Bringing Community College Faculty to the Table To Improve Science Education for All

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> A persistent theme in this diverse set of reports [on science education] is the call for collective action. Dialogue with colleagues and peers is one step toward that end. But collective action is more than talking together; it is taking responsibility for the active sharing of ideas and materials− building on, connecting to, and enhancing the work of others… We must also find a way to identify and bring new voices into the dialogue (1, p. 24).

At a 2005 Math Science Partnership Workshop at the National Academy of Sciences, a panel was asked "who needs to be at the table in the next months and years as this nation tackles the critical work of transforming science, technology, engineering and mathematics (STEM) education (2)." We believe that bringing community college faculty to the table and empowering them as leaders in science education would have a significant impact on the quality of science education in America.

Community colleges play a major and increasing role in U.S. higher education. Although they sometimes struggle under the pressure of multiple missions, they have exceptional faculty who focus on teaching and maintain the quality of core transfer and occupational programs (3). There has been a long history of calls from leaders in science education for a greater engagement of community colleges in the improvement of the science literacy for all Americans. Experience suggests that inclusion of community college faculty in systemic reform efforts can have wide-ranging benefits for science education. But the potential for community college impact is often constrained by a lack of engagement in

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the larger academic community and by limited access to scholarly resources. Some relatively small changes in our inter-institutional interactions could help us significantly increase the impact of community colleges in transforming science and math education.

The Major Role of Community Colleges in Higher Education

It is increasingly likely that today's undergraduates have attended one of America's nearly 1200 community colleges. This likelihood is correlated with being from the west or southwest, having parents from a lower socio-economic group or lacking higher education, being ethnically Latino or American Indian, or having had limited success in high school math and science (4-5). Forty-six percent of all undergraduates in public higher education are enrolled in a community college (4) and over 73% of all undergraduates have attended a community college at some point in their college career (6).

Although less than half of community college students nationwide intend to transfer to a four-year institution when they enter the freshman class, attendance at a community college is a viable pathway to a bachelor's degree (7). Students who begin postsecondary education in a community college and transfer more than 10 credits have a better than 62% bachelor's degree completion rate, which compares well with completion rate of 74% for students who begin at four-year institutions and earn less than 10 credits from community colleges.

Community colleges also have had a significant role in the education of recent science, technology, engineering and mathematics graduates (8). Forty-four percent of recent STEM graduates have attended a community college. About half of all bachelors graduates, one third of masters graduates, and 8% of all doctoral graduates have attended a community college. Community college attendance rates for recent STEM graduates vary significantly by geography: 65% if from the Pacific region but only 25% if from the New England region. Twenty-eight percent of all recent STEM graduates received an associate's degree from a community college before transferring (8), which suggests that over one quarter of all recent STEM graduates took their introductory science and math courses at a community college. This and the high rate of attendance for bachelors graduates may correspond with the suggestion from other studies that large numbers of K-12 teachers are taking their science and math courses at community colleges (9-10). Thus, community colleges are having significant direct and indirect impacts on science education at all levels.

A <u>Long</u> History of Calls for Collaboration with Community Colleges

Most of the calls for collective action in higher education recommend collegial interactions within departments, interdisciplinary collaborations among STEM departments, or more recently, connections with departments of education (1). We find it significant that many reports, recognizing the potential for significant impact, explicitly call for partnerships of other institutions with community colleges to improve science

education. In the seminal Neal Report (11), a National Science Board committee concluded that:

> The major identified needs for science education in the two-year colleges are in the areas of: (a) faculty development, (b) courses and curricula, and (c) facilities and equipment… many two-year college faculty are prevented by geographical considerations from any significant interaction with faculty at research institutions. Relatively modest partnership support from NSF for faculty development could lead to genuine improvements in science and mathematics instruction [at two-year colleges]. … The two-year colleges are a part of higher education. Their transfer programs provide large numbers of upper division students to four-year institutions. Articulation at this transfer point is difficult and requires serious and permanent collaborative efforts between the source and acceptor colleges. (p. 34)
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> The [National Science] Foundation should: … actuate cooperative projects among two-year and four-year colleges and universities to improve their educational efficiency and effectiveness. (p. 46)

A decade later, in *Shaping the Future* (12), an advisory committee to the National Science Foundation reported:

