ENVIRONMENTAL AND SPATIAL TECHNOLOGY (EAST) PROJECT – AN INDUSTRY/EDUCATION COLLABORATION THAT WORKS FOR FEMALES AND MINORITIES

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Abstract *— 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.*

Index Terms — Best practices, duplication, equity model, 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 state of Hawaii. The Women in Technology Project started in the fall of 1999. It was decided that the Women in Technology Project would be most effective if it brought best practice models from around the country to Maui for duplication.

In January, 2000, the Women in Technology Project was approached by a local teacher interested in bringing an Arkansas-based program, the Environmental and Spatial Technology (EAST) Project, to Maui. This paper will describe the EAST Project model, why it is a best practice model for encouraging female and under represented minority students in math, science, engineering and technology, and how the EAST Project was successfully duplicated on Maui.

WHAT IS EAST?

EAST was first implemented in 1995 at Greenbrier High School in Arkansas with 20 at-risk students. The EAST Project model is best described as a performance-based learning environment that combines problem-based service learning and advanced technological applications.[1] EAST is integrated into the high school curricula as an elective class that is structured around students taking on specific projects that help their schools and communities. They use the capabilities of a sophisticated computer laboratory as a resource to complete these projects.

EAST exists in an interdisciplinary lab where the intellectual and problem-solving growth of students, not the technology-rich environment, is the focus. Although EAST students have sophisticated technology at their disposal, it is important to understand that the class itself is not about teaching technology. Experience with technology education has demonstrated that teaching technology for technology's sake robs students of a meaningful educational experience. Students who have been "taught" technology applications make the mistake of thinking that their worth is based on the applications that they have mastered.[2] EAST is about using technology as a starting point in the development of the relevant goal of creative, open-minded and innovative problem solving in the context of teamwork, responsibility, and personal initiative that provide the channel through which students develop their creative thinking skills.

In EAST, student interest is the motivator, not preconceived student ability. Each student shares in a rich and rewarding educational experience that, at various times, makes them the "expert" in their specialty or a driving force behind the completion of a project. As a result of the infrastructure support provided by school, community, and industry partnerships, EAST schools can establish and sustain a multifaceted interdisciplinary, service-learning curriculum integrated with advanced technical applications from the following disciplines: architecture, animation, computer aided design (CAD), 3D design engineering, digital imagery, electrical design, global positioning systems (GPS), geographical information systems (GIS), image analysis, networking, system administration, programming,

Raster editing and manipulation, visualization, and web development.[3]

The teacher's role in EAST is to focus on the intellectual development of each student, while integrating basic traditional curriculum objectives into the class through application to the service project goals. Student success is measured by how much growth the students demonstrate in mastering and applying basic skills and concepts, as well as progress made toward the development of creative and critical thinking skills. To accomplish this, students are linked with peers, faculty, business and university partners, and community members who channel their energy and expertise by collaborating with the students in a consultative relationship. From the students' point of view, project-based service-learning activities do not look or feel like school in a traditional sense. Since the students work together with industry and community members to apply cutting-edge technology to a problem presented by a "client" from the community, the learning environment created is more like the modern technology workplace than a classroom. Expectations are extremely high, and students are expected to produce tangible results that satisfy a community need.

Based on ongoing evaluations, students in the program nationwide appear to have met or exceeded expectations. Student information transfer has been greatly enhanced by tapping into kinetic and visual learning styles. By allowing students to become personally engaged in their learning process and by requiring the students to take personal initiative, the students have developed into active learners capable of taking on the personal responsibilities necessary to insure success in a team effort. Students mentor one another, develop personal accountability, and acquire ownership in both the project and the learning process. This results in a collaboration of creativity, student achievement, improved self-esteem, and expanded opportunities. Students are exposed to strategies that help them move from the traditional self-centered approaches of learning to more realistic (and more relevant) skill sets that stress understanding, collaboration, and a team approach to problem resolution. EAST also provides students with a place in their schools where they can integrate and apply the knowledge that they acquire in their other classes.

Teachers provide students with opportunities to experiment while using relevant tools. They allow students to make and profit from mistakes, which fosters the students' ability to become self-reliant problem-solvers. In EAST, the teacher is not the traditional "sage on the stage". Rather, the teacher's role is to be the "guide on the side". Teachers in the EAST lab are not called "teachers", but are called "facilitators". The teacher is freed from having to be an expert in every one of the applications being used. Instead, they are experts at cultivating student development. This relationship structure better reflects the modern workplace, with the teacher playing the role of a project leader, synthesizing the specialties of all the members of the team with an eye toward the project as a whole.

