AC 2008-2413: SERVICE LEARNING: COMMUNITY AND CULTURAL VALUES THAT ENGAGE UNDER REPRESENTED GROUPS INTO THE STEM PIPELINE

Leslie Wilkins, Maui Economic Development Board

Isla Young, Maui Economic Development Board, Inc.

ISLA YOUNG: Ms. Young joined the MEDB Women in Technology Project in December 2003. She serves as a Program Manager working with students, educators, industry leaders, and the community. She serves as the Hawaii statewide coordinator for Project EAST profiled in this paper. She holds a baccalaureate degree in Business and Information Systems form the University of Phoenix. Email: isla@medb.org.

Service Learning: Community and Cultural Values that Engage Under Represented Groups into the STEM Pipeline

Abstract

Environmental and Spatial Technology (EAST) is a high school elective class that uses sophisticated technology in service projects designed to improve students' critical thinking and problem solving skills. EAST is a national initiative that now includes more than 220 schools in Arkansas, California, Hawaii, Iowa, Illinois, Louisiana, Oklahoma and Pennsylvania. It is a project-based, service-learning class that integrates technology into the traditional high school curriculum. EAST students work in teams to solve real world problems in their schools and communities. Among the technologies that EAST students interact with on a daily basis are: networking and network system administration, presentation applications, computer aided design (CAD), visualization software, global positioning systems (GPS), geographical information systems (GIS), web page design, computer generated animation, solid modeling and assembly, database management, computer programming, and design concepts and applications. There are over 12,000 students nationwide participating in EAST.

EAST develops partnerships with industry and government agencies to provide access to technology for the students to use in their projects. The benefit of this model for females and minorities is the requirement that recruitment and selection for participation in the EAST program represent the diversity of the school's student population in terms of gender, academic performance, age, race, and socio-economic status. There are on-site visits by the program administrator to ensure that there is equitable access to participation for all students and that the student enrollment is representative of the student body. Equity is improving because it is emphasized.

Introduction

Introducing and teaching STEM concepts via hands-on activities has been found to stimulate interest in STEM for *all* students, including girls.[1] According to the National Council for Research on Women, "strategies that increase girls' success in the sciences are also effective with boys, especially those from underrepresented groups."[2] One strategy that the Council identified as effective in encouraging girls in STEM is the incorporation of a cooperative, hands-on approach in math and science programs.[3] Programs combining hands-on activities such as student designed projects, and the provision of role models through mentoring, internships, and career-oriented field trips have been found to lead to interest in STEM, increased self-confidence, and better skill and concept development by girls.[4]

Research also shows that girls are less likely than boys to be involved in informal science and mathematics activities outside of school, in-school program initiatives are a desirable way to provide girls with equal opportunity and access.[5] In order to stay engaged, female students need to see mathematics and science as interesting and fun[6]. This often means demonstrating real-world applications that improve people's lives[7].

This paper focuses on a specific gender equity-based program launched in Hawaii in 2000 and its continued evolvement over the next seven years. The Environmental and Spatial Technology (EAST) Project was selected based upon its cost effectiveness, ease of duplication, the collaboration of community, industry and educators, efficacy as a program model and the potential for institutionalization. The purpose of this paper is to share the program's experiences with this initiative as a possible best practices model for other program developers.

The EAST Project

The EAST Project originated in/and continues its national administration in Little Rock, Arkansas — as a collaboration between industry, school districts, community organizations, and institutions of higher education.

Through its partnerships with school districts and higher education, it has developed the academic methodology to offer the staff development and program infrastructure for students in K-16. EAST Projects utilize students and sophisticated technology to work with community organizations to develop service-based learning projects to solve community problems. To date, the Hawaii implementation has focused on a high school delivery, with one middle school program.

EAST started in 1995 with one Arkansas school. It has since expanded exponentially and been named a model program by the International Center for Leadership in Education. In 2006-2007, EAST Projects were in place in more than 220 schools in Arkansas, California, Hawaii, Idaho, Illinois, Oklahoma, Pennsylvania and Louisiana.[8] There now are over 12,000 students nationwide participating in EAST.