> Many contributors called our attention to the value added by partnerships among colleges and universities, as well as among faculty. Virtually all administrators and faculty from community colleges who wrote to us stressed the value of partnerships in improving the quality of education in community colleges. (p. 19)

And in *From Analysis to Action* (13), a National Research Council convocation concluded that:

> Undergraduate education will not change in a permanent way through the efforts of 'Lone Rangers.' Change requires ongoing interaction among communities of people and institutions that will reinforce and drive reform. (p. 6)
>
> [A]cross institutions, large-scale reform requires coherent efforts at many different sites to build self-sustaining communities of reformers… including those among institutions of the same kind, among institutions in the same region, or among programs in the same discipline. (p. 32-33)

And even the most recent report from the Mathematics and Science Education Initiative of the Business and Higher Education Forum (14) calls for increased collaboration to effect systemic reform. In particular, they call for the creation of educational councils in every state to promote collaboration to create a high quality mathematics and science education for all students, and they assert:

> Council membership also must include community college leaders, since the number of students taking basic undergraduate courses in mathematics and science at these institutions is both large and increasing. (p. 14)

In addition to the numerous reports focusing on undergraduate STEM education in general, there have been several that focus specifically on community colleges. A 1989 Report on the National Science Foundation Workshop on Science, Engineering and Mathematics Education in Two-Year Colleges (15) made several recommendations for NSF support of partnerships in addition to many for improving STEM education.

> The NSF [should] establish programs designed to encourage the formation and strengthening of partnerships involving the two-year colleges and other institutions by: (a) providing Federal support for model programs; (b) supporting resource and faculty development necessary to make these viable; and (c) supporting liaison conferences among institutions with such programs. (p. 5)

A follow-up workshop (16) that included two-year college STEM faculty and administrators along with NSF staff drew the following conclusions.

> Participants in the workshop called for community college faculty to take leadership roles in improving science, mathematics, engineering and technology education at all levels. Rather than recommending sheltered programs targeting community colleges exclusively, they encouraged community college faculty and administrators, NSF, and other national organizations to work together to increase the role of community colleges in improving education in all institutions and at all levels. (pg. 2)

> Two year colleges are ideally positioned to serve as catalysts for educational improvement and to address the national concern for literacy, since they most accurately reflect the diversity of the population… This workshop concluded that, through collaboration and cooperative efforts, the educational community can and must improve the quality and effectiveness of instruction in mathematics, science engineering and technology programs. (pg. 3)

An NSF workshop in 1992 met to discuss the role of professional societies in STEM education at two-year colleges (17). A plenary on "where do we go from here" concluded that:

- [P]rofessional societies need to recognize the large and significant role the two-year community plays in educating America's youth.(p. 9)
- [Two-year college faculty] contributions to society and to the furtherance of their discipline all too often are not recognized by their four-year and university faculty colleagues … by their deans and presidents, [and by] many of the scientific societies. (p.9)

- A theme that kept coming through is that by working with the societies and getting our colleagues more involved, we can build a stronger coalition with the four-year community.
- A concern raised in several of the working groups has been the sense of isolation experienced by many faculty at two-year colleges… professional societies must establish networks to help eliminate that feeling of isolation.
- [Finally, to increase the quality of proposals submitted by two-year college faculty,] professional societies must encourage networking and collaborative efforts between two-year and four-year institutions. (p. 9-10)

In 1996 and concurrent with *Shaping the Future* and with *From Analysis to Action*, the American Association of Community Colleges convened a group of national leaders to develop strategies for community colleges to improve STEM education (18). They too highlighted the significant role of collaboration in achieving STEM education goals.