One major factor in the success of the EAST Project model is the attitude that the facilitator and the school provide. With the focus on the accomplishment of goals, the EAST lab is transformed from a classroom into a collaborative "proving ground" of ideas. The role of the school and the facilitator is to work alongside the students in accomplishing their goals, not as the final judges of right and wrong answers.

EAST Projects

It is difficult to convey the EAST Project model without seeing the results as the students themselves present them. The accomplishments of the students in meeting service-project objectives, and their ability to present their work product to the community in a professional manner, are so impressive that in some employers recruit EAST participants directly into the workforce straight out of high school.

For the purpose of example, we will describe one project completed by students in Arkansas. The students did a project for the local school board, which was looking for a location for a new primary school. Students used advanced technology to solve the problem. First, they identified the existing population of students in grades K-4 in the county. Then, since the purpose of the project was to project where the biggest need was going to be in five years, they needed to extrapolate from the available data. While the census data was eight years old, it did provide the number of households, number of people per household, and average age range. Working from this, students then needed to account for new homes in the county over the intervening eight years since the census. They did this by referring to city water department records, since the department supplies water to all county residents. Students then analyzed the data to get an idea which areas were growing and which areas met the need requirements of the primary school. Once the data analysis was complete, students developed a presentation and made their recommendation, which was adopted by the school board. Property has since been selected and building plans have been approved for the new school.[4] The Arkansas project is an example of one of the many service projects completed by students nationwide applying technology solutions in the EAST Project.

Industry-Community-Education Collaboration

The EAST Project model has demonstrated success as a dynamic catalyst in transforming teacher-centered classrooms into student-centered Information Age learning centers. Originating and driven from within education, EAST began as, and continues to succeed as, a grass roots collaboration between education and industry.

The EAST Project model is the result of collaboration between Wellsco Graphics Solutions, Intergraph Corporation, The University of Arkansas and the Greenbrier

School District. As a project-based, service-learning model, EAST is focused on physical results that rely on the school and community to provide meaningful projects for the students. The community becomes a wellspring for the student, a place where the project originates, and where the resources exist to solve the problems that arise. In the process, the student becomes a productive participant in her community, working in collaboration with community members to achieve project goals. In many cases, the EAST Lab has resources that local communities do not have, and, combined with a knowledgeable user base of students, a treasure for the local community is created. In return, business and community partnerships allow students to collaborate with companies to solve real-world problems.

EAST develops true, symbiotic partners in its relationship with business and industry. The partners in the EAST Project model assume part of the responsibility of making sure that the students have the tools necessary to work on the projects that they undertake, thereby assuming part of the responsibility for providing students with an opportunity to grow and achieve. The other part of the responsibility for providing opportunities for success rests with the local schools.

WHY EAST IS A PEDAGOGICAL MODEL THAT WORKS FOR FEMALES AND MINORITIES

The pedagogical model of the EAST Project: project-based; service-learning; focus on creative and critical thinking skills; teaming of students with peers, teachers, businesses and community members; goal of real, tangible results; stress on collaboration; integration of kinetic and visual learning styles, encompasses a variety of educational strategies that are effective with a wide variety of students, particularly female and under represented minority students.

According to the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, "Many of the strategies advocated by both the national mathematics and science standards, such as hands-on activities and cooperative learning, have been found to stimulate interest and understanding of science and technology for all students, including girls, underrepresented minorities, and persons with disabilities."[5]

The EAST Program model also incorporates a number of key elements recommended by the AAUW Education Foundation's report, *Tech-Savvy: Educating Girls in the New Computer Age*. According to the report, "Computing ought to be infused into the curriculum and subject areas that teachers care about in ways that promote critical thinking and lifelong learning."[6] The report calls for a redefinition of information technology fluency that requires facility with relevant skills, concepts and capabilities. The best way to achieve this new fluency is by engaging students in "coherent, ongoing projects to achieve specific goals in subjects that are relevant and interesting to them."[7] This is what the EAST Project model is based upon, the project-based service learning that is recommended by the AAUW Education Foundation.

