INVESTING IN TOMORROW’S TEACHERS: THE INTEGRAL ROLE OF THE TWO-YEAR COLLEGE IN THE SCIENCE AND MATHEMATICS PREPARATION OF PROSPECTIVE TEACHERS

STEERING COMMITTEE REPORT TO THE NATIONAL SCIENCE FOUNDATION

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SUMMARY

The workshop Investing in Tomorrow’s Teachers: The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers was held in Washington, DC on March 12 – 14, 1998. Eleven exemplary two-year college programs chosen in a national competition were highlighted at the conference. Over 100 individuals participated, including faculty and administrators from two-year colleges already engaged in exemplary activities in teacher preparation; faculty and administrators from science, mathematics, and education departments in two- and four-year colleges who have

responsibility for the various components of teacher preparation; representatives from national disciplinary professional societies and organizations specifically devoted to the preparation of teachers; and current preK-12 teachers and pre-service teachers from two-year colleges. Participants considered the role of two year colleges in the preparation of teachers and then developed a set of recommended actions.

Current Role

It has become increasingly apparent that the resources of the nation’s community colleges must be utilized fully if the need for a teaching force well prepared in science, mathematics, engineering, and technology (SMET) is to be met. Generally, neither two-year colleges, nor the four-year institutions where teachers complete their preparation, nor the schools that hire teachers fully recognize the essential role of two-year colleges in teacher preparation. In many ways, the preparation of teachers is a hidden mission of two-year colleges. Many future elementary and middle school teachers are taking most, if not all, of their college-level science and mathematics courses at two-year colleges. Equally important is the potential for each of the nation’s two-year college to provide active leadership in recruiting the next generation of elementary and secondary school teachers. Two-year colleges, with their orientation towards teaching and their strategic locations, are in a pivotal position to recruit and help prepare the next generation of science and mathematics teachers as well as give students preparing to teach in the elementary grades a strong grounding in science, mathematics, and technology.

Recommended Actions

Recommendations for action were developed in the following areas:

- recruitment of prospective teachers;
- strengthening undergraduate science, mathematics, engineering, and technology courses;
- pre-teaching experiences;
- in-service activities;
- liaisons between two-year colleges and four-year institutions; and
- connections with business and industry, professional societies, and other organizations.

The recommendations, detailed in this report and summarized below, address actions two-year
colleges can undertake by themselves and in partnership with four year colleges or professional societies.

Two-year colleges should:

- Recruit and attract the best students to the teaching of science, mathematics, engineering, and technology.
- Actively involve SMET faculty and administrators in institution-wide recruitment of prospective teachers through such activities as visiting area high schools in coordination with guidance counselors or participating in on-campus visitation days for prospective students.
- Include teacher preparation efforts into the colleges’ mission and strategic plans.
- Provide meaningful and frequent professional development in SMET both within and across disciplines for full-time and adjunct faculty.
- Offer continuing education programs for teachers as a regular component of workforce training initiatives to meet the needs of regional employers.

Two-year colleges should collaborate with four-year colleges and universities and school systems to:

- Coordinate student advising for prospective teachers between two-year and four-year institutions concerning the transfer of courses, financial support, and program requirements.
- Eliminate the barriers of course transferability by articulating transfer agreements between two-year colleges and four-year institutions that are mutually established through open communication concerning specific course content and expectations.
- Design and implement high-quality science, mathematics, and technology curricula.
- Engage potential teachers in preK-12 tutoring, mentoring, and enrichment programs in SMET fields.
- Cooperate with local school districts and institutions such as science museums and mathematics and science centers to provide SMET pre-teaching experiences for two-year college students.
- Engage potential teachers as teaching assistants in inquiry-based SMET classroom and laboratory settings and in testing and evaluation.
- Engage professionals in the community from business and industry to provide students and
faculty in two-year colleges with information and perspective about how science, mathematics, and technology are applicable to teaching and other career tracks.

- Promote joint professional education activities involving student groups between two-year colleges and four-year institutions.
- Work with local school systems and state policy officials to establish stronger teacher certification standards.

Professional societies should work with two-year colleges to:

- Highlight the roles of two-year colleges in the science and mathematics preparation of future teachers.
- Seek students from two-year colleges for membership and welcome as members two-year college students who wish to pursue careers as teachers.