> To build a rigorous and relevant sequence of dovetailed SMET programs, systemic change is required. To create this change, active partnerships with all of society's stakeholders must come together and contribute − their time, expertise, experience, physical resources, and money. (p. 1)
>
> [Community college faculty development opportunities should include] collaborative meetings with secondary school instructors and with four-year college and university faculty to help ensure that changes at one level are not made in isolation from the rest of the education system. (p. 9)

Throughout these reports, there has been frequent mention of the potential of community colleges and the need for all of higher education to improve the preparation of K-12 teachers. In 1998, NSF convened a workshop specifically to address the role of community colleges in teacher preparation (9). They prepared an extensive list of recommendations for improving teacher preparation ranging from recruitment of prospective teachers and strengthening STEM courses to providing pre-teaching experiences and in-service activities. They further highlighted the need for collaborations with four-year institutions and connections with business and industry, professional societies, and other organizations. Their recommendations included the following:

- 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 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. (p. 18-19)

Experience with Collaboration Suggests Benefits and Strategies to Increase Impact

NSF has made some significant efforts to promote science education reform in collaboration with community colleges as well as to involve community college faculty in most levels of NSF operations. NSF support to community colleges has increased from less than half a million dollars in 1990 to about $35 million in 1995 (18) and over $75 million in 2004 (19). A notable program is the Advanced Technology Education program, which forms nearly two thirds of the direct funding to community colleges and supports partnerships with community colleges to enhance the technical workforce. Other programs do not specifically target community colleges, but can have a significant impact. For example, Math Science Partnerships (MSP), which began in 2002, integrate the work of higher education STEM faculty with that of K-12 teachers to improve math and science education. A recent experience with an MSP partnership illustrates the potential for transformation through collaboration and shows how bringing community colleges to the table can improve science education.

Project Pathways is a Math-Science Partnership based at Arizona State University that seeks to enhance K-12 math and science learning by developing, implementing and evaluating a series of model in-service courses and professional learning communities that enhance teachers' content knowledge and pedagogical skills. To accomplish this massive undertaking across multiple school districts, the project employs numerous faculty and graduate students as well as a cadre of community college faculty. As the first course in the series was a mathematical functions course and a major goal of the project is to integrate math and science, the project employed over a dozen community college math faculty in its first year – nearly half of whom came from a single department at Scottsdale Community College. The community college faculty coordinator, Sally Jacobs, reported that this group accomplished a tremendous amount for the project and that this collaborative effort had a transformative effect on the community college faculty involved. Through this effort, the department as a whole has been intellectually stimulated, resulting in a more reflective approach to teaching and learning issues and many changes to their teaching practice.

As the project progresses to integrated math and science courses, more community college faculty from other disciplines and campuses are getting involved. According to

Project Pathways Director, Marilyn Carlson, the project was designed to impact undergraduate education at the university through the interdisciplinary involvement of faculty and graduate students, but not explicitly to transform science and math education at community colleges. The Scottsdale experience may be instructive for the evolution of partnerships with community college faculty and promoting this serendipitous transformation. Clearly, it is very significant that community college faculty are recognized for their potential to make valuable contributions to the project and that they are compensated appropriately for it.

The Scottsdale experience also suggests that it is important that the there be a large enough group to constitute a critical mass to push the department past the tipping point for change. Their impact was probably amplified because of the number of participants from a single department. For other situations, it may be possible for an interdisciplinary group to achieve critical mass with nurturing and leadership. Other factors, which may have been significant, include the facts that the group was focused on a common goal and that their dialog was motivated by input from interactions with external content and pedagogical experts. Thus, it appears that the course design team essentially constituted a faculty learning community exhibiting many of the key attributes that have been shown to promote success: safety and trust, openness, respect, responsiveness, collaboration, relevance, challenge, enjoyment, esprit de corps, and empowerment (20).

In bringing community college faculty to the table to transform science education, it is important to consider what is done to make them equal partners in the process. First, we must consider the resources available to community college faculty that would allow them to contribute fully as partners and to function as scholars in their own right. One of the most critical deficiencies in the community college environment is access to scholarly resources. For example, most university scholars have unprecedented access to literature searches and full text journal articles from their desktop computers, whereas most community college faculty members lack sufficient access to most of the current literature. Many of the best inquiry activities for science education at any level spring directly from the pages of recent research journals. That these resources are not generally available to either community college instructors or K-12 teachers is one of the great disappointments of the digital science library movement. Statistical software and regular seminars are other resources that most university faculty take for granted, but which are generally lacking at community colleges. Thus, it seems critical that universities take some steps to provide access to scholarly resources to collaborating institutions.