The EAST Project model also encompasses the elements called for by the *National Science Education Standards* upon which many state departments of education rely in shaping their own educational content standards. The *Standards* require that students learn more skills than just observing, inferring, and experimenting. They call for students to participate in the scientific process of inquiry by describing objects and events, asking questions, constructing explanations, testing those explanations against current scientific knowledge, and communicating their ideas to others.[8] Again, this is what the EAST Project model challenges students to accomplish by tasking them with a community need to which to apply the relevant technology in forming a solution, and then packaging and communicating that solution to a community "client".

The EAST Project utilizes a pedagogical model that it has developed with the input of both K-12 and postsecondary educators, and that not only reflects the latest research on what works for females and minorities, but also integrates an on-going process of program evaluation.

EAST's Equity Requirement

It is not by accident that the EAST Project model exemplifies the pedagogical styles that have been demonstrated to engage students regardless of gender, race/ethnicity, socio-economic status, academic status, or learning style. In doing so, it reflects the most important element of the *National Science Education Standards* for those concerned with equity in math, science, engineering and technology education; that these subjects and careers are for ALL students. The *Standards* includes language specifying that science education is for all students, regardless of age, gender, cultural or ethnic background, disabilities, aspirations, or interest and motivation.[9]

The EAST Project was conceived and designed to serve a diverse population of students, from those identified as special education to "average" students to the advanced and gifted students. The EAST experience is provided to ALL students based upon their interest and effort, not their pre-test scores or accumulated past achievement.

The EAST philosophy is based on the following educational principles:

- All students have value and deserve the opportunity to demonstrate their value to their school and community.
- Education must be relevant, challenging, purposeful and student-centered.
- Educators should serve as resource guides and learner facilitators.
- Learning should be self-directed and oriented towards real-world projects.

- High expectations must be maintained and must drive all students.

These principles underlay the fundamental value of equity that is a key component of the EAST Project success. Every school participating in EAST must execute a "Statement of Assurances", which, among other things, obligates the school to ensure that student participants in the EAST Project reflect the demographics of the school's student body by age, gender, race/ethnicity, academic status and socio-economic status. The ongoing backlash against affirmative action notwithstanding, this school/community/industry initiative requires equity of opportunity and participation as a keystone of the program's success. In order to ensure compliance with the equity component, site visits of schools are conducted.

EAST AS A MODEL FOR DUPLICATION

EAST has been developed as a model intended for ease of duplication. The effectiveness of the infrastructure for duplication of EAST is demonstrated by its exponential growth. EAST began with one school and 20 students in 1995. By the 2000 academic year, 95 schools and 10,000 students from Arkansas, Alabama, Illinois, Louisiana and Hawaii were participating.

From its beginning, EAST has been supported by an academic partnership, the infrastructure of which brings local educators together with local, national, and international companies that have relationships with universities across the country, and whose user base provides a network of additional support at the local level. By integrating these available resources with a successful educational model, this infrastructure has provided the capability of duplicating the EAST model to a broad base of additional sites across the country.

This infrastructure also makes it possible to provide a wealth of technology resources to participating schools at a minimal cost. Through these industry, community, and education partnerships, 55 schools had received a total of $33,218,359 worth of technology by January, 2000. Of this, $26,992,223 in value came from private partner contributions, $2,522,319 came from grant contributions, and $3,703,817 came from the schools themselves. This represents a value-to-cost ratio of 9:1. In other words, individual schools contributed $0.11 for every dollar of technology received through EAST. The EAST Project industry partners come to each new site with $400,000 in free technology equipment, technical support and staff development. The software alone is worth $25,000 per seat in each EAST Lab.

The value in technology hardware and software offered by the EAST industry partnerships is very attractive for schools and provides a strong incentive. However, the schools must also provide a commitment. For each school participating in EAST, the local school district must "buy in" by raising about 20 percent of the capital funds for the program from local businesses and community resources. The greatest expense of EAST is the up-front cost of the EAST computer lab. The total cost of each lab is approximately $500,000, with 20% or $100,000 of the cost coming from the local community. Once the lab is in place, however, the cost, other than providing a teacher/facilitator, is about $2,000 a year for professional development.