Implementation of the recommendations of this report requires all groups involved in the preparation of teachers to take a more proactive role than in the past. Two-year colleges must plan and work cooperatively with four-year colleges and universities, school systems, professional societies, business and industry, state, local, and national government agencies, and with each other. No one group can do it alone. All must cooperate. With support from the National Science Foundation and others who share this vision, two-year colleges can help our nation produce a teaching workforce highly qualified in science, mathematics, and technology.

INTRODUCTION

In order to better understand and increase the awareness of the role of two-year colleges, a major resource in teacher preparation, the Division of Undergraduate Education of the National Science Foundation (NSF) convened a national conference *The Integral Role of the Two-Year College in the Science and Mathematics Preparation of Prospective Teachers* in Washington, DC on March 12 – 14, 1998. Eleven exemplary two-year college programs chosen in a national competition were highlighted at the conference. In introducing them, the NSF's director, Dr. Neal Lane, remarked:

*The exemplary activities being showcased here accomplish the best of all possible*
educational objectives. They equip students with skills that enable them to step directly into today's technological workforce. They also provide the broader opportunities to learn mathematics and science and to practice habits of mind and problem solving techniques that will serve students well if they are called to teaching or other careers.

At the conference, science and mathematics faculty, presidents, and other administrators from these eleven colleges joined other national leaders to assess successful two-year college teacher preparation approaches underway and to develop specific recommendations concerning how two-year colleges can better help to meet the national need for well-prepared teachers of science, mathematics, and technology. This role of helping to prepare future teachers was recognized as consistent with the community based and student centered missions articulated by two-year colleges. Yet, the role of two-year colleges in teacher preparation has often gone unrecognized. In many ways, the preparation of teachers is a hidden mission of two-year colleges.

Over 100 individuals participated, including:

- faculty and administrators from eleven two-year colleges who are among those already engaged in exemplary activities in teacher preparation;
- faculty and administrators from science, mathematics, and education departments in two- and four-year colleges who have responsibility for various components of teacher preparation;
- representatives from national disciplinary professional societies and from organizations specifically devoted to the preparation of teachers; and
- current preK-12 teachers and pre-service teachers from two-year colleges.

Participants developed detailed recommendations concerning the role of two-year colleges in the following areas:

- recruitment of prospective teachers;
- strengthening undergraduate science, mathematics, engineering, and technology courses;
- pre-teaching experiences;
- in-service activities;
liaisons between two-year colleges and four-year institutions; and
connections with business and industry, professional societies, and other organizations.

Subsequent sections of this report lay out the conference's specific recommendations articulating how two-year colleges can move individually and collectively to ensure that all involved in the science, mathematics, and technology preparation of prospective teachers recognize the crucial role of two-year colleges and that two-year colleges with their partners develop programs that meet the national need for well-qualified teachers.

BACKGROUND

The science, mathematics, and technology preparation of the next generation of teachers is critical to the social and economic future of the nation. Demographics indicate that the nation's colleges and universities must begin to produce many more teachers than they are currently producing. There is an even greater need for teachers willing and prepared to teach in the inner cities, in remote rural areas, and in schools with large minority populations and for mathematics and science teachers in all regions. The performance of United States students on international tests suggests that it is no longer acceptable to put into classrooms large numbers of middle and high school science and mathematics teachers who have neither majored nor minored in mathematical or scientific disciplines. Nor is it acceptable to hire elementary school teachers with inadequate preparation in science and mathematics.

Historically, teacher preparation has been considered the province of a small number of four-year colleges and universities. While two-year colleges have always played an unrecognized role in teacher preparation, with support from NSF and their communities, two-year colleges are beginning to take more active leadership roles in undergraduate science, mathematics, engineering, and technology (SMET) instruction, and in particular in the science and mathematics courses taken by future teachers. Currently, two-year colleges enroll nearly half of all United States undergraduates and over one-third of all students taking science, mathematics, and engineering and technology (SMET) courses. In increasing numbers, two-year colleges are recruiting more future teachers, providing them with stronger mathematical and scientific preparation, and utilizing their college resources to meet the challenges facing
elementary and secondary education. According to Luther Williams, NSF’s Assistant Director for Education and Human Resources,

The resources of the nation’s community colleges must be utilized fully if the need for a teaching force well prepared in science, mathematics, engineering, and technology is to be met.