In making community college faculty equal partners in collaboration, some institutions are considering a further step. They are giving community college collaborators some official affiliation with the university. For example, Arizona State University is considering giving some community college faculty adjunct faculty appointments in recognition of their contributions to the educational mission of the university. This achieves many of the separate steps mentioned above because adjunct faculty status confers considerable privileges, and it can be a relatively simple task to accomplish. Moreover, recognizing community college faculty makes a statement that the university

values their contributions and that they are equal partners in the collaboration to transform undergraduate education.

Needs for Further Action − Project Kaleidoscope

Despite calls for active collaboration and recognizing that some progress has been made, much remains to be done. As was noted in 1996 "The [various types of] two-year and four-year … institutions have not yet responded substantially to the recognized need for cooperation and collaboration. Walls still exist between disciplines and academic units." (11, p. 40) That this statement is still generally true today is supported by a recent NSF-funded National Community College Conversation (21). For systemic change, these community college leaders concluded that:

> Isolated, episodic, or incremental changes are insufficient [… and that] preparing learners for the knowledge age requires thinking, teaching, and learning outside and across these content "silos." (p. 11)

Project Kaleidoscope (PKAL) has long advocated collaboration and networking to improve science education and may be able to contribute to the solution of this problem. In *What Works: Building Natural Science Communities* (22), PKAL recommends that we must:

> Develop partnerships focused on strengthening undergraduate STEM. Each sector of the science and mathematics community has a unique contribution to make in addressing national goals. We can accomplish more by working together than by working alone. (p. 5)

And in *Then, Now, and In the Next Decade: A Commentary on Strengthening Undergraduate Science, Mathematics, Engineering, and Technology Education* (23), the past, present and future of undergraduate education were described as:

> [Then in the mid 1980s:] American higher education was concentrated primarily at traditional colleges and universities. The two-year colleges were gaining notice as an emerging presence. Collaboration, communication and partnerships across sectors of higher education were limited.
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> [Now in the mid 1990s to 1999:] Institutions from each sector are included in educational coalitions supported by NSF and other funders, leading to a better understanding of commonalities and differences among institutional missions.
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> [In the next decade 1999-2009:] Colleges and universities should: … collaborate across boundaries of discipline, sector, and geography, building networks of innovators and adapters to strengthen undergraduate learning with all deliberate speed. (p. 5-6)

Community college faculty members have been involved in PKAL since the implementation of their *Programs That Work* (1992) and their *Faculty for the 21st Century* (F21, 1994). But until recently, PKAL had not specifically targeted community colleges for active involvement in their informal alliance to transform undergraduate education. Beginning in fall 2004, PKAL initiated a discussion on the state of STEM education in the nation's community colleges culminating in a strategic planning workshop in February 2005. This group solicited input from community college PKAL F21 members and other interested parties nationwide. Analysis of the extensive comments received led to the conclusion that most of the barriers to participation of community colleges in improving science education still exist for many if not most community colleges.

These data reinforced the need for a group like PKAL to help community college faculty to become leaders in education, promoting the understanding and appreciation of science and technology by all students, thereby enabling them to be informed and productive citizens, professionals, and scientists of tomorrow. The goals of Project Kaleidoscope in Two-Year Colleges (PKALTYC) are to:

- Empower two-year college faculty as leaders in STEM education, scholarship and research.
- Ensure seamless STEM education pre-K−16 and beyond.
- Create meaningful learning experiences in science for students at all levels consistent with how people learn.

At the February 2005 meeting, strategies were identified to achieve each of these goals, but in doing so it appeared that the first goal of empowering community college faculty is a prerequisite to achieving the other goals. Strategies for empowering community college faculty include:

- Increasing the communication, collaboration, and partnerships with and among community college faculty by developing a two-year college STEM network, promoting K-16 and community partnerships, and communicating opportunities to engage in STEM education reform, scholarship and research.
- Enhancing the intellectual environment for faculty at two-year colleges and in their communities by increasing the access to scholarly resources like digital libraries, supporting local STEM disciplinary and pedagogical discussions, and organizing community events for dissemination of scholarship and professional development.
- Promoting the scholarship of teaching and learning in community colleges by disseminating research on specific teaching and learning interventions, promoting scientific research in STEM education, and dissemination of opportunities for peer review and communication of scholarship from two-year colleges.

