all topics addressed in the eighteen workshops held since MER's 1988 inception. We categorized these into the following domains: general issues, direct connections with K-12, university issues, general K-12 issues, and systemic issues. The matrix in Table 6 presents the results of this analysis. While this is a rough estimate of the workshop foci (because we are not considering the quality or the length of time of each session), it shows some interesting trends. Clearly, MER has shifted its focus away from K-12 and toward undergraduate issues over the past seven years. In fact, undergraduate curriculum/calculus reform (a subtopic within "university issues") has been addressed about as frequently as has the entire topic "direct connections with K-12." In the following section we explore another dimension of this focus on undergraduate mathematics education reform in terms of the way MER participants allocated their time for educational activities.

Respondents to our mailed survey were asked to characterize their current involvement in a range of educational activities.[5] Almost three-quarters of the mathematician respondents reported they were considerably or very involved in undergraduate curriculum reform, 60% of these respondents indicated they were considerably or very involved in calculus reform, and 57% said they were involved at a similar level in undergraduate programs for mathematics majors. This makes sense in that it appears to us that calculus reform is the most common aspect of undergraduate reform. These were the only three items with a majority of mathematician respondents indicating that they were at least considerably involved in the respective reform effort. However,

[5] Questions for K-12 educators differed from those directed at the groups affiliated with higher education because we felt it inappropriate to ask K-12 educators a series of questions regarding undergraduate and graduate education reform. Instead, we provided space on the questionnaire for the K-12 group to describe such activities with which they were involved. (See Appendix for questionnaires.)

more than 40% of the mathematician respondents said they were at least considerably involved in: K-12 curriculum reform, increasing the participation of underrepresented minorities, increasing the participation of women, undergraduate programs for pre-service teachers, and programs for in-service teachers (see Table 7). While the majority of MER participants devote much time and effort to educational initiatives at the undergraduate level, a substantial portion reported spending a considerable time working on K-12 education issues. In fact, approximately one-quarter of the respondents said they were "very involved" with both K-12 curriculum reform and programs for in-service teachers.

When we analyzed current involvement of the mathematicians by gender, a few differences emerged (see Table 8). Females indicated they were relatively more involved (considerably or very involved) than males in several areas, particularly those related to K-12 education such as undergraduate programs for pre-service teachers (65% females; 39% males), programs for in-service teachers (65% females; 40% males), and K-12 curriculum reform (54% females; 38% males). As might be expected, noticeably more females than males were involved in trying to increase the participation of women (56% females; 39% males).

As expected, mathematics-educator respondents reportedly were more involved than mathematician respondents in K-12 educational activities, such as curriculum reform (79%) and work with in-service (79%) and pre-service (69%) teachers. The mathematics educator respondents were noticeably less involved than mathematicians in activities dealing with undergraduate and graduate mathematics programs (see Table 7).

The majority (80%) of K-12 teachers responding to the survey were involved in mathematics education activities extending beyond their own classrooms. For example, teachers are involved in their Statewide Systemic Initiatives (SSI), serve as Principal Investigators for a NSF teacher enhancement workshop, present information at NCTM and other professional conferences and participate in reform in their own schools and districts. One teacher helped develop a calculus curriculum (with NSF support) that is slated to be published this year. Another wrote,

> *I present workshops on quantitative literacy in K-12 and NCTM curriculum standards. I use these materials in my math classes. I am on a leadership team of an NSF grant to write materials for data driven mathematics. I develop assessment materials for 9-12.*

Clearly, MER participants are involved in a wide range of educational activities, but we needed to determine whether or not MER, as an network, contributed to the effectiveness of these endeavors. To this end, we questioned participants at the Baton Rouge Teacher Preparation Workshop about MER's role in their work and we included a

few open-ended questions on our mailed survey about how respondents' association with MER helped to further the goals of their own projects.

A majority of respondents (59% of mathematicians; 47% mathematics educators) indicated that MER has been helpful in furthering the goals of their own projects. Most of those who commented indicated that MER played a valuable role in helping them to feel less isolated and "helped solidify my confidence in my own teaching innovations." One of the ways that MER helped people feel less isolated was by providing opportunities for individual mathematicians to interact with one another.

Facilitating face-to-face interaction is an important role for MER. Mathematicians with educational interests tend to be relatively isolated in most mathematics departments, at least in terms of their educational work. MER provides an important function by facilitating communication among mathematicians and others interested in mathematics education reform. If MER only served to facilitate communication among mathematicians interested in education or helped individuals feel like they were doing valid educational work, we would question its value, especially as a NSF-funded program. However, many participants indicated that MER actually facilitated participants' learning about new techniques or contributed in other ways to the furthering of their projects and educational agendas.

The most common way that MER has moved beyond reaffirming participants' own educational experiences is by teaching participants about new methods and/or materials for improving mathematics education. Many participants at the Baton Rouge workshop indicated that they received information about teaching and curriculum that they can use in their own classes. This sentiment was echoed more generally by respondents to the mailed survey. For example, one person wrote,

> *I have used others' ideas to expand my own efforts -- especially in the area of teacher preparation, both secondary and elementary,*

and more specifically another respondent wrote,

> *Don Lewis gave a talk at Michigan [a calculus reform workshop] that gave a conceptual framework for calculus reform. We ran into one of the problems he described. Knowing the framework helped us solve the problem.*

While relatively few new mathematics assistant professors are associated with MER, one who was involved reported,

> *Attending a workshop helped me to organize my thinking about the teaching of mathematics during my first year as a faculty member.*

Several respondents mentioned MER's assistance in furthering their larger educational initiatives beyond those in their own classrooms and, even in some cases,

beyond their own departments. Helping to make educational work more acceptable within members' departments was seen by participants as an important contribution of MER. For example, one respondent reported that

MER members influenced my administration that my work is important

and another wrote,

...my ability to cite peer institutions to administration was improved.

Others cited MER's role in helping to promote educational reform beyond the boundaries of their department. Several respondents indicated that MER helped them learn enough and to feel confident enough to participate in educational reform at the state level. For instance, one person said,

> *I'm involved in math education in my state at levels K-12 along with college and I feel more comfortable about my participation because of MER.*

One particularly noteworthy comment indicated that MER participants relied on the MER workshops to influence educational policy in their state:

> *My state organization paid to send a state board of education official to a MER workshop. This was the best way to expose her to the ideas that we were thinking about in the state.*

Most respondents were able to offer constructive advice regarding growth, particularly concerning duplicating activities with other organizations. Some mathematicians felt that other large professional organizations (such as the MAA and perhaps NCTM) and their avenues of dissemination (such as the UME Trends newsletter and the MAA publications) could incorporate much of what MER does.

> *Do we need another organization? In the beginning MER brought a fresh perspective and brought new players to the discussions. This is less the case now.*

> *Overlap in programming with MAA; overlap in policy issues with AMS." "MER is 'nice' but probably not essential. MER's main function, I believe, is to try to get a significant number of faculty around the country involved in math education in an attempt to break down anticipated departmental resistance to change.*

> *MER is a forum for the exchange of ideas, experience, etc..*

> *Communication is very important, though whether we need to spend a large chuck of increasingly scarce NSF funds on the mere dissemination of ideas and experience is not something I'd strongly support.*

We return to our evaluation questions for this aspect of the MER Forum. While MER's organizational emphasis has shifted away from K-12 issues over the years, many MER participants devote a considerable amount of time to K-12 mathematics education and many feel supported in their efforts by their MER colleagues. Some participants indicated they gained valuable insights about K-12 educational issues as a result of the MER Forum, insights that allowed them to participant in educational reform in some ways they might have been unable to without their association with MER.

At the undergraduate and graduate levels, most of MER's effectiveness has been exhibited through participants' learning about new forms of teaching for their own classrooms, calculus reform issues, and technology in the classroom. Participants feel supported by MER in their efforts to reform the undergraduate curriculum, particularly the calculus sequence, the most common educational concern at the undergraduate level. The preparation of pre-service teachers has been the focus of MER workshops during the past few years and while MER has taken some important steps in addressing these issues, the relative absence of mathematics educators (discussed later in this chapter) has limited the MER's effectiveness.

The higher levels of involvement in undergraduate educational reforms compared to K-12 concerns is not that surprising considering that most MER participants work in university settings. College education is what they know best. Although many respondents indicated they were actively involved in K-12 mathematics education, these individuals were still a minority of survey respondents.

We have very little to say about our question about MER's role in supporting/facilitating members as they engage in educational research. Participating in educational research did not seem to be of interest to participants, nor did many program sessions deal with this topic. Our few conversations with MER participants and other mathematicians about this issue revealed very little interest in conducting inquiry about the teaching and learning of mathematics; they were more interest in service-type projects such as developing curricula or providing in-service workshops. In some cases, opportunities for collaboration with mathematics educators arose because of a funded reform project that included an educational research requirement. There were, however, several participants who were charged with evaluating some of their new educational initiatives and from what we observed at the Baton Rouge workshops, many of these participants were struggling to step outside of their quantitative paradigm to find ways to fairly evaluate the effects of their programs. Perhaps MER should consider offering a few sessions at one of their next workshops about methods for conducting educational evaluations.

Considering the paucity of resources available for these efforts, it may be wise for MER to concentrate on supporting efforts in undergraduate education rather than "force" K-12 participation on its members. This is not to say that MER should ignore the interests of their members engaged in K-12 issues, but instead of devoting entire workshops to K-12 issues, portions of "undergraduate" workshops could be focused on some K-12 issues or "special interest groups" within MER could be established to support the efforts of members involved in less popular pursuits. As the following excerpt indicates, the upcoming (November, 1996) workshop designed to build connections across all levels appears to be an effort that could accommodate the needs of a wide range of participants.

> *In the last decade curricular reform efforts in mathematics have been flourishing at the K-12 levels and at the undergraduate level. The purpose of this workshop is to encourage discussion of the mathematical themes, pedagogical strategies, and implementation issues that relate to curricular efforts at all levels, and to promote discussion of how the efforts at each level can contribute fully to the mathematics education enterprise. (MER workshop announcement, August 24, 1995)*

Table 7.
Current Involvement of respondents in educational activities.

	Mathematician		Math-Educator	
	Frequency	Valid %	Frequency	Valid %
Please indicate the extent of your involvement in the following:				
K-12 curriculum reform				
Not at all	46	24.7	1	5.3
A little	61	32.8	3	15.8
Considerably	34	18.3	4	21.1
Very	45	24.2	11	57.9
Undergraduate curriculum reform				
Not at all	5	2.6	4	21.1
A little	44	23.3	4	21.1
Considerably	74	39.2	4	21.1
Very	66	34.9	7	36.8
Increasing the participation of under-represented minorities (not women)				
Not at all	49	26.3	3	15.0
A little	62	33.3	6	30.0
Considerably	41	22.0	4	20.0
Very	34	18.3	7	35.0
Increasing the participation of women				
Not at all	36	19.3	3	15.0
A little	70	37.4	6	30.0
Considerably	49	26.2	4	20.0
Very	32	17.1	7	35.0
Undergraduate programs for math majors				
Not at all	22	11.7	11	55.0
A little	59	31.4	4	20.0
Considerably	63	33.5	3	15.0
Very	44	23.4	2	10.0
Reform related to graduate mathematics education				
Not at all	85	46.7	9	47.4
A little	53	29.1	2	10.5
Considerably	29	15.9	3	15.8
Very	15	8.2	5	26.3

Table 7 (continued).

	Mathematician		Math-Educator	
	Frequency	Valid %	Frequency	Valid %
Please indicate the extent of your involvement in the following:				
Undergraduate remedial courses				
Not at all	92	49.2	12	60.0
A little	49	26.2	5	25.0
Considerably	20	10.7	1	5.0
Very	26	13.9	2	10.0
Calculus reform				
Not at all	31	16.3	10	50.0
A little	45	23.7	7	35.0
Considerably	59	31.1	3	15.0
Very	55	28.9	0	0.0
Undergraduate programs for pre-service teachers				
Not at all	49	26.3	2	10.5
A little	52	28.0	4	21.1
Considerably	30	16.1	4	21.1
Very	55	29.6	9	47.4
Programs for in-service teachers				
Not at all	62	33.5	0	0.0
A little	37	20.0	4	21.1
Considerably	35	18.9	5	26.3
Very	51	27.6	10	52.6
Involvement with specific groups of K-12 students.				
Not at all	108	59.3	6	31.6
A little	42	23.1	7	36.8
Considerably	16	8.8	4	21.1
Very	16	8.8	2	10.5
Reform efforts at the school district level				
Not at all	83	45.1	4	21.1
A little	62	33.7	7	36.8
Considerably	24	13.0	3	15.8
Very	15	8.2	5	26.3

Table 7 (continued).

	Mathematician		Math-Educator	
	Frequency	Valid %	Frequency	Valid %
Please indicate the extent of your involvement in the following:				
Reform efforts from statewide initiatives				
Not at all	85	46.2	6	31.6
A little	52	28.3	3	15.8
Considerably	19	10.3	4	21.1
Very	28	15.2	6	31.6
Other				
Not at all	9	52.9	1	25.0
A little	3	17.6	0	0.0
Considerably	1	5.9	0	0.0
Very	4	23.5	3	75.0

Table 8
Current involvement in educational activities by gender of respondent.

	Male		Female	
	Frequency	Valid %	Frequency	Valid %
Please indicate the extent of your involvement in the following:				
K-12 curriculum reform				
Not at all	38	27.9	8	16.0
A little	46	33.8	15	30.0
Considerably	23	16.9	11	22.0
Very	29	21.3	16	32.0
Undergraduate curriculum reform				
Not at all	3	2.2	2	4.0
A little	33	23.7	11	22.0
Considerably	53	38.1	21	42.0
Very	50	36.0	16	32.0
Increasing the participation of under-represented minorities (not women)				
Not at all	40	29.4	9	18.0
A little	43	31.6	19	38.0
Considerably	28	20.6	13	26.0
Very	25	18.4	9	18.0
Increasing the participation of women				
Not at all	32	23.4	4	8.0
A little	52	38.0	18	36.0
Considerably	31	22.6	18	36.0
Very	22	16.1	10	20.0
Undergraduate programs for math majors				
Not at all	14	10.1	8	16.3
A little	43	30.9	16	32.7
Considerably	48	34.5	15	30.6
Very	34	24.5	10	20.4
Reform related to graduate mathematics education				
Not at all	69	51.1	16	34.0
A little	35	25.9	18	38.3
Considerably	21	15.6	8	17.0
Very	10	7.4	5	10.6

Table 8 (continued).

	Male		Female	
	Frequency	Valid %	Frequency	Valid %
Please indicate the extent of your involvement in the following:				
Undergraduate remedial courses				
Not at all	69	50.0	23	46.9
A little	39	28.3	10	20.4
Considerably	11	8.0	9	18.4
Very	19	13.8	7	14.3
Calculus reform				
Not at all	19	13.6	12	24.0
A little	37	26.4	8	16.0
Considerably	43	30.7	16	32.0
Very	41	29.3	14	28.0
Undergraduate programs for pre-service teachers				
Not at all	42	30.4	7	14.6
A little	42	30.4	10	20.8
Considerably	24	17.4	6	12.5
Very	30	21.7	25	52.1
Programs for in-service teachers				
Not at all	53	38.7	9	18.8
A little	29	21.2	8	16.7
Considerably	28	20.4	7	14.6
Very	27	19.7	24	50.0
Involvement with specific groups of K-12 students.				
Not at all	83	61.5	25	53.2
A little	31	23.0	11	23.4
Considerably	10	7.4	6	12.8
Very	11	8.1	5	10.6
Reform efforts at the school district level				
Not at all	65	47.8	18	37.5
A little	45	33.1	17	35.4
Considerably	15	11.0	9	18.8
Very	11	8.1	4	8.3

Table 8 (continued).

	Male		Female	
	Frequency	Valid %	Frequency	Valid %
Please indicate the extent of your involvement in the following:				
Reform efforts from statewide initiatives				
Not at all	68	50.4	17	34.7
A little	36	26.7	16	32.7
Considerably	15	11.1	4	8.2
Very	16	11.9	12	24.5

Collaboration Within and Among Professional Communities

MER primarily is interested in facilitating communication among mathematicians about educational issues (i.e., communication within the mathematics community). The 1993 MER funding proposal clearly states that MER's primary goal is to support research mathematicians as they engage in educational reform activities. Also, MER clearly does not want to make collaboration between mathematicians and mathematics educators a focal point of its organization. In fact, Fisher (1990b) states that

> *It is also significant that [research mathematicians] formed collaborations with other mathematicians or scientists, rather than with professional educators, to further their work. (p. 3)*

The prevailing culture of the mathematics community appears to regard mathematics "ability" as its most important criteria and this "ability" is most notably found in research mathematicians. As a result, they are regarded with the highest status by the mathematics community. While observing the Baton Rouge workshop, we heard several people say, when referring to mathematics educators, "S/he is a very capable mathematician, but s/he's doing math education now." It seemed that much of the person's credibility as a mathematics educator was still derived from their mathematics "ability". Only when they met this mathematics criteria would their educational ideas have much credibility.

Although MER does not actively support it, MER clearly does not oppose such collaborations between mathematicians and educators either. Collaboration between math and education departments would be an important advance in communications. While the co-directors do not make an issue out of it, MER seems to have some interest in fostering collaboration between mathematicians and educators (i.e., collaboration across communities). For example, several noteworthy mathematics educators (e.g., Tom Romberg, Mary Lindquist, Alan Schoenfeld) serve on the MER Advisory Board. In fact, beliefs driving MER include that

Immersion in one aspect of education yields unexpected insights and opportunities for improving other parts of the educational picture...What may be most novel about the experience of educational work is the recognition that college and university mathematics faculty are part of a much larger community of professional educators and teachers of mathematics. (Fisher, 1991, p. vii)

Exactly where MER stands on the issue of how important cooperation is between these two groups of professionals is not clear. This uncertainty is reflected in the comments of the mathematics and K-12 educators who, at times, felt MER was supportive of them and, at other times, felt that they did not belong to this organization.

Regarding communications within the community of research mathematicians on educational issues, survey respondents were positive about the effects of MER. Mathematicians felt that the types of people brought together by the MER Forum was clearly its most unique aspect. The majority of those who offered a comment felt that MER attracts a different subset of professionals than other organizations because it involves traditionally research-oriented higher education mathematics departments in K-12 mathematics education reform.

Unique (in my experience) in reaching a community of mathematicians whose interest in educational issues may be long-standing but whose involvement is fresh and new!

I know of no other group whose purpose is to get university-level mathematics instructors to discuss the teaching of their subject."
"Most other education groups are low in the esteem of research mathematicians.

To me, MER was mainly a group of kindred spirits.

Even some math educators who felt that MER provided information that is available elsewhere appreciated the fact that MER attracted research mathematicians. One wrote,

I think that MER duplicates services available through math education organizations, however, many mathematicians do not participate in those organizations and MER reaches them.

Meeting other colleagues and hearing about innovations they are trying in their classes (both informal sessions and formal discussions).

...to meet and collaborate with kindred spirit.

Regarding the communication between professional communities, it is much less effective. For this evaluation we defined collaboration with mathematics educators broadly and included issues such as familiarity with mathematics education literature and key issues

in mathematics education reform, in addition to traditional types of personal collaboration. While less than half of the mathematicians (40%) agreed that they usually consult educational research literature for information about mathematics reform, we suspect this percentage is substantially more than what might be true of a random sample of mathematicians. On the other hand, a majority of mathematicians said they usually consult mathematics educators for research about mathematics reform and approximately two-thirds of these respondents said they collaborate with mathematics educators at least once or twice each semester (see Table 9). Such limited corroboration between these experts leads to MER mathematicians "recreating the wheel" when it comes to addressing educational issues. Perhaps worse that re-creating the wheel is the failure to do so and approaching educational reform as if it can be done by instinct alone.

