AC 2009-1822: EXPANDING YOUR HORIZONS: A STEM CAREER CONFERENCE FOR 7TH- AND 8TH-GRADE GIRLS

Deborah Hochstein, University of Memphis
Ms. Hochstein is Dept. Chair for the Engineering Technology Department at the University of Memphis. She earned a B.S. in Physics from Georgian Court University and a M.S.E. from the University of Akron.

Shelia Moses, University of Memphis
Ms. Moses is the Academic Services Coordinator for the Herff College of Engineering at the University of Memphis. She earned a B.A. in Criminal Justice and a M.P.A. in Public Administration from the University of Memphis.

Daphne Jones, Memphis City Schools
Ms. Jones is the Mathematics Coordinator for the Memphis City School System. She earned a B.S. and M.S.E. in education from the University of Central Arkansas. She is currently pursuing the Ed.D. from Arkansas State University.
Expanding Your Horizons:
A STEM Career Conference for 7th and 8th Grade Girls

Abstract

A recent study performed for the Memphis Regional Economic Development Council reported that Memphis is facing several key challenges including: gaps between education, workforce development and business; African-Americans under-represented in high-tech occupations; and low level of educational attainment. To address these concerns they recommended that efforts be made to: better communicate emerging career opportunities to lower income youth, especially in the early grades; develop programs to reduce the drop-out rate; and place emphasis on math, sciences, language and critical thinking.

To this end, the University of Memphis hosted a one-day STEM career conference for 7th and 8th grade girls. It was sponsored through a grant from the American Association of University Women (AAUW) and the Herff College of Engineering and utilized the support system available through the national Expanding Your Horizons (EYH) network. The EYH network is a non-profit membership organization of educators, scientists, mathematicians, parents, community leaders, and government and corporate representatives whose mission is to encourage young women to pursue careers in the STEM fields through the use of role models and hands-on activities. Their goal, and the goal of this conference is to motivate girls to become innovative and creative thinkers ready to meet 21st Century challenges.

The day long workshop was divided into five tracks where students and parents had the option of attending the track session of their choice. Each student selected from one of the following four tracks: (a) Engineering, (b) Healthcare, (c) Computer Technology and (d) Basic Math & Science. The fifth track was reserved for parents interested in learning more about preparing to send their child to college. Within each track the student participated in four different workshops. Each workshop was led by a female professional currently working in the STEM field. The workshop contained information about career options, a hands-on activity related to attaining a position in that career field and an opportunity for participants to ask questions.

Survey instruments were used to assess the success of this event. A Pre and Post survey was administered to assess any changes in the student’s knowledge of or attitude toward STEM careers. Each student was asked to complete a short survey for each workshop to determine which ones were most effective. Also each workshop leader, as a representative from local industry, was asked to complete a survey that evaluated the effectiveness of the conference. The results of the analysis of these surveys are included in the conference paper as well as a “lessons learned”. There are two long term impacts of this conference. The first and most obvious is the impact the conference will have on the students who participate. The experience has the potential to influence the student long after the event is over. The second impact will promote the establishment of a new chapter of EYH in West Tennessee.

Introduction
There have been numerous studies that document the disparity between the number of women and men entering the Science, Technology, Engineering, and Mathematics (STEM) fields. Furthermore, studies have shown that this disparity is first evident by the end of elementary school.\textsuperscript{1,2} In 2005, the findings of a survey conducted at Penn State New Kensington of both students majoring in STEM and a control group of college students in non-scientific and non-engineering fields were published through the American Society for Engineering Education (ASEE) Annual Conference & Exposition. The intent of this survey was to examine the demographics, influences and perceptions that may have enabled students to consider a career in science or engineering. A main finding of that survey is, “... that although great progress has been made in eliminating certain disadvantages that keep girls from entering the science and engineering pipeline, the great divide between girls and engineering remains due to a lack of familiarity with the nature and possibilities of engineering and engineering technology.”\textsuperscript{3}

A National Science Foundation report states that beginning in 2000, roughly half of the science and engineering bachelor’s degrees were granted to women, up from 25% in 1966.\textsuperscript{4} However, this is not the case in Memphis, Tennessee. At the University of Memphis, approximately 10% of the undergraduate degrees in science and engineering has been granted to women. This is of particular concern because Memphis has several large companies, FedEx, Medtronics, Smith-Nephew, Wright Medical, etc. whose impact on economic development has been significant. These companies would like to be able to expand and recruit from the local labor supply. But, evidence indicates efforts must be made locally to encourage young people to enter into technical careers.

