

Engaging Middle School Girls by Aligning Culture and Science

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Abstract

Now in its fourth year, “Excite Camp” is premised upon the engaging curriculum marriage of culture and science. The program creates interest in math and science among Native Hawaiian middle school girls, by exposing them to respective applications in their community, in tandem with the sophisticated science of their native culture and history. Program development for Excite Camp is provided by The Women in Technology (WIT) Project of the Maui Economic Development Board, Inc. (Maui, Hawaii) and is funded in part by the Department of Labor as a workforce development project.

Research indicates that the transition from middle school to high school is a critical time when girls often lose interest in math and science. They view these career fields as boring, not relevant to their lives, and Caucasian male-dominated. As a result, they do not pursue them. WIT has been working with Kamehameha Schools (a private school for Native Hawaiians) and the U.S. Air Force Research Laboratory to address the dual barriers of gender and ethnicity facing Native Hawaiian girls by exposing them at this pivotal point to technology in the context of their community and native culture.

Each year, the WIT project invites female scientists of Native Hawaiian ancestry who are involved in math and science-based careers to the camp to participate in the activities and provide mentoring for the students. WIT also employs a team-based, instead of the individual or competition-based, paradigm that has been proven to be more effective for girls’ education.

This paper will present survey results, anecdotal evidence, multi-year tracking and improvements/revisions to the program as it progressed through its fourth year. Its importance to this conference is the demonstration of how WIT analyzed available research and developed community-based, culturally appropriate and cost-effective programming. These programs provide on-going validation for the need to effect policy changes to fund programs like Excite Camp that will have positive career choice implications for indigenous populations of girls. Culturally aligned programming can contribute significantly to building self-efficacy and lifting dual barriers of ethnicity and gender.

Background

Launched in 1999, the Maui-based Women in Technology Project (WIT) is funded by the U.S. Department of Labor as a workforce development project. Its mission is to encourage women and girls to pursue education and careers in science, technology, engineering and math (STEM) in the state of Hawaii.

In 2001, WIT approached the U.S. Air Force on Maui to allow student access to its classified asset the Maui Space Surveillance Complex and to partner in an educational outreach program designed to engage native Hawaiian middle school girls in STEM education and careers on Maui. The partnership also involved Kamehameha Schools, a private school funded by the Estate of Princess Bernice Pauahi Bishop to fulfill her desire to create educational opportunities in perpetuity to improve the capability and well being of people of Hawaiian ancestry. Kamehameha Schools provided some seed funding for the project, WIT led the program development including gender equity principles and minority outreach, and the U.S. Air Force offered students the opportunity to visit the Maui Space Surveillance Complex, as well as technical and program development assistance.

The first Excite Camp was held August 1-3, 2001. The three-day event was designed to serve as a model for integrating the scientific traditions of indigenous peoples into current science education. The goals were:

- To provide a venue for WIT to reach middle school girls of native Hawaiian ancestry and other ethnic minorities in Hawaii
- To develop a model workshop/curricular program integrating hands-on math and science learning with exposure to science and technology positions on Maui that will “excite” middle school girls into pursuing careers in these fields
- To provide an opportunity for the U.S. Air Force and growing Maui-based technology companies to share their technology and research with Maui students as part of an integrated education program that demonstrates the relevance of science and technology in the community
- To maximize the impact of this program initiative while achieving cost and time effectiveness for the various partners

The initial Excite Camp was based loosely upon the following model programs.

- Attracting Women into Engineering Summer Workshop, Rowan University College of Engineering (Jahan, et. al.,2001)
- Outreach Activities by Benet Laboratories, U.S. Army Armament Research, Development and Engineering Center, Watervliet, New York (Kendall, Johnson, 2001)
- IBM Excite Camp at Purdue University (Stwalley, 2001)

Since then, the program has steadily grown in recognition among middle school girls and high tech employers, successfully improving the quality of its native Hawaiian and ethnic minority

applicants each year, as well as the creativity and educational value of its program activities and mentor presentations.

Program Approach

Hawaii public schools traditionally rank poorly in math and science compared to the rest of the nation. According to year 2003 findings from the National Assessment of Educational Progress, Hawaii 8th graders rank lower than 31 other jurisdictions in math (U.S. Dept. of Education, et. al., 2000) and rank lower than 36 other jurisdictions in science (DOE, et. al., 2000).