> *I think that mathematicians need a better appreciation of what math educators actually do and I would encourage MER to have more participation by math educators and a presentation of their research. In small doses they will provide some reality therapy for mathematicians who are very aware of the need for solid background before doing research, but think that education reform can be done by gut instinct.*

To build these bridges, MER needs to help facilitate communication between these two groups, and the workshops appear to be the perfect setting for this activity. MER attracts a fair number of mathematics educators and K-12 personnel to its workshops, particularly those workshops related to K-12 issues such as teacher preparation. Often the mathematics educators attend workshops because they are invited to speak about their area of expertise or a related mathematics education issue. Therefore, it is important to understand how well MER is meeting the needs of mathematics educators and K-12 teachers so that more mathematics educators will feel welcome at these workshops and would be available to help foster these cross-community connections[6].

The limited communication is perceived by all sides. Very few mathematician survey respondents said that MER helped them become more aware of the concerns of mathematics educators. Math educators would like MER to address teacher education more and provide more outreach to educators.

> *The MER philosophy doesn't seem to take the results of math education seriously (as far as I can recall). I don't think this is peculiar to MER, it also seems true of the calculus reform movement, However, I think it's a serious mistake since people involved in reform aren't helped by what's*

[6]It is important to note that we received relatively few responses to our survey from mathematics educators in education departments (N=20) or from K-12 teachers (N=8) so the conclusions drawn from these data are tentative. Perhaps the low response rate of mathematics educators results from their lack of identification with MER.

been done in education research and don't have a language in which to communicate the changes they see.

Several responses from K-12 teachers, while indicating that the opportunity to share ideas with others in the field was important, were a bit critical of the Forum.

The most positive feature of the MER Forum is in addressing the gaps between various mathematical professionals. I find it difficult to get college faculty to work with me, unless its their own grant -- my goals, as a teacher, are not so important...few mathematicians know anything at all about NCTM unless they step in to criticize something that's been done already.

A chance for discussion among the three groups (K-12, mathematics educators and mathematicians). Unfortunately, I don't believe any minds were changed. In fact, I think people came with the idea that change is O.K. for others but not for those that attended the meeting.

I did not feel that college faculty were interested in what pre-college teachers had to say.

Perhaps finding a way to address the status of teachers in general, and what they learn in college in particular. We don't expect enough of teachers, we don't reward them for their expertise, and we don't develop expertise in them....The policy making committees of NCTM and NSF, the journals, the offices, are rarely held by classroom teachers. This year's president [Mary Lindquist] is a notable exception, and even she has retired from the classroom to a university position.

Nevertheless, many of the mathematics educators who responded to our mailed survey reported that they valued MER. Several respondents explicitly mentioned networking and dissemination as the most important aspects of MER and many mathematics educators and K-12 professionals found it very beneficial to be able to interact with research mathematicians.

Mathematicians are learning to be more open to education and psychological research.

MER has given me access to people whom I would otherwise not know and who would not know me. But I have not taken full advantage of this access and that is my own fault.

Actually, I have been hesitant to interact with college staff, since I am 'only' a high school teacher. However, our local MER members have also become active in NCTM, really making it easier for us to interact with them.

Convergence of math and math education communities.

Sharing of ideas between leaders in reform and 'followers' like me who are interested, but have no idea where to start.

The most positive feature is that research mathematicians, educators, elementary and high school teachers are dialoging about common problems. At one time, there was no communication among these groups.

Another unique aspect (mentioned second most often) is that MER seems to serve as a bridge between the two seemly separate communities of mathematicians and mathematics educators. Comments to this effect include:

MER plays a special role in bridging the cultures of research and education.

It's a unique opportunity for bringing mathematicians and mathematics educators together in the same place, without either side feeling like 'outsiders'.

The strong mix of research mathematicians with mathematics educators provides a unique blend of ideas; these groups are 'thrown together' in an intellectual proximity that is unusual.

MER brings communities together in large meetings. Nobody else does this. The Joint Meetings are too large and largely exclude K-14; MSEB meetings are very small.

It reaches out to inform mathematicians of educational work they might be interested in, increases their interest, helps them 'jump in.' Absolutely unique, enormously valuable.

The seven math educators who responded to this question echoed the feelings of the mathematicians and indicated that it is the types of people MER brings together that makes it a unique organization. They felt that MER provided a bridge between the math and education departments which other organizations do not provide. *"Provides a niche for mathematicians who want to be involved."* Four of the five K-12 respondents felt that communication between K-12 teachers and higher education mathematicians was the most unique aspect of MER. *"MER strongly encourages K-12 teachers to participate and give valuable commentary within the same forum as college level educators."* Yet they still felt that there was room for improvement:

MER is the only organization I know of (except maybe the American Statistical Association) that really works at getting 'pure mathematicians' to talk with mathematics educators about the need for and effects of reform in math education. However, I was still just a high school teacher...

The mathematics educators and K-12 teachers suggested several ways MER could better meet their needs and serve the larger interest of mathematics education reform. Several respondents suggested that the Forum address new or expanded topics, such as learning styles, curricular outcomes and more attention to the subject matter.

The meeting I attended had extremely hostile overtones towards discussion of subject matter content.

MER leaders should focus on a small set of precisely defined issues. In same sense they allow all issues to look equal. In so doing, the issues end up centered on general calculus reform.

Another respondent suggested that MER members can learn much from published education research. Recognizing the expertise in other fields can help these two communities build bridges because without mutual respect, it is unlikely that real collaboration can ever occur.

The MER philosophy doesn't seem to take the results of math education seriously (as far as I can recall). I don't think this is peculiar to MER, it also seems true of the calculus reform movement, However, I think it's a serious mistake since people involved in reform aren't helped by what's been done in education research and don't have a language in which to communicate the changes they see.

K-12 teachers would like MER to explicitly include them in activities which they feel would lend more credibility to their experience. For example, this could be accomplished by asking K-12 personnel to organize a break-out session, participate on a panel for a morning discussion, or design sessions specifically for the benefit of a K-12 audience. Greater participation by K-12 faculty would facilitate more meaningful conversation between pre-college and college faculty.

One of the key missing elements is that the leaders of the Forum, that is, the co-directors and Advisory Committee Members, provide very limited opportunities for professional interaction among mathematicians and mathematics educators. In most cases, MER workshops are either targeted toward research mathematicians **or** mathematics educators (K-12 and up) but not **both** groups at the same workshop. Perhaps if MER organized workshops that would attract a cross-section of these groups, MER could capitalize better on some of the opportunities available to break down barriers.

By not specifically catering to the needs of educators, the Forum does nothing to dispel the notion that mathematicians "look down on" educators both at the university and K-12 levels.

In summary, MER has attracted many mathematics educators and K-12 teachers as members in the Forum, yet we question whether or not MER has capitalized on this pool of talent to help further its mission. Many of the non-research mathematician participants do not feel particularly welcome in the MER community. It appears that MER is not meeting the needs of its non-mathematician constituents and therefore it is unlikely that this constituency will grow larger enough to allow MER to serve in a "bridge-building" capacity

between these two cultures. We realize that trying to meet the needs of non-research mathematicians could appear to divert MER from its main mission of facilitating educational reform activities of mathematicians, yet we believe that this will make MER stronger and more effective in the long run. Perhaps MER leaders already have recognized this void in their organization. The most recent (November, 1995) Cornell workshop appears to be a positive move toward bringing these professional communities together.

Table 9.
Collaboration with mathematics educators.

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
I am more aware of the issues in mathematics education reform as a result of the MER Forum.						
Strongly Disagree	12	6.3	2	11.8	1	9.1
Tend to Disagree	44	22.9	6	35.3	2	18.2
Tend to Agree	87	45.3	6	35.3	6	54.5
Strongly Agree	49	25.5	3	17.6	2	18.2
I usually consult literature in the field of educational research for information about mathematics education reform.						
Strongly Disagree	52	28.0		N/A		N/A
Tend to Disagree	59	31.7				
Tend to Agree	49	26.3				
Strongly Agree	26	14.0				
I usually consult mathematics educators for research about mathematics education reform.						
Strongly Disagree	44	23.7		N/A		N/A
Tend to Disagree	46	24.7				
Tend to Agree	74	39.8				
Strongly Agree	22	11.8				
How often do you formally or informally collaborate with educators in education departments on your own campus?						
Never	33	18.1		N/A		N/A
Once/year	28	15.4				
Once or twice/semester	52	28.6				
Once or twice/month	30	16.5				
More than 2 times/month	39	21.4				

Indications of systemic change

One of MER's main goals in its most recent funding proposal is encouraging "systemic reform." This is currently a very popular goal for educational endeavors but is often stated without the accompaniment of a definition for systemic reform. MER is no

exception to this generality. One definition which we found particularly useful comes from Jenness & Barley (1995) who wrote

> *Systemic reform is characterized by (1) development of new or reformulation of existing systems rather than simply conducting new programs or activities, (2) the engagement of key partners in effective relationships to promote change, and (3) the identification of new roles and relationships for all players inside and outside the educational system. ... A systemic approach to reform differs considerably from the more traditional 'project mentality' approach of the past. Systemic change is about building infrastructure for reform; replacing/revising system elements rather than adding new ones; focusing change on oneself first rather than on others; building on system strengths rather than fixing deficits; understanding that reform is a long-term, evolving process, not a 'quick fix'; addressing all dimensions of the system rather than focusing on one or two; building capacities and marshaling resources; being part of mainstream reform efforts, not focusing on specific projects; focusing on lessons learned rather than concentrating efforts on creating models for replication; placing power in the hands of those in the system rather than relying only on funders or top-down change agents (1995, p. 53).*

We have adopted Jenness' & Barley's definition of systemtic reform (as opposed to other, more specific ones[7]) to judge MER's effectiveness in influencing systemic change. These criteria focus on the extent to which MER encourages the development of new working relationships both within the mathematics community and among other related disciplines, and whether broad changes have occurred within the mathematics community in addition to local or individual types of change. We do not discount the local and individual changes that the Forum may facilitate and, in fact, have quite a bit to say about these positive changes on this level. However, individual changes, if they are expected to be a route to systemic change, would be a very slow route toward this end.

In our survey of participants, we found that when mathematicians are involved in educational reform activities, these activities tend to be personal, individual changes unassociated with those of other mathematicians. The three most common types of individual changes were (1) enhanced awareness of educational issues, (2) strengthened feelings of support, and (3) improved classroom pedagogy. While changes of a systemic nature were less prevalent, they did exist and seemed to revolve around friendlier attitudes toward educational activities within university math departments. In the pages that follow, we discuss both individual and broader levels of change. (In addition to the broad changes

[7] For example, the National Science Foundation's strategy for systemic reform is consistent with these ideas but is more specific. NSF's Statewide Systemic Initiatives (SSI) project is based on the premise that "meaningful reforms in schools are most likely to be achieved through state initiatives that set clear and ambitious learning goals and standards, align all of the available policy levers in support of reform, stimulate school-level initiatives, and mobilize human and fiscal resources to support these changes." (Consortium for Policy Research in Education, 1995.)

mentioned here, we found the departmental network to be an extensive movement toward systemic reform; this is discussed in detail in a later chapter.)

Individual and Local Changes

First, the most commonly cited benefit of the Forum by survey respondents was the acquisition of a general awareness of educational activities, information which enhanced personal teaching and/or research. Approximately 60% of mathematicians and K-12 educators, and 47% of the math-educators said their association with the MER Forum has been helpful to furthering the goals of their own projects (see Table 10). More than 70% of the mathematicians and K-12 educators and a majority of mathematics educators (over 50%) feel more aware of issues in mathematics education as a result of the Forum (see Table 9). In response to an open-ended question about awareness of educational issues, mathematicians most frequently mentioned heightened awareness of (1) calculus reform and the use of technology (graphing calculators and computers) in the classroom and (2) mathematicians' involvement in mathematics education reform. These two issues were cited between two and three times more than any other category of response. Other issues for which respondents indicated a raised awareness were: (a) why calculus reform was implemented; (b) how traditional, research-oriented mathematics departments reward faculty for educational endeavors; (c) the tension between the pressure to publish and teach effectively; (d) diversity/minority representation; (e) K-12 teacher preparation; (f) state systemic initiatives and other large-scale collaboration projects; and (g) ways to improve pedagogy in the math classroom. Several respondents indicated that MER opened their eyes to the involvement of research mathematicians in math education issues. Although the responses from math educators were limited (8), they were similar to the mathematics group. More awareness of calculus reform and mathematicians' role in mathematics education reform were the most commonly cited issues. The few K-12 teacher respondents mentioned most frequently increased awareness of calculus reform and use of technology in the math classroom.

A second change which participants attributed to the Forum was the creation of a supportive atmosphere for educational reform activities. Perhaps the major function of the MER Forum is to build relationships among mathematicians and others interested in mathematics education reform. In order to get a sense of how this network-building operated, we asked a series of questions about respondents' interactions with other colleagues dealing with mathematics education issues. Comments toward this end included:

I feel less isolated. I would like to attend more workshops to feel more connected and to be able to call on others to share ideas, problems, etc.."
"It is good to hear that your ideas are in tune with the current trends and practices.

I am involved in math education in my state at levels K-12 along with college and feel more comfortable about my participation because of MER.

More than seventy percent of respondents from all three groups agreed they would feel comfortable contacting or calling MER colleagues about professional matters (see Table 11). Respondents appeared more willing to contact colleagues about mathematics reform issues than about personal teaching issues or mathematical research issues. For example, approximately two-thirds of respondents indicated they had contacted a colleague about mathematical reform issues at least once, while slightly more than 40% said they had contacted colleagues more than once about personal teaching issues, and only 15-20% had contacted MER colleagues about mathematical research issues (see Table 11). Considering how specialized mathematics research has become, it is understandable that MER colleagues do not regularly contact one another about mathematical research, nor is this a major goal of the MER Forum. It is more important that MER participants capitalize on the opportunities to connect with "kindred spirits" about educational issues than research concerns. We analyzed these items for the mathematician respondents by gender and found that males and females had very similar response patterns (see Table 12).

A third individual level change attributed to the MER Forum was that of classroom pedagogy. Almost half of the mathematician respondents agreed that they changed their own teaching as a result of their involvement with the MER Forum. A similar percentage of K-12 educators, but slightly less than one-quarter of the math-educators, reported they changed their teaching as a result of MER (see Table 10).[8]

Attending a workshop helped me to organize my thinking about the teaching of mathematics during my first year as a faculty member."

MER has helped solidify by confidence in my own teaching innovations."

When we asked those who said they had changed their own teaching to specify the impetus for these changes, more than 80% of these mathematicians attributed changes in their teaching to specific experiences and information from MER workshop(s) they had attended and more than 65% of the mathematicians said they could attribute changes to information in the MER newsletter or other MER publications, and/or continued networking with MER

[8] The sample of math-educators and K-12 teachers who said they changed their teaching is too small (N=4 and 5, respectively) discuss the attribution of their changes.

colleagues. It appears that participants use multiple sources of information from MER to reflect on their own teaching.

Fourth, some mathematicians found MER to be the impetus for reflection on their teaching philosophy and on issues of students who traditionally have been marginalized by mathematics instruction, specifically women and underrepresented ethnic minorities.

> *More consideration of my philosophy of teaching/learning when designing a mixture of experiences for my students.*

> *Judge my effectiveness as a teacher by the success of my students.*

In the following paragraphs, we discuss some of the ways these reported changes have been translated into practice.

Cooperative learning is the most popular change in mathematicians' classroom teaching. The second most frequently cited change in pedagogy is the incorporation of technology into the math class, specifically the use of graphing calculators and DERIVE, Mathematica and other computer software. Other pedagogues that have made their way into the college mathematics classroom include more hands-on activities, more class participation, reformed math curricula such as Harvard Calculus, and new types of assessments. Some examples of these changes include:

> *Insistence on students explaining and justifying their computations.*

> *Less chalk and talk, more worksheets with group discussion and student participation at the board.*

> *Take home exams with provision for working with a different partner on each problem. Partners discuss problems together but write up their solutions individually. With my help, each student works to present a basic theorem to the class, expanding the book's presentation. Each student finds a problem (or composes one) to present to the class.*

Several mathematicians could not attribute changes in teaching directly to MER, believing that these changes were inevitable, yet the following comments suggest that these participants still attribute at least an indirect effect to MER.

> *My teaching changes continually with a huge set of factors producing change. This question implies more isolation of impetus.*

> *I feel like being part of MER has solidified my confidence in how I teach but MER was not the cause of my change. That was internal.*

> *While MER might not be the direct cause, it has reinforced my commitment to change. E.g., using alternative assessments like portfolios, projects and more group work.*

Very few K-12 and math educators indicated they changed their pedagogy (3 and 2 comments, respectively). Perhaps this is because the Forum is not specifically directed toward these groups and, as such, the pedagogues which mathematicians found new were not new to them.

ERIC

Table 10.
Changes due to the MER Forum.

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
I have changed my own teaching because I have been involved with MER.						
Strongly Disagree	40	20.9	8	47.1	3	27.3
Tend to Disagree	60	31.4	5	29.4	2	18.2
Tend to Agree	76	39.8	4	23.5	5	45.5
Strongly Agree	15	7.9	0	0.0	1	9.1
I feel I can attribute the impetus for these changes in my teaching to information in the MER newsletters, other MER publications, and/or continued networking with colleagues affiliated with MER.*						
Strongly Disagree	4	4.9	1	25.0	2	33.3
Tend to Disagree	23	28.0	1	25.0	1	16.7
Tend to Agree	52	63.4	2	50.0	2	33.3
Strongly Agree	3	3.7	0	0.0	1	16.7
I feel I can attribute the impetus for these changes in my teaching to information and experiences at the MER workshop(s) I have attended.*						
Strongly Disagree	1	1.3	1	25.0	2	33.3
Tend to Disagree	11	14.5	2	50.0	1	16.7
Tend to Agree	56	73.7	1	25.0	1	16.7
Strongly Agree	88	10.5	0	0.0	2	33.3
Has your association with the MER Forum been helpful to you in terms of furthering the goals of your own projects?						
Yes	103	59.2	7	46.7	5	62.5
No	68	39.1	8	53.3	3	37.5
Somewhat	3	1.7	0	0.0	0	0.0

* Includes only those respondents who "agreed" or "strongly agreed" that they changed their teaching because of their involvement with MER.

Table 11.
Collegial interactions as a result of the MER Forum.

	Mathematician		Math-Educator		K-12	
	Frequency	Valid %	Frequency	Valid %	Frequency	Valid %
After participating in one MER workshop, I felt comfortable calling/ contacting MER colleagues I had just met about professional matters.						
Strongly Disagree	11	6.2	2	11.1	0	0.0
Tend to Disagree	36	20.2	1	5.6	1	10.0
Tend to Agree	90	50.6	6	33.3	7	70.0
Strongly Agree	41	23.0	9	50.0	2	20.0
Since your first MER workshop, how frequently have you contacted MER colleagues about:						
Personal teaching issues?						
Never	100	57.5	9	52.9	5	55.6
Once	19	10.9	3	17.6	1	11.1
2-5 times	44	25.3	5	29.4	3	33.3
6-10 times	3	1.7	0	0.0	0	0.0
More than 10 times	8	4.6	0	0.0	0	0.0
Mathematics education reform issues?						
Never	66	36.9	6	33.3	5	50.0
Once	18	10.1	3	16.7	1	10.0
2-5 times	62	34.6	3	16.7	2	20.0
6-10 times	11	6.1	2	11.1	2	20.0
More than 10 times	22	12.3	4	22.2	0	0.0
Mathematical research issues?						
Never	139	85.3	11	68.8	7	77.8
Once	7	4.3	1	6.3	1	11.1
2-5 times	14	8.6	2	12.5	1	11.1
6-10 times	1	0.6	1	6.3	0	0.0
More than 10 times	2	1.2	1	6.3	0	0.0

Table 12.
Collegial interactions as a result of the MER Forum by gender of respondent (Mathematics departments only).

	Male		Female	
	Frequency	Valid %	Frequency	Valid %
After participating in one MER workshop, I felt comfortable calling/contacting MER colleagues I had just met about professional matters.				
Strongly Disagree	6	4.7	5	9.8
Tend to Disagree	29	22.8	7	13.7
Tend to Agree	66	52.0	24	47.1
Strongly Agree	26	20.5	15	29.4
Since your first MER workshop, how frequently have you contacted MER colleagues about:				
Personal teaching issues?				
Never	74	59.2	26	53.1
Once	12	9.6	7	14.3
2-5 times	29	23.2	15	30.6
6-10 times	3	2.4	0	0.0
More than 10 times	7	5.6	1	2.0
Mathematics education reform issues?				
Never	47	36.7	19	37.3
Once	11	8.6	7	13.7
2-5 times	45	35.2	17	33.3
6-10 times	9	7.0	2	3.9
More than 10 times	16	12.5	6	11.8
Mathematical research issues?				
Never	100	85.5	39	84.8
Once	4	3.4	3	6.5
2-5 times	10	8.5	4	8.7
6-10 times	1	0.9	0	0.0
More than 10 times	2	1.7	0	0.0

Broader changes

Although the majority of changes cited dealt with individuals, quite a few respondents felt that MER also influenced broader levels of changes such as changes within their mathematics departments, between the math and education departments on their campuses, with their campus administrators, and/or new involvement in large-scale educational reform projects.

In general, respondents reported that the attitudes in their departments toward mathematics education reform were fairly positive[9]. Slightly more than half of the respondents agreed that involvement in mathematics education reform was highly valued in their department and almost three-quarters of the respondents indicated that mathematics education reform was accepted and supported in their departments (see Table 13). The discrepancy between these two items is related to the difference between "accepted" and "highly valued." It appears from this survey (and much of our other data) that mathematics education is accepted in most mathematics departments but is not as highly valued as mathematics research. Nevertheless, it is important that a majority of these mathematicians perceived mathematics education to be highly valued in their department. We do not know if this is characteristic of the general population of mathematics departments. We suspect that MER participants, even though they are in the minority in most departments, tend to come from departments on the more "pro-education" side of the continuum of mathematics departments; other less-receptive departments might not even support sending anyone to a MER meeting.

Further, approximately three-quarters of the respondents indicated that attitudes toward mathematics education have become more positive and more than 80% said new mathematics education projects and programs have been supported by their departments during the past five years (see Table 13). While these were the five years during which MER began promoting educational issues in the mathematics community, the public, state legislatures and other higher education policymakers began increasing the pressure on universities to improve the education they offer to undergraduates during this same time frame. It is difficult to attribute these changes in departmental attitudes solely to MER, these shifts are more likely the result of external pressures on universities. Nonetheless it appears that MER helped provide some leadership as mathematics departments have been called upon to address educational issues.

The following quotations illustrate these points:

---

[9]This section describes the attitudes of mathematics departments toward educational reform as reported largely by members of the individual network. Only respondents who identified themselves as mathematicians in mathematics departments were asked to reply to this section of the survey.

Because of MER, many [faculty] who were once vehemently opposed to any reform are beginning to at least listen and lean toward change.

I've been able to cite instances where the use of technology has proved useful to bolster moving my department in that direction.

My ability to cite peer institutions to my administration was improved.

It has given me ideas for submitting my own grants to improve the teaching/learning of university-level mathematics.

Departments have become more supportive of revised pedagogy including the use of technology, colloquia on educational issues, other forms of interdepartmental communication and use of technology.

Seminars on issues of teaching and learning are very well attended [and] email newsletter on teaching and learning is heavily subscribed to.

I was asked to speak on statewide reform at a departmental colloquium.

Encouraging experimentation with collaborative learning.

There is a sporadic seminar addressing reform issues.

Several people in the department are trying experimental and innovative approaches, or are working directly with in-service projects for teachers.

The primary indicators of positive departmental attitude changes toward mathematics education reform are: (1) improvements in curricula, (2) new institutional support and (3) attention to better pedagogy. Curricular changes primarily affected calculus courses and frequently involved the adoption of the Harvard calculus program. At several institutions the curricula were improved in other areas of mathematics as well. Development of more entry level math courses, development of graduate level courses focusing on pedagogical issues, remedial education reform, re-writing pre-service programs for math majors, support for emerging scholars programs and designing a math/science core for undergraduates are some of the other areas of curricular reform in which MER participants are involved.

In an effort to learn more about the mathematics education efforts in mathematics departments, we asked respondents questions about the number of faculty members involved in a variety of activities. The data in Table 14 are presented as the percent of faculty members involved in seven activities. Departments surveyed ranged in size from less than five faculty to over one-hundred; the majority of respondents were in departments with 11-25 faculty (26%) or 26-50 faculty members (31%, see Table 14).

Table 13.
Attitudes of mathematics departments toward educational reform
(respondents from mathematics departments only).

	Frequency	Valid %
Involvement in mathematics education reform is highly valued in my department.		
Strongly Disagree	23	12.0
Tend to Disagree	67	35.1
Tend to Agree	73	38.2
Strongly Agree	28	14.7
In my department, the atmosphere toward mathematics education reform is one of acceptance and support.		
Strongly Disagree	18	9.4
Tend to Disagree	36	18.8
Tend to Agree	105	55.0
Strongly Agree	32	16.8
During the past five years, the atmosphere in my department toward mathematics education reform has changed, becoming more positive towards it.		
Strongly Disagree	9	5.0
Tend to Disagree	39	21.8
Tend to Agree	106	59.6
Strongly Agree	25	14.0
During the past five years, new projects and programs related to mathematics education have been supported by my department.		
Strongly Disagree	4	2.2
Tend to Disagree	28	15.7
Tend to Agree	94	52.8
Strongly Agree	52	29.2
Has your institution hosted a (MER) workshop?		
Mathematics department respondents		
Yes	26	13.8
No	163	86.2
Math-educator (Ed-depts.) respondents		
Yes	4	22.2
No	14	77.8

Table 14.
Percent of mathematics department faculty involved in various educational activities

	Frequency	Valid %
Total Number of Faculty in Department		
5 or fewer	10	5.0
6-10 faculty	20	10.1
11-25 faculty	52	26.1
26-50 faculty	61	30.7
50-75 faculty	29	14.6
76-100 faculty	8	4.0
More than 100 faculty	19	9.5
Percent of Faculty Involved in the Following Activities:		
K-12 Math Education Reform		
0%	32	17.7
1-20%	116	64.1
21-40%	24	13.3
41-60%	6	3.3
61-80%	2	1.1
81-99%	1	0.6
100%		
Undergraduate Math-Ed Reform		
0%	7	3.8
1-20%	79	43.4
21-40%	46	25.3
41-60%	24	13.2
61-80%	6	3.3
81-99%	10	5.5
100%	10	5.5
Teacher Preparation		
0%	34	18.8
1-20%	112	61.9
21-40%	26	14.4
41-60%	5	2.8
61-80%	2	1.1
81-99%	2	1.1
100%		

Table 14 (continued).

	Frequency	Valid %
Reform of Graduate Education for Mathematics Students		
0%	91	50.3
1-20%	67	37.0
21-40%	18	9.9
41-60%	3	1.7
61-80%	0	0.0
81-99%	2	1.1
100%		
Reform of Graduate Education for Math-Education Students		
0%	117	65.0
1-20%	50	27.8
21-40%	11	6.1
41-60%	1	0.6
61-80%	0	0.0
81-99%	1	0.6
100%	0	0.0
Teacher In-Service Activities		
0%	47	26.3
1-20%	107	59.8
21-40%	21	11.7
41-60%	3	1.7
61-80%	0	0.0
81-99%	1	0.6
100%	0	0.0
Mathematics Research		
0%	15	8.4
1-20%	26	14.6
21-40%	27	15.2
41-60%	31	17.4
61-80%	36	20.2
81-99%	33	18.5
100%	10	5.6

In general, it appears that relatively few (fewer than 20%) faculty members in each of the respondents' departments were involved in educational activities. For example, while 44% of the respondents reported that more than 60% of the faculty in their departments were involved in mathematics research, only 14% of respondents indicated that more than 60% of the faculty in their department were involved in undergraduate mathematics reform and this activity had higher levels of faculty involvement than any of the other educational initiatives (see Table 14). Graduate education (for both mathematics and math-education majors) reform appears to have the fewest number of faculty members involved, while undergraduate reform for mathematics majors has the highest reported level of faculty involvement in departments represented by the survey respondents.

In order for educational reform to become sustained in university mathematics departments, the typical reward structure of higher education institutions will have to support faculty members' participation in educational initiatives. In an effort to judge the current levels of institutional support we asked respondents to indicate how they distributed their time compared to their perceptions of how their institution expected them to spend their time (see Table 15). Most respondents reported working a lot of hours; the majority indicated they worked more than 50 hours per week and almost 20% said they worked more than 60 hours on an average week. While most people tend to think they work more hours than they actually do, these respondents still seem to work fairly long hours, perhaps in an effort to balance their multiple responsibilities. For example, two of the faculty members responsible for the majority of mathematics educational activities at UCSB reported having to start their days at 5:00 a.m. and reserve certain blocks of time in order to maintain their mathematics research agenda in addition to all of their other initiatives.

Most respondents indicated that they spent relatively less time on mathematics research/scholarship than their institution expects for promotion and tenure, but considerably more time on math education reform, service, and administrations than compared to what their department expects. Interestingly, respondents reported that the amount of time they spent teaching was roughly equivalent to what they perceived their department expected (see Table 15).

Recent institutional support includes rewards for educational involvement such as consideration in promotion and tenure decisions, release time for educational involvement, becoming more respectful of educational involvement and general administrative support.

> *Faculty have been promoted for national educational efforts; faculty have been hired for education work alone."*

Establishment of 90 minutes of faculty development time each week for in-service development. Support for a system of five faculty development workshops for in-service development.

I, no longer, am criticized for my involvement. Much more education innovation is taking place.

As mentioned earlier, the two teacher preparation workshops attracted a relatively higher percentage of women compared to other topics. One female participant at the Baton Rouge (11/94) Teacher Preparation workshop said, *"Well, this is the women's work in the math department."* To pursue this issue we analyzed by gender the way respondents indicated they spent their time and the way they perceived of their departments' expectations for their distribution of work activities (see Tables 17 & 18). Males indicated they worked approximately four hours more than females (51.3 and 47.1 hours, respectively) on the average week, but there were some interesting differences in the way this time was distributed. Women indicated that they spent significantly more time (42% of their time) on teaching than men (35%) and somewhat more time on mathematical education reform activities (females=20%; males=16%). Whereas men reported spending somewhat more time on both research (females=13%; males=18%) and administration (females=12%; males=15%) than women (see Table 16).

The respondents' perceptions of their departments' expectations correlated with the way they actually spent time, though none of these mean differences were statistically significant (see Table 18). Women indicated that, on average, they were expected to spend approximately 44% of their time, compared to 38% for men, related to teaching. These percentages were essentially reversed for perception of time expected for research. On average, women perceived they were expected to spend approximately twice as much time on educational reform activities compared to men's perceptions of their departments' expectations (females=10%; males=5%).

Another strength of the Forum is the legitimization it provides of mathematics education reform within the mathematics research community, a theme that has cropped up in response to other survey questions as well.

Affecting positively mathematics education reform mainly by legitimizing mathematics education and get rid of its second-class status.

Give higher standing to consideration of teaching as part of serious work with university math departments.

The 'respectability' of MER so that participants feel empowered to return to their campuses and push for changes.

They have made mathematics education issues socially acceptable in research math departments.

Related to legitimization, some participants felt that the greatest benefit of the Forum is that it provides a concrete example of the movement toward educational reform in the mathematics community.

That it exists! That it is trying to create the awareness of how students learn mathematics.
Mathematicians with their hearts in the right places -- paying attention to crucial educational issues.
A group with a purpose -- changing the environment in undergraduate education.

It is not surprising that mathematicians (or any academics, for that matter) tend to work individually to change their own practice rather than combine efforts to change the system in which they work -- a system which is steeped in centuries of tradition and in which they have succeeded. Changing educational beliefs and practices is very difficult. It is the culture of academia to work on one's own research, perhaps collaborating with other experts in specific fields but not necessarily with your neighbors next door. Systemic reform will require mathematicians and others to begin to adopt the attitude that changing your own practices is important but is not enough to change the entire system of mathematics education. We support MER's efforts to bring about systemic change and hope that this organization will put even more effort into changing entire university mathematics departments so that they value and reward educational activities of their faculty. The departmental network, discussed in the next chapter, is intended to do just this.

References

Jenness, M. & Barley, Z. (1995). Using cluster evaluation in the context of science education reform. *New Directions for Program Evaluation*, no. 65, Spring, pp. 53-69.

Table 15.
Percent of time respondents spend on various activities compared with their perceptions of departmental priorities for promotion and tenure decisions (respondents from mathematics departments only).

	actual time spent		perception of priorities	
	Frequency	Valid %	Frequency	Valid %
Total Hours Worked/Week				
Less than 40	31	19.3	37	38.5
40-49 hrs	35	21.7	14	14.6
50-59 hrs	64	39.8	36	37.5
60-69 hrs	22	13.7	6	6.3
More than 70 hrs	9	5.6	3	3.1
Mean (hours)	50.21		46.04	
Std. Dev. (hours)	11.02		12.49	
Teaching				
0%	8	5.0	5	5.4
1-20%	33	20.6	12	12.9
21-40%	62	38.9	38	40.9
41-60%	40	25.0	26	28.0
61-80%	13	8.1	10	10.8
81-99%	4	2.5	0	0.0
100%	0	0.0	2	2.2
Mean (hours)	17.96		18.05	
Std. Dev. (hours)	9.86		9.55	
Mathematics Research/ Scholarship				
0%	30	18.8	2	2.2
1-20%	79	49.4	24	25.8
21-40%	34	21.3	25	26.9
41-60%	15	9.4	24	25.8
61-80%	2	1.3	15	16.1
81-99%	0	0.0	1	1.1
100%	0	0.0	2	2.2
Mean (hours)	8.26		19.05	
Std. Dev. (hours)	8.07		11.33	

Table 15 (continued).

	actual time spent		perception of priorities	
	Frequency	Valid %	Frequency	Valid %
Math Education Reform Activities				
0%	15	9.4	43	47.8
1-20%	97	60.6	42	46.7
21-40%	39	24.4	4	4.4
41-60%	5	3.1	0	0.0
61-80%	2	1.3	0	0.0
81-99%	0	0.0	0	0.0
100%	2	1.3	1	1.1
Mean (hours)	8.83		3.03	
Std. Dev. (hours)	8.86		5.93	
Service				
0%	17	10.6	16	17.4
1-20%	115	71.9	69	75.0
21-40%	26	16.3	7	7.6
41-60%	1	0.6	0	0.0
61-80%	0	0.0	0	0.0
81-99%	1	0.6	0	0.0
100%	0	0.0	0	0.0
Mean (hours)	6.53		4.42	
Std. Dev. (hours)	5.94		3.65	
Administration				
0%	57	36.1	48	53.9
1-20%	62	39.2	35	39.3
21-40%	20	12.7	4	4.5
41-60%	11	7.0	1	1.1
61-80%	6	3.8	1	1.1
81-99%	1	0.6	0	0.0
100%	1	0.6	0	0.0
Mean (hours)	7.56		2.81	
Std. Dev. (hours)	10.98		5.93	

Table 15 (continued).

	actual time spent		perception of priorities	
	Frequency	Valid %	Frequency	Valid %
Other (please specify)				
0%	133	86.9	81	94.2
1-20%	13	8.5	4	4.7
21-40%	5	3.3	1	1.2
41-60%	2	1.3	0	0.0
61-80%	0	0.0	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.0	0	0.0
Mean (hours)	1.42		0.41	
Std. Dev. (hours)	4.8		2.36	

Table 16.
Percent of time respondents spend on various activities by gender
(respondents from mathematics departments only).

	Males		Females	
	Frequency	Valid %	Frequency	Valid %
Total Hours Worked/Week				
Less than 40/week	23	19.3	8	19.0
40-49 hours	24	20.2	11	26.2
50-59 hours	47	39.5	17	40.5
60-69 hours	16	13.4	6	14.3
More than 70 hours/week	9	7.6	0	0.0
Mean (pct. time)	51.29 *		47.14	
Std. Dev. (pct. time)	11.34		9.52	
Teaching				
0%	5	4.2	3	7.1
1-20%	26	22.0	1	2.4
21-40%	46	39.0	4	9.5
41-60%	32	27.1	18	42.9
61-80%	6	5.1	8	19.0
81-99%	3	2.5	7	16.7
100%	0	0.0	1	2.4
Mean (pct. time)	34.8		41.9 *	
Std. Dev. (pct. time)	18.6		21.9	
Mathematics Research/ Scholarship				
0%	19	16.1	11	26.2
1-20%	59	50.0	20	47.6
21-40%	26	22.0	8	19.0
41-60%	12	10.2	3	7.1
61-80%	2	1.7	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.0	0	0.0
Mean (pct. time)	18.0		13.3	
Std. Dev. (pct. time)	16.9		13.6	

Table 16 (continued).

	Males		Females	
	Frequency	Valid %	Frequency	Valid %
Math Education Reform Activities				
0%	13	11.0	2	4.8
1-20%	72	61.0	25	59.5
21-40%	27	22.9	12	28.6
41-60%	3	2.5	2	4.8
61-80%	2	1.7	0	0.0
81-99%	0	0.0	0	0.0
100%	1	0.8	1	2.4
Mean (pct. time)	15.8		20.1	
Std. Dev. (pct. time)	15.1		17.2	
Service				
0%	12	10.2	5	11.9
1-20%	83	70.3	32	76.2
21-40%	21	17.8	5	11.9
41-60%	1	0.8	0	0.0
61-80%	0	0.0	0	0.0
81-99%	1	0.8	0	0.0
100%	0	0.0	0	0.0
Mean (pct. time)	13.5		11.1	
Std. Dev. (pct. time)	11.5		8.5	
Administration				
0%	40	34.2	17	41.5
1-20%	48	41.0	14	34.1
21-40%	13	11.1	7	17.1
41-60%	10	8.5	1	2.4
61-80%	4	3.4	2	4.9
81-99%	1	0.9	0	0.0
100%	1	0.9	0	0.0
Mean (pct. time)	15.2		12.1	
Std. Dev. (pct. time)	21.0		18.1	

Table 16 (continued).

	Males		Females	
	Frequency	Valid %	Frequency	Valid %
Other (please specify)				
0%	100	87.0	33	86.8
1-20%	9	7.8	4	10.5
21-40%	4	3.5	1	2.6
41-60%	2	1.7	0	0.0
61-80%	0	0.0	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.0	0	0.0
Mean (pct. time)	2.9		2.1	
Std. Dev. (pct. time)	9.0		7.3	

Table 17.
Respondents' perceptions of departmental priorities for promotion and tenure (respondents from mathematics departments only).

	Males		Females	
	Frequency	Valid %	Frequency	Valid %
Total Hours Worked/Week				
Less than 40/week	25	36.2	12	44.4
40-49 hours	12	17.4	2	7.4
50-59 hours	24	34.8	12	44.4
60-69 hours	6	8.7	0	0.0
More than 70 hours/week	2	2.9	1	3.7
Mean (pct. time)	47.0		43.5	
Std. Dev. (pct. time)	11.6		14.4	
Teaching				
0%	4	5.8	1	4.2
1-20%	7	10.1	4	16.7
21-40%	33	47.8	6	25.0
41-60%	17	24.6	9	37.5
61-80%	7	10.1	3	12.5
81-99%	0	0.0	0	0.0
100%	1	1.4	1	4.2
Mean (pct. time)	38.0		43.9	
Std. Dev. (pct. time)	18.8		22.8	
Mathematics Research/ Scholarship				
0%	0	0.0	2	8.0
1-20%	16	23.5	7	28.0
21-40%	20	29.4	5	20.0
41-60%	18	26.5	7	28.0
61-80%	12	17.6	3	12.0
81-99%	1	1.5	0	0.0
100%	1	1.5	1	4.0
Mean (pct. time)	42.4		37.7	
Std. Dev. (pct. time)	22.5		26.5	

Table 17 (continued).

	Males		Females	
	Frequency	Valid %	Frequency	Valid %
Math Education Reform Activities				
0%	34	51.5	9	37.5
1-20%	30	45.5	12	50.0
21-40%	2	3.0	2	8.3
41-60%	0	0.0	0	0.0
61-80%	0	0.0	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.8	1	4.2
Mean (pct. time)	4.9		10.1	
Std. Dev. (pct. time)	6.5		20.5	
Service				
0%	13	19.1	3	12.5
1-20%	49	72.1	20	83.3
21-40%	6	8.8	1	4.2
41-60%	0	0.0	0	0.0
61-80%	0	0.0	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.0	0	0.0
Mean (pct. time)	9.7		8.7	
Std. Dev. (pct. time)	7.5		7.1	
Administration				
0%	38	58.5	10	41.7
1-20%	22	33.8	13	54.2
21-40%	3	4.6	1	4.2
41-60%	1	1.5	0	0.0
61-80%	1	1.5	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.0	0	0.0
Mean (pct. time)	5.7		5.3	
Std. Dev. (pct. time)	11.3		9.2	

Table 17 (continued).

	Males		Females	
	Frequency	Valid %	Frequency	Valid %
Other (please specify)				
0%	62	96.9	19	86.4
1-20%	1	1.6	3	13.6
21-40%	1	1.6	0	0.0
41-60%	0	0.0	0	0.0
61-80%	0	0.0	0	0.0
81-99%	0	0.0	0	0.0
100%	0	0.0	0	0.0
Mean (pct. time)	0.7		1.2	
Std. Dev. (pct. time)	4.9		4.3	

Table 18.
Percent of time respondents spend on various activities compared with their perceptions of departmental priorities for promotion and tenure decisions by rank (respondents from mathematics departments only).

	actual time spent		perception of priorities	
	Frequency	Valid %	Frequency	Valid %
Total Hours Worked/Week				
Less than 40 hours				
Non-tenure track	3	42.9	1	50.0
Asst. Prof.	3	16.7	8	61.5
Assoc. Prof.	4	13.3	11	44.0
Full Prof.	16	18.0	14	29.2
Administrator	5	31.3	2	28.6
40-49 hours				
Non-tenure	1	14.3	0	0.0
Asst. Prof.	1	5.6	0	0.0
Assoc. Prof.	8	26.7	4	16.0
Full Prof.	21	23.6	8	16.7
Administrator	4	25.0	2	28.6
50-59 hours				
Non-tenure	3	42.9	0	0.0
Asst. Prof.	11	61.1	5	38.5
Assoc. Prof.	10	33.3	6	24.0
Full Prof.	34	38.2	23	47.9
Administrator	5	31.3	2	28.6
60-69 hours				
Non-tenure	0	0.0	0	0.0
Asst. Prof.	3	16.7	0	0.0
Assoc. Prof.	7	23.3	3	12.0
Full Prof.	10	11.2	2	4.2
Administrator	2	12.5	1	14.3

Table 18 (continued).

	actual time spent		perception of priorities	
	Frequency	Valid %	Frequency	Valid %
More than 70 hours				
Non-tenure	0	0.0	1	50.0
Asst. Prof.	0	0.0	0	0.0
Assoc. Prof.	1	3.3	1	4.0
Full Prof.	8	9.0	1	2.1
Administrator	0	0.0	0	0.0
Mean - Std. Dev. (hours)				
Non-tenure	43.71	12.59	59.00	26.87
Asst. Prof.	49.83	9.43	41.15	13.53
Assoc. Prof.	51.87	9.67	46.76	15.82
Full Prof.	51.53	10.43	46.81	9.70
Administrator	42.69	14.68	44.43	11.15

Chapter 5: MER's Departmental Network

In an attempt to continually improve the Forum, MER established its departmental network in 1994 to supplement its ongoing individual-oriented activities. Part of the rationale for this new endeavor is as follows:

> *Models of departments in which the departmental culture promotes regular, thoughtful study of its educational responsibilities are needed. What does exist are examples of departments in which excellent educational activities are in progress, but these educational activities are regarded by and large as peripheral to the main mission of the department, namely, mathematics research. Often the educational reform activities depend on a two tiered faculty structure in which a faculty of adjunct and/or untenured teachers bear the instructional load for the special programs. Special programs developed by regular faculty are often regarded as "Professor X's project" rather than the department's responsibility, and the projects are unlikely to survive without the founder's involvement. Further, the assumption that researchers need to be protected from educational involvement still prevails, even in departments at the vanguard of educational reform. The dichotomy between mathematics education and mathematics research persists at the deepest level: mathematics is viewed as continually evolving, but mathematics education is viewed as a set of problems that need fixing so that things can return to "normal." (MER document, April 1994)*

The department network was established as a three year experiment "to develop models of departments in research oriented universities in which educational goals are integral to the departmental mission and are supported by broadly based faculty participation in educational programs (Saunders, 1995)." MER perceived the need for this network for the following reasons (which are philosophically similar to the rationale for the individual network): educational initiatives in mathematics departments tend to be isolated from other, similar, activities; in each department there are only a few faculty who have taken the responsibility for educational activities (outside of one's own teaching); and there is not an "overall vision, unified purpose, intellectual discourse, and passionate commitment" for mathematics education reform among mathematicians.

All departments with representatives on the Advisory Committee were invited to join, in addition to a few other departments. Thirteen departments were originally invited to join this new network and send a team of 3-5 faculty to the first annual workshop at the

University of Texas at Austin in May 1994. The State University of New York at Stony Brook sent a team to the Santa Barbara workshop and has since joined the network. The focus is on research-oriented mathematics departments because these influence the activities of other types of post-secondary institutions and they are the key to changing both undergraduate and graduate education in mathematics. Reforming the education and attitudes of future teachers of mathematics is a key component of this new network. The vehicle through which this is to occur is the sharing of experiences, both good and bad, among departments.

Prior to discussing our understanding of the departmental network, it is important to note that the "network" is only in its formative stages, therefore much of our analyses are focused on describing the departments and their educational activities. We discuss our findings with an eye toward MER's potential role at facilitating the educational activities across these departments. We discuss our findings as they relate to the network as a whole rather than limiting ourselves to our case-study universities. However, as might be expected, most of our examples will be drawn from our four case-study sites.

Overview of sites

The four mathematics departments ranged in size from 28 to 53 tenure-track faculty members and all are Ph.D. granting state institutions. These departments are all considered research mathematics departments within Research-I universities. Typical of large universities with extensive science departments, the mathematics department devotes much of its instructional energy to service courses, especially the Calculus sequence for science and engineering majors. The majority of faculty members teach between one and three courses per semester (though two is the normal load) so that they can have time to devote to their research. The major educational agenda item at these universities is the reform/redesign of the undergraduate calculus sequence; this is the one educational issue, outside of one's own teaching, that occupies a significant amount of faculty time. For example, at one university (PSU), approximately one-third of the faculty members spent an entire academic year, meeting bimonthly, to discuss, study, and plan for the revision of their calculus courses. Educational activities beyond the walls of the mathematics department, including teacher preparation, curriculum design, teacher in-service work, and statewide planning for the reform of mathematics instruction, are generally limited to a small percentage of the mathematics faculty. In the following section we provide a brief overview of the mission of the departments followed by a discussion of current educational activities. Where appropriate, we discuss MER's actual and potential relationship to these activities.

Departmental Mission

Typical of most state universities, the mathematics departments at the institutions we visited tried to balance their tripartite mission of research, teaching, and service. At these elite research institutions, teaching and research were the highest priority, while service to the non-university community appeared to be least important. Research at these institutions was clearly important to their reputation within the mathematics community and to help them attract graduate students. Because each of these universities had so many faculty members, there was not a distinct mathematical research identity associated with these institutions. However, certain groups at particular institutions, e.g., typology at UCSB, fluid dynamics at PSU, had particularly high status. Most faculty members perceived a strong emphasis on research productivity and quality in tenure and promotion decisions. The reputation for high quality mathematical research is central to the identities of these departments.

The teaching demand at these universities is distributed among courses for mathematics majors at the graduate and undergraduate levels, service courses -- particularly the calculus sequence -- for science and engineering majors, and mathematical content and methods courses for pre-service mathematics teachers. Some of the universities in the MER network offer "remedial" (i.e. high school-type mathematics classes), intermediate algebra, and pre-calculus courses and take this very seriously (i.e., Rutgers which offers a 2-semester sequence for returning adult students with particularly poor preparation or unfavorable prior experience in mathematics). Others do not offer these classes and there is still some debate about whether college mathematics departments should be offering any "pre-college" mathematics. UCSB for example, does not offer remedial courses but offers its students the option of enrolling in pre-calculus courses at Santa Barbara City College, just a few miles away from the UCSB campus.

All of the mathematics departments we studied were very involved in pre-service teacher preparation. As a baseline, all were responsible for mathematics content courses for mathematics majors, but moving further along the continuum, some mathematics departments taught the mathematics methods courses for elementary and secondary pre-service teachers, while at others (e.g., Penn State) there is an actual mathematics major for pre-service secondary mathematics teachers.

MER has held several workshops focused on issues about the undergraduate mathematics major. None of the schools we examined had a uni-dimensional conception of the mathematics major; all had several options available to students choosing to study mathematics. UT-Austin, for example, has both B.S. and B.A. options, with the B.S.

being the "traditional" mathematics curriculum and at Penn State there are seven different concentrations under the umbrella of mathematics major, including such areas as actuarial sciences, applied/industrial mathematics, secondary mathematics teacher preparation, and preparation for a graduate program in mathematics.

Most of the departments involved with MER -- and most mathematics departments in the country -- spend most of their teaching efforts helping to meet the mathematical needs of other university departments. For most social and life science majors, this usually translates into successful completion of the calculus sequence. Students in the physical sciences and engineering typically complete several more mathematical courses in addition to the calculus sequence. A relatively small percentage of students in lower compared to upper division classes are mathematics majors. Therefore, most mathematics departments serve the university by providing them with courses that serve as important foundations for their own majors. Investing the time and resources to reform these courses is an important contribution to the university.

Another aspect -- less popular among students -- of the way in which the mathematics department serves other departments is by helping to trim the number of majors in those departments. A few mathematicians recognized that calculus was not really necessary for undergraduate students in business, psychology, or even biology but they insisted on the calculus requirement because they knew that a large portion of students would fail and therefore be eliminated from some of these more popular majors. The mathematics professors with whom we spoke did not think this was the appropriate way for these other departments to handle their overcrowding, but they did not seem to mind the mathematics department's reputation for rigorous standards.

There does not appear to be a systematic effort to serve the non-mathematics community outside of the university. Individual faculty members at each institution serve local school districts, state initiatives, textbook selection committees, and mathematics clubs, but there are few institutional links --with the exception of State Systemic Initiatives -- between mathematics departments and the non-university community. However, there are several cases, where individual faculty members are supported by their departments in carrying out their community efforts. This is not to say they are relieved of their research and teaching expectations, but these outside efforts are at the least not discounted and, in some cases, they are valued for the publicity they bring to the university and the department.

Demographics

MER has collected a great deal of information that adequately describes the demographic characteristics of its member departments. Our intent is not to repeat that information here, but to briefly summarize certain key aspects.

Faculty of mathematics departments usually have an over-representation of white men. The departments in the MER Network, except for Howard University, do not depart from this typical pattern. However, several of the departments have worked hard to attract women to their faculty ranks, although women still only constitute 5-10% of the tenure-track faculty members in these departments and they make up 4-20% of the total full-time faculty. For the twelve departments for which we have data, women constitute an average of 10.5% of the full-time faculty which is essentially the same as the national average for Ph.D.- granting mathematics departments (Albers, Loftsgaarden, Rung, & Watkins, 1992).

These departments, and mathematics and science departments in general, have had a more difficult time increasing the percentage of minorities. There are still very few faculty members of color in any of these departments. However, many of the people we interviewed expressed concern about this pattern and were working to increase the numbers of minorities in their graduate student population with the hopes of eventually expanding the pool of minority faculty candidates.

Minorities and especially women are represented at a much higher rate among graduate students than they are among faculty. In most of the MER departments, females constituent approximately one-quarter to one-half of the graduate student population. People of color make up approximately 5% of the population of mathematics graduate students; this is still a very low percentage, but considerably higher than has been true in previous years (Oakes, 1991). Many of the MER departments indicated in documents submitted to MER that they have several specific strategies (e.g., contacts in departments around the country, alumni) to recruit talented female and minority candidates. Most of these department have upwards of one-hundred graduate students with an approximate average retention rate (completion of the Ph.D. / number of first year students) of 40-50%. Due in part to the culture of mathematics departments and because these schools are all considered top-notch institutions, the qualifying exams are a difficult hurdle for graduate students. These exams are an important factors in this retention rate, and according to many of the graduate students we interviewed, a major source of stress. The exams are certainly a factor in the recruitment procedures and policies. Several of the department chairs indicated that they do not want to admit students who cannot pass their exams. As

one chairman said when asked about recruitment policies for minorities, "we're just happy to find any American students who can pass our qualifying exams."

We found the highest level of minority and female participation at the undergraduate level. This attrition from the quantitative "pipeline" has been well documented in other places (Berryman, 1983; Oakes, 1990), but these departments have taken some very productive steps to attract and retain minority mathematics and science majors. Females typically represent one-third to one-half of the mathematics majors in these departments, while non-Asian minorities usually make up less than 20% of the students. In two of our sites with high Latino populations, Hispanic students constituted 12% of the mathematics majors at one institution and 19% at the other. These percentages are impressive because in both cases, Latinos have a higher representation as mathematics majors than they do in the undergraduate population in general. We discuss some of these efforts in more detail in our section on Minority Enhancement Programs. Mathematics departments have not been as successful attracting and retaining African American students, though it is not clear why. The departments in the MER network with the highest minority representation tend to be located in areas with relatively high Hispanic populations.

Prior and Current Educational Activities

All of the universities invited to join the departmental network had been engaged in a variety of educational activities prior to their association with the Forum; it was one of the reasons why they were invited to join in the first place. However, the amount and types of educational activities varies considerably. In the following pages we describe the major types of educational initiatives at these departments and the role that MER has played and might play in the future helping to sustain these efforts.

Undergraduate curriculum reform.

Undergraduate curriculum, including calculus reform is by far the most common mathematics education activity at these four universities. This is the case at all of the schools involved in the Departmental Network according to information gathered at the Santa Barbara (1995)workshop. The major reform efforts at these schools were the use of Harvard Calculus materials, interdisciplinary efforts, teaching excellence, and the incorporation of technology into the curriculum. In the following section, we elaborate on some of these reforms and describe how these departments' involvement with MER has contributed and can contribute to these efforts. Minority enhancement programs were in place at all of the institutions in the network, but because many of these programs serve both graduate and undergraduate students, they are described in a separate section.

Calculus reform. Experimentation with "reform" calculus, most often Harvard Calculus, and some of the concomitant structural changes, e.g., use of graphing calculators, smaller classes, has occurred at all four of the universities, to varying degrees. None of the departments have jumped completely into the Harvard model. Most have started with a few experimental sections and even those that have adopted the Harvard text for large portions of their calculus sequences have been forced to modify some of the structural changes, such as smaller classes, in order to work within university budgetary constraints. However, Penn State, for example, has a commitment to move all of their "mainstream" calculus courses to sections not larger than 35 students. In offering their retrospective opinions, the faculty at these institutions were divided in their initial and often continuing opinions of the Harvard Calculus model. Many said they appreciated the relevance to real world problems and the depth of coverage in certain areas, yet others appeared appalled by the exclusion of specific topics, "they don't even include coverage of the Central Limit Theorem!". Another common concern among faculty was that this curriculum required more "mathematical maturity" to teach than traditional calculus courses and they were concerned about their department's ability to properly staff these courses. These concerns were not taken lightly at any of these departments and at Penn State, for example, approximately one-third of the faculty members met bi-monthly for an entire year prior to deciding to adopt the Harvard text for the majority of their sections.

Not all institutions equate calculus reform with Harvard Calculus. For example, Rutgers faculty does not support the Harvard materials but supports cooperative learning pedagogy in calculus, another type of reform. The current large class sizes without any promise of an increase in resources for reducing class size is the primary concern at Rutgers. While all university departments are serious about "their content," these mathematics departments were admirably concerned about the quality and accuracy of the mathematics they were presenting to their students.

Considering that the departmental network is only 2 years old, it might be difficult to credit MER with moving these departments toward reform calculus. While many of these departmental efforts have been seemingly independent of MER, many individual faculty members had attended one of the calculus reform workshops hosted by MER and used this information to try to bring about changes at their own university. For instance, Ken Millett at UCSB and Jerry Bona at Penn State have been involved with MER for many years. The faculty at UCSB were in the midst of their Harvard Calculus "experiment" at the time when the first departmental network meeting was held and this workshop was an influential factor in moving the Harvard model to a wider audience. The department chair at UCSB, Mike Crandell, said that discussing the advantages and disadvantages of certain

mathematical reform issues with other chairs from influential mathematics departments gave him the sense that he was not isolated in these endeavors and that he could go back to his faculty and say, "well at Michigan, they're doing this." Another UCSB faculty member invited by his chair to attend the first departmental workshop was an admitted skeptic about mathematics reform and said that he appreciated that workshop presenters were not simply there pushing Harvard calculus. He said he appreciated the candor in their remarks and it made him feel that MER did not exist to simply push a single point of view. Information gathered at the departmental meeting in Santa Barbara revealed MER's influence in bringing about calculus reform in certain departments. For example, faculty from the University of Nebraska, whose chair -- Jim Lewis -- has been involved with MER for a long time, credited MER's influence as a factor in the strong department-wide support for reforming the calculus sequence. On the other hand, calculus reform is not a settled issue, for example, one faculty member said, "For a couple of years we adopted the Harvard Calculus but a counter revolution now has us on a two track program." MER, which according to many, presents a balanced view about calculus issues, will likely have to continue hosting workshops dealing with this pervasive concern.

Teaching excellence. The results of our survey of individual MER members revealed that MER was useful at providing information and resources for faculty members to improve their own teaching. MER, throughout the years, has incorporated many sessions in its workshops aimed toward improving teaching effectiveness so it is not surprising that the Santa Barbara departmental workshop included a session, "Policies and initiatives for promoting excellence in teaching." This type of session is an important complement to other efforts designed to improve individual teaching capabilities. Individual efforts will only go so far without departmental support. Issues discussed in this session summarized what individual departments and other organizations had been doing to try to gain a better understanding of effective teaching. They wanted to develop this understanding for use in peer evaluation and support and to develop policies supportive of teaching excellence. While the participants did not arrive at any firm conclusions, their collaboration provided them with more information than any individual department would have had without this meeting. They planned to continue these discussions via the internet. This is a good example of how work with department-level initiatives can foster some of the efforts aimed at individual mathematicians.

Use of technology. One pedagogical innovation occurring in many departments is the incorporation of technology into the mathematics curriculum. These include using graphing calculators, having students use mathematical software packages to solve problems, and having instructors use the software during their lectures to demonstrate the

mathematical concepts. Penn State has embraced the use of technology and constructed a "smart" classroom with a computer terminal built right into the lectern which is linked to a projection device. The instructor then uses statistical software to help demonstrate abstract concepts. Students are provided the opportunity to view dynamic images of a rotation, for example, rather than static overhead pictures. However, faculty members realized that only having students view the professor's use of the software was not enough so they obtained funds to construct computer laboratories where students can use Mathematica and/or Maple with their homework problems. To go even further, Penn State is now in the process of constructing a computer teaching laboratory where students and faculty can work on computers in the context of class. With this type of setting, traditional form of mathematics pedagogy will need to be altered to take advantage of the technological opportunities. The mathematics faculty have asked one of the math education faculty members and a graduate student to help implement a formative evaluation.

Many other departments use computer packages to help teach mathematical concepts and while all are not as fully integrated as Penn State's system, many are moving in that direction. For instance, Rutgers has integrated computer exercises into ordinary differential equations for engineers. Most departments are using graphing calculators in many of their mathematics courses, especially in the reformed calculus sequence. In fact, MER's department network is playing an important role in this regard. The University of Texas-Austin is using reports of the success of graphing calculators at other MER departments as evidence to leverage bring this technology into their own department. There appears to be some debate about the efficacy of technology for improving learning in mathematics. Some faculty members, though clearly a minority, felt that technology could be a crutch and students would not be able to develop their mathematical understanding, while the majority felt that technology allowed students to move into complex and realistic problems more quickly, thereby helping them to better develop their conceptual understanding. MER could provide a useful role by hosting sessions or even full workshops about the many issues (both policy and pedagogical) related to the incorporation of technology into the mathematics curriculum.

Interdisciplinary Programs. Development of interdisciplinary courses and programs appears to be a concern for members of the departmental network. Several sessions at the Santa Barbara workshop alone were devoted to interdisciplinary issues, particularly interdisciplinary programs with science and engineering departments. Faculty members were concerned about the need for mathematicians to stay involved in the mathematics teaching that occurs in other subjects, both because they care deeply about the quality of the mathematics taught and because of survival reasons.

The changes are coming whether we participate or not. For example, statistics is taught across the campus, but statisticians don't have the control. I'd like to see us retain our control over the mathematics (Stephen Dunbar, May 6, 1995).

This MER member suggested that mathematics is a "stealth subject" because it enters many subjects quietly and sometimes deeply. He suggested that mathematicians think of two components, vertical and horizontal. "Students should have a wide, broad base of many aspects of mathematics from which to draw" which is the horizontal aspect and the vertical component is that "some math will be learned deeply when the situation arises." However, this speaker stated that this type of mathematics learning might not take the shape of a typical semester-long course, rather "the math has to be delivered on a just-in-time basis."

Several of the institutions we studied had interdisciplinary programs or agreements in existence. In fact, Rutgers recently revised its objective for undergraduate education to focus on "a reorganization of how knowledge is covered, of how various knowledges are constructed and connected (Rutgers Committee on Undergraduate Curriculum, 1992)." Most often, these took the form of courses developed jointly or by one of the departments to serve the needs of both groups of students. These tended to be in the "applied" mathematics arena. For example, two faculty members at Penn State developed a course in symbolic manipulation that the physics department made a requirement before it was even taught. Few, if any, of these programs took the "just-in-time" approach, but they did appear to be effective initiatives at this time.

In spite of isolated programs at some of the universities, there does not appear to be a widespread use interdisciplinary approaches, in part because the logistics is often prohibitive. To help come to grips with some of these problems, MER hosted a work-session at the Santa Barbara conference that brought together faculty members from many of the institutions represented to try to conceptualize an NSF proposal for an interdisciplinary program across the various universities. Naomi Fisher, as MER's organizational representative was concerned with finding a way that MER could help promote interdisciplinary efforts within the mathematics community. The discussion among these faculty members, administrators, organizational representatives (AMS, NSF) was wide ranging and explored a wide variety of issue related to the logistics and conceptualization of ambitious project designed to foster interdisciplinary efforts at several universities. While no firm plans were penned at this meeting, many ideas were flushed out and plans to continue communicating were established. It is clear that this type of inter-

university effort would not have happened nearly as easily with MER's facilitation. Interdisciplinary efforts with education departments are discussed in a separate section later in this chapter.

Graduate Education reform

While many departments have been focusing on undergraduate issues, areas of concern about graduate mathematics education started to surface in the departmental network. In response to these needs, MER hosted its second departmental network, focused on issues of graduate education.

One of the driving forces behind the interest in graduate mathematics education is the dwindling number of jobs available for new Ph.D.'s, many of whom will have a very difficult time finding an academic job in a research institution -- the type of career for which they have been prepared. The shrinking job market will obviously lead to a reduction in the number of people interested in pursuing graduate degrees in mathematics, thereby reducing the "value" of these departments in the academy.

> *I'm talking about the horrible job market. We need to talk about this. We used to admit 27 Ph.D. students each year, now we only admit 6 or 7. We haven't done a very good job giving students and complete teaching experience (Stephen Greenfield, Rutgers University, May, 5, 1995).*

Many recent graduates have searched for postsecondary teaching positions, but have found that without teaching experience at the college level, they were unprepared to become viable candidates. As one faculty member from UCSB mentioned, "all of our students who have gone out for interviews have had to lecture to calculus classes." Many of the graduate students with whom we spoke have taken it upon themselves to try to become competitive for the limited jobs. They have tried to find teaching opportunities instead of just serving as teaching assistants so they could establish their own teaching record. However, a few institutions (e.g., Washington, Minnesota) offer courses or workshops focused on teaching issues. Rutgers already has a TA training program which provides ongoing mentoring during the graduate students' first semester of a teaching assignment. Other students have concentrated on publishing several mathematical articles before graduating to improve their record when searching for research positions. Finally, many of the students we interviewed were trying to do both, teach and publish before graduating to maximize their chances for career success. In the past, most faculty members at these Research-I institutions assumed their students, with a superior mathematics education and some research experience, would not have any trouble securing positions. While many faculty members continue to act as if that were still the case, all of the

departments in the MER network realize that special efforts are required to help their students become more marketable.

> *As others have mentioned, the failure of our graduate students to find jobs is causing us to re-think our graduate programs. It is hard to figure out how to gear our programs toward the future job market (Faculty member, University of Arizona).*

Much of the discussion among graduate students -- and MER should be complimented for inviting panels of graduate students -- and faculty at the Santa Barbara workshop centered around such changes in preparation as more opportunities to teach classes, offering a course/workshop in teaching methods, and helping graduate students start their own programs of research. Several schools have been making an effort to build up their applied mathematics programs -- an area traditionally seen with lower status than pure mathematics -- in an effort to increase their graduates' chances of finding jobs. Some schools (e.g., Penn State, U of Minn) even have started or plan to start a Master's program in applied mathematics to help fill this growing need. A faculty member from the University of Oklahoma mentioned that their graduates -- all of whom have had experience using technology in the classroom -- have been very successful in the job market.

Another component of the discussion among graduate students and faculty related to the value of and preparation for qualifying exams. "We think we're getting great information, but students don't seem to think they're getting anything out of it [the exams] (Harvey Keynes, May 5, 1995)." It appears that student feel that they are supported by their institutions (emotionally and financially) while they prepare for these exams and that many concerns seem to have been handled within individual departments. Larger issues related to the qualify exams were raised briefly. One faculty member at the Santa Barbara workshop suggested the group might examine core courses, "Are we just preparing students for the qualifying exams? Are they what we should be doing?" However, the few people who responded did not appear to understand the intent of this question. They focused on teaching style and background of the students in their responses, when the questioner (with whom this was later confirmed) was talking about the actual mathematics content. The issue of mathematics content represented on qualifying exams, which is somewhat related to the ideas about "just-in-time" mathematics and other issues about what content is important for math and other majors, could be an interesting workshop or series of sessions. It might also be interesting to have MER hold a series of discussions about the interaction of these exams (with a fixed standard for passing) with trying to provide more opportunities for traditionally underrepresented minorities in the pool of graduate students.

There were some immediate benefits for graduate students as a result of this workshops. Faculty members and graduate students do not often get the opportunities to

speak openly about policy issues related to graduate education. Faculty members appreciated hearing from graduate students and seeing them in this new light,

> *This session has really allowed grad students to show how articulate and thoughtful they were.*
>
> *I want to change the atmosphere in the graduate student body in our department. It was useful for me to hear what other departments do in their programs, but particularly useful to hear what the graduate students had to say.*

While this increased awareness is important, more tangible benefits resulted from an impromptu brainstorming period toward the end of one of the sessions. Faculty members started talking about the possibilities of having graduate students visit other nearby MER universities to give research presentations. This idea expanded to include graduate student exchanges (where a student would visit another university for a semester to take a series of courses). Another idea suggested related to the idea that many schools will find a way to employ their recent Ph.D.'s for a year or two if they have not found a job. Someone suggested these post-doctorates might increase their job prospects if they could work at another university in an adjunct role so that graduate of Penn State, for example, might spent a year at UT-Austin as an adjunct faculty member. This serendipitous discussion was evidence supporting the importance of face-to-face interaction at workshops for MER members.

Minority Enhancement Programs

All of the institutions we visited had special programs designed to enhance minority participation in mathematics, ranging from specially designed calculus courses to more elaborate programs for fostering minority participation from several avenues.

University of Texas-Austin and Rutgers University operate Treisman-type programs (Emerging Scholars Program and Project Excel, respectively) which are intended to retain math majors by helping them to succeed in their math courses. Rather than being remedial programs, these programs are presented as an honors course and only select students are invited to participate. These calculus intervention programs are designed to address the problem of minority students failure by easing minority students' transition into the academy. They provide an environment where African American, Latino, and Native American students are the majority and Whites are the minority. In this program, students attend three weekly two-hour study sessions with a T.A. present who assigns creative, real-world problems to groups of three or four students to solve. Central to the Emerging Scholars Program are the challenging material, many hours of study, and development of a community centered around shared intellectual interests and common professional goals.

Students in the UT-Austin felt that other "abstract" subjects like computer science or organic chemistry would benefit from similar intensive workshops. When asked what types of students would benefit, the students replied:

> *only dedicated students, not ones who just want to 'survive' calculus but those who want to learn! Also, [it] takes a lot of extra time -- it's hard work and maybe not very fun.*

Further, Emerging Scholars students felt that the benefits of the program included:

> **Building bonds with one another.*
> **Forming study groups outside of class for tests and stuff. Study groups in other classes are not as successful. Not forced to attend.*
> **Personal attention.*
> **Definitely did better last semester because of this program.*

At University of California-Santa Barbara there are several programs designed to foster minority participation in science and mathematics. Some of these programs are collaborative initiatives across several departments and colleges/universities, while others were started and are maintained in the mathematics department. Two faculty members (Ken Millett is the regional director) are very involved in UCSB's Cooperative Initiative with the California Alliance for Minority Participation in Science, Engineering, and Mathematics (CAMP) program, an NSF-funded project. The goal of this program is to double the number of minority students who successfully complete undergraduate studies with a bachelor of science degree. CAMP supports, among many other things, research internships for minority students, but in the mathematics department, the Math Achievement Program (MAP) is the most visible and expansive CAMP program. MAP was started to offer additional support for minorities in the calculus sequence. Using the Harvard Calculus curriculum, the MAP program provides students with an intensive recitation/workshop experience (90 minutes, 3 times/week) to supplement specific calculus courses. These workshops, limited to 20 students, are all held in the MAP classroom. Students are able to use this room for studying when other workshops are not in session. It was more comfortable than a traditional mathematics classroom; students worked at one of several large tables and there were several comfortable chairs around the outside of room. An advisors area was set off from the main classroom by low dividing wall. Students appeared to feel comfortable in this room and while it is an intangible variable, it is a likely factor in the positive outcomes of this program. Minorities were not required, but were "strongly encouraged" to attend. According to the faculty coordinators and an internal evaluation, this program has been fairly successful at helping minorities succeed in

calculus. This program uses the Harvard calculus approach and served as the pilot program for using Harvard calculus in most of the other sections.

There are several programs at UCSB to enhance minority participation in mathematics that are also K-12 outreach initiatives. For the most part, these projects are regional efforts in which faculty members from UCSB participate, and in some cases, direct. The Tri-County Mathematics Project (discussed under K-12 outreach efforts), the South Coast Mathematics Partnership, and the Mathematics Teaching Fellowship program are three such initiatives. The Teaching Fellow program, a joint effort between the Graduate School of Education and the Department of Mathematics, places minority undergraduate mathematics majors as interns in public schools with a "hand-picked" cooperating teacher. The major purpose is to recruit more minorities into the mathematics teaching profession with the intent that these well prepared teachers will teach in traditionally under-served areas of the state. This pre-credential experience also helps students get a sense if teaching is something they want to pursue. The goal of the "South Coast Mathematics Partnership (SCMP) is to improve teaching and learning, particularly for students of color" at K-16 levels of education. A major focus of this project has been the development of a summer mathematics program for high school students, their teachers, and undergraduates interested in teaching. Similar to the Teaching Fellow program, SCMP pairs minority undergraduate students to work with practicing teachers. Both the undergraduates and the teachers receive training in the use of the Interactive Mathematics Program (IMP) and then they (as a team) teach this material to high school students in a summer school program. Much of the efforts from this project are directed toward Oxnard County, a farming area with a very high percentage of minority students. This program, therefore, serves the needs of in-service teachers, pre-service teachers, and high school students.

At Penn State, most of the minority enhancement efforts are directed toward the calculus sequence. Henry McCoullum, an Associate Dean in the College of Science responsible for minority recruitment and retention, wanted to find a way to help minority students succeed in calculus. According to the Associate Dean, the mathematics department has been more willing than other College of Science departments to participate in efforts to retain minority students. Together with the Mathematics department, special small (approximately 30 students) sections were created where minority students were clustered. With the relatively low population of minorities at Penn State in general, there would be very few minorities in any given calculus section. It was felt that clustering minority students in a few sections might give them more opportunities to succeed because the environment would be safer for participation and forming study groups. According to the

Associate Dean, they selected a very highly regarded teacher with a commitment to the goals of the program to lead these sections. Similar to UCSB, they used the Harvard Calculus curriculum in these sections first prior to expanding them to the entire department. Further, because these original small sections were so effective for minority students, the mathematics department was able to secure additional resources from the central administration to teach all calculus courses in small sections.

K-12 Outreach by Mathematics Departments

There are many initiatives where members of the mathematics department take their expertise into local K-12 communities which generally can be classified into in-service teacher enhancement activities, curriculum design projects, and mathematics education policy work. At University of Texas-Austin, mathematics faculty and graduate students work with mathematics education faculty at the Regional Geometry Institute, a project for local high school teachers. This is a summer institute with year round follow-up and e-mail contacts for a group of about 15 teachers which has been in operation for at least five years. The teachers participating in this institute are very excited about it and feel very strongly that it is needed. Yet, none of the teachers, faculty or graduate students is involved with MER. In fact, one of the faculty members was familiar with MER and made it clear that this project is *not* a result of MER. This same university also houses The Dana Center from which the Statewide Systemic Initiative, as well as other projects, are directed by one of the math faculty members.

UCSB's Tri-County Mathematics Project, a branch of the California Mathematics Project, conducts professional development institutes for K-14 teachers aimed at implementing the California Mathematics Framework while meeting the needs of diverse learners. The South County Mathematics Partnership, discussed above, is also a professional development program for teachers focusing on helping teachers implement IMP. Julian Weissglasses' Equity in Mathematics Classroom project provides in-service training for diversity issues related to mathematics teaching and learning. These three projects have two common threads -- they intend to improve the mathematics content and pedagogical content knowledge of mathematics teachers while designing appropriate strategies for meeting the needs of diverse learners. Further, these projects have a well-developed network that draws on the expertise on a range of people including mathematicians, educators, policymakers, and community members.

Rutgers University has an interdisciplinary center for math, science and computer education which is directed by a math faculty member and a jointly appointed math, education, and physics faculty member. Many outreach projects with K-12 teachers

operate through this center, bringing together math faculty and local teachers. In addition, the Statewide Systemic Initiative is directed from this center.

At Penn State t.. re are essentially no outreach efforts with local K-12 schools. The only faculty member involved in these efforts left the university voluntarily last year.

Perhaps the most well known curriculum design project that serves to bring the expertise of university faculty members into K-12 settings is Phil Wagreich's Teaching of Integrated Math and Science (TIMS). This projects was originated prior to MER's existence, in fact, working with TIMS led Wagreich and others (Keynes) to write the first MER funding proposal. This project has evolved into an elementary science and mathematics text and will undoubtedly have far-reaching influence on elementary education.

Bridges Between Mathematics and Education Departments

Bridges between the mathematics and education departments exist to varying extents at all four universities. At one institution, a mathematics education faculty member has recently been invited to be a co-PI on a recently submitted educational technology grant for building a computer laboratory to teach computer-based mathematics classes. The mathematics education faculty member was invited to join the grant to be the evaluator of the learning processes and outcomes associated with teaching college mathematics using technology-based methods. Three departments teach the math content courses and, because teacher certification is a fifth year certificate at these schools, most secondary mathematics teachers received their B.S. or B.A. from the math department. These courses are taken seriously by math faculty; one assistant professor recently redesigned one of the courses for elementary teachers so that it follows the NCTM Standards. He is now planning to redesign the other required course for elementary teachers.

At another university, three of the mathematics faculty have close ties with education certification faculty, especially in terms of helping to recruit minorities into teaching. At this university, there are several programs designed to pair minority interns (undergraduate mathematics majors or recent graduates with a B.S. in mathematics who have indicated an interest in teaching) with experienced teachers. In one of these programs, the pairs work on developing plans to implement reform curricula, while in another program the intern is placed in the classroom of a "hand-picked" teacher to give them a good experience. These initiatives at UCSB are all accomplished with the collaboration of the Graduate School of Education as well as teachers and State Department of Education officials throughout the state.

University of Texas-Austin stands out among the others because they have two faculty members jointly appointed to both the mathematics and education departments. These faculty members have offices in each building and are the primary advisors for undergraduate math majors wanting to teach in K-12 schools. These professors teach math courses as well as education courses. These appointments have existed for many years. A second unique aspect of this site is that mathematics faculty, including the jointly appointed faculty but also others, frequently serve on education graduate students' dissertation committees. Certainly not all of the math faculty have acted in this capacity but there have been at least five. Lastly, this university has appointed a mathematics educator to their math faculty, not as a joint appointment but as a full math professor, a very unusual situation. Reportedly there were some political reasons for doing this such as the potential funding this person could bring to the university but this has had a significant positive impact on the department's image.

In terms of the MER Forum promoting the building of bridges between mathematics and education departments, it is not clear that MER has helped in this area yet at the departmental level. However, several of MER's recent teacher preparation workshops for individuals have attempted to foster connections among mathematicians, math educators, and K-12 teachers. It is not clear if building bridges between education and mathematics departments is a very high priority across these department, nor is it clear that these mathematics departments feel they have much to gain from close associations with education departments, except in the area of teacher preparation. However, several mathematics and mathematics education faculty members, individually, have suggested that it would be helpful if there were better connections between these two departments and that MER seems to be a likely candidate organization to help build these bridges.

In addition, the information from the Baton Rouge Workshop indicates that there may be some missed opportunities for thinking about building bridges between mathematics and education departments in the area of mathematics teacher education and educational reform in general. Mathematics educators in both mathematics and education departments, mathematicians, and K-12 teachers were all well-represented, yet the majority of people at this conference indicated that the mathematics and education departments at their universities do not have a very strong, if any, working relationship. Many participants suggested that MER could serve as a bridge between these two cultures.

Institutional Rewards for Math Education Reform Involvement

Many of the faculty members engaged in educational activities have chosen this path due to a personal commitment to improving undergraduate and, in fewer cases, K-12

education. For a few others, their interest in education is correlated with their declining research agenda and their sense of responsibility to be doing something important for the department. Faculty members who maintain an active mathematical research program while making significant contributions to educational issues are required to perform "double-duty." For example, I asked one faculty member who was especially active in teacher in-service work, considered an excellent teacher, but just received an fairly sizable NSF grant for mathematics research how he managed to do both. He said that he tries to block out certain days for just doing research. While he was still clearly respected by the rest of his department and the larger mathematics community, he admitted that he cannot possibly be as a productive of a researcher as he was before his involvement in educational issues, yet he felt that his creativity had improved. However, he deliberately chose to pursue his educational interests even if it meant slowing his progress toward full professor because he felt these interests were too important to ignore.

If a faculty member is not one of the rare people who can maintain an active mathematics research agenda while contributing to educational reform, they often pay a price in terms of a slower promotion rate. At all of the institutions we studied, perhaps one or two faculty members had been promoted to full professor largely as a result of their educational efforts. In these rare cases, it was difficult and required a longer time frame than is typical for such promotions. Often, it is not the "fault" of the mathematics department. They are responding to direct or indirect pressure from the College of Science (where most are housed) or from the larger university community. One long-time faculty member who had been promoted to full professor for her educational work said that if mathematics was in the College of Science when she first came up for tenure [at that time it was in Liberal Arts], she never would have been promoted.

It seems that "decent" teaching is a necessary but not sufficient condition for tenure and promotions at all four institutions. The Deans and Chairs say that teaching is part of the reward structure and that even faculty members with solid research productivity will not be granted tenure or promotion if their teaching is much below par. While adequate teaching is required for most faculty (there are still exceptional researchers who are promoted and tenured regardless of teaching capabilities), teaching alone will not get one promoted or tenured. The primary focus at these institutions is still research and they are very forthright about it. Each of the institutions believes it has made educational progress because now teaching is at least one component of such decisions. Many people with whom we spoke at the Santa Barbara workshop or during our site visits expressed hope that MER could help make educational efforts more acceptable throughout their departments and universities.

...However, there is potential for MER developing an effective database covering several campuses. MER may provide leverage for making math pedagogy more acceptable at research universities (UCSB faculty member, May 5, 1995).

Conclusions: MER's role in departmental education reform

The mathematics departments comprising MER's Departmental Network are engaged in a variety of educational activities, most of which are directed toward undergraduate issues, although there is an increasing emphasis on graduate education reform. When we first started this evaluation, we did not expect to find strong evidence of MER's impact on the educational activities in these departments because the Network was only one year old. For the most part, many of the educational initiatives described in this chapter were underway prior to the formation of the department network. However, the second departmental workshop (May, 1995) held in Santa Barbara demonstrated the potential for MER's role in facilitating departmental reform. In the following paragraphs we discuss some of the ways that MER has already helped and can continue to help bring about departmental reform. On the other side of the coin, we discuss some of the hurdles to MER's success. We do this with the intent that, if the Departmental Task Force and co-director agree with our findings, these can be addressed so that MER's departmental network may reach its full potential.

By including these thirteen departments as founding members, MER has gotten itself off to a good start. All of these departments are fairly involved in educational work and almost all have at least one faculty member with strong ties to MER, either as an Advisory Board Member, co-director, or participant in an individual workshop. These ties helped to give MER instant credibility in the department.

Beginning with my attendance at a MER meeting, I have been able to steer the Department through a number of difficulties that have arisen -- either because I understood the framework in which other people worked or I had gotten specific tips. The MER Network has been useful as a vehicle to explain my ideas on [minority] access and help expand the number of universities thinking and acting realistically on improving access (Raymond Johnson, Dept. Chair, University of Maryland, May 6, 1995).

MER's request that the department chair attend the first meeting was an important strategic move to help increase the likelihood of broad acceptance within the department. At Penn State University, this link was broken when the department chair and MER co-director took a position at another institution. He was the main tie to MER and it will be important for MER to foster that degree of loyalty in the current (interim) chair. Because of the extra

work required for the chair and major liaisons, there needs to be a fair amount of trust in MER to help sustain these efforts and believe they will be worthwhile. Penn State appears close to falling into this situation. In fact, they were the only department that did not send a team to the May, 1995 meeting in Santa Barbara.

Generally less than half of faculty members in each of the departments we visited had heard of MER and even fewer (less than one-quarter) understood the implications of their departments' relationship with the MER Forum. More frequently we heard comments such as, "oh that's the organization that Professor X is involved with." The degree of awareness and interest in MER is clearly variable across departments. The level of involvement appears related to the general interest in education throughout the department and the degree to which liaisons have attempted to spread the word throughout their faculty. Some departments specifically invited "cynics" to attend the departmental workshops to help provide more credibility/evidence for the efficacy of their departments' involvement when reporting back to their colleagues.

In addition to the yearly departmental workshops and MER newsletter, departmental members are all subscribed to an electronic mail listserver. The original plan was to have only a few faculty members subscribed from each department and then these individuals "moderate" the information and decide what to forward to their colleagues. This system has its merits especially because it prevents MER from being seen as too proselytizing and possibly sending too much mail to those not ready to participate. This is consistent with MER's general approach; they do not force educational ideas down people's throats, rather they serve as gentle prodders to help facilitate reform. However, we think it might be beneficial to open up the listserver to any individual in the departments with an interest in joining instead of limiting it to the appointed liaisons. As far as we can tell, there has not been a lot of traffic on this list (we've been subscribed since the end of 1994), so there does not seem to be too much danger of alienating people by flooding their e-mail boxes. This will also relieve the liaisons with some of the responsibility of having to decide who is interested in each message and forwarding it to them.

One finding from our departmental analysis was particularly striking. Pre-college mathematics educational activities rests on the shoulders of very few faculty members. While some of these departments were engaged in some very impressive K-12 reform efforts, they seemed somewhat precariously supported by a small fraction of the department and not by the departments as a whole. If these faculty members left their departments or decided not to continue with their efforts, these initiatives would likely falter. This scenario actually occurred at Penn State University as a result of the departure of David Bressoud. Whenever we asked about K-12 initiatives, people almost always told

us that "David used to do that" and they made it clear that nobody had continued with his efforts. Even at a school such as UCSB where three of 28 faculty members (a relatively high percentage) were responsible for essentially all of the important and impressive K-12 projects, it still seemed somewhat non-institutionalized.[10] Only at the University of Texas-Austin, with a mathematics educator on the faculty, did we feel that there was true institutional support. This is not to detract from the laudatory efforts of the mathematicians working on educational problems, but they are not rewarded nor expected to work on K-12 issues. Without these institutional supports, it is doubtful that these K-12 initiatives can become systemic.

The greatest strength of the departmental network is the quality of the workshops. While most participants were extremely positive about their experiences at individually-oriented workshops, the departmental workshops appear to offer even more opportunities for facilitating and sustaining educational reform. Department members were extremely positive about their experiences and we witnessed some spontaneous initiatives start as a result of the inter-departmental collaboration.

> *It looks like it [participation in the department network] will lead to graduate student exchanges, ancillary talks by grad students at research meetings, our sharing computer based projects we developed, with a return of others' efforts eventually perhaps (University of Nebraska faculty member, May 6, 1995).*

Simply bringing groups of like-minded mathematicians together might be beneficial, but MER deserves credit for structuring this workshop in a way that maximized the positive outcomes. Having an overarching theme to guide the workshop while scheduling breakout sessions to accommodate specific interests helped faculty members feel like they were gaining insights about topics important to their departments. The following quotes characterize this perspective:

> *As chair, this gives more ammo to get people to move and work so we don't get left in the dust. I am particularly interested in the [mathematics] major now.....*
> *Next step is to get MER "leaders", e.g., Nebraska, out here to meet the Department. Without MER, I wouldn't have a clue about Nebraska, Oklahoma State, and the sort of thing going on there (Mike Crandell, Dept Chair, UCSB, May 6, 1995)*

> *Innumerable instances of 'Oh yes, we have that problem too.' Also a couple of ideas that grew as they bounced (Virginia Warfield, University of Washington, May 6, 1995).*

[10]However, the departmental support is fairly strong due in part to the influence of MER, but also to the strong mathematical reputation of these two faculty members.

These types of insights might be able to occur in a non-face-to-face context, but it is unlikely. People grow to feel comfortable with one another relatively in personal setting especially with all of the informal contact time (e.g., meals) built into the schedule. Several noteworthy developments resulted from these "bouncing ideas" at the Santa Barbara workshop. Graduate and post-doctoral student exchanges and internships was an idea that emerged from this meeting and because so many department chairs were present and agreed with the suggestions, it appears that these ideas will come to fruition. Another idea that was brought to the meeting , but was discussed and elaborated in Santa Barbara was a departmental survey to provide comparative information for department chairs and others to use when trying to leverage more resources from the central administration. This could eventually lead to a database to help people find information quickly about specific issues. For example the concern expressed by the Penn State department chair could be addressed with a MER database:

> *Our math majors dropped in number from 303 in 1988 to 143 in 1994. I'd be real interested to hear how other institutions deal with this.*

Another area of reform that emerged from the departmental workshops (both Austin and Santa Barbara) were several collaborative projects between two or more departments. For example, the Universities of Nebraska and Oklahoma, as a result of their interactions at the first departmental meeting in Austin, collaborated on a planning grant to help infuse mathematical sciences across the undergraduate curriculum. Further, several institutions met at the Santa Barbara workshop to discuss plans for a substantial interdisciplinary initiative. This type of collaboration could occur without MER, but having an organization such as MER to facilitate these types of interactions helps speed the progress toward mathematics education reform.

References

Berryman, S. (1983). *Who will do science?* Washington, DC: The Rockefeller Foundation.

Oakes, J. (1990). Opportunities, achievement, and choice: Women and minority students in science and mathematics. *Review of Research in Education, 16*, 153-222. Washington: AERA.

Conclusions

Broad-based reform, called for in much educational rhetoric and encouraged by the national standards and assessment movement, probably will require the creation of professional communities with specific interests such as the MER Forum. If this occurs, then we must be able to address questions related to whether such professional networks are effective, how they work, and whether they contribute to systemic change. Systemic reform will require mathematicians and others to begin to adopt the attitude that changing your own practices is important but is not enough to change the entire system of mathematics education. We support MER in its efforts to bring about systemic change and hope that this organization will put even more effort into promoting participation in and acceptance of educational activities within university mathematics departments.

Initially we hoped to discover, through our interviews and following leads, recognizable paths from the voluntary network through several intermediaries to actual mathematics education reform activities. In some cases we found such paths, however, in most cases the paths were uncertain and landmarks unclear. Our ability to discover such associations between MER participants and educational activities limited our study. To compensate for a possible underestimation of MER's effects in this area, we purposefully selected these four case study sites because this is where we were most likely to find educational initiatives already in place. As a result, our analysis of MER's effect is a balanced one.

We expanded our conceptualization of the target group for interviewing and observations beyond participants to include non-participants associated through direct and indirect ways. Through in-depth interviews with a diverse group of department personnel we hoped to trace MER-generated ideas from the core group of MER participants to other faculty in university mathematics departments. We sought to find a way to detect subtle lines of communications among people so that the impact of the network could be reasonably assessed. In particular, we paid attention to uncovering and making explicit underlying communication patterns which involve the MER Forum.

Once we began looking for indirect MER influences instead of narrowly focusing on changes directly attributable to MER, we discovered several possible MER successes and failures which otherwise we might have missed. For example, we found that MER provided support to mathematicians interested in improving their own teaching, leadership to mathematics departments, and legitimization of educational interests. Although mathematicians generally could not attribute changes in their teaching directly to MER and

believed that these changes were inevitable, their comments suggest that these participants still attribute at least an indirect effect to MER.

Although the majority of MER's impact was reported to be on an individual level, to some extent MER also influenced broader levels of change, such as changes within mathematics departments. Since many institutions of higher education sought to improve the education they offer to undergraduates during this same time frame, it is difficult to attribute these changes in departmental attitudes solely to MER. These shifts are equally likely to be the result of external pressures on universities. Nonetheless, it appears that MER helped provide some leadership as mathematics departments have been called upon to address educational issues.

We looked to see whether institutional rewards had been changed at any of the universities associated with MER. In order for educational reform to become sustained in university mathematics departments, the typical reward structure of higher education institutions will have to support faculty members' participation in educational initiatives. At some departments we found institutional support for educational endeavors had expanded to include consideration of these activities in promotion and tenure decisions, release time for educational involvement, becoming more respectful of educational involvement and general administrative support.

Another strength of the Forum that emerged from this line of inquiry is the legitimization MER provides to mathematics education reform within the mathematics research community. It seems that providing a concrete example of what other mathematicians are doing in educational reform is valuable.

Our approach to the evaluation uncovered some negative attitudes toward MER as well. Some participants and non-participants felt that MER duplicated activities of the major professional organizations and most MER activities could be incorporated by them. Some participants commented that the benefits of the network could be realized over the Internet while others said the face-to-face interactions were crucial to successful networking and dissemination of ideas.

We return to our original evaluation questions and provide our evaluative conclusions:

1) How can we best portray MER's program?

Given the length of the report, we briefly repeat some of our key findings here and refer readers to Chapters 2, 4 and 5 for more detail. The Mathematicians and Education Reform Forum (MER) is a voluntary association targeting the academic mathematics community in four-year colleges and universities which promotes becoming involved in or deepening their involvement in mathematics education reform all educational levels. MER

is dedicated to facilitating the institutionalization of mathematics education reform within the mathematics community. Since its inception in 1988, MER has expanded from the original Network targeted toward individuals to also include a Departmental Network targeted at mathematics departments of research universities. MER's primary activities include hosting participant workshops approximately two times per year (a total of 18 to date), creating and distributing a twice-yearly newsletter, and sponsoring special sessions and a banquet at the Annual Joint Societies Meetings of the AMS and MAA. Presently, there are over 750 people on the MER Newsletter mailing list which, because the original Network does not have a formal membership, is the best indication of its size. A thirteen member Advisory Committee and an eleven member Task Force (which both include the four MER co-directors) direct the program.

Participants reported that MER's primary role is one of facilitator and supporter, rather than an initiator of new ideas. By helping to support mathematicians already involved in educational reform, MER functions by taking people where they are and facilitating their movement toward an increasingly sophisticated perspective on education. We have come to understand that MER functions as a support mechanism for those members of the mathematics community already involved in educational efforts and have incorporated this conception of "effective" into our evaluation.

2) Is the individual component of the MER Forum an effective means of mathematics education reform?

We conclude that the individual component of the Forum is successfully facilitating mathematicians' participation in undergraduate mathematics education reform and, to a lesser extent, in K-12 mathematics education reform. In general, MER acts as a support mechanism for those members of the mathematics community already involved in educational efforts and this is very valuable to MER participants.

Most participants reported that they valued MER workshops and felt these were the mechanisms responsible for changing their educational efforts. The workshops bring together mathematicians and mathematics educators with a wide range of experience and knowledge of educational issues. For the most part, participants indicated that the workshop experience helped validate many of the ideas they already had and/or that they learned a few new ideas that they expected to incorporate into their current or future activities. Workshop participants placed a premium on opportunities to interact with their colleagues and indicated that the face-to-face exchanges were the most valuable aspects of the workshop. Much of the information presented at workshops, for example introductions to the NCTM Standards and uses of cooperative learning, is not new in the

field of mathematics education. Although this was not "cutting edge" mathematics education, it was new information to many mathematicians and MER was responsible for introducing many of these educational ideas to the mathematics community.

3) Is the Departmental Network of the MER Forum an effective means of mathematics education reform?

The mathematics departments comprising MER's Departmental Network are engaged in a variety of educational activities, most of which are directed toward undergraduate issues, although there is an increasing emphasis on graduate education reform. For the most part, many of the departments' educational initiatives were underway prior to the formation of the department network. However, the second departmental workshop (May, 1995) held in Santa Barbara demonstrated the potential for MER's role in facilitating departmental reform.

All of these departments are involved in educational work and almost all have at least one faculty member with strong ties to MER, either as an Advisory Board Member, co-director, or participant in an individual workshop. These ties helped give MER instant credibility in the department. MER's request that the department chair attend the first meeting was an important strategic move to help increase the likelihood of broad acceptance within the department. Because of the extra work required for the chair and major liaisons, there needs to be a fair amount of trust in MER to help sustain these efforts and believe these efforts will be worthwhile.

Generally, less than half of faculty members in each of the departments we visited had heard of MER and even fewer (less than one-quarter) understood the implications of their departments' relationship with the MER Forum. More frequently we heard comments such as, "Oh, that's the organization that Professor X is involved with." The degree of awareness and interest in MER is clearly variable across departments. The level of involvement appears related to the general interest in education throughout the department and the degree to which liaisons have attempted to spread the word throughout their faculty. Some departments specifically invited "cynics" to attend the departmental workshops to help provide more credibility/evidence for the efficacy of their departments' involvement when reporting back to their colleagues.

One finding from our departmental analysis was particularly striking. Pre-college mathematics educational activities rests on the shoulders of very few faculty members. While some of these departments were engaged in some very impressive K-12 reform efforts, they seemed somewhat precariously supported by a small fraction of the department and not by the departments as a whole. If these faculty members left their

departments or decided not to continue with their efforts, these initiatives would likely falter. Even at a school such as UCSB, where three of 28 faculty members (a relatively high percentage) were responsible for essentially all of the important and impressive K-12 projects, it still seemed somewhat non-institutionalized. Only at the University of Texas-Austin, with a mathematics educator on the faculty, did we feel that there was true institutional support. This is not to detract from the laudatory efforts of the mathematicians working on educational problems, but they are not rewarded nor expected to work on K-12 issues. Without these institutional supports, it is doubtful that these K-12 initiatives can become systemic.

The greatest strength of the departmental network is the quality of the workshops. While most participants were extremely positive about their experiences at individually-oriented workshops, the departmental workshops appear to offer even more opportunities for facilitating and sustaining educational reform. Department members were extremely positive about their experiences and we witnessed some spontaneous initiatives start as a result of the inter-departmental collaboration. Simply bringing groups of like-minded mathematicians together might be beneficial, but MER deserves credit for structuring this workshop in a way that maximized the positive outcomes.

Having an overarching theme to guide the workshop while scheduling breakout sessions to accommodate specific interests helped faculty members feel like they were gaining insights about topics important to their departments. People grow to feel comfortable with one another in personal settings, particularly with all of the informal contact time (e.g., meals) MER builds into the schedule. Several noteworthy developments resulted from spontaneous exchanges at the Santa Barbara workshop. For example, one idea that emerged was that of providing internships and post-doctoral experiences for students and graduates of other universities -- a sort of "exchange program". Because so many department chairs were present, this idea could be responded to and discussed immediately. As a result, it appears that the exchange program will come to fruition.

Another area of reform that emerged from the departmental workshops (both Austin and Santa Barbara) were several collaborative projects between two or more departments. For example, the Universities of Nebraska and Oklahoma, as a result of their interactions at the first departmental meeting in Austin, collaborated on a planning grant to help infuse mathematical sciences across the undergraduate curriculum. Further, several institutions met at the Santa Barbara workshop to discuss plans for a substantial interdisciplinary initiative. This type of collaboration could occur without MER, but having an organization such as MER to facilitate these types of interactions helps speed the progress toward mathematics education reform.

4) Is MER an example of systemic reform?

Using Jenness' & Barley's definition of systemic reform (see chapter 4) to judge MER's effectiveness in influencing systemic change, we examined the extent to which MER encourages the development of new working relationships both within the mathematics community and among other related disciplines, and whether broad changes have occurred within the mathematics community in addition to local or individual types of change. We do not discount the local and individual changes that the Forum may facilitate and, in fact, have quite a bit to say about these positive changes on this level. However, individual changes, if they are expected to be a route to systemic change, would be a very slow route toward this end.

We found that when mathematicians are involved in educational reform activities, these activities tend to be personal, individual changes not associated with those of other mathematicians. The three most common types of individual changes were: (1) enhanced awareness of educational issues, (2) strengthened feelings of support, and (3) improved classroom pedagogy. While changes of a systemic nature were less prevalent, they did exist and seemed to revolve around friendlier attitudes toward educational activities within university math departments. Further, as the Network expands there might be a point in the near future where MER is influencing a critical mass of mathematicians. We think this support and facilitation of individuals is a crucial first step in helping to bring about systemic reform among a group of people used to acting on their own.

In contrast with the individual network, the departmental network appears to be a much quicker move toward systemic reform. By having a group of people from each department attend the workshops, participate on the listserver, and interact with other departments, it seems more likely that actual reforms will take hold. MER has involved the department chairs in each of the first two workshops and has even held sessions specifically for these administrators. This is an important factor in bringing about departmental changes especially compared to the individual network (even though many chairs are involved in this), because the key decision-makers are already on-board. With the support of the department chairs and key faculty members, it becomes easier to pressure the central administration to enact favorable policies or increase resources. The Santa Barbara workshop provided evidence of how departmental and inter-departmental initiatives can be planned and implemented if a critical mass of the department is already involved.

In conclusion, according to the criteria established earlier -- MER as a support mechanism for those members of the mathematics community already involved in educational efforts -- we believe MER is effectively facilitating mathematics education

reform among university mathematicians. MER has succeeded at a difficult task: an organization that is too prescriptive might alienate many potentially interested mathematicians, while an effort too *laissez faire* may accomplish very little. MER appears to walk this fine line with a good sense of balance, gently adding new ideas to the education agenda. We have noted that most individual and departmental MER participants, and MER as an organization, focus reform efforts at the postsecondary level in spite of the K-12 emphasis stated in some of the funding proposals. This focus on postsecondary mathematics education is the case of MER participants working in areas where they have the most expertise and the most to offer the mathematics education agenda. Improved coordination with mathematics educators and K-12 educational organizations will allow MER to coordinate its efforts with those occurring in pre-college mathematics. The efficacy of MER's workshops appears to cut across both the individual and departmental networks. Originally we had questions about the use of resources to support these events when other, more "financially efficient" mechanisms were available. After visiting workshops and interviewing participants, we began to get a sense of just how important the face-to-face contact was to these individuals. A recent Op-Ed article that appeared in the New York Times (Moss, 1996) after the blizzard that paralyzed the east coast accurately represents our views:

> *We are gregarious animals. We want to see what other people look like when we talk to them. Sometimes technology gives clues: we can sometimes tell when someone we're talking to on the phone is smiling. But in hallways we pick up nuances like eye contact, closeness or withdrawal.*
> ....
> *What will always be absent from cyberspace is space where we meet people we did not necessarily plan to meet. ... Perhaps new technology will strengthen our sense of physical presence in cyberspace. In the meantime, it is becoming more urgent for us to use the time we share in real space to create the equivalent of hallway conversations..... (p. A11):*

Our evidence suggests that MER, especially through their workshops, provides this shared space for hallway conversations about mathematical reform to occur.

References

Consortium for Policy Research in Education (May, 1995). *Reforming Science, mathematics, and technology education: NSF's statewide systemic initiatives.* New Brunswick, NJ: Author

Fisher, Naomi (1990a). Mathematicians working in precollege education. CBMS Issues in Mathe matics Education, volume 1, pp. 1-7.

Fisher, Naomi (1990b). The idea for a network for mathematicians working in precollege education. CBMS Issues in Mathematics Education, volume 1.

Fisher, Naomi (1991). Foreword. CBMS Issues in Mathematics Education. Volume 2. Washington, DC: American Mathematical Society. p. vii.

Hall, R. M. & Sandler, B. R. (1986). *The Campus climate revisited: chilly for women faculty, administrators, and graduate students : final report..* Washington, DC : Association of American Colleges : U.S. Dept. of Education, Office of Educational Research and Improvement.

Jenness, M. & Barley, Z. (1995). Using cluster evaluation in the context of science education reform. *New Directions for Program Evaluation*, no. 65, Spring, pp. 53-69.

Moss, R. (1996, January). No space like shared space. *The New York Times, 655*, 50307, A11. January 15, 1996.

Shadish, W., Cook, T. & Leviton, L. (1991). *Foundations of program evaluation: Theories of practice*. Sage: Newbury Park, CA..

Stake, R. E. (1993). Program evaluation, particularly responsive evaluation. In Madaus, G. & Stufflebeam, D. (Eds.) *Evaluation models: Viewpoints on educational and human services evaluation*. Boston: Kluwer-Nijhoff Publishers, pp. 287-310.

Appendix A
Supplemental Questions for MER Baton Rouge (11/94) Evaluation

The following questions are designed to supplement the end-of-workshop evaluation form that was included in your introductory packet. The questions included below are designed to gather information about you, as MER participants, in terms of your present and future educational activities and how the MER Network in general, and this workshop is related to those activities. For most of the question below, we ask for specific examples as part of your response; these examples are crucial to our understanding of your activities and of MER, in general, so please be as specific as possible with these example. Feel free to attach extra pages or use the backs if necessary. We will keep all responses completely confidential but we are asking for your name to allow us to link your responses to the MER end-of-workshop form and to your application materials to help provide us with a more complete understanding of MER and its participants.

Name _____ Institution _____

_____

Position/rank _____

1. What types of mathematics teacher preparation activities (e.g. pre-service or in-service math content or methods courses, curriculum development, outreach workshops) have you been involved with during the last two years at your university/college? Please provide as many specific examples as possible and group into the following categories

   K-12 education -- please indicate specific grade level(s) (includes outreach work in schools, curriculum development):

   Undergraduate level (includes pre-service education, designing undergraduate curricula):

   Graduate level:

   Other:

2. What other types (other than teacher preparation) of mathematics activities have you been involved with during the last two years at your university/college? Please provide as many specific examples as possible and group into the following categories.

   K-12 education (please indicate specific grade level(s):

   Undergraduate level:

   Graduate level:

   Other:

3. How do think the information presented at this MER workshop will enhance the mathematics education reform activities you are currently involved with? Please describe the way you foresee specific workshop information interacting with your current educational activities.

4. Can you think of any mathematics education reform topics that you would have like to had addressed at this workshop but were not? Please describe the types of topics you would have liked addressed.

5. Do you feel that the presenters, in general, modeled good pedagogy? Please describe what you considered examples of good and/or poor pedagogy.

6. What might you **do differently** as a result of the workshop in your teacher preparation activities during the (please provide specific examples):

   next month?

   next semester?

   next year?

7. What types of activities might you **continue with** as a result of the workshop in your teacher preparation program during the following time periods (i.e., what you learned in the workshop reinforced what you had been doing; please provide specific examples):

   next month?

   next semester?

   next year?

8. What might you do in terms of "spreading the word" at your mathematics department about math education reform upon your return (e.g., offering seminars, talking to colleagues, reporting to administrators)? Please be specific.

9. Does your department (or you specifically) have a working relationship with the education faculty at your institution? If yes, please describe briefly the extent of this relationship. If you are a mathematics educator in an education department, please describe your relationship with the mathematics department.

a. **If no,** have you received any information from this workshop that might help you make connections with the education (or mathematics) department upon your return? Please explain.

10. What beneficial aspects of the workshop could **only** be obtained by being physically present at the Baton Rouge gathering? That is, which aspects of the workshop would not have been as beneficial via some other mode of communication (written materials, telephone contact, video-tapes, etc.)?

11. Do you feel that there were any aspects of the workshop that you need **not** have been physically present to have benefited (e.g., you could have received the same understanding via written material, video, or some other medium)? Please explain why or why not.

Appendix B
Mailed Survey Instruments (3 versions)

MATHEMATICIANS, MATHEMATICAL SCIENTISTS AND MATHEMATICS EDUCATORS IN DEPARTMENTS OF MATHEMATICS/APPLIED MATHEMATICS/STATISTICS/COMPUTER SCIENCE

MER Forum Questionnaire

February, 1994

Please circle the following categories that apply to you.

1. What is your gender?

   Male 1
   Female 2

2. Please circle the classification that best describes your racial/ethnic descent.

   American Indian/Alaska native 1
   Asian/Pacific Islander 2
   White (Not Hispanic) 3
   Black (Not Hispanic) 4
   Hispanic 5

3. In what year where you born? 19____ (year)

4. How did you find out about MER?

   mailing from MER 1
   recommended/informed by colleagues 2
   MER newsletters 3
   posted announcements 4
   other (please specify: _____) 5

5a. Have you attended a MER banquet at the Joint Mathematics Meetings?

   yes 1
   no 2

5b. If yes, would you recommend the banquet to your colleagues?

   yes 1
   no 2

6a. Is the MER Forum newsletter helpful to you?

   yes 1
   no 2

6b. Which of the following sections of the MER newsletter do you find helpful (circle all that apply):

   information on basic MER activities 1
   feature articles regarding new and longstanding programs and projects 2
   essays on the current state and future of mathematics education 3
   information on MSEB 4
   other (please specify:_____) 5

7a. Are you aware of the MER publications in the CBMS Issues in Mathematics Education volumes?

   yes 1
   no 2

7b. Have you read any of these CBMS publications?

yes 1
no 2

8. Have you attended the MER special sessions at the Joint Mathematics Meetings?

yes 1
no 2

Please use the following scale to answer the next four questions:

1	*2*	*3*	*4*
not at all	*a little*	*considerably*	*extremely*

Circle the appropriate number in the chart below.

9. To what extent did the existence of the MER special sessions at the Joint Mathematics Meetings influence your decision to attend the Meetings?	1	2	3	4
10. To what extent did these MER special sessions influence your decision to attend a MER workshop?	1	2	3	4
11. To what extent were these special sessions useful to you? If you found them useful, please explain how they were useful: _____ _____ _____	1	2	3	4
12. To what extent are the CBMS Issues in Mathematics Education volumes useful to you? If you found them useful, please explain how they were useful: _____ _____ _____	1	2	3	4

13. Have you attended a MER workshop?

yes 1
no 2
(If no, please skip to question 16 on the following page.)

14. Which of the following MER workshops have you attended? *(Circle all that apply.)*

July 1988 at the University of Illinois (Chicago, IL) 1
May 1993 at UC Berkeley (Berkeley, CA) 2
July 1989 at the University of Minnesota (Minneapolis, MN) 3
March 1990 at Ohio State University (Columbus, OH) 4
June 1990 at Harvard University (Cambridge, MA) 5
March 1991 at University of Arizona (Tucson, AZ) 6
May/June 1991 at University of Washington (Seattle, WA) 7
March 1992 at UC Berkeley (Berkeley, CA) 8
July/Aug 1992 at Bowdoin College (Brunswick, ME) 9
November 1992 at Rutgers University (New Brunswick, NJ) 10
March 1993 at UC Berkeley (Berkeley, CA) 11
July/Aug 1993 at the University of Michigan (Ann Arbor, MI) 12
November 1993 at RPI (Troy, NY) 13
May 1994 at the University of Texas (Austin, TX) 14
November 1994 at Southern University (Baton Rouge, LA) 15

15. Why did you attend this/these MER workshop(s)? *(Check all that apply. If you have attended more than three workshops, answer for the first three only.)*

	Workshop: First	Second	Third
A colleague recommended that I attend.			
My department chair recommended that I attend.			
I was an invited speaker on the program.			
I was invited to make a small group presentation.			
I wanted to meet people who share my interests in **mathematics education reform.**			
I wanted to meet people who share my interests in **mathematics research.**			
I, personally, did not have to pay for the trip.			
I wanted to visit the city/university where the workshop was held.			
I wanted to meet the MER Co-directors and other leaders.			
I wanted to exchange ideas with professional peers.			
I was particularly interested in the theme of the workshop.			
Other (please describe): _____ _____			

16. What is the highest educational degree you hold?

Bachelor's (B.A./B.S., any field) 1
Master's 2
Ph.D. in Mathematics 3
Ph.D. in Math Education 4
Ph.D. in another field (please specify: _____) 5
Ed.D 6
Other (please specify: _____) 7

17. To which of the following mathematics, mathematics education, and education professional organizations do you belong?

AMS (American Mathematical Society) 1
MAA (Mathematical Association of America) 2
SIAM (Society of Industrial and Applied Mathematics) 3
AWM (Association for Women in Mathematics) 4
NCTM (National Council of Teachers of Mathematics) 5
AMATYC (American Mathematical Association of Two-Year Colleges) 6
AERA (American Educational Research Association) 7
Other (please list the mathematics, mathematics education or education organizations' full names and acronyms) 8

_____
_____

18. How many years have you been a faculty member at the school at which you presently work (including this year)?

_____ (total years)

19. How many years have you been a faculty member at other schools? _____ (total years)

Please use this four-point scale to indicate the extent of your agreement with the following statements:

1	*2*	*3*	*4*
Strongly Disagree	*Tend to Disagree*	*Tend to Agree*	*Strongly Agree*

Circle the number corresponding to the level of your agreement for each statement.

20. **I am more aware of the issues in math education reform as a result of the MER Forum.** If you circle 3 or 4, please give up to two specific examples of reform issues you are more aware of now than you were before your exposure to MER: 1)_____ _____ _____ 2)_____ _____ _____	1	2	3	4
21. **MER duplicates services provided by other organizations.** Please indicate what you consider to be the unique aspects of MER or the aspects duplicated by other organizations: _____ _____ _____ _____	1	2	3	4
22. **After participating in one MER workshop, I felt comfortable calling/contacting MER colleagues I had just met about professional matters.**	1	2	3	4

23a. I have changed my own teaching because I have been involved with MER. *(If you circle 1 or 2, skip to question 24; otherwise, continue.)*	1	2	3	4
23b. I feel I can attribute the impetus for these changes in my teaching to information in the MER newsletters, other MER publications, and/or continued networking with colleagues affiliated with MER.	1	2	3	4
23c. I feel I can attribute the impetus for these changes in my teaching to information and experiences at the MER workshop(s) I have attended.	1	2	3	4

Please provide two examples of changes in your classroom teaching:

1)_____

_____

_____

2)_____

_____

_____

24. Since your first MER workshop, how frequently have you contacted MER colleagues about:

(Please place an X in the appropriate box.)

	never	once	2 - 5 times	6 - 10 times	more than 10 times
a) personal teaching issues?					
b) mathematics education reform issues?					
c) mathematical research issues?					

25. Would you attend another MER Forum workshop if the topic were of interest to you and:

a) all expenses were paid?

yes 1
no 2

b) you had to pay for your own transportation and conference fee?

yes 1
no 2

c) you had to pay for all of your own expenses, including room and board?

yes 1
no 2

26. Please describe the two most vital reforms needed in mathematics education, in your opinion. (e.g., types of curriculum, pedagogy, or assessment improvements you feel are most important). If you need more space for your response, please attach an additional page to the end of the survey.

1) _____

2) _____

27. In your opinion, what is the most positive feature of the MER Forum?

28. If you could make <u>one</u> suggestion regarding how to improve MER, what would it be?

29. Has your association with the MER Forum been helpful to you in terms of furthering the goals of your own projects?

yes 1
no 2

If yes, please elaborate: _____

30. If you work in an academic institution, what is your present rank? (Fill in one only.)

Graduate student 1
Instructor 2
Lecturer 3
Senior Lecturer 4
Assistant Professor 5
Associate Professor 6
Professor 7
Other (please specify: _____) 8

31. If you work at an academic institution, have you hosted a workshop at your institution?

yes 1
no 2

32. What do you perceive as the benefits of and drawbacks to hosting a workshop? (If you have already been involved in hosting a workshop, please comment on how easy or difficult it was to work with MER in this way.)

33. Using the following scale, please indicate to what extent you have been involved with the following mathematics education reform activities during the past two years?

1 not at all *2 a little* *3 considerably* *4 very*

Circle the appropriate number in the chart below.

a) K-12 curriculum reform	1	2	3	4
b) Undergraduate curriculum reform	1	2	3	4
c) Increasing the participation of underrepresented minorities (not including women)	1	2	3	4
d) Increasing the participation of women	1	2	3	4
e) Undergraduate programs for math majors	1	2	3	4
f) Reform related to graduate mathematics education	1	2	3	4
g) Undergraduate remedial courses	1	2	3	4
h) Calculus reform	1	2	3	4
i) Undergraduate programs for pre-service teachers	1	2	3	4
j) Programs for in-service teachers	1	2	3	4
k) Involvement with specific groups of K-12 students (e.g., gifted & talented or special needs students)	1	2	3	4
l) Reform efforts at the school district level	1	2	3	4
m) Reform efforts from statewide initiatives	1	2	3	4
n) Other, please specify: _____	1	2	3	4

34. Briefly describe the type of mathematics education reform with which you are most involved. (Please attach an additional page if necessary.) _____

35. Please estimate the number of faculty in your department involved in the following activities:

	#
K-12 math education reform	____
Undergraduate math education reform (for both math and non-math majors)	____
Undergraduate teacher preparation reform	____
Graduate math education reform for math grad students	____
Graduate math education reform for math ed grad students	____
Teacher enhancement for in-service teachers	____
Research mathematics	____

36. What is the total number of faculty in your department? ____

37. How often do you formally or informally collaborate with educators in education departments on your own campus? *(Please circle appropriate number.)*

1	2	3	4	5
never	once per year	once or twice per semester	once or twice per month	more than twice per month

38. Using the following definitions, please divide your work time among these professional activities:

Teaching: Class preparation, scheduled classroom instruction, grading, advising and working with students.

Mathematics Research and Scholarship: Activity that leads to professional growth (library work, reading, exploratory inquiries, etc.) and/or a concrete product (an article, report, monograph, book, grant proposal, etc.).

Mathematics Education Reform Activities: Includes activities such as curriculum development, improvements in pedagogy, outreach to K-12 schools, and other reforms.

Service: Work in college/university meetings, community activities and professional association involvements.

Administration: Management activities at the department level.

Other: Special projects, etc..

	# of hours/week you spend on each activity, during a **typical** week	# of hours you believe your department prefers for promotion/tenure/merit raise decisions
Teaching	_____	_____
Mathematics Research/ Scholarship	_____	_____
Mathematics Education Reform Activities	_____	_____
Service	_____	_____
Administration	_____	_____
Other (please specify)	_____	_____

BEST COPY AVAILABLE

40. ***Please use this four-point scale to indicate the extent of your agreement with the following statements:***

1	*2*	*3*	*4*
Strongly Disagree	*Tend to Disagree*	*Tend to Agree*	*Strongly Agree*

Circle the number corresponding to the level of your agreement for each statement.

a. Involvement in mathematics education reform is highly valued in my department.	1	2	3	4
b. In my department, the atmosphere toward mathematics education reform is one of acceptance and support.	1	2	3	4
c. During the past five years, the atmosphere in my department toward mathematics education reform has changed, becoming more positive towards it. If you circle a 3 or 4 here, please provide two specific examples of recent departmental attitude changes toward mathematics education: 1. _____ _____ _____ 2. _____ _____ _____	1	2	3	4
d. During the past five years, new projects and programs related to mathematics education have been supported by my department. If you circle 3 or 4, please provide two specific examples of new educational projects or programs: 1. _____ _____ _____ _____ 2. _____ _____ _____	1	2	3	4
e. I usually consult literature in the field of educational research for information about mathematics education reform.	1	2	3	4
f. I usually consult mathematics educators (i.e., professionals in education) for research about mathematics education reform.	1	2	3	4

May we have your name, phone number and email address so that we may contact you if we have any questions or would like any further information about the MER Forum?

Name:_____ **Phone #:(___)**_____ **E-mail address:** _____

Thank you for your participation!
Please return this questionnaire in the stamped, self-addressed envelope provided

MATHEMATICS EDUCATORS IN EDUCATION DEPARTMENTS
MER Forum Questionnaire
February, 1994

Please circle the following categories that apply to you.

1. What is your gender?

Male 1
Female 2

2. Please circle the classification that best describes your racial/ethnic descent.

American Indian/Alaska native 1
Asian/Pacific Islander 2
White (Not Hispanic) 3
Black (Not Hispanic) 4
Hispanic 5

3. In what year where you born? 19____ (year)

4. How did you find out about MER?

mailing from MER 1
recommended/informed by colleagues 2
MER newsletters 3
posted announcements 4
other (please specify: _____) 5

5a. Have you attended a MER banquet at the Joint Mathematics Meetings?

yes 1
no 2

5b. If yes, would you recommend the banquet to your colleagues?

yes 1
no 2

6a. Is the MER Forum newsletter helpful to you?

yes 1
no 2

6b. Which of the following sections of the MER newsletter do you find helpful (circle all that apply):

information on basic MER activities 1
feature articles regarding new and longstanding programs and projects 2
essays on the current state and future of mathematics education 3
information on MSEB 4
other (please specify:_____) 5

7a. Are you aware of the MER publications in the CBMS Issues in Mathematics Education volumes?

yes 1
no 2

7b. Have you read any of these CBMS publications?

yes 1
no 2

8. Have you attended the MER special sessions at the Joint Mathematics Meetings?

yes 1
no 2

Please use the following scale to answer the next four questions:

1	*2*	*3*	*4*
not at all	*a little*	*considerably*	*extremely*

Circle the appropriate number in the chart below.

9. To what extent did the existence of the MER special sessions at the Joint Mathematics Meetings influence your decision to attend the Meetings?	1	2	3	4
10. To what extent did these MER special sessions influence your decision to attend a MER workshop?	1	2	3	4
11. To what extent were these special sessions useful to you? If you found them useful, please explain how they were useful: _____ _____ _____	1	2	3	4
12. To what extent are the CBMS Issues in Mathematics Education volumes useful to you? If you found them useful, please explain how they were useful: _____ _____ _____	1	2	3	4

13. Have you attended a MER workshop?

yes 1
no 2
(If no, please skip to question 16 on the following page.)

14. Which of the following MER workshops have you attended? *(Circle all that apply.)*

July 1988 at the University of Illinois (Chicago, IL) 1
May 1993 at UC Berkeley (Berkeley, CA) 2
July 1989 at the University of Minnesota (Minneapolis, MN) 3
March 1990 at Ohio State University (Columbus, OH) 4
June 1990 at Harvard University (Cambridge, MA) 5
March 1991 at University of Arizona (Tucson, AZ) 6
May/June 1991 at University of Washington (Seattle, WA) 7
March 1992 at UC Berkeley (Berkeley, CA) 8
July/Aug 1992 at Bowdoin College (Brunswick, ME) 9
November 1992 at Rutgers University (New Brunswick, NJ) 10
March 1993 at UC Berkeley (Berkeley, CA) 11
July/Aug 1993 at the University of Michigan (Ann Arbor, MI) 12
November 1993 at RPI (Troy, NY) 13
May 1994 at the University of Texas (Austin, TX) 14
November 1994 at Southern University (Baton Rouge, LA) 15

15. Why did you attend this/these MER workshop(s)? *(Check all that apply. If you have attended more than three workshops, answer for the first three only.)*

	Workshop: First	Second	Third
A colleague recommended that I attend.			
My department chair recommended that I attend.			
I was an invited speaker on the program.			
I was invited to make a small group presentation.			
I wanted to meet people who share my interests in **mathematics education reform.**			
I wanted to meet people who share my interests in **mathematics research.**			
I, personally, did not have to pay for the trip.			
I wanted to visit the city/university where the workshop was held.			
I wanted to meet the MER Co-directors and other leaders.			
I wanted to exchange ideas with professional peers.			
I was particularly interested in the theme of the workshop.			
Other (please describe): _____ _____			

16. What is the highest educational degree you hold?

Bachelor's (B.A./B.S., any field) 1
Master's 2
Ph.D. in Mathematics 3
Ph.D. in Math Education 4
Ph.D. in another field (please specify: _____) 5
Ed.D 6
Other (please specify: _____) 7

17. To which of the following mathematics, mathematics education, and education professional organizations do you belong?

AMS (American Mathematical Society) 1
MAA (Mathematical Association of America) 2
SIAM (Society of Industrial and Applied Mathematics) 3
AWM (Association for Women in Mathematics) 4
NCTM (National Council of Teachers of Mathematics) 5
AMATYC (American Mathematical Association of Two-Year Colleges) 6
AERA (American Educational Research Association) 7
Other (please list the mathematics, mathematics education or education organizations' full names and acronyms) 8

_____
_____

18. How many years have you been a faculty member at the school at which you presently work (including this year)?

_____ (total years)

19. How many years have you been a faculty member at other schools? _____ (total years)

Please use this four-point scale to indicate the extent of your agreement with the following statements:

1	*2*	*3*	*4*
Strongly Disagree	*Tend to Disagree*	*Tend to Agree*	*Strongly Agree*

Circle the number corresponding to the level of your agreement for each statement.

20. **I am more aware of the issues in math education reform as a result of the MER Forum.** If you circle 3 or 4, please give up to two specific examples of reform issues you are more aware of now than you were before your exposure to MER: 1)_____ _____ _____ 2)_____ _____ _____	1	2	3	4
21. **MER duplicates services provided by other organizations.** Please indicate what you consider to be the unique aspects of MER or the aspects duplicated by other organizations: _____ _____ _____ _____	1	2	3	4
22. **After participating in one MER workshop, I felt comfortable calling/contacting MER colleagues I had just met about professional matters.**	1	2	3	4

23a. **I have changed my own teaching because I have been involved with MER.** *(If you circle 1 or 2, skip to question 24; otherwise, continue.)*	1	2	3	4
23b. **I feel I can attribute the impetus for these changes in my teaching to information in the MER newsletters, other MER publications, and/or continued networking with colleagues affiliated with MER.**	1	2	3	4
23c. **I feel I can attribute the impetus for these changes in my teaching to information and experiences at the MER workshop(s) I have attended.**	1	2	3	4

Please provide two examples of changes in your classroom teaching:

1)_____

_____

_____

2)_____

_____

_____

24. Since your first MER workshop, how frequently have you contacted MER colleagues about:

(Please place an X in the appropriate box.)

	never	once	2 - 5 times	6 - 10 times	more than 10 times
a) personal teaching issues?					
b) mathematics education reform issues?					
c) mathematical research issues?					

25. Would you attend another MER Forum workshop if the topic were of interest to you and:

a) all expenses were paid?

yes 1
no 2

b) you had to pay for your own transportation and conference fee?

yes 1
no 2

c) you had to pay for all of your own expenses, including room and board?

yes 1
no 2

26. Please describe the two most vital reforms needed in mathematics education, in your opinion. (e.g., types of curriculum, pedagogy, or assessment improvements you feel are most important). If you need more space for your response, please attach an additional page to the end of the survey.

1) _____

2) _____

27. In your opinion, what is the most positive feature of the MER Forum?

28. If you could make <u>one</u> suggestion regarding how to improve MER, what would it be?

29. Has your association with the MER Forum been helpful to you in terms of furthering the goals of your own projects?

yes 1
no 2

If yes, please elaborate: _____

30. If you work in an academic institution, what is your present rank? (Fill in one only.)

Graduate student 1
Instructor 2
Lecturer 3
Senior Lecturer 4
Assistant Professor 5
Associate Professor 6
Professor 7
Other (please specify: _____) 8

31. If you work at an academic institution, have you hosted a workshop at your institution?

yes 1
no 2

32. What do you perceive as the benefits of and drawbacks to hosting a workshop? (If you have already been involved in hosting a workshop, please comment on how easy or difficult it was to work with MER in this way.)

_____

_____

_____

_____

_____

33. Using the following scale, please indicate to what extent you have been involved with the following mathematics education reform activities during the past two years?

1	*2*	*3*	*4*
not at all	*a little*	*considerably*	*very*

Circle the appropriate number in the chart below.

a) K-12 curriculum reform	1	2	3	4
b) Undergraduate curriculum reform	1	2	3	4
c) Increasing the participation of underrepresented minorities	1	2	3	4
d) Increasing the participation of women	1	2	3	4
e) Undergraduate programs for math majors	1	2	3	4
f) Reform related to graduate mathematics education	1	2	3	4
g) Undergraduate remedial courses	1	2	3	4
h) Calculus reform	1	2	3	4
i) Undergraduate programs for pre-service teachers	1	2	3	4
j) Programs for in-service teachers	1	2	3	4
k) Involvement with specific groups of K-12 students (e.g., gifted & talented or special needs students)	1	2	3	4
l) Reform efforts at the school district level	1	2	3	4
m) Reform efforts from statewide initiatives	1	2	3	4
n) Other, please specify: _____	1	2	3	4

34. Briefly describe the type of mathematics education reform with which you are most involved. (Attach an additional page if necessary.)

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

May we have your name, phone number and email address so that we may contact you if we have any questions or would like any further information about the MER Forum?

Name: _____ **Phone #:** (___)_____ **E-mail address:** _____

Thank you for your participation!

Please return this questionnaire in the stamped, self-addressed envelope provided.

K-12 TEACHERS
MER Forum Questionnaire
February, 1994

Please circle the following categories that apply to you.

1. What is your gender?

Male 1
Female 2

2. Please circle the classification that best describes your racial/ethnic descent.

American Indian/Alaska native 1
Asian/Pacific Islander 2
White (Not Hispanic) 3
Black (Not Hispanic) 4
Hispanic 5

3. In what year where you born? 19____ (year)

4. How did you find out about MER?

mailing from MER 1
recommended/informed by colleagues 2
MER newsletters 3
posted announcements 4
other (please specify: _____) 5

5a. Have you attended a MER banquet at the Joint Mathematics Meetings?

yes 1
no 2

5b. If yes, would you recommend the banquet to your colleagues?

yes 1
no 2

6a. Is the MER Forum newsletter helpful to you?

yes 1
no 2

6b. Which of the following sections of the MER newsletter do you find helpful (circle all that apply):

information on basic MER activities 1
feature articles regarding new and longstanding programs and projects 2
essays on the current state and future of mathematics education 3
information on MSEB 4
other (please specify:_____) 5

7a. Are you aware of the MER publications in the CBMS Issues in Mathematics Education volumes?

yes 1
no 2

7b. Have you read any of these CBMS publications?

yes 1
no 2

8. Have you attended the MER special sessions at the Joint Mathematics Meetings?

yes 1
no 2

Please use the following scale to answer the next four questions:

1	*2*	*3*	*4*
not at all	*a little*	*considerably*	*extremely*

Circle the appropriate number in the chart below.

9. To what extent did the existence of the MER special sessions at the Joint Mathematics Meetings influence your decision to attend the Meetings?	1	2	3	4
10. To what extent did these MER special sessions influence your decision to attend a MER workshop?	1	2	3	4
11. To what extent were these special sessions useful to you? If you found them useful, please explain how they were useful: _____ _____ _____	1	2	3	4
12. To what extent are the CBMS Issues in Mathematics Education volumes useful to you? If you found them useful, please explain how they were useful: _____ _____ _____	1	2	3	4

13. Have you attended a MER workshop?

yes 1
no 2
(If no, please skip to question 16 on the following page.)

14. Which of the following MER workshops have you attended? *(Circle all that apply.)*

July 1988 at the University of Illinois (Chicago, IL) 1
May 1993 at UC Berkeley (Berkeley, CA) 2
July 1989 at the University of Minnesota (Minneapolis, MN) 3
March 1990 at Ohio State University (Columbus, OH) 4
June 1990 at Harvard University (Cambridge, MA) 5
March 1991 at University of Arizona (Tucson, AZ) 6
May/June 1991 at University of Washington (Seattle, WA) 7
March 1992 at UC Berkeley (Berkeley, CA) 8
July/Aug 1992 at Bowdoin College (Brunswick, ME) 9
November 1992 at Rutgers University (New Brunswick, NJ) 10
March 1993 at UC Berkeley (Berkeley, CA) 11
July/Aug 1993 at the University of Michigan (Ann Arbor, MI) 12
November 1993 at RPI (Troy, NY) 13
May 1994 at the University of Texas (Austin, TX) 14

November 1994 at Southern University (Baton Rouge, LA) 15

15. Why did you attend this/these MER workshop(s)? *(Check all that apply. If you have attended more than three workshops, answer for the first three only.)*

	Workshop: First	Second	Third
A colleague recommended that I attend.			
My department chair recommended that I attend.			
I was an invited speaker on the program.			
I was invited to make a small group presentation.			
I wanted to meet people who share my interests in **mathematics education reform.**			
I wanted to meet people who share my interests in **mathematics research.**			
I, personally, did not have to pay for the trip.			
I wanted to visit the city/university where the workshop was held.			
I wanted to meet the MER Co-directors and other leaders.			
I wanted to exchange ideas with professional peers.			
I was particularly interested in the theme of the workshop.			
Other (please describe): _____ _____			

16. What is the highest educational degree you hold?

Bachelor's (B.A./B.S., any field) 1
Master's 2
Ph.D. in Mathematics 3
Ph.D. in Math Education 4
Ph.D. in another field (please specify: _____) 5
Ed.D 6
Other (please specify: _____) 7

17. To which of the following mathematics, mathematics education, and education professional organizations do you belong?

AMS (American Mathematical Society) 1
MAA (Mathematical Association of America) 2
SIAM (Society of Industrial and Applied Mathematics) 3
AWM (Association for Women in Mathematics) 4
NCTM (National Council of Teachers of Mathematics) 5
AMATYC (American Mathematical Association of Two-Year Colleges) 6
AERA (American Educational Research Association) 7
Other (please list the mathematics, mathematics education or education organizations' full names and acronyms) 8

_____
_____

18. How many years have you been a faculty member at the school at which you presently work (including this year)?

_____ (total years)

19. How many years have you been a faculty member at other schools? _____ (total years)

Please use this four-point scale to indicate the extent of your agreement with the following statements:

1	*2*	*3*	*4*
Strongly Disagree	*Tend to Disagree*	*Tend to Agree*	*Strongly Agree*

Circle the number corresponding to the level of your agreement for each statement.

20. **I am more aware of the issues in math education reform as a result of the MER Forum.** If you circle 3 or 4, please give up to two specific examples of reform issues you are more aware of now than you were before your exposure to MER: 1)_____ _____ _____ 2)_____ _____ _____	1	2	3	4
21. **MER duplicates services provided by other organizations.** Please indicate what you consider to be the unique aspects of MER or the aspects duplicated by other organizations: _____ _____ _____ _____	1	2	3	4
22. **After participating in one MER workshop, I felt comfortable calling/contacting MER colleagues I had just met about professional matters.**	1	2	3	4

23a. **I have changed my own teaching because I have been involved with MER.** *(If you circle 1 or 2, skip to question 24; otherwise, continue.)*	1	2	3	4
23b. **I feel I can attribute the impetus for these changes in my teaching to information in the MER newsletters, other MER publications, and/or continued networking with colleagues affiliated with MER.**	1	2	3	4
23c. **I feel I can attribute the impetus for these changes in my teaching to information and experiences at the MER workshop(s) I have attended.**	1	2	3	4

Please provide two examples of changes in your classroom teaching:

1)_____

_____

_____

2)_____

_____

_____

24. Since your first MER workshop, how frequently have you contacted MER colleagues about:

(Please place an X in the appropriate box.)

	never	once	2 - 5 times	6 - 10 times	more than 10 times
a) personal teaching issues?					
b) mathematics education reform issues?					
c) mathematical research issues?					

25. Would you attend another MER Forum workshop if the topic were of interest to you and:

a) all expenses were paid?

yes 1
no 2

b) you had to pay for your own transportation and conference fee?

yes 1
no 2

c) you had to pay for all of your own expenses, including room and board?

yes 1
no 2

26. Please describe the two most vital reforms needed in mathematics education, in your opinion. (e.g., types of curriculum, pedagogy, or assessment improvements you feel are most important). If you need more space for your response, please attach an additional page to the end of the survey.

1) _____

2) _____

27. In your opinion, what is the most positive feature of the MER Forum?

28. If you could make <u>one</u> suggestion regarding how to improve MER, what would it be?

29. Has your association with the MER Forum been helpful to you in terms of furthering the goals of your own projects?

yes 1
no 2

If yes, please elaborate: _____

30. To what extent can you attribute your involvement in mathematics education reform activities at any educational level to your involvement with MER? *(Please circle the appropriate number.)*

1	2	3	4
not at all	a little	a considerable amount	very much

Please explain: _____

31. Please describe the types of K-12 mathematics education reform activities which you have been involved with during the past two years. (Attach an additional page if necessary.)

32. Please describe the types of undergraduate and/or graduate mathematics reform activities which you have been involved with during the past two years. (Attach an additional page if necessary.)

May we have your name, phone number and email address so that we may contact you if we have any questions or would like any further information about the MER Forum?

Name: _____

Phone number: (____)_____ **E-mail address:** _____

Thank you for your participation!
Please return this questionnaire in the stamped, self-addressed envelope provided.

BEST COPY AVAILABLE