A recent study performed for the Memphis Regional Economic Development Council reported a hidden labor supply of 532,090 workers in the metropolitan area.\textsuperscript{5} The report states that Memphis is facing several key challenges:
- African-Americans are under-represented in high-tech occupations
- Gaps exist between education, workforce development and business
- Educational attainment is low
- Performance in math and science is low

The study’s recommendations relevant to this project are:
- Better communicate emerging career opportunities to lower income youth, especially in the early grades
- Develop programs to reduce the drop-out rate
- Place emphasis on math, sciences, language and critical thinking

Memphis City Schools (MCS) and Shelby County Schools (SCS) have adopted the State of Tennessee’s new Framework which centers on mathematics, science, and technology. It is “based on the notion that learning science and mathematics are better enhanced when experienced through active engagement of inquiry, technology, and engineering or STEM Education.”\textsuperscript{6} See Figure 1 below.
“The educational vision reflected in the Framework is that a carefully designed, coherent, and properly implemented set of K-12 mathematics learning experiences will enable all students to:

1. Develop a deep understanding of the key mathematical concepts, principles, and theories drawn from contextual applications
2. Apply process skills by posing questions and investigating phenomena through the language, procedures, and tools of mathematics
3. Be aware of how engineering, technology, and science are integrated into the historical and cultural advancement of mathematics
4. Think and act in away that demonstrate a positive attitude toward problem-solving and personal decision-making about issues that affect society.”

The State of Tennessee’s goal is to ensure that students emerge from high school “fully prepared for transitioning to higher education, careers in the technical workforce, and service to their communities or nation.”

The Expanding Your Horizons (EYH) conference reported in this paper and the organization developed to implement it, is one response to the increasing need for workforce development and compliments the efforts currently underway in the school systems. There is some evidence that intervention projects such as this one targeting middle school girls have been successful in promoting STEM careers.

**Background on Expanding Your Horizons**
“The Expanding Your Horizons Network (formerly the Math/Science Network) started in 1974 as an informal group of women scientists and educators in the San Francisco Bay Area who were concerned about low female participation in math courses. They began planning coordinated efforts to strengthen their individual programs and establish mutual support on a volunteer basis.”

Expanding Your Horizons (EYH) conferences began nationally in 1976 in California and have active branches in over 89 locales in 32 states, and have served over 625,000 girls nationwide. In the State of Tennessee, there is an active branch hosted by Middle Tennessee State University (MTSU) located in Murfreesboro, which is Central Tennessee. The American Association of University Women (AAUW) provided the seed money for the first EYH workshop held at Middle Tennessee State University in 1997 under the guidance of Dr. Judith Iriarte-Gross. That coalition has been able to secure additional grants for annual conferences and most recently branch out to Eastern and Western Tennessee with informational presentations encouraging the start of local coalitions to develop EYH conferences.

In April 2007, Dr. Judith Iriarte-Gross and Karen Claud from MTSU arranged for a meeting to be held in Memphis and invited women from the public school systems, local community college and university systems, civic organizations and professional societies. The professional women who attended the meeting were affiliated with organizations whose mission is to educate young women and prepare them for a productive adulthood. These organizations included: Girls Inc. of Memphis, Girl Scouts Heart of the South, Memphis City Schools, Shelby County Schools, the University of Tennessee, Crichton College and the University of Memphis. The purpose of the meeting was to present an overview of the EYH organization in general and the activities conducted by the MTSU branch. The goal of the meeting was to formulate an EYH coalition in Memphis that would organize and sponsor programs in West Tennessee that encourage young women to study math and science. The attendees were very impressed by the results achieved at MTSU and agreed to meet again to discuss the possibility of hosting a similar event in Memphis. This was the start of the EYH – West Tennessee conference.