The mission of EAST is to promote critical thinking and problem solving skills of all students, regardless of their socio-economic background or previous level of achievement. By engaging students in an educational environment steeped in emerging technologies and focused on self-direction and community service, students can become life-long learners and problem solvers. This program model was selected for implementation in Maui County because it offers the kind of STEM learning environment that has demonstrated effectiveness for girls and boys, as well as the real-world relevance girls need to remain interested in STEM education.

The EAST Project was also chosen because it offers a great value for the school. Under the program, each participating school is provided with the technology infrastructure, hardware, software and staff development necessary leveraging funding outside the Department of Education budget. The technology infrastructure includes the development of a special computer lab with very sophisticated hardware and software.

Hawaii schools have been funded through leveraged grants, industry and community support. Even with this extramural funding model the cost per school is substantial -- close to $100,000. In return for the technology and program infrastructure, EAST schools must comply with a number of program requirements. Of these, most impressive from an equity standpoint, is the requirement that student participants reflect the demographics of their school's student body by age, gender, race/ethnicity, socioeconomic status, and academic status. This stipulation ensures

that all students at the school receive equal access to what EAST has to offer, and that EAST Project resources are allocated equitably to all students. It not only makes school administrators and teachers aware of the need for equality of access and opportunity, it obligates their responsiveness to diversity, and provides the incentive to do so. There are on-site visits by the program administrator to ensure that there is equitable access to participation for all students and that the student enrollment is representative of the student body.

Real-world application

EAST is unlike any other class in today's high school curriculum. It is a project-based, service-oriented course that provides students with the most current, high-end software available in the most progressive fields in the world. Among the technologies that EAST students interact with on a daily basis are: networking and network system administration, presentation applications, computer aided design (CAD), visualization software, global positioning systems (GPS), geographical information systems (GIS), web page design, video production, computer generated animation, solid modeling and assembly, database management, computer programming, and design concepts and applications. In the surveys of student participants described below, access to computers and software are repeatedly referenced by the students as highlights or benefits of the program. In 2006, 42% of female participants cited learning software applications and 14% cited greater computer skills as benefits of the program. In 2007, these figures were 32% and 10%.

The learning environment is unique because each class is led by a facilitator who guides the students in their own self-driven learning process. Each student team works with at least one technical advisor/mentor from the community who acts as a role model while providing the students with insights into the application of the technology to community needs and to the local workplace.

At the outset of the course, students are encouraged to tinker with an assortment of software applications. As their comfort level with computers and software increases, they are encouraged to discover an issue in their community they feel passionately about and begin to consider how they might use technology to solve a real-world problem.

In the process of solving vexing community problems, the students learn to become creative, intuitive, adaptive learners who can solve unpredictable, real-world problems as part of a team. Consistent with national research cited above, female participants do in fact cite real-world problems, helping others, or connections to people as a highlight or benefit of their participation in EAST. Recent examples of student projects include a variety of environmental efforts, including examinations of electricity usage and alternative energy, recycling promotion, invasive plant species eradication, and stewardship of fishing environments; efforts to promote teamwork, collaboration, and cooperation within a school community; and a campaign to educate a community about relationship violence.

Each student is required to develop a website on which they track the progress of their community project. Students frequently become so involved in their EAST Project work that they come in to work in the EAST lab during lunch, recesses, and after school. Mentors and

other community partners also make visits during school hours to help with projects.

Key components of Hawaii's EAST program have been a focus on the unique cultural values while providing students the vehicle to give back to their communities. The Hawaiian culture is based on taking care of the 'aina (land) and the people of the islands. The program intertwines service learning with community based projects to create an environment inviting to both underrepresented groups and girls. Many students are first attracted to the program knowing they are creating real world solutions in their *own* communities and the mastery of the sophisticated software tools is secondary.[9] The platform aligning cultural and community values set EAST apart from the routine computer lab course. We have found that the connection between the Hawaiian culture and high tech has increased the percentage of underrepresented groups and girls participating in the EAST program.

