AIMING AT SYSTEMIC CHANGE BY ADDRESSING EQUITY HEAD ON

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Abstract — The Women in Technology Project researchers reviewed the available literature on the under representation of women and minorities in math, science, engineering and technology. This review of the literature pointed to gender and other inequities as the root of the under representation problem. The Project focused its program development and outreach efforts on creating systemic change to address inequities in the community, educational and employment environments and developing programs that require gender and other equity. Outreach efforts include on-going education and collaboration with community, education and industry leaders throughout Hawaii. Program development includes duplication of national model K-12 programs, the Environmental And Spatial Technology (EAST) Project and Future Scientists and Engineers of America (FSEA), as well as gender-equity training workshops for community, education and industry leaders based on training provided by consultants from the Washington Research Institute Center for Gender Equity.

Index Terms — Best practices, duplication, equity model, gender equity, high school, K-12, model program, school-community based.

INTRODUCTION

The Women in Technology Project of the Maui Economic Development Board, Inc. in Maui, Hawaii is funded by the U.S. Department of Labor as a workforce development project. The mission of the Women in Technology Project is to encourage women and girls to pursue education and careers in math, science, engineering and technology in the counties of Maui, Hawaii and Kauai in the state of Hawaii.

The Project was launched during Fall, 1999, and the first priority of the Project was a needs assessment. Assessment Report Part One: Women and Girls Represent an Untapped Resource to Meet Employer Demand for Technology Workers in Maui County[1] documented the under representation of women in the science, math, engineering and technology (“SMET”) education pipeline and employment in Maui County and the state of Hawaii. The Report included the results of a survey of science and technology industry leaders in Maui County, encompassing existing and projected workforce development needs in SMET. The Report analyzed the Maui County and Hawaii data in the context of the national under representation of women in SMET and the existing national shortage of skilled SMET workers.

The assessment phase of the Project also required review of the existing literature on the under representation issue, and analysis of best practices and model program initiatives. This review of the literature, and of model programs with a demonstrated track record of success, convinced the Project team of the efficacy of focusing on systemic change through addressing equity issues directly. A number of initiatives nationwide have focused on special programs for girls, or under represented minorities, only. However, there is considerable debate whether creating an artificial all-girl environment is the best solution. By addressing gender equity head-on in a co-educational environment, we directly address those responsible for creating an inequitable educational and industrial environment by offering equity training and providing equitable recruitment and retention strategies. Until the historic inequities of the academic and social environments are addressed and rectified, the under representation of women, and minorities, in SMET can only be chipped away at in a piece meal fashion. The problem of the under representation of women and minorities in SMET is not the responsibility of women and minorities to overcome, but requires systemic social change by those within the system whom have perpetuated, however unintentionally, the inequities at the root of the problem. Just as separate is not equal, treating girls and minorities differently by offering them “special” programs is not sufficient to solve this problem.

The Women in Technology Project is uniquely positioned to address equity issues because it is administered by the Maui Economic Development Board, Inc., a non-profit organization committed to economic development and industry diversification in Maui, Hawaii. As an industry-driven organization, its Board of Directors consists of high-ranking executives from the local science, engineering and technology industries, top administrators of the local department of education and community college, and local political and community leadership. The commitment of these industry, education and community leaders to the mission of the Women in Technology Project as the Board members of its administering body has been crucial to continuing collaboration and dialogue to address the under representation of women and minorities in SMET education and employment in Hawaii.

In working to create systemic change, the importance of shaping a common goal, in terms that meet the bottom line for industry and community leaders, cannot be stressed enough. Fortunately, there is currently an abundance of research available documenting the need for a diverse SMET, and providing evidence that promoting diversity is not merely socially responsible, but is good business practice that enhances corporate performance.[2]
LEADERSHIP TRAINING WORKSHOP – A GENDER EQUITY TRAINING IN DISGUISE

The review by Women in Technology Project researchers of WEPAN Conference Proceedings from prior years revealed an article regarding the Carnegie Mellon Summer Institute for Computer Science Advanced Placement Teachers (6APT), an NSF-funded three-year project that delivers integrated instruction in gender equity and the C++ programming language.[3] First offered in the summer of 1997, the project integrated C++ training as a means of attracting teachers as program participants, and utilized it as an opportunity to demonstrate to teachers gender equity principles for the high school computer science classroom.