Progress on this "empowering" goal and the strategies to accomplish it will help to reduce the often-cited isolation from intellectual endeavors and lack of scholarly resources that often characterizes community colleges. Furthermore, the construction of K-16 networks and intellectual communities will build inter-institutional trust for ensuring seamless K-16 STEM education and the critical mass of concern necessary for

transforming our institutions into learner-centered educational communities. This group within PKAL would build upon the successes of groups such as the American Mathematical Association in Two-Year Colleges (AMATYC) to leverage the potential of professional societies to promote change and amplify the considerable influence of PKAL to effect change.

The potential of PKALTYC for impact is demonstrated by the models for collaboration that can be extracted from the experience of our founding group. The NSF Advanced Technology Education (ATE) program is particularly ripe with examples of inter-institutional collaborations to develop the US workforce. For example, there are over twenty NSF- funded, advanced technology center grants distributed across the nation at two-year schools. These centers serve as workforce resources for particular technologies. For example, Bio-link is a biotechnology center grant located at City College of San Francisco. Bio-link hosts a website that provides a listserv for communication, a curriculum clearinghouse, a virtual laboratory, and a database of known two year biotechnology programs and companies by state. Unlike other center grants, Bio-link also has six regional centers. For example, the South Central Regional Center is housed at Austin Community College in Austin, Texas and is responsible for assisting and coordinating programs in six states: Texas, Arkansas, New Mexico, Colorado, Louisiana, and Oklahoma. If a high school, two-year or a four-year college wants to start a biotechnology program or course, they can contact any regional center or the main center in Northern California, and find out everything they need to know: from how to design a biotech lab and curriculum for training students in bioprocessing to how to establish articulation agreements among high schools, two-year, and four-year colleges.

Faculty members from Gainesville College, which is a two year college in the University System of Georgia, were co-PIs in an ATE grant with the University of West Georgia called the Georgia Geo-Spatial Literacy Project. This project trained about thirty faculty from across the Southeast and many disciplines in GIS and remote sensing techniques. This training helped these faculty members develop a vision of how geospatial tools apply to their particular disciplines, research and courses. A Gainesville College faculty member was also a co-PI and founding member with the University of West Georgia and Kennesaw State University on the US Geological Survey (USGS) funded Georgia View project in 2003. Georgia View is a part of the larger America View project that has a goal of developing the user community for remotely sensed satellite imagery in education, government and industry. Here we have another example of two-year and a four-year colleges successfully working together to develop STEM literacy.

Disciplinary research partnerships with community colleges exist across the country. For many years, the University of Wisconsin-Madison had a very successful program that supported through competitive grants collaborative work between its faculty and faculty at the 13 campuses of the University of Wisconsin Colleges (the two-year, liberal arts, transfer institutions of the UW System). Faculty from the UW Colleges spent two months during the summer doing research with UW Madison faculty on topics of mutual interest and enjoyed most of the privileges of the UW Madison faculty. In addition to supporting collaborative efforts during the summer, such programs can foster

collaborations that go beyond the period of the grant and create opportunities that would otherwise have not existed.

Although many community college faculty have long maintained disciplinary research programs, they often have difficulty involving undergraduate students because of limited facilities and because of a student perception that two-year colleges are not a place where research happens. Partnerships are enabling some community college faculty to establish undergraduate research experiences for their students. Ranging from the NIH Bridge programs to NSF Research Experiences for Undergraduates (REU) programs, most of these efforts depend on collaborations with four year institutions for their success. For example, William Rainy Harper College and Harold Washington College have partnered with Hope College and Illinois State University to establish a community college Research Experiences for Undergraduates site. Besides providing an authentic research experience for community college students to enhance their attitudes and skills in STEM fields, these colleges are providing professional development opportunities for community college faculty and building a local and regional network for inter-institutional collaboration.

Central Oregon Community College is partnering with Oregon State University to develop an atmospheric monitoring station at Mt. Bachelor, Oregon. Faculty in Environmental and Molecular Toxicology and Chemistry at Oregon State University initiated the partnership with the community college because the research was not possible without a local connection. The also wanted to reach out to underrepresented students. Community college students collect samples for OSU and participate in construction, troubleshooting and maintenance on instruments located at the site. Graduate students, post-doctoral scientists and the PIs themselves all have frequent contact with the community college students. Their involvement enlivens their academic life by introducing them to research and connecting them with the larger academic community.