The EYH – West Tennessee program began with a Community Service Grant from the AAUW awarded to The University of Memphis. The co-chairs on the AAUW grant are Deborah J. Hochstein, Dept. Chair of Engineering Technology and Shelia R. Moses, Academic Services Coordinator. Partnerships were developed with representatives from the Memphis City and Shelby County School systems, Memphis local chapter of AAUW, Girls Scouts Heart of the South, and Girls Inc. to assist in organizing the EYH-West Tennessee conference. The EYH – West Tennessee program is the only EYH program in West Tennessee and only one of two EYH programs in the State of Tennessee.

The target audience for this one day conference was middle school girls attending Memphis City and Shelby County Schools. The MCS system is in an urban area where 87% of the students are African American. The Memphis City School system is the largest school system in Tennessee with a student population of 118,000. The surrounding Shelby County School system is in a suburban setting with a population of over 45,000 students and 32% of the students are African American.

The goal of this conference was to make middle school girls, in Shelby County, Tennessee aware of career opportunities in fields where they are traditionally underrepresented such as Science, Technology, Engineering, and Mathematics, (STEM). Studies have indicated that interest in
science, engineering, and mathematics as career options peaks during middle school years for young women and minorities. In MCS and SCS systems, counseling on high school courses begins at the end of middle school. The anticipated outcome of this conference was that middle school girls will elect to continue to study math, science and STEM related subjects in high school. Research has shown that middle school girls’ attitudes about careers in math and science affect young women’s persistence and involvement in advanced coursework during their high school years. This finding suggests that there is a need for intervention at the middle school level or earlier. Our premise is that interest in a particular career path will lead a girl down a productive educational path. Motivation, education and mentoring are critical to a woman’s success in any profession, but harder to acquire in STEM fields. Our aim is to instill confidence to where these young women will be inspired to pursue a career path in one of the STEM fields.

Overview of EYH – West Tennessee Conference

The first EYH – West Tennessee conference at The University of Memphis was held on October 18, 2008. We served 148 girls and 40 parents and teachers. For many of the 7th and 8th grade girls, it was their first visit to a university campus. Participants came from 43 different schools. There were 17 Memphis City Schools represented, 9 schools from Shelby County, 9 private schools, 5 schools from bordering counties in Mississippi and the Home School Association.

We followed the typical EYH conference format: registration, keynote address, two morning workshops, lunch, two afternoon workshops, and closing remarks. Three separate parents’ workshops were also offered.

Postcards with online registration information were sent to the local school systems and were distributed through the Girl Scouts Heart of the South and Girls, Inc. A $10 registration fee was charged for both girls and parents to cover the cost of lunch and supplies. Both Girl Scouts Heart of the South and Girls Inc. sponsored scholarships for girls who needed financial assistance. We did receive a Community Action grant for start-up funding from the American Association of University Women and matching funds provided by the Herff College of Engineering.

Each participant received a tote bag with a packet of information at registration. The information was provided by different organizations. The Expanding Your Horizon Network provides a Student Packet that can be copied and distributed to each girl who registered with information on different STEM careers. Games and activities relating to math and science are also included in the EYH Student Packet. Medtronic provided rulers and Cummins, Inc. supplied the girls with Laser Quest tickets and ID Wallets. We received GRITS wristbands, bookmarks, pens, and pamphlets from Middle Tennessee State University Girls Raised in Tennessee Science (GRITS). Girl Scouts Heart of the South provided boxes of Girl Scouts cookies and 2009 pocket calendars. The girls received notebooks and pens from the University of Tennessee Health Science Center.