It was estimated that over the three years of the project, it would enroll from 15-20 percent of Advanced Placement Computer Science teachers in the country.[4] Evaluation of 1997 participants showed significant enrollment changes in computer science classes in participants’ schools for the 1998-1999 school year. In a New Jersey school, enrollment of girls increased from 9 to 25 percent, in a Texas school, enrollment of girls increased from 5 to 31 percent, and in a California school, enrollment of girls increased from 8 to 25 percent.[5]

The Women in Technology Project contacted the authors of the 6APT article to consult on possible duplication of this project in Maui. Unfortunately, the cost of duplication was prohibitive. In addition, girls are not under represented in Advanced Placement Computer Science or other computer classes in Maui County. As an alternative, the Women in Technology Project retained a consultant from the Washington Research Institute Center for Gender Equity, which had staffed the 6APT project, to provide a gender equity training for Women in Technology Project staff and local community, education and industry leaders.

In July, 2000, with the assistance of Karen Peterson of the Washington Research Institute a gender equity training was held on Maui. The title of the workshop was "Leadership Training Workshop for Educators and Industry: Strategies for the Recruitment and Retention of Women and Girls in Science, Math and Technology.” As a demonstration of their commitment to the success of the program, the provosts of each community college statewide committed to sponsor video conferencing of the workshop at their campuses. Therefore, the workshop was offered by video conference, at no cost to the Project, simultaneously to eight campuses on all six of the major Hawaiian islands.

The workshop was attended by 59 representatives of education, industry and the community. Participants included administrators of the state College of Engineering and four community colleges, the President of a local utility company, personnel from local technology companies and government laboratories, and local teachers and principals. Twenty-one percent of participants represented high schools, 18 percent represented community colleges, 9 percent represented university administrators, 12 percent represented industry, 13 percent represented government, and 25 percent represented the community.

The workshop required registrants to complete homework prior to attending that asked them to review examples of the under representation of women in SMET education or employment at their organization. The agenda included a discussion of this homework as a starting point, which proved an excellent means of bringing the issue home to the participants.

The President of a local utility company provided an introductory address on industry perspective of the need for a diverse technology workforce. Thereafter there was a full-group discussion on why girls do, and do not, enter and stay in SMET. The workshop leader then addressed the classroom and business climate, using role plays, visualizations, and presentations demonstrating behaviors by educators and employers that promote an inequitable atmosphere.

There were then small group discussions about what participants could personally do about recruitment and retention of girls and women. The workshop concluded with the participants working individually to develop and present personal action plans to address the under representation of women and girls at their institution. The workshop format relied upon participant participation in group discussion and personal reflection. This format was very successful in providing a non-hostile means of helping the participants recognize their personal responsibility for perpetuating inequity, however unintentionally.

Evaluations were completed by 44 percent of participants. Prior to the workshop, only 56 percent of respondents were aware of job opportunities in SMET in Hawaii. Ninety-six percent of respondents indicated that the workshop raised their awareness of the job growth in SEMT projected in Hawaii over the next several years. Prior to the workshop, 88 percent of respondents were aware that females are dramatically under represented in education and employment in SMET. Ninety-two percent of respondents indicated that the workshop raised their awareness. Prior to the workshop, 73% of respondents actively encouraged or supported females in pursuing or succeeding in careers in SEMT. After the workshop, 100 percent of respondents indicated they will now actively support. Eighty-eight percent of respondents expected to readily incorporate the strategies and techniques learned at the workshop into their classroom or workplace. Ninety-six percent of the respondents committed to helping expand the impact of the workshop by sharing what they learned with their colleagues. Asked to rate their commitment to action on gender equity in SEMT, 21% rated it “medium” and 79% rated it “high”.

Since the workshop was held in July, after high school and university enrollment was already closed, it is difficult to gauge the immediate impact of the workshop on enrollment or retention in SEMT education. We do have
some promising enrollment and retention information from the one program still enrolling after the workshop. Both the director and counselor for this degree program, which offers a B.A. in Computer Science at a local community college campus via distance education, attended the workshop. The 1998 cohort of this program was only 26 percent female, and only 42 percent of those females re-enrolled for the second semester. The 2000 cohort of this program was 29 percent female, and ALL of these females have enrolled for the second semester. Therefore, female retention increased 58 percent from 1998 to 2000. In addition, while females were only 18 percent of students re-enrolling for the second semester for the 1998 cohort, females were 38 percent of students continuing to the second semester for the 2000 cohort, a net gain of 20 percent.