All schools participating in the EAST Project must also make a commitment to program success by assuring the existing participants and consortium partners that the basic principles and concepts upon which the EAST Project model is founded will be followed. Some of the most important responsibilities of the Local Education Agency (LEA), constituting the individual schools and their school districts, are:

- The LEA will commit to staff development on a continuing basis for the lead EAST facilitator, and to initial training for at least one other support staff. This staff development consists of 23 days of training, provided by EAST, in the first year and seven days of training in succeeding years.
- The LEA will commit the necessary resources required to insure the on-going success of the EAST Program.
- The LEA will recognize that the EAST Program will be an integral part of its curriculum, and thus seek to adopt, integrate, and expand the advanced applications project-based service-oriented methodology inherent in the EAST model.
- Students recruited and selected for the EAST Program will represent the diversity of the institution's student population in terms of gender, academic performance, age, race, and socioeconomic status. Additionally, students will be encouraged to attend, off-campus training and educational opportunities that are sponsored or endorsed by the EAST Program.
- The LEA will agree to participate in periodic on-site evaluations by EAST personnel for the purpose of program improvement and enhancement.

The EAST Project has grown to include middle school students and community college students as participants. The low cost to value ratio for schools makes this program very attractive for duplication at schools that have struggled to meet technology infrastructure or staff development goals. Unlike programs that donate computers, but not the trained staff or the infrastructure for them, EAST provides everything necessary for a functioning laboratory.

The EAST Project model relies continuously on existing national partnerships that have been forged. For example, the curriculum for the EAST facilitator training program is written by the University of Central Arkansas College of Education. The University of Arkansas at Fayetteville's Center for Advanced Spatial Technology (CAST) and the Louisiana State University College of Design provide some

of the technical training for EAST. The EAST Project website, www.eastproject.org, provides technical support, resources and training for students and teacher/facilitators on-line.

The Duplication of EAST in Maui, Hawaii

The Women in Technology Project had just been launched when project staff were approached by a local teacher in January, 2000, interested in bringing the EAST Project to Maui. In spring, 2000, EAST Project staff and several EAST Project students traveled from Arkansas to Maui to give presentations to industry, education, government and community leaders. The Women in Technology Project staff was impressed by the quality of the presentations given by the Arkansas students, and by the advanced nature of the solutions they produced. The Women in Technology Project also found the EAST Project model to be consistent with Women in Technology Project research conducted on Maui.

A Women in Technology Project survey of Maui high school students had asked what could be done to encourage students to take science, math and technology classes. Females were more than twice as likely as males to indicate that they would want to take science if it was made more relevant to their lives (37% to 16%). Students of both genders indicated they would want to take science if there were more interesting projects (41% of females, 42% of males), more team projects (20% of females, 24% of males), and more hands-on activities (37% of females, 39% of males). Students also said they would take science if it would help them get a good job, demonstrating that students were not aware of existing job opportunities and reflecting a "disconnect" between students and the larger workplace community around them.[10]

Maui students responded that similar things would engage them in mathematics education. The top priorities for male students discussing math education were: more hands-on activities (39%), more interesting projects (34%), more team projects (24%), and if it would help getting a good job (20%). The top responses for female students were: more interesting projects (27%), more relevance to life (24%), and better teachers (23%).[11]

The Women in Technology Project agreed to provide funding for EAST duplication in Maui because the EAST Project model provides what Maui County high school students, female and male, asked for in the Women in Technology Project survey. The service-learning and work-like environments provide the relevancy so important to female students. The need for interesting, hands-on, team-based projects is also clearly met through the EAST Project model. However, the EAST Project model does not merely satisfy the needs of students in Maui County, but reflects national data on engaging females and minorities in science, math, engineering and technology. In doing so, the EAST Project model also satisfies educational content standards, an issue of prime importance to teachers and administrators nationwide in this era of standards reform.

Hawaii is in some ways unique, since our education system is run at the state, not county or district level. This, plus our "laid-back" lifestyle, could have stalled implementation of the EAST Project for years. However, with the support of the Maui County mayor, local industry, and a visionary district superintendent, the EAST Project team implemented the program in Maui very rapidly. Within six months of the first meeting, by the end of June, 2000, an EAST Laboratory, consisting of hardware and software, was installed and operational at Lahainaluna High School and Maui High School, both on the island of Maui. Installation of the labs included placement of the necessary cabling to wire the labs. The work was accomplished in rapid fashion because EAST provided the hardware, software, and professional development, as well as technical support, needed to get the job done. The school drew upon its own community resources, parents, and students to provide the person-power to unpack everything and to pull wires through the structure to get the labs set-up.