A best practices review was made of model programs nationwide designed to encourage middle school girls of under-represented race/ethnic ancestry in STEM. The existing research suggests that girls experience a precipitous decline in interest in math and science beginning with the middle school years, the main barriers being the perception of these subjects as boring, a disconnect with the relevance of these fields, and a sudden decline in confidence in these subjects (Campbell, 2000).

Native Hawaiian/Pacific Islanders have been identified as an under-represented race/ethnic group in STEM. Barriers for under-represented race/ethnic groups, according to the research, are focused mostly on lack of equal opportunity to educational opportunities and the resulting lack of academic preparation in math and science (Maui Economic Development Board, 2000.) For example, students of under-represented race/ethnicity are more likely to attend schools with teachers not properly trained or certified to teach math and science, and to attend schools where math and science performance is below the national average.

As a means of addressing the dual barriers for native Hawaiian girls, the program goal was to provide the girls with confidence-building exercises in math and science using models that have had demonstrated success, as well as providing the girls exposure to educational opportunities in math and science in which they might not otherwise have the opportunity to participate.

After three years of continual refining, the following strategies have been identified as crucial elements of any STEM program aimed at native Hawaiian and other ethnic minority middle school girls.

- *Hands-on activities* demonstrating math and science principles in a context that made them relevant for the girls.
- *Team-based atmosphere*, as opposed to individual or competition based. Team-based learning has shown to be a more effective catalyst for girls' education.
- *Mentoring opportunities*. Each student team had a woman mentor who was raised on Maui and was either enrolled in higher education or employed in science and technology. Mentoring has proven to be one of the most successful mechanisms for encouraging girls into these fields.
- *Exposure to science and technology in their communities*. The need for relevance has been identified as crucial for girls to make the connection between math and science

as academic pursuits, and math and science as meaningful careers. In order to accomplish this, it was imperative for the girls to see how people working in their community use math, science and technology.

Program development for Excite Camp 2004 reflected an incorporation of program model elements based on the research, evaluation and success of prior years' camps in 2001, 2002 and 2003. In addition, a review of other model programs was conducted and implemented as new activities, which included:

- Experiments from Try Science (www.tryscience.org)
- Akimeka's Digital Bus equipment (motion sensors)
- Oceanit's MOSAIC PVC Telescope Activity

Recruitment

To take full advantage of the opportunities and benefits offered by hands-on participation and personal mentoring, the 2004 Camp was limited to 20 girls, the optimal number recommended by the 2002 Excite Camp evaluation. The entire group could then be easily divided up with four girls per mentor.

In 2004, middle school girls of native Hawaiian ancestry and other ethnic minority backgrounds were again targeted for recruitment. Each interested student was required to complete the Registration and Permission form. A total of 20 girls were selected from an applicant pool of 34.

To ensure WIT's outreach services were equally distributed throughout Maui intermediate schools, selection was also based on securing a spot for a representative from each school. Students represented seven different middle schools on Maui, which included home-schooled students of 7th and 8th grade age.

Program Agenda

The primary focus of the program was to introduce the girls to the U.S. Air Force Research Laboratory's Maui Space Surveillance System. This facility sits atop the summit of 10,000 foot Haleakala Volcano, and houses the Advanced Electro-Optical System (AEOS) telescope, the nation's largest optical telescope designed for tracking satellites. Haleakala Volcano provides some of the best viewing conditions in the world, and is also home to the University of Hawaii Institute for Astronomy.

The program also focused on exposing the girls to the technology companies of the Maui Research and Technology Park and the Maui High Performing Computing Center (MHPCC) which emphasize careers in astronomy, optical imaging, and supercomputing.

In 2004, participating organizations included Maui Community College, Maui High Performance Computing Center, Pacific Disaster Center, Oceanit and Monsanto. As in the previous year, Day

One took place entirely at Maui Community College, Day Two at the Haleakala Summit, and Day Three at the Maui Research and Technology Park in Kihei.