The conference started with our keynote speaker. It is important that the EYH keynote speaker be a professional woman who is a mentor and encourages young women to consider their options in science and math careers. The keynote speaker for this conference was Laura Whitsitt, Vice President of Research and Innovation for Smith & Nephew’s orthopaedic division. Ms. Whitsitt earned both her Bachelor of Science and Master of Science in Mechanical Engineering from the
University of Memphis. Laura shared with the girls the importance of education and how her education provided her with the skills needed for her career.

The main focus of the conference was to introduce the girls to career opportunities in Science, Technology, Engineering, and Mathematics (STEM) by providing the girls with hands on experience in each workshop. The four workshop tracks to choose from were: Engineering, Healthcare, Basic Science/Math, and Computer Technology. In each track, the girls went to four different workshops.

**Engineering**
- Biomedical Engineering: Making a Difference
- Mechanical Engineering: It's Rocket Science
- Industrial Engineering: It's all in the Process
- Electrical Engineering: Ohms & Volts & Amps...Oh My!

**Healthcare**
- For the Love of Animals and People
- Heart and Soul
- Hit Me With Your Best Shot
- Oh My Aching Back

**Basic Science/Math**
- From One Plant: Many Plants
- Natural Disasters As agents of environmental change: What do satellite images show us?
- What Physics got to Do With It...Everything!
- Where's It Rockin'?

**Computer Technology**
- Code Crunching
- Designing Myspace, YourSpace, OurSpace – Architecture 101
- Picture This
- Robotic Takeover

In each of the fifty minute workshops, the presenters were encouraged to have the girls participate in a hands-on-activity. Hands-on activities such as: building and designing a house made with graham crackers and peanut butter, planting plants, building and firing a bottle rocket or how to properly take your pulse or give a shot, demonstrated to the girls that they can do science and math related jobs. Meeting women professionals in a specific field provided the girls an opportunity to experience a career they might consider and learn about the math and science courses required to pursue it.

The girls attending the workshops were provided with an opportunity to mentor with female college students majoring in one of the STEM fields as they chaperoned and assisted the girls from one location to the other throughout the day. Also in each of the workshops, the girls had an opportunity to ask the woman professional questions regarding her career, education, and exciting opportunities in STEM careers. Another benefit is the girls met other girls their age with interests in science and mathematics.
The anticipated outcomes for the conference were: provide an awareness of possible career paths in the STEM fields, provide an environment that motivates a young woman to pursue one of those careers, and provide an opportunity to be mentored by female college students and successful women in STEM fields. Success of the conference was determined by comparing the results of students’ pre-surveys conducted at registration to the results of students’ post-surveys at the end of the day and through short evaluations to be completed at the end of each workshop by both the students and workshop leaders.

The conference offered parent workshops in educational preparation, student life, and financial aid assistance. In the first morning workshop on Student Life, the parents were welcomed on campus by the university’s Vice President of Student Affairs, and the Associate Dean of Student Residence Life. Both speakers shared with the parents the benefits of students getting involved on campus and described the campus environment as well as the opportunity for the students to live in learning communities. The parents indicated on their surveys that they found the workshop to be informative and thought both speakers were enthusiastic, prepared, and knowledgeable. Parents and teachers expressed interest in having a workshop on what courses the girls need to take for high school.

The speakers for the High School Prep workshop were a high school guidance counselor and a university college advisor. This workshop was on the importance of taking math and science courses in middle school and high school and how to start preparing for ACT and SAT tests. The Financial Aid workshop was also beneficial to the parents even though their daughters are only in middle school. The financial aid presenters consisted of a two year community college and a four year university. They both shared information with the parents on types of financial assistance, how to complete the financial aid packets, scholarship information, and the importance of meeting deadlines. Overall, the parents enjoyed the three parents’ workshops, however, some parents expressed they needed a break in between the workshops.

Lunch consisted of pizza, salad and Girl Scouts cookies and was served in the building lobby to students, workshop leaders, parents, and volunteers. Some of the parents complained about being served pizza and that the 50 minute lunch break was too long.