THE NEED

The number of new teachers that will be needed within the next decade is daunting. The U.S. Department of Education predicts that 40% of current public school teachers will retire or leave the profession by the 2003-4 school year. At the same time, school enrollments are rising dramatically. In the next ten years, America will need to hire two million new teachers to replace the generation of teachers about to retire and to keep up with rising enrollments. The NSF report Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology (NSF 96-139), as well as many other studies, have made a persuasive case that America’s future teachers require stronger backgrounds in science, mathematics, and technology. The number of teachers essential for a strong school system becomes even greater as additional states legislate limits on class sizes.

In many parts of the country, a large percentage of elementary and middle school science and mathematics classrooms are currently being staffed by teachers with little or no college-level training in science or mathematics. In his address The State of Mathematics Education: Building a Strong Foundation for the 21st Century on January 9, 1998 at the annual joint meeting of the American Mathematical Society and the Mathematical Association of America, U.S. Secretary of Education Richard Riley lamented:

Presently, 28 percent of high school math teachers do not have a major or minor in mathematics. The average K-8 teacher takes three or fewer mathematics or mathematics education courses in college. Furthermore, fewer than one-half of 8th grade mathematics teachers have ever taken a course in the teaching of mathematics at this level. Equally distressing, the teacher qualifications are even lower in low income and minority schools. We must do better.
Secretary Riley also noted that 18 percent of high school science teachers neither majored nor minored in science. In the physical sciences, where 12th grade student performance lags the most in international assessments, almost half of American students are taught by teachers without a major or minor in that field.

The recently released reports of the Third International Mathematics and Science Study (TIMSS) reveal that U.S. students are less successful than their counterparts in other nations as they progress through the various grade levels. Although students in elementary grades at least match international averages in the TIMSS, the performance of high school seniors is almost last in both mathematics and science. The reasons for this poor level of performance are complicated, but significant improvement would be encouraged by a teaching corps that is well prepared in both content and pedagogy of science, mathematics and technology.

Many new teachers must be encouraged, willing, and prepared to teach in the inner cities, in remote rural areas, and in schools with large minority populations. In July of 1997, President Clinton also called attention to the need for well-trained college graduates to enter the teaching profession and, in particular, to the critical need for teachers who can serve as role models for inner-city students.

ROLE OF TWO-YEAR COLLEGES

According to data gathered by the American Association of Community Colleges (AACC), the more than 1,100 two-year colleges across the country currently enroll about 45% of all U.S. undergraduates, with more than 5 million students in credit classes (1997 AACC Facts, 1997). In the fall of 1992, two-year institutions accounted for over 40% of all undergraduate science, mathematics, engineering, and technology courses and 34% of all undergraduate SMET course enrollments (Shaping the Future). While precise data do not exist, it is estimated that more than 40% of teachers completed some of their science and mathematics course work at two-year colleges. Indeed, many future elementary and middle school teachers are taking most, if not all, of their college-level science and mathematics courses at two-year colleges.
Generally, neither two-year colleges, nor the four-year institutions where teachers complete their preparation, nor the schools that hire them fully recognize the essential role of two-year colleges in teacher preparation. The fact that two-year colleges are already heavily engaged in the mathematical and scientific preparation of teachers is one reason to recognize more prominently this priority of two-year schools. However, an equally important reason is the opportunity of each two-year college in the nation to make important contributions to recruiting and training the next generation of elementary and secondary school teachers. Because excellent instruction is the primary focus at two-year colleges, their faculty members are well positioned to provide leadership in the quality of instruction in mathematics and science. Furthermore, two-year colleges are often located in regions directly serving rural and urban communities where new teachers will be needed most. Thus, two-year colleges, with their orientation towards teaching and their strategic locations, are in a pivotal position to recruit and help prepare the next generation of science and mathematics teachers as well as give students preparing to teach in the elementary grades a strong grounding in science, mathematics, and technology.

RECRUITMENT OF PROSPECTIVE TEACHERS

Two-year colleges play a critical role in attracting people with a high potential for becoming excellent teachers. These institutions are strategically positioned in urban and rural regions, enroll a large proportion of the nation’s minority college students, and welcome returning adults. Given this large and diverse student body, the nation benefits to the extent that the most talented in this large student population consider teaching as a career option.