Students Teams and Mentors

Students were pre-assigned to teams versus self-selected teams at prior camps. The girls were paired in a team of two, who were then matched with another team to form a group. The methodology used to determine teams/groups included the following criteria:

- Each group was assigned members ranging in age from 11 to 13 so that older girls were teamed with younger girls. This was done to allow the older girls to serve as leaders or mentors to the younger girls.
- Girls who were known to be friends or from the same school were placed on different teams. This was done to encourage the girls to make new friends and minimize “clique” interaction.
- Instead of announcing the team assignments on Day One, each participant was given an envelope that enclosed half of a puzzle piece. They were instructed to find the person (team partner) who had the matching half of the puzzle. All puzzle pieces were strategically made the same shape with 5 different colors to designate the 5 groups.

To encourage questions, a question and answer component was introduced, with the girls instructed to ask at least three questions from any of the presenters during the three-day entire camp. At the end of the Camp, the girls’ question and answer forms were collected, and in return, each girl received an “Excite Camp 2004” T-shirt.

Hands-On Activities

Spaghetti Bridge – Students were tasked with building a bridge made from spaghetti and marshmallows by forming two pyramids connected by a piece of spaghetti as the “bridge.” After constructing the bridge, the girls were then instructed to see how many pennies the bridge could hold. The objectives of the Spaghetti Bridge were to: 1) have the girls become acquainted with each other by 2) working together as a team, while 3) both teammates had equal opportunity for hands-on time.

Computer Disassembly and Reassembly Activity - the student teams learned to disassemble and then reassemble computers to working order. The “test” came at the end when the teams reassembled the computer back to working order and booted it up.

Astronomy Model ? PVC Telescope Activity - Developed by Oceanit, a progressive Hawaii-based engineering, science, and research company specializing in optics manufacturing, the activity focused on constructing a telescope from PVC pipes. Oceanit sponsored and presented the activity highlighting important astronomy and physics principles while introducing the girls to the history of optics.

Additionally, the activity was a perfect tie-in to the next day's Maui Space Surveillance System site visit to see the U.S. Air Force's AEOS Telescope. The girls were permitted to take home the telescopes to experiment with viewing the moon, stars, and space.

Indy 100 – Pencil Car (Motion Sensor Activity) - Participating company Akimeka provided the equipment and education specialist who talked to the girls about the use and technology of motion sensors. The objectives was to work together to 1)create a race car, 2)measure the velocity of the car using a Motion Detector, and 3) determine the fastest car among the groups. The project required students to perform the following roles when measuring the velocity or speed -- car driver, motion detector operator, computer technician, and data entry specialist.

Float Da Boat - also known as Das Boat by FSEA, challenged students to design a boat constructed using a single piece of foil that could carry as many marbles as possible before sinking. The concepts of engineering design, buoyancy, and volume (Archimedes Principle of Displacement) were introduced.

Ice Cream Engineering - Students learned that making ice cream the “old fashioned” way is all about science and engineering. Concepts of freezing temperature and the effect of salt on freezing temperature were demonstrated.

Site Visits

Maui Space Surveillance System

- ***Native Hawaiian Voyaging Presentation.*** Prior to the departure to Haleakala, a female UH Astronomy student educated the girls about her experience navigating aboard the *Hokule'a*, a double-hulled canoe authentically duplicating the original Hawaiian voyaging canoe. She discussed how native Hawaiians used the stars to navigate and predict weather patterns, and gave a brief history about zodiac signs. It was such a positive experience for the girls to see that young, cool local girls are intelligent and can be passionate about science and astronomy. On post-event surveys, four girls stated that they wanted to become astronomers, in part because of this presentation.
- ***Advanced Electro-Optical System (AEOS) Telescope.*** With U.S. Air Force personnel conducting the tour, the students were able to view up close the AEOS Telescope, learn about its functions, and why Haleakala summit is considered one of the best telescopic viewing sites in the world.

Oceanit - Students were presented an overview of Oceanit and its diversified research and development activities. After the PowerPoint presentation, students were treated with demonstrations at the newly opened Maui Optical Systems and Imaging Center (MOSAIC) of Oceanit.

Monsanto - Students learned that Monsanto is a leader in biotechnology research with genetically-engineered corn crops on Maui. In addition to the PowerPoint presentation, students were taken out to the crop fields to see firsthand what they had learned in the meeting room.