Our first EYH – West Tennessee conference ended with a closing session. All participants were asked to complete the post survey form. At the closing session, we thanked everyone for participating in the conference and shared with the girls and parents information about any upcoming activities. The highlight of the closing session was the awarding of door prizes such as tee-shirts, Laser Quest tickets, baseball hats, Girl Scout cookies, STEM posters, water bottles, and key chains. At the end of the day, parents were inquiring about registration and volunteer opportunities for next year’s conference.

**Results**

Participant surveys were used as the primary instrument to measure the effectiveness of the conference. The nature of the questions on the post survey issued at the end of the day when the girls reconvened for closing remarks can be broken down into two categories. One is a measure of their attitude toward math and science. Another is a measure of the effectiveness of the counseling they received in the various workshops.
Three questions were asked of the girls that reflected their attitude toward mathematics, science and interest in STEM careers. As can be seen in figures 2 and 3, the girls did not distinguish between math and science and the majority claimed to learn that math and science is more important than they thought.

The responses from the third question, “Based on what you have learned and heard at the conference, how much more interested are you in math, science and engineering careers than you were before the conference?” are reflected in figure 4.
Forty-six percent claimed that they were “way more interested” in math, science, and engineering careers than before the conference. This is encouraging because studies show that girls are less likely to enroll and succeed in high school classes such as calculus, chemistry, or physics. While they are not prohibited from taking math and science classes, many girls experience a downward spiral around the age of 12 in their attitude toward and confidence in their ability to pursue these courses.\(^\text{10}\)

Ten questions were asked of the girls on the post survey that reflected counseling provided by the speakers and workshop leaders. The questions top rated responses are listed in Table 1.

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Response</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>How helpful was the conference in providing you with new information about science and engineering careers?</td>
<td>More helpful than I thought it would be</td>
<td>71%</td>
</tr>
<tr>
<td>How helpful was the conference in providing you with new information about math and computer science?</td>
<td>More helpful than I thought it would be</td>
<td>57%</td>
</tr>
<tr>
<td>How has your understanding of what math and science courses are required to enter a particular college major or vocational career changed because of this conference?</td>
<td>Much clearer</td>
<td>49%</td>
</tr>
<tr>
<td>After attending the workshops and meeting the professional women who ran them, please check the best statement that best describes your perceptions.</td>
<td>The role models took way more math courses than I thought their careers required them to take</td>
<td>58%</td>
</tr>
<tr>
<td>How useful was the conference in providing specific information about where you can go if you have further questions about math and science careers?</td>
<td>Very useful</td>
<td>62%</td>
</tr>
<tr>
<td>After attending the workshops and meeting the professional</td>
<td>The role models</td>
<td>54%</td>
</tr>
</tbody>
</table>
women who ran them, please check the best statement that best describes your perceptions.

took way more science courses than I thought their careers required them to take

| How useful was the conference in helping you plan your high school and college courses? |
|---------------------------------------------------------------|-----------------|
| Very useful                                                  | 55%             |
| How useful was the conference in introducing you to careers that you had previously thought about for yourself? |
| Very useful                                                  | 57%             |
| How useful was the conference in introducing you to careers you knew nothing about? |
| Very useful                                                  | 57%             |
| How useful was the conference in helping you understand what a professional does in a normal day? |
| Very useful                                                  | 55%             |

Table 1: Post Survey Results of Questions Related to Academic and Career Counseling

Daphne L. Jones, Mathematics Coordinator for School Operations of Memphis City Schools, was able to interview four participants three months after the conference. They were still very excited about their experience at the conference. Some of their comments included:

- “I enjoyed the experiments we did in the Rocket Design engineering class.”
- “They had so many experiments and allowed us to actually plant plants and keep them.”
- “I especially liked the part when I was sitting in a chair, and they held two magnets on either side and spun me around to show the effect of gravity.”
- “The part that I enjoyed the most was when we learned how to plant plants and were able to take our plant home. My plant is still very tall and pretty.”