In an effort to expand the pool of prospective teachers and to improve the academic preparation of teachers in SMET, two-year colleges must identify, attract, nurture, and guide individuals from within their student population who have the potential to become excellent teachers. Recruitment and encouragement of prospective future teachers at two-year colleges should be undertaken as a comprehensive, coordinated effort, tied directly to the institution’s long-term strategic plan. State policies and structures should be reevaluated to ensure that they do not hinder efforts to recruit new teachers. Most importantly, SMET college faculty and advisors must heighten respect for the teaching profession as a worthy career for outstanding students.
Recognizing that they have a major role to play in the recruitment of students into careers in teaching, two-year colleges should:

- Recruit and attract the best students to the teaching of science, mathematics, engineering, and technology.
- Actively involve SMET faculty and administrators in institution-wide recruitment of prospective teachers through such activities as visiting area high schools in coordination with guidance counselors or participating in on-campus visitation days for prospective students.
- Work collaboratively with school systems and four-year institutions to develop recruitment and retention programs.
- Create networks among business and industry and community-based and religious organizations for effective recruitment into teaching.
- Join with professional associations to initiate public campaigns on community, state, and national levels to emphasize the need, importance, and rewards of teaching as a profession.
- Recruit potential teachers from various segments of the population, including minorities and underrepresented groups, mid-career changers, paraprofessionals, and other nontraditional students.
- Provide prospective students with complete information regarding pathways to SMET teacher certification.
- Provide students with research-oriented science experiences that encourage them to consider science or mathematics as an academic major and teaching as a profession.
- Advocate for financial incentives such as scholarships, loans, or loan forgiveness on the federal and state levels for students who plan to teach.
- Encourage businesses and foundations to develop and/or expand financial incentives for students who plan to teach.
- Offer programs with strong SMET components to prepare paraprofessionals for full certification.
- Include teacher recruitment efforts in the colleges' mission and strategic plans.
INVESTING IN TOMORROW'S TEACHERS: THE INTEGRAL ROLE...

STRENGTHENING UNDERGRADUATE SCIENCE, MATHEMATICS, ENGINEERING, AND TECHNOLOGY COURSES

Two-year colleges have a responsibility to ensure that prospective teachers complete science, mathematics, and technology courses of the highest quality. Programs of study for future teachers should include multidisciplinary approaches and be informed by discipline based research in teaching and learning as well as research in education and cognitive science. Because teachers usually base their own teaching approaches on the way that they have been taught, it is vital that college courses emphasize inquiry activities and experiential discovery.

Excellence in instruction is the primary focus at two-year colleges. Thus two-year college science, mathematics, engineering, and technology faculty are positioned to provide national leadership in the quality and nature of instruction. Many future preK-12 teachers choose teaching as a career after completing the first two years of college. Structuring all two-year college mathematics and science instruction to reflect active, participatory, discovery-oriented approaches provides those students who become teachers a sound foundation in both the content and methods of science and mathematics and enhances the entry-level mathematics, science, and technology experiences for all students.

Two-year college SMET faculty should:

- Ensure that SMET courses and experiences become more centered in the student and the processes of the SMET disciplines.
- Ensure that all students have frequent access to inquiry-based experiences in and outside of class.
- Collaborate with preK-12 teachers and four-year faculty to design and implement high-quality science, mathematics, and technology curricula.
- Integrate results of cognitive research and standards-based curriculum development into SMET instruction.

Two-year colleges SMET departments should:

- Hire and support full-time and adjunct faculties who incorporate standards-based instruction.
• Provide meaningful and frequent professional development in science, mathematics, engineering, and technology both within and across disciplines for full-time and adjunct faculty.

• Encourage and support full-time and adjunct faculty’s participation in professional organizations and development activities.

• Provide reassigned time for faculty to engage in classroom research, curriculum development, and dissemination.

Federal, state, and private funding agencies should support:

• Development of standards-based SMET curricula at the introductory college level.
• Collaboration among preK-12 teachers, two-year college faculty, and four-year college and university faculty to implement curricula.
• Local and regional initiatives that enhance communication and collaboration among SMET and other disciplines.
• Professional development activities for faculty who teach in SMET fields.

PRE-TEACHING EXPERIENCES

Experiences that introduce students to the excitement of helping others to learn and acquaint them with the rewards of teaching are critical to the recruitment and development of the workforce of future teachers. Two-year colleges, in collaboration with others, should actively seek to engage students and faculty in authentic pre-teaching experiences that encourage and support prospective teachers. In order to provide this engagement, each college must assess its current policies and practices, and a full commitment must be made through initiatives at local, state, and national levels.

