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**An Interactive Event Model to Introduce Young Women to
Engineering:
Evolution of a Scalable Program and Lessons Learned**

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Abstract

This paper presents a model used successfully at two institutions as an outreach mechanism to middle school and high school aged young women. As the driving force behind the particular outreach event at each of the institutions, the author provides lessons learned to implement, strengthen, and sustain similar activities on her own and other campuses. The spotlight event is a day-long, hands-on program exposing the participants to many options in engineering. A hallmark of the program is its interactive nature, allowing the participants to see how math and science can be used to make the world a better place.

Introduction

Females are traditionally underrepresented in the science and engineering fields, and their loss to the workforce can negatively affect the quality of the future domestic science, technology, engineering, and mathematics (STEM) workforce¹. All students progress through an educational pipeline, and the female STEM pipeline experiences a number of leaks during which students lose interest in science and engineering. These leaks can occur anywhere from elementary school through the graduate level and can be due to a number of different factors². Resources applied to reducing the pipeline leaks can have a dramatic impact on the diversity and the effectiveness of the future STEM workforce³. In addition to low income and ethnic minority students, pre-college students hailing from rural areas often have less access to the types of programming and mentoring which open their eyes to STEM career options⁴.

This paper describes both an easily scalable program model to bring middle and high school young women onto campus and the evolution of that program. By comparing the initial iteration of the program with its current state, lessons are distilled in the hopes that other programs will be able to reduce their learning curve.

The Initial Program

Throughout the evolution of the program, the goal was to build a hands-on experience in a supportive, female-only environment, factors seen as the keys to success in other programs⁵. While all of the participants have been female, the presenters have been a mix of men and women. This gender mix occurred partly of the philosophical reason of showing the young women that there are men who care about diversifying the field, but also because of the practical constraint of the limited number of female faculty and

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students in engineering. This section describes the first iteration of the program at a medium-sized, suburban comprehensive university and the current state of the program at a small, rural engineering and science focused university.

The first iteration of the program occurred when the author was an engineering student at a medium-sized, suburban comprehensive university. She spearheaded a group with the university's Society of Women Engineers (SWE) chapter to create a "Women in Engineering Day". This day long program was held on a Saturday and open to high school aged women curious about STEM careers. The event was advertised by sending a mailing to every high school math and science teacher in a 50 mile radius. A ten dollar charge per participant was set, though any teacher who called and requested a scholarship for a student had the scholarship granted. The cost was set more to increase the likelihood that the person who registered would actually attend than to offset the cost of food and supplies. Every school that sent at least three participants was allowed to send a teacher for no cost. All of the logistical work was accomplished by the student members of SWE and the SWE chapter funds bore the brunt of the costs.

The day-long program began with the approximately 75 participants placed into groups of eight to ten students. Each group was led by a student SWE member. The participants were given a diagram showing how the engineering buildings were connected and challenged to work together to find their way to their first hands-on session without going outside. The way the buildings were attached to one another as the land-locked campus expanded ensured that this was not a trivial task. Each group then attended a series of three hands-on workshops lead by engineering students and faculty. All of the participants and many of the workshop facilitators gathered for lunch following the workshops. In the afternoon, the high school women participated in the "Engineering Olympics." The Engineering Olympics contained several events, set up track and field style, to showcase both some of the skills which help engineers succeed and simplified versions of some of the engineering technical competencies. Events ranged from building paper towers to a listening and giving instructions Lego challenge. The final stop in the day-long event was a panel discussion with engineering students, faculty, and practicing engineers. The program was well received. The Women In Engineering Day still occurs to this day, though it has missed some years due to ups and downs in the sponsoring student group.

The Current Life of the Program

When the author became a faculty member at her current institution, she heard that there was a renewed drive to facilitate improved recruitment and retention of women STEM students. The South Dakota School of Mines and Technology (SDSM&T) is a small, rural university focused on quality engineering and science education. While some national trends addressing the loss of female STEM students at the college level are similar to those at SDSM&T, SDSM&T lags significantly behind national trends in several ways. Nationwide, women earn nearly half of all baccalaureate degrees in science and engineering combined¹, but in 2003, only 15% of the SDSM&T graduating class were female STEM students. At the national level, approximately 20% of STEM graduates are female engineering students¹, and in 2003, fewer than 10% of the

graduating engineering students at SDSM&T were female. When the author was asked to help develop a female-only program as part of SDSM&T's E-Week events, she recalled her earlier experience and agreed.