This improvement is even more impressive in the context of the degree program as a whole. These improvements were for a subset of students enrolled in the computer science degree program of the state university, but attending classes via distance education from a community college campus on a separate island. These enrollment and retention improvement were achieved only among the students attending at the geographically separate community college site. While female students were 29 percent of initial enrollment in the degree program at the community college site, females were only 20 percent of initial enrollment in the degree program as a whole. In fact, female enrollment in the degree program as a whole had declined 5 percent from 1998 to 2000. Therefore, within this degree program, the improvements shown in female enrollment and retention were only demonstrated at the community college site, the site where the director and counselor had attended the equity workshop. This subset of students at the community college site actually had female enrollment 9 percent higher than that of the degree program as a whole.

The Leadership Training Workshop created a core of leaders in education, industry and the community both educated in equity issues and committed to working with the Women in Technology Project to address them. These leaders have provided volunteers for other Project initiatives, and have worked to address equity problems within their own organizations. For example, community college and university representatives from the workshop are working together to improve articulation of their 2-year and 4-year degree programs, easing the path for students, the majority of them female, from the community college to university level.

An additional, and unanticipated, benefit of this training is the access it has provided, through someone trained in equity issues, to the workshop participant’s school or business. Having a knowing point of contact within an organization has proven an invaluable asset to other Women in Technology Project initiatives.

MODEL PROGRAMS PROMOTING EQUITY I: FUTURE SCIENTISTS AND ENGINEERS OF AMERICA

Pursuing the commitment to developing programs based on an equity model required some diversion from the "traditional" path. While the Women in Engineering programs that make up the majority of WEPAN membership have focused on developing, mostly from scratch, programs only for girls, our equity model required programs that were, at least, co-educational. This co-education component was particularly important in developing relationships with local public schools, since many schools hesitate to collaborate on gender-specific programs in the anti-Affirmative Action age. The goal of the Women in Technology Project was to identify equity-based model programs for duplication. It was not considered cost-effective, given the initials two-year funding horizon of the Project, to develop and implement a program from scratch.

Intensive literature and web-based research revealed a model program with an equity component, Future Scientists and Engineers of America. This organization offers a turn-key program offering hands-on, team-based, project-oriented activities through a club for grades 4 to 12. The benefit of this program was not only that the program management infrastructure, including program development materials, training materials, curricula, and activity materials, were already in place, but that it was available on a cost-effective basis. This program could be adopted, with little effort, as an after-school or curricular program by schools at an annual cost, including all project and training materials, even t-shirts, of only $1,500 per 25 students.

Not only is this program cost-effective and simple to implement, is also incorporates the basic pedagogical methodology recommended not only by state and national educational content standards, but also by the equity research on what works for girls and minorities. The National Science Education Standards call for science as inquiry, though which students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others.[6] This is what the Future Scientists and Engineers of America program accomplishes with its hands-on, team-based, objective-oriented approach. In this program, students are engaged in science, math, engineering and technology because the program calls for the students to participate together in “doing” the process of inquiry and creation. These hands-on, inquiry-based program have been found to stimulate interest in and understanding of science and technology for all students, including girls and under represented minorities.[7]

In addition, the Future Scientists and Engineers of America program model requires gender equity, in that the participating students should include equal numbers of girls as boys. The Women in Technology Project contacted the FSEA leadership to learn about their success in achieving
A Statewide Approach

In Maui, the Women in Technology Project is funding the initial launch of the programs at the high school level, while recruiting funding support for programs at the elementary and middle school level. The total cost to the Women in Technology Program to reach approximately 125 students, 60 of them girls, through a weekly club at five public high schools is approximately $7,500 plus staff time. The cost and staff commitment to reach these girls are similar to the costs of holding a one-day conference or workshop, with the exception that Future Scientists and Engineers of America is a community-school-education collaboration that will become systemic within the schools and have a lasting benefit for years to come.