Two-year colleges should:

• Engage potential teachers in preK-12 tutoring, mentoring, and enrichment programs in SMET fields.
• Cooperate with local school districts and institutions such as science museums and mathematics and science centers to provide pre-teaching experiences.
• Engage potential teachers as teaching assistants in inquiry-based SMET classroom and laboratory settings and in testing and evaluation.
• Support faculty efforts to initiate programs of SMET pre-teaching experiences for prospective teachers.
• Work with four-year colleges and universities to provide structured opportunities for prospective teachers to visit preK-12 classrooms and to observe a variety of science and mathematics teaching strategies, use of technology, assessment, and individual work with students.
• Provide prospective teachers with support structures (future teacher associations, faculty mentoring, and advising programs) that provide career exploration and articulate transfer paths to professional certification.
• Acknowledge pre-teaching activities through formal recognition, student record annotation, and other incentives.
• Provide financial support and incentives such as internships to encourage students to engage in pre-teaching experiences.
• Work with industry and business to enable future teachers to learn about the role of science, mathematics, and technology in the workplace.
• Work with four-year colleges and universities and the schools to provide early field experiences for students.

IN-SERVICE ACTIVITIES

From the college faculty point of view, in-service and pre-service activities are closely linked. Two-year colleges, with their presence in many communities, are a natural resource for delivering professional development for preK-12 teachers. Two-year college faculty are well versed in working with adult learners and are well positioned to take leadership roles in providing and supporting these in-service activities. A by-product of participation by two-year college faculty in in-service activities is an increased appreciation of the value of standards-based instruction that may be reflected in improvements to their own college courses. In particular, participation in in-service teacher training may generate faculty involvement and interest in the recruitment and preparation of prospective teachers at two-year colleges.
Two-year colleges should:

- View the provision and support of strong SMET in-service programs for current preK-12 teachers as an area of high priority.
- Offer continuing education programs for teachers as a regular component of workforce training initiatives to meet the needs of regional employers.
- Work collaboratively with other providers of professional development opportunities to offer a rich overall continuing education program in all SMET areas.
- Recognize that, in many rural areas, the two-year college must serve as the primary provider of continuing education opportunities and, in conjunction with area school systems and four-year institutions, develop a comprehensive in-service SMET program.
- Design SMET professional development activities that foster utilization of research-based and standards-based pedagogy.

Professional associations should:

- Seek adequate funding for mutually beneficial partnerships among two-year colleges, preK-12 schools and other contributors to SMET teacher professional development.
- Create SMET programs that simultaneously address the continuing professional development needs of faculty from preK-12 schools, two-year colleges, and four-year institutions.

Two-year college administrators should:

- Support professional development opportunities in SMET such as team teaching, teacher exchanges, sabbatical assignments, and peer observation among faculty from preK-12 schools, two-year colleges, and four-year institutions.
- Provide incentives for the professional growth and development of all faculty who participate in the science, mathematics, and technology preparation of prospective preK-12 teachers.
- Establish expectations that all faculty who participate in the science, mathematics, and technology preparation of prospective preK-12 teachers be involved in ongoing professional growth and development activities.
Traditionally the preparation of teachers of science and mathematics has been viewed as the exclusive purview of four-year institutions. Because a large percentage of prospective preK-12 teachers begin their education in two-year colleges, two- and four-year colleges must work collaboratively in the science, mathematics, and technology preparation of future teachers. Not only do students at two-year colleges transfer to four-year institutions to complete their education training and certification, but faculty at two-year colleges are themselves the product of the four-year institutions. Although two- and four-year colleges have different overall missions, in the area of science and mathematics teacher preparation, they must share a common goal to prepare preK-12 teachers who are well trained, qualified, and motivated. To reduce barriers that hinder smooth transition of prospective teachers, colleges and universities need to improve transfer programs, partnerships, and professional development opportunities.