Program Results

During the 2000-2001 school year, the Mayor of Maui County recognized the value of the EAST program to Maui's technologically-challenged high schools and provided funding to implement EAST at two high schools. At that time, one school -- Lahainaluna High -- had been ranked as one of the least technologically proficient schools in the state. Within a year of the implementation of EAST, Lahainaluna High's program was awarded the Best EAST Project nationwide at the EAST National Conference. EAST in Maui was so successful in its pilot year that it was implemented at an additional three high schools and one intermediate school in 2002.

EAST's community-based model continued to prove effective with the Maui projects showcased at the 2003 EAST Partnership Conference: "Project Typhus," "Dome School," Hawaiian Commercial & Sugar Virtual Tour," and "The Anti-Drought Project." For the third year in a row, Maui's EAST schools took top honors in the national competition measuring them against more than 200 schools. In 2004, students at King Kekaulike High School received one of only four Founders Awards given at the Conference to a Project EAST school that best embodies community interaction, collaboration with schools and business, integration of technology and student growth.

Since Maui EAST students began participating in statewide as well as mainland and international competitions, they have not only received broader recognition, but also the opportunity to network with other schools in diverse communities, compete at a national level, access high-end training workshops and gain exposure to college recruitment and scholarships. When asked for the highlight experience of their year in EAST, many students reference the national competition.

In 2005, Maui EAST schools became the first high schools in the state to receive "AutoCAD" software and training. "AutoCAD" is the worldwide industry standard for 2D and 3D computer-aided design. The unprecedented learning opportunity is a result of successful negotiations between Maui County's EAST program administrator, and AutoDesk, the company that originated the widely used drafting and design application.

AutoDesk agreed to match the 25 software licenses WIT purchased for Maui's EAST labs by a

factor of five, resulting in a total of 125 user licenses and complete facilitator training outside the workplace. Normally, AutoCAD use is primarily limited to those organizations that need and can afford it. Industry trainers from the mainland made a special trip to Maui to conduct facilitator and student training.

In the 2004-2005 school year, Maui's EAST program administrator began surveying participating students and teachers about their experiences with Project EAST in the hopes of fine-tuning the program and beginning to track its impact on students. Surveys were collected from students at the 5 participating high schools (147 the first year, 82 the second, and 210 the third) and the participating middle school (23 the first year, 32 the second and 16 the third). The surveys revealed a fairly even participation across grade levels, slightly weighted toward the older grades in high school and the younger in middle school. Data was also received from facilitators at five schools in 2005.

Of the high school students surveyed in 04-05, 76% reported that their participation in Project EAST had increased their interest in studying STEM. In 05-06, this figure was 82% and in 06-07, it was 76%. For the last two years, the figures are further broken down to examine the impact on female students and the findings are that 81% and 75% of female students report the the EAST experience increased their interest in STEM. Female students who come into the program reporting no interest in STEM and leave reporting an increased interest are perhaps of most interest for future research into impacts of the program. In 2006 there were 9 such students (out of 43) and in 2007 there were 20 (out of 63).

Project EAST also positively impacted student interest in pursuing STEM careers. In 2005, 61% of students entered the program with a desire to pursue a STEM career and that number increased to 71% after participation. In 2006, the initial percentage of interested students was 66%, which increased to 72% after participation. In 2007, the initial percentage of interested students was 58% and the number increased to 66% after participation. When these numbers are broken down further to show just the experience of the female students, the number leaving the program with the intention of pursuing a STEM career was 72% in 2006 and 51% in 2007. Again, of special interest are the females who began the program reporting no interest and left the program intending to pursue a STEM career. In 2006 this number was 5 (out of 43) and in 2007 it was 9 (out of 63).