The new program, called "E-Week GIRLS" is a school-day long program was held during the national Engineers Week (E-Week). E-Week GIRLS is open to both high school and middle school women curious about STEM careers. The event was advertised by sending a mailing to every high school math and science teacher in a 100 mile radius. The radius was set to include some of the more far-flung school districts in the rural region. A five dollar charge per participant was set with any student receiving free or reduced fee lunch qualifying for a full scholarship. Again, the cost was set more to increase the likelihood that the person who registered would actually attend than to offset the cost of food and supplies. A letter was sent to local companies asking them to support the program with donations. The first year, five companies stepped forward and additional firms stated that they would in future years if given more lead time. All of the logistical work was accomplished by committee of faculty and staff. All budget concerns not covered by the sponsors and the participant fees were covered jointly by the Vice President of Academic Affairs and the Vice President for University and Public Relations.

Assuming the event would attract around 50 participants in its first year, the committee planned for 75. They developed a program that began with a welcome session featuring a short keynote address by a local female engineering graduate. The participants then were divided into groups led by a current science or engineering student. Each group attended three hands-on workshops each featuring a different facet of the science and engineering world. After the workshops, the high school students attended a lunch featuring the university's Outstanding Recent Graduate Award while the middle school students attended a lunch featuring the announcement of a new dinosaur discovery. The afternoon consisted of the "Passport to Engineering and Science" which was very similar to the "Engineering Olympics" and a closing session.

The event program, as designed, would have worked very well for about 50 participants. What the author and the rest of the organizing committee did not anticipate was the strong desire in the ranch and farm communities of the region to introduce their young women to STEM career options. Registrations were finally cut off at 135 participants and the organizers were turning participants away for the entire week before the event. Schools sent purchase orders to cover the participant costs and sent their students by the bus-load. The combination of strong interest in the program and the logistical barriers of running the Passport to Engineering and Science with more than around 50 participants at a time forced the author to design a scalable format for the event. The new format brings all of the participants together at three times during the day: the welcome session, lunch, and the closing session. Between the welcome session and lunch and then again between lunch and the closing session are a series of "slots". Each slot is 25 minutes long with five additional minutes of travel time. The hands-on workshops are designed to fit into either one or two slots. The Passport to Engineering and Science events have been broken up into the slots as well as activities similar to the previous year's morning

workshops. As the event occurs on a class day, this format also allows the workshop facilitators greater flexibility in matching their available time with the program. Also, additional participants can be added by finding six more slots, rather than searching for ways to fit them into the current room sizes or increasing group sizes. The new design of the event is constrained only by the number of participants that can fit in the largest room on campus and the ability of the organizing committee to find enough workshops to fill each slot. In its second year, the program hosted over 160 participants.

Current Program Evaluation

While the first iteration of the program did not have systematic evaluation, a drawback of the fully student-run model, the current iteration is assessed yearly. While the preference for particular workshops shifts, just over 94% of the participants felt that the E-Week GIRLS program helped them to learn about their career options. Additionally, 94% of participants found it helpful to meet and talk to current female students on the SDSMT campus. Of those who expressed a positive reaction to meeting and talking with current female engineering students, just over 78% are considering attending college on our campus. The positive assessment of the program is reflected in a comment one participant made to her friend: “This program has ruined my life. Until today, I knew exactly what I wanted to do, now I have too many options.”

Comparison of the Two Program Iterations

While the two events described are iterations of the same program, they have significant differences. First, the original program is organized by a student group. While the fact that the program still operates testifies to the strength of the student group, the ups and downs in the consistency of the program are directly related to normal changes in the student organizations over time. Second, the current iteration of the program is specifically designed to be scalable, giving greater flexibility to the organizers while retaining the integrity of the participants’ experience. One of the by products of scalability is the third major difference, STEM community involvement. The current iteration of the program, in an attempt to fill as many slots as possible, has encouraged participation by groups such as the National Weather Service to do hands-on activities showing some of the varied career paths available to STEM students. The forth and fifth major differences are of focus: the original program is for high schoolers interested in engineering. The current iteration with which the author is involved broadens the focus to include both the science fields and middle school aged participants. Finally, since the SDSM&T program is in conjunction with E-Week as well as being faculty and staff led, it is able to occur on a weekday rather than a weekend.