MODEL PROGRAMS PROMOTING EQUITY II:
ENVIRONMENTAL AND SPATIAL TECHNOLOGY (EAST) PROJECT

The Environmental and Spatial Technology (EAST) Project is a high school class that uses technology in service projects designed to improve student’s critical thinking and problem solving skills. It is a national community-based initiative offering a project-based, service-learning class that integrates technology into the high school curriculum by having students work in teams to solve real world problems in their communities. Technology infrastructure, hardware, software and staff development is provided to schools at a cost of $0.11 per dollar of value received. The technology that students use include: network system administration, computer aided design, visualization software, global positioning systems, geographical information systems, computer animation, solid modeling and assembly, programming, and design applications. There are over 10,000 students nationwide participating in this affordable and duplicable program. EAST requires that participating students represent the diversity of the school’s student population by gender, academic status, race/ethnicity, and socio-economic status. There are on-site visits to ensure that student enrollment meets the equity requirement.

The Women in Technology Project found the equity component integrated into the EAST Project model to be consistent with its mission of encouraging girls in math, science, engineering and technology, and provided funding support for its implementation at two Maui County high schools. The EAST Project team implemented the program in Maui, including installation of two complete EAST Project laboratories, within seven months. The installation of the EAST Laboratory at one high school instantly repositioned that school from being the least technologically equipped high school in the state to the most technologically advanced in the state.

At implementation, both Maui high school pilot sites were able to achieve the equity goals. For example, of the approximately 99 students whom have participated in EAST since its inception on Maui, 44 percent of them have been girls. Forty-four percent female enrollment in a high school
technology class is nearly double the 22 percent female enrollment in the computer science department of the University of Hawaii at Manoa, and far outpaces the national average female enrollment in Advanced Placement Computer Science classes of only 17 percent. Based on the EAST Project success at the two pilot Maui high schools, the Women in Technology Project is working with local government, business, education and community leaders to implement the EAST Project at all other Maui County high schools.

**CONCLUSION: RUNNING THE NUMBERS**

From 1990, the year WEPAN was founded, to 1998, first year full-time undergraduate enrollment of women in engineering increased an insignificant 1.9 percent (17.7% to 19.6%). During the same period, African American enrollment actually declined 0.4 percent, from 8.9 percent in 1990 to 8.5 percent in 1998. Hispanic enrollment increased 1.2 percent, from 6.2 percent in 1990 to 7.4 percent in 1998.8] Bachelor degrees in computer science conferred on women fell from 30.2 percent in 1990 to 27.3 percent in 1997, a decline of almost 3 percent.

Looking at what little change has really taken place demonstrates that real program successes have been very few. For example, Purdue University's Women in Engineering Program was the first of its kind in the United States when it was established in 1969. From 1969 to 1979, the number of women enrolled in its Schools of Engineering climbed from 1 percent to an impressive 15 percent. However, this has only improved an additional 7 percent in the last 20 years, from 15 percent in 1979 to 22 percent in 2000.9]

Clearly, a new approach is necessary. Striving for a "critical mass" through supplemental programs for girls and under-represented minorities is not sufficient. The real problem is not with the females and under-represented minorities, but with the educational and employment atmosphere that precludes equal access to the science, math, engineering and technology pipeline. Developing equity-based K-12 programs, or, even better, promoting the model programs that already exist, systematically addresses historic inequities, and teaches students to work together in an equitable environment, the skills necessary for a diverse workplace.

The process of promoting and implementing equity-based programs, such as EAST and Future Scientists and Engineers of America, has benefits beyond getting representative numbers of girls and under-represented minorities, and disadvantaged students, access to academic and extra curricular math, science, engineering and technology programs. The process of educating participating educators and business members while implementing the program, and beginning the dialogue on equity, has even more value, because it starts the process of systemic change. Another benefit of EAST and Future Scientists and Engineers of America is that they provide the pedagogical models called for by national and local education standards. Since they offer cost-effective means of adopting a pedagogical model that conforms with educational content standards, especially hands-on activities, there is a value-added aspect to them, since they offer educators and program administrators access to curricular models they are hard pressed to develop on their own.

**REFERENCES**


[5] Ibid., 111.


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