In 2005 and 2006, the administered survey also investigated recruitment by asking students how they learned about Project EAST. In 2005, the largest number, 47%, learned of the class through friends, while only 18% learned through a teacher, 14% through a classroom presentation, 6% from a parent, 5% from a guidance counselor and 4% from a flyer. In 2006, the findings were similar, but, when broken down by gender, it was revealed that females (49%) were even more influenced by friends than males (39%), and also more influenced by teachers: 23% as compared to males 13%. Male and female students were roughly equally likely to have heard about EAST from a parent (10% and 9%), a counselor (13% and 12%), or flyer (10% and 7%).

These findings are relevant to anyone seeking to recruit females into a STEM program and indicate that encouraging enrolled students to talk to their friends about the program may be more effective than trying to promote the program through teachers, parents, counselors, or any

other means. Under these conditions, Project EAST enrollment should continue to thrive, as 97% of students in 2005 said they would recommend EAST to a friend. This number was 94% in the 2006 survey and 84% in the 2007 survey.

Students were also questioned to determine what appeals to them when they are deciding to enroll in the class. The biggest response (45% in 2005, 48% in 2006, and 46% in 2007) was that it sounded fun, followed by an interest in science and engineering (35% in 2005, 31% in 2006, and 26% in 2007). When these responses were broken down by gender in the review of the 2006 and 2007 data, the findings were that "sounded fun" was by far the most significant reason, with 44% of females reporting this was a factor, as compared with the next most common factor, STEM interest, at only 23%. Project EAST must be delivering on the promise of being interesting and fun because the vast majority of students (88% in 2005, 91% In 2006, and 84% in 2007) said the class met their expectations.

According to the surveys, the Projects have also done fairly well at the goal of gender and ethnic equity. Across all high schools, for those students designating a gender, 40% were female in 2005, 39% in 2006, and 34% in 2007. These numbers are stellar compared to the numbers of women currently pursuing STEM degrees, but still show there is a long way to go before true equity is achieved. The formal survey conducted in 2005 and informal conversations with facilitators since indicate that, while most facilitators make it a point to seek out female students, there are no recruitment methods designed specifically to attract females or other under represented students currently in use. The program administrator's project director plans to become more directly involved with facilitators regarding recruitment for fall 2008.

Perhaps the biggest coup of the EAST program in terms of introducing more females to the STEM pipeline is the fact that virtually every female EAST participant surveyed who was returning to high school the following year reported that she planned to take a math or science class. Many of these returning students were taking both math and science, and significant numbers (61% in 2006 and 30% in 2007) were taking higher math (geometry, trigonometry, pre-calculus, calculus or physics). Recent informal conversations with some of these students indicate that some have consciously chosen to select these courses as a result of their experience with EAST and learning about career opportunities in technology.

The EAST model continues to set the standard in workplace skill development for students. By leveraging county funding with federal investment, Maui's Women in Technology has used Project EAST to provide increased training opportunities for students, enabling them to gain skills to compete in the global marketplace. The primary challenge in working with the program has been the limited ability of the national leadership to facilitate investment in communities outside of Arkansas. The vast majority (154 out of 180, or 86%) of the schools with web-links on the national EAST website are from Arkansas, where EAST began and continues its national headquarters and program deployment.[10] If more schools from other states participate, more program pedagogy and training capacity can reside from within local communities.

Conclusion

Project EAST focuses on gender-equitable rather than gender specific programs to encourage

more girls in STEM. This strategy reflects a growing body of literature that suggests that academic models and standards that are effective for encouraging girls in STEM, such as hands-on, community-oriented and team-based programs that utilize mentors, are effective for all student groups. By utilizing an equity-based approach, it is hoped that these programs can help more directly address the inequities that have led to the under-representation of women in STEM.

The EAST Project program results regarding equity are encouraging, but not cheap. While the cost to the school and community was substantial, approximately $100,000 per school, the value of technology and expertise made available to the school is exponentially greater. In Maui County, EAST is implemented as part of the regular school curriculum, and offers a technology lab including hardware, software, technical assistance and appropriate teacher development valued at several hundred thousand dollars. In addition to the opportunities afforded its current participants, EAST presents opportunities for further research into what attracts and retains females to STEM education and influences their choice of STEM careers.

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