Two- and four-year colleges and universities should:

- Work together to develop two-year college SMET programs that provide seamless transition to teacher preparation programs at four-year institutions.
- Coordinate student advising for prospective teachers between two-year and four-year institutions concerning the transfer of courses, financial support, and program requirements.
- Eliminate the barriers of course transferability by articulating transfer agreements between two-year colleges and four-year institutions that are mutually established through open communication concerning specific course content and expectations.
- Reduce the cultural barriers and misconceptions between two-year colleges and four-year institutions by encouraging the exchange of faculty and facilitating SMET topical workshops.
- Support transition of students through the personal involvement of SMET faculty at two-year and four-year institutions.
- Work collaboratively to ensure that two-year colleges and four-year institutions are both represented as preK-16 SMET educational policy is formulated.
• Increase the number of partnerships between two-year colleges and four-year institutions focusing on joint SMET program development and dissemination.

• Promote joint professional education activities involving student groups between two-year colleges and four-year institutions.

• Work with local school systems and state policy officials to establish stronger teacher certification standards.

• Develop collaboratively a teaching track for M.S. and Ph.D. SMET students whose career goal is to teach at two-year colleges.

• Increase sustainable joint SMET professional development opportunities (co-teaching, teacher exchange, and others) by preK-12 institutions and two- and four-year colleges for full-time and adjunct faculty.

• Encourage partnerships that jointly address major public issues facing SMET educational policy and practice (e.g., adoption of standards, approaches to teaching practices and content, mandatory program requirements, expectations of students’ skills and knowledge, appropriate role of technology in SMET teacher preparation, and roles of teaching assistants and adjunct faculty in preK-12 SMET teacher preparation.)

CONNECTIONS WITH BUSINESS, INDUSTRY, AND PROFESSIONAL SOCIETIES

Two-year colleges contribute significantly to the economic health and vitality of the cities or regions in which they are located. As a result, groups or organizations that have a stake in the success of students at two-year colleges can have great influence on two-year college programs. These include SMET professional societies at local, regional, state, and national levels as well as business and industry, other professional societies, parents, informal education agencies, museums, legislative bodies, and accrediting agencies. Awareness by these communities of the contributions of two-year colleges in the science, mathematics, and technology preparation of prospective teachers is vital. Two-year colleges should convene forums on their campuses with representatives from state legislatures, members of the preK-12 and higher education communities, and business and industry to discuss issues of SMET teacher preparation.
Business and industry should:

- Provide internships and other opportunities to enable future teachers and teacher educators to learn about the role of science, mathematics, and technology in the workplace.
- Communicate clearly to future teachers expectations about the desired characteristics of potential employees.
- Provide scholarships for students and support for equipping laboratories and enhancing technology.
- Engage professionals in the community to provide students and faculty in two-year colleges with information and perspective about how science, mathematics, and technology are applicable to teaching and other career tracks.

SMET Professional Societies should:

- Highlight the roles of two-year colleges in the science and mathematics preparation of future teachers.
- Seek students from two-year colleges for membership and welcome as members students who wish to pursue careers as teachers.
- Promote opportunities for full participation of prospective SMET teachers at professional meetings.
- Establish student chapters on two-year college campuses.
- Recruit faculty from two-year colleges to join and assume leadership roles.
- Publicize efforts by two-year colleges in teacher preparation through various media and to a variety of targeted audiences.

A CALL FOR ACTION

The science, mathematics, and technology preparation of the next generation of elementary and secondary schoolteachers is a critical national concern. Every two-year college in the country has the opportunity and responsibility to address this challenge. This leadership conference calls upon the nation’s two-year colleges to make teacher preparation in SMET a major priority. This requires assessment by each college of its priority and current practices and full commitment on the part of all sectors of the two-year college community—presidents,
trustees, faculty, and students—and collaborations with all pertinent education and community sectors.

Participants in this workshop developed a comprehensive set of detailed recommendations concerning the role of two-year colleges:

- **Two-year colleges should actively recruit prospective teachers from the areas that the two-year colleges serve.** Two-year colleges are uniquely placed to participate in recruiting the numbers of teachers that are needed nationally and, in particular, to recruit future teachers who can best understand the needs of the communities that the colleges serve.

- **Two-year colleges should demonstrate leadership in strengthening the undergraduate mathematics, science, and technology courses taken by prospective teachers at both two- and four-year colleges.** Two-year college faculty specialize in the development and teaching of freshman and sophomore courses and are therefore in a pivotal position to provide national leadership in this area.