Transfer has always been a core mission of community colleges. Some recent collaborations are producing innovative and effective 2+2 transfer programs. Scottsdale Community College and Arizona State University are partnering to offer an NSF-funded undergraduate program in mathematical biology. Lower division coursework offered at SCC prepares students for transfer into upper division courses at ASU. Summer workshops at the university give SCC students research experiences leading to a mini-thesis project. After transfer, students continue coursework in mathematical biology and engage in more sophisticated research for a senior thesis. Extensive mentoring is built into the program with research faculty and graduate students in mathematical biology supporting students at all levels. It is expected that this collaborative 2+2 program will increase the skilled workforce in mathematical biology and enhance graduate programs in quantitative biology.

Another innovative 2+2 partnership involves Montgomery College and The University of Houston in Texas. Montgomery College's two-year biotechnology program is seamlessly articulated with the University of Houston's four-year biotechnology

program. In fact, once a student has taken one biotechnology course at Montgomery College, the student is automatically enrolled at the University of Houston. The student finishes the two-year program, gets a job in industry, and continues with their four-year degree at the same campus. Utilizing the facilities at the community college, the university provides the courses making up the next two years, paying the two-year school for laboratory assistants, faculty, equipment and supplies. What a deal for the university, the community college and especially for the student!

Two-year schools are also at the forefront of enhancing educator quality in their districts and are naturally positioned to do so as the bridge between PK-12 and four-year institutions. For example, the Central Wisconsin PK-18 Council includes stakeholders from all educational levels – faculty, administrators, and area business representatives. Its purpose is to improve student achievement through enhanced educator effectiveness and increased organizational capacity in PK-12 and institutions of higher learning in the Central Wisconsin area. Two of its guiding principles are to ensure that its efforts are supported by research-based best practices and to establish a forum for initiatives and issues to be brought forward, discussed and resolved. Priority areas of work within the Council include implementing best practice/professional development, developing leadership capacity, and building a seamless system of educator quality.

Gainesville College is another two-year college with a model K12 program. They were funded by the NSF in 2002 to have a K12 outreach in GIS and remote sensing. This project has resulted in a very rich collaboration with area K12 institutions, including the development of geospatial curricula for high schools. In 2002, Gainesville College was a PI in a grant from the Teacher Quality program, funded by the 'No Child Left Behind Act'. Gainesville College Physics and the University of North Georgia Science Education departments had a year-long project that trained 18 K12 physical science teachers in using computer-interfaced data collection and simulations.

Math Science Partnerships such as the Arizona State University Project Pathways described above continue across the country today. As these projects mature, their focus turns to sustainability, which can be aided by engaging the receptive faculty of the nation's community colleges. The barriers to community that exist are being overcome by employing models such as faculty learning communities. Connections between institutions like this have great potential for advancing PKALTYC goals and can serve as models for efforts elsewhere. With sufficient attention, such collaborative efforts can be replicated across the country, and PKALTYC can play an important role in serving as a clearinghouse of information and in supporting two-year schools interested in developing such projects.

One of the first initiatives of PKALTYC will be to promote a model for collaboration called the Community College Connection. Key components of this initiative are 1) developing a pilot program to encourage university-community college faculty collaboration, 2) increasing the access of community college faculty to scholarly resources, and 3) formalizing the affiliation of community college faculty who are engaged in scholarship with the university. Adaptation and implementation of this model

will promote institutionalization of community college collaboration in much the same way that the successful Preparing Future Faculty program has resulted in the broadening of graduate education.

Community college faculty members certainly have great potential for transforming undergraduate STEM education both through the number of students they educate and through their interactions with current and future teachers. We are convinced that bringing community colleges to the table is an essential ingredient for us to have success in improving science education for the future of the United States. However, we must progress toward making community colleges equal partners in this endeavor. Bringing community college faculty to the table is just the first step. It is equally important that they are empowered to contribute to their fullest potential while seated at the table for STEM education reform.