Pacific Disaster Center Presentation - Pacific Disaster Center provides applied information and research and analysis support for disaster management. Students learned how Global Positioning System (GPS) modeling could be used to analyze and contain Dengue Fever on Maui.

Maui High Performance Computing Center – Visual Lab - Students learned about satellite and aerial photography, and enjoyed a demonstration of how the Center's 3-D imaging technology is used for research.

Maintaining Company/Presenter Participation and Relationship

As a follow-up to the event and to continue positive relationships with Excite Camp 2004's hosting companies and presenters, parents were asked to encourage their daughters to write thank you letters to two companies/presenters. The companies and presenters were pre-selected in advance for each student based on the highest company ratings each provided on her own survey.

Eighty percent of the participants completed this request. Each company and presenter received two or more letters from the students. All were extremely pleased and expressed appreciation for this gesture. This approach helped WIT maintain and improve its relationships with existing partners while allowing the Project to compile tangible results of the program.

Cultural Elements

Persons of native Hawaiian or part-native Hawaiian ancestry make up approximately 25% of the population of Maui County (County of Maui, 2003). Therefore, it is appropriate to the community that certain cultural aspects of the program maintain their relevance to native Hawaiian girls.

- Native Hawaiian female students from the local community college's computer networking degree program were sought as mentors and role models for the event.
- The visit to Haleakala included presentations by two female native Hawaiian cultural experts. One of the women talked about the cultural, environmental and religious significance of Haleakala Volcano, while the other highlighted ancient Native Hawaiians who explored the Pacific with seafaring canoes using traditional navigation techniques and astronomy.
- Finally, tours of tech companies showcased the role of female and male native Hawaiian employees, as well as women of other ethnicities. Students also meet female interns at MHPCC, who make up over 33% of the summer interns.

Program Evaluation

Like its name, Excite Camp's mission is to expose the girls to math and science in their

community in a way that they would perceive as exciting, fun, and relevant. In doing this, a balance needed to be struck between the educational objectives of the event and the need to keep it engaging for the girls. Based on their ranking of and comments on Excite Camp overall, the 2004 event continued to be successful in achieving this balance.

- Eighty-five percent of the students rated the overall program content and format as “excellent.” (Excellent is the highest rating.)
- An overwhelming majority of 95 percent responded “yes” when asked if Excite Camp had “raised” their awareness of technology-related job opportunities in Maui County. Fifty percent indicated they were already aware of technology-related jobs in Maui County prior to the Camp.
- When asked if they would consider a career in science, math, engineering or technology prior to and after the camp, the number of students interested in STEM careers increased by 52 percent after the camp.
- A majority of 90 percent responded positively when asked if they would recommend Excite Camp to other female students.

Recommendations

1. Qualify the selection process. Excite Camp is currently open to all seventh and eighth grade girls of native Hawaiian ancestry and other underrepresented ethnic backgrounds throughout Maui county. However, due to the Camp’s overwhelming popularity and limited enrollment, the selection process has become increasingly difficult.

Recommendation:

- In addition to contacting parents to inform them of limited space, the selection process, and additional requirements (i.e. US Citizenship, disclosure of health conditions, etc.), student applicants should be asked to describe why they are interested in attending and what they hope to get out of the camp.
- This information will help further qualify the applicants and ensure a diverse group from different backgrounds who can interact well with each other.

2. Encourage more mentor leadership and support in their groups. While each mentor was provided project resources and training prior to the workshops, this focused on the technical or logistical aspects of the projects. On occasion, it was observed that mentors used their free time during the event to socialize with the other mentors rather than staying fully engaged with their groups.

Recommendation:

- Strictly advise mentors that they are accountable and responsible for all students in their respective groups and that peer mentor socializing can be done prior to or after event.
- Also, training/discussion should be provided on how to: appropriately and tactfully intervene during inappropriate behaviors; get students to interact with one another

using fun methods; assess when intervention is needed; and know what to do when accidents occur.

3. Work with parents to prepare for the unexpected. There were several students who became ill during and after the trip to the Maui Space Surveillance Complex.

Recommendation:

- Advise parents to pack extra clothing for their daughter to take on all three days of Camp.

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