Lessons Learned and Recommendations

Looking back at both the evolution of the program and the major differences between the implementation of the original idea and the current creation at SDSM&T, there are several lessons that can be taken to reduce the learning curve of other groups wishing to create similar programs on their campus. These lessons are categorized as: resources, consistency and continuity, student involvement, STEM community involvement, and scalability.

Table 1. Differences Between the Two Iterations

	First Iteration	Current Iteration
Organized by	Students	Faculty and Staff
Scalability	Limited	High level
STEM community involvement	Limited	Encouraged
Topic focus	Engineering only	Engineering and science
Participant age focus	High School	Middle and High School
Program timing	Weekend	Weekday

Resources for events of this nature include both the financial resources for food and supplies and the human resources to provide interesting activities.

- *Acquiring internal resources.* People near the top of the academic organization chart in most institutions have budget funds earmarked for K-12 recruitment. Asking these people for seed (first year only) money can help get the program started while a reputation is built to acquire corporate and private donors.
- *Acquiring external resources.* In-kind donations as well as cash are useful if you know in advance what your program needs will be.
- *Gathering people resources.* Human resources should also be evaluated to assure they will fit the needs of the program. All volunteers in your event need to be chosen to ensure positive interactions with the participants. Talk to workshop facilitators ahead of time to help them understand the focus and objectives of the event. If necessary, graciously turn down a volunteer or workshop that the committee feels will not lead to a positive response from the target participants.

Consistency and continuity are key not only to continuous improvement of your event, but also to building a strong, positive reputation with your target market.

- *Concern with the overall impression.* Remember that the impressions of participants, their parents, and their teachers will become part of their overall image of your institution. Work with the people on your campus who have the most experience in creating positive campus visits (i.e. the admissions department) to acquire promotional material and learn about potential pitfalls before your event occurs. For example, discussions with the admissions and public relations groups at SDSM&T helped E-Week GIRLS plan for parking and student drop-off for the program.
- *Details matter.* The attention to detail the parents experienced before the event began supported the positive reaction received by the event programming itself. It also translates to parents as “this is a place where my child will be well taken care of as a student”.

Without the involvement of current students, programs of this type are not only logistically difficult, but also lose a large amount of their impact on the participants.

- *Current students as group guides.* Have students act as group leaders or group guides in order to give the participants a chance to ask one-on-one questions about being a college student and studying STEM subjects.

- *Current students running workshops.* Put students in charge of the some of the workshops to show the participants that these role models of a near age to the participants are truly involved as members of the STEM campus community.

STEM community involvement should be encouraged wherever feasible. Broadening the view of the engineering career path gives the participants better information of their choices. Broadening the visibility of your program with the community will help you get donors for the next year.

- *Alumni involvement.* Bring a graduate back to campus to address the participants about her career path.
- *Local industry involvement.* Invite local organizations and industry on campus to do hands-on activities demonstrating how STEM degrees can take students into interesting and non-traditional careers.
- *Local non-profit agency involvement.* Bring in STEM-degreed volunteers of local not for profit agencies to talk about how STEM competencies can be used to make the world a better place.

There are other lessons learned for successfully hosting similar events:

- Think about the scalability of your event up front. One week before the day of the event is too late to make smooth logistical transitions when the demand for participation far outweighs the supply.
- If both middle school and high school women are included in your event, make sure your scalability plan keeps the two age levels in separate groups wherever possible. This will assist your workshop facilitators in gearing their activities to the grade and energy levels of the students. The older students will also appreciate not having the younger students dogging their steps.
- Check schedules with the middle and high schools before finalizing the event day. Many schools in the SDSMT area chose to bring a school bus full of participants. If, however, the school has the day off, the students are not easily accessible to their teachers and thus the program.

Outreach events are a great way to open the eyes of middle and high school students to STEM career options and encourage them to keep taking math and science. These lessons learned apply to many types of outreach events.

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Biographical Information

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