References

1. Project Kaleidoscope, Recommendations for Action in support of Undergraduate Science, Technology, Engineering, and Mathematics (Project Kaleidoscope, Washington, DC., 2002; www.pkal.org)
2. National Research Council Math Science Partnership Workshop, Washington D.C., June 26-28, 2005
3. T.R. Bailey, Community Colleges in the 21st Century: Challenges and Opportunities. Community College Research Center Brief Number 15, January 2003, 4 pp. (www.tc.columbia.edu/CCRC)
4. American Association of Community Colleges, Community College Fact Sheet (AACC 2005; http://www.aacc.nche.edu/Content/NavigationMenu/AboutCommunityColleges/Fast_Facts1/Fast_Facts.htm)
5. C. Adelman, *Moving into town− and moving on: the community college in the lives of traditional age students.* (U.S. Department of Education, Washington, DC, 2005)
6. National Center for Education Statistics, 1999–2000 National Postsecondary Student Aid Study (U.S. Department of Education, NPSAS:2000; http://nces.ed.gov/das/library/tables_listings/show_nedrc.asp?rt=p&tableID=179)
7. C. Adelman, *Principal Indicators of Student Academic Histories in Postsecondary Education, 1972-2000* (U.S. Department of Education Washington, DC, 2004)
8. J. Tsapogas, "The role of community colleges in the education of recent science and engineering graduates" (National Science Foundation, Washington, DC, 2004, InfoBrief 04-315)
9. *Investing in Tomorrow's Teachers: The Integral Role of Two-year Colleges in the Science and Math Preparation of Prospective Teachers*, (National Science Foundation, Washington, DC, 1998)
10. S. Parsons, "We teach how we were taught: the role of community colleges in the preparation of our future K-12 teachers" (National Science Foundation, Washington, DC, October/November 2003: ss8-ss9; http://www.aacc.nche.edu/Content/NavigationMenu/ResourceCenter/Projects_Partnerships/Current/AdvancedTechnologicalEducation/parsons.pdf)

11. NSB National Science Board. *Undergraduate Science, Mathematics and Engineering Education: Role for the National Science Foundation and Recommendations for Action by Other Sectors to Strengthen Collegiate Education and Pursue Excellence in the Next Generation of U.S. Leadership in Science and Technology* (National Science Foundation, Washington DC, 1986; www.nsf.gov NSB 86-100)
12. *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology* (National Science Foundation, Washington, DC, 1996)
13. *From Analysis to Action: Undergraduate Education in Science, Mathematics, Engineering, and Technology Report of a Convocation* (National Academy Press, Washington, DC, 1996)
14. *A Commitment to America's Future: Responding to the Crisis in Mathematics and Science Education* (Business and Higher Education Forum, Washington, DC, 2005)
15. *Report on the National Science Foundation Workshop on Science Engineering, and Mathematics Education in Two-Year Colleges* (National Science Foundation, Washington, DC, 1989)
16. *Matching Actions and Challenges: Report of a National Science Foundation Workshop on Science, Engineering, and Mathematics Education in Two-Year Colleges* (National Science Foundation, Washington, DC, 1991)
17. *Partners in Progress: Report of a National Science Foundation Workshop on the Role of Professional Societies in Science, Technology, Engineering, and Mathematics Education in Two-Year Colleges* (National Science Foundation, Washington, DC, 1992)
18. American Association of Community Colleges, *Improving Science, Mathematics, Engineering, and Technology Instruction: Strategies for the Community College* (Community College Press, Washington, DC, 1996)
19. Council for Resource Development, *Federal Funding to Two-Year Colleges Report: 2004-2005* (Council for Resource Development, Washington, DC, 2005)
20. Cox. M.D. "Introduction to Faculty Learning Communities," *Building Faculty Learning Communities*, M.D. Cox and L. Richlin (eds.) New Directions for Teaching and Learning No. 97:5-23, Jossey-Bass, San Francisco, 2004).
21. What Does It Mean To Be Educated in the 21st Century: The National Community College Conversation (National Science Foundation, Washington, DC, 2005; http://www.mc.maricopa.edu/nsf)
22. Project Kaleidoscope, *What Works: Building Natural Science Communities* (Project Kaleidoscope, Washington, DC, 1991; http://www.pkal.org/template2.cfm?c_id=394)
23. Project Kaleidoscope, *Then, Now, & In the Next Decade: A Commentary on Strengthening Undergraduate Science, Mathematics, Engineering and Technology Education* (Project Kaleidoscope, Washington, DC, 1999)
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