The overall responses to these post survey questions that address academic and career counseling are very positive. They help to further demonstrate the importance of hosting conferences of this type. Many of us assume that this type of counseling is done by parents, teachers and guidance counselors. The fact of the matter is most of what students know about engineering jobs is learned on television or in the movies. A study done on middle school students’ attitudes and knowledge about engineering, by faculty at the New Jersey Institute of Technology, reported that 79% of the students never heard about engineering from a school counselor, 68% never heard about it personally from a teacher, 44% never heard about it from a parent and 65% never heard about it from a friend. In a separate document, this faculty reported that while school counselors have positive attitudes toward engineers, they lack the fundamental knowledge about engineering careers and various resources such as summer and after school programs that can help students to explore engineering as a possible career.

Future Plans

In 2004, the ASEE Engineering K-12 Center produced a report titled “Engineering in the K-12 Classroom: An Analysis of Current Practices & Guidelines for the Future”, that included six guidelines for improving K-12 engineering education and outreach. Three of these guidelines were fundamental to our 2008 Expanding Your Horizons conference.
• “Hands-on learning: Make K-12 science curriculum less theory-based and more context-based (hand-on), emphasizing the social good of engineering and demonstrating how it is relevant to the real world.”\textsuperscript{13} When talking to the workshop leaders emphasis was placed on creating an activity that the girls could participate in. Surveys completed by the girls of the individual sessions indicate that this was achieved in all but one workshop.

• “Make Engineers “Cool”: Outreach to urban schools and females more aggressively, and create more mentors and role models to attract these constituencies.”\textsuperscript{13} All of the students, workshop leaders and guest speakers were female. The girls were also mentored by female college students who served as guides for the day. The girls were able to talk to professional women working in all different occupations in the STEM fields.

• “Partnerships: Create better incentives for all groups to engage in K-12 outreach (especially higher education and industry).”\textsuperscript{13} This conference was the product of a collaboration of people from K-12 and post secondary education, and civic organizations whose mission is to enhance the lives of young women, and industry professionals.

While we consider the 2008 Expanding Your Horizons Conference to be a success, improvements are planned for the 2009 conference. First and foremost the registration process is going to be enhanced allowing girls to register for any workshop that is open. In the 2008 conference, the girls registered for one of four possible tracks and that dictated the workshops they attended. The tracks were discipline specific and did not allow the girls as much variety as they wanted. A registration and scheduling website is available through the Expanding Your Horizons Network. Second is the enhancement of activities available to adult participants. The 2008 conference had a track that listed three workshops for parents. This track was attended by siblings in high school, teachers, and counselors in addition to parents. The 2009 conference will offer workshops targeted at the needs and interests of this expanded audience. The primary challenge for the 2009 conference will be funding. The 2008 conference was funded in part by the Herff College of Engineering at the University of Memphis and in part through a grant from the American Association of University Women. With the groundwork laid in the 2008 conference we are cautiously optimistic that sufficient funds will be available through the Herff College of Engineering, unused 2008 registration fees, 2009 registration fees and private donations.

Efforts to encourage young girls to study mathematics and science have been going on for many years. There are more women than ever working in STEM related fields. But, there is still a great need to encourage outreach projects such as the one described in this paper. “Girls have shifted from a “we can’t do it” paradigm to a “we can, but I don’t want to” orientation.”\textsuperscript{14} A recent report of a longitudinal evaluation of EYH conference outcomes by faculty at Humboldt State University states, “Most (81\%) of the girls surveyed had a positive or very positive reactions to EYH. Most (87\%) had math or science related majors in college. Almost half (48\%) reported moderate to strong influence of EYH on their undergraduate major.”\textsuperscript{9} Other studies have shown that alumni of these conferences tend to enter nontraditional careers and take more math and science courses than girls are expected to take. Overall, hosting this EYH
conference was a rewarding experience. Its long term effect on the educational and career choices of the participants, while unknown at this time, is expected to be positive.

Bibliography