AC 2012-3965: UNIVERSITY/INDUSTRY LED TRANSPORTATION FOCUSED WEEKEND OUTREACH PROGRAMS FOR 7TH-12TH GRADE GIRLS: A CONTEXT FOCUSED FRAMEWORK

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University/Industry Led Transportation Focused Weekend Outreach Programs for 7th-12th Grade Girls – a Context Focused Framework

Motivation

The percentage of women age 16 and older in the U.S. workforce has steadily increased from 30 percent in 1950 to about 46.5 percent in 2008¹. Despite this increasing presence in the workforce in general, women remain under-represented in engineering and the transportation industry. In 2008, only 10.4 percent of all civil engineers in the United States were women¹. In the category of transportation and material-moving occupations, which includes both white and blue collar jobs, the percentage of full-time employed female workers totaled only 13 percent in 2008¹. This low percentage is alarming and as a nation, the transportation industry is missing out on a talented pool. Perhaps part of the reason that this percentage is so low is that women are not aware of how transportation impacts society lives. Prevalent research supports this as in a survey of the general public, many do not view STEM careers as those that directly benefit society^{2, 3}. Additionally, many studies show that women are attracted to careers that can improve society, including the quality of people's lives^{2, 4}. Transportation