The lack of the necessary electrical and wire infrastructure at Lahainaluna High School, the oldest school west of the Rockies, had been a seemingly insurmountable technological obstacle for the school. The installation of the EAST Laboratory at Lahainaluna High School instantly repositioned that school from being the least technologically equipped high school in the state, where students learned keyboarding on typewriters, to the most technologically advanced in the state.

Since the Hawaii economy has been in recession for the last 10 years, it helped that the school and community combined only needed to come up with 20% of the actual cost of implementing the EAST labs. The major cost of implementing EAST is the cost of building the EAST Lab, which will vary depending on the existing resources and infrastructure in the school. In Maui, the cost of the labs was $500,000 each. The community/school contribution required was $100,000 per school for the two schools. The support of the Maui county and Hawaii state government were significant in reaching the community/school portion of the funding obligation. The Maui county government committed $30,000 of the cost of the two EAST Labs, and the Women in Technology Project provided $10,000. The remainder came from other community supporters, and a portion from the school and Department of Education. Development of a local high technology industry is an important state and county policy commitment, which certainly helped ease the way for funding of this initiative here. While it was not necessary here in Maui, EAST does provide support in guiding interested schools toward outside funding sources and grants.

Once the EAST Labs were installed, which was accomplished incredibly fast, the next goal was training for students and teacher/facilitators. In order to provide on-site training for an initial cadre of students, and their

teacher/facilitators, an Advanced Applications Camp was offered by EAST on Maui from June 23 to July 9, 2000, at the Lahainaluna High School campus. The camp was composed half of students from Maui and half of students from Arkansas, who were brought to Maui by EAST to share their expertise in a team environment. The camp teamed the Arkansas and Hawaii students together on several projects as a means of providing training for the Hawaii students in a team-based atmosphere.

Projects undertaken by the students at the camp included:

- Using GPS and GIS to map fire access routes, water sources, fences and potential staging areas at an isolated national park as a resource for effective firefighting.
- Working with the Civilian Conservation Corps at Haleakala National Park to collect GPS points for a 3D map to aid in prioritizing conservation at the park.
- Mapping and imaging the high-water mark along Maui coastline to provide a baseline for monitoring beach erosion.
- Using GPS and GIS to locate and map a historic Hawaiian archeological site. Based on the students' work, the location of the site was determined and funding of $400,000 has been committed for restoration of this significant cultural landmark.

An open house was offered to demonstrate the accomplishments of the students at the camp. Attending the open house, it was gratifying to view the EAST Project equity model in practice. It was a unique experience to see high school students from Hawaii and Arkansas, of all races and ethnicities, socio-economic and academic statuses working together. The pride of the students in their work was apparent as they, as a team, presented the results of their labors. It demonstrated that not only can equity be achieved in the technology classroom at the high school level, but that doing so has benefits for all students that goes beyond their intellectual growth. Encouraging teamwork in a diversity environment also fosters students' growth as individuals capable of working in collaboration with people of different genders, races, or socio-economic backgrounds, whom they may not otherwise have the opportunity to know.

The EAST Project was implemented as part of the high school curricula at Lahainaluna and Maui high schools at the beginning of the 2000 school year. EAST at both schools was able to achieve the equity goals, including parity by gender and race/ethnicity. The crowning achievement of EAST in Maui came in February, 2001, at the national EAST Partnership Conference in Arkansas, where the Lahainaluna EAST team was awarded Best Overall Project among the 98 schools participating. It was a great honor for Lahainaluna to win the award given they were competing against more experienced EAST schools. In addition, a female high school senior from the winning Lahainaluna team plans to enter the College of Engineering at the University of Hawaii this fall.

Based on the success of the two pilot EAST high schools on Maui in meeting the gender and race/ethnicity equity requirements, the Women in Technology Project is collaborating with the Mayor of Maui County to implement EAST in all Maui high schools. The mayor has created a fundraising campaign called TechReady to raise the funds to expand EAST to the remaining five high schools in Maui.

We are enthusiastic about EAST, which was incredibly easy to implement and which created a strong sense of pride in a historically disadvantaged public school system. We encourage anyone interested to contact Bridget Chitwood, (bridget@eastproject.org, 501-371-5000) or Elizabeth Cowan (ecowan@wellscoinc.com, 800-317-1080). They can provide EAST materials and will work with you and your local school officials to implement EAST in your area.

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