- **Two-year colleges should provide rich and varied pre-teaching experiences in SMET for their students.** Students beginning their undergraduate work need pre-teaching opportunities including mentoring and tutoring preK-12 students and serving as instructor aides in a variety of elementary, secondary and college settings. The activities can help students confirm their interest in teaching mathematics and science by involvement in pre-teaching experiences that foster creativity, curiosity, and inquiry.

- **Two-year colleges should provide in-service SMET courses and experiences for current teachers.** Providing continuing education in science, mathematics, and technology is particularly important for two-year colleges located in large urban areas with specific needs. In many rural areas, the two-year college must serve as the primary provider of comprehensive in-service programs, developed in conjunction with local school systems.
Conference participants also recognized that activities by two-year colleges related to teacher preparation must be undertaken in conjunction with four-year institutions and others involved in the science, mathematics, and technology preparation of prospective teachers.

- **Two-year college efforts in the preparation of teachers must take place in close coordination with four-year institutions.** Careful attention must be paid to articulation agreements and clear policies must be developed concerning transfer, joint advising, and joint-registration.

- **Two-year colleges and four-year institutions must collaborate to strengthen and align science, mathematics, and technology courses for prospective teachers, to establish student transfer agreements, and to provide mutual support for one another’s role in teacher education.**

- **Two-year colleges must become full partners in all discussions about the SMET preparation of future teachers.** Fully engaging two-year colleges in the preparation of teachers will require liaisons with business and industry, professional societies, state legislatures, and statewide and national policy boards.

- **Faculty in two- and four-year colleges and universities should establish cooperative ventures affecting teacher preparation activities.** A dialogue between faculty should be established among two-year colleges, four-year college and university science and mathematics departments, and colleges of education.

It is the expectation of conference participants that the above recommendations will lead to action. Conference participants, professional societies, and other national leaders designed to highlight the role of the two-year college in teacher preparation are already accomplishing much; however, further efforts must also take place nationally.

- **The need for more information was highlighted.** Conference participants recognized as a high priority the need for more detailed information concerning the role of two-year colleges in the SMET preparation of teachers. In particular, data should be collected on
a national level to determine what percentage of new teachers studied mathematics and science education at two-year colleges and the extent of the studies.

- **Effective partnerships are needed involving many groups.** Two-year colleges should work with the American Association of Colleges for Teacher Education (AACTE), the Holmes Partnership, and others, to facilitate understanding and recognition of the role of two-year colleges in teacher preparation.

- **External support is needed to initiate change.** Financial support from federal, state, corporate, and foundation sources is necessary for full implementation of these recommendations.

**ACTIONS TAKEN AS A RESULT OF WORKSHOP**

- Two-year college presidents, deans, and other administrators returned from the conference and committed their institutions and systems to an increased focus on the preparation of SMET teachers.

- The American Association of Community Colleges (AACC) is sending letters to all two-year colleges announcing the recommendations of this conference. The communication includes testimonials from presidents at the colleges recognized at this conference, indicating the impact that teacher preparation initiatives have had on their institutions.

- The American Mathematical Association of Two-Year Colleges (AMATYC), through the Teacher Preparation Subcommittee of its Program/Curriculum Issues Committee, is referring the recommendations to the AMATYC membership for action. AMATYC has included in its next conference program sessions featuring the teacher preparation activities of the colleges recognized at this conference. Recent AMATYC newsletter articles have addressed the conference activities.

- The American Association of Physics Teachers, through its Two-Year College in the Twenty-First Century (TYC21) program, has formed a national alliance of fifteen regional networks. A special “Bridges” session at the 1998 summer TYC21 conference
addressed bridging activities concerning the training of prospective precollege teachers and showcased many of the exemplary activities.

- The Virginia Mathematics and Science Coalition in conjunction with the National Association of Statewide Science and Mathematics Coalitions (NASSMC) has agreed to devote a special issue of *The Journal of Mathematics and Science: Collaborative Explorations*, to the conference and reports of the work of the eleven exemplary activities.

- The League for Innovation in the Community College has invited members of the Conference Steering Committee to submit a Leadership Abstract on the role of two-year colleges in preK-12 teacher preparation.

- The Mathematical Association of America (MAA) has highlighted the work of the conference and the role of two-year colleges through a feature article in *FOCUS*: “Enlisting Two-Year Colleges in Educating Mathematics Educators.”

- Recruiting New Teachers, Inc. is conducting a study of community college programs that both encourage and enable prospective teachers to complete the baccalaureate degree and link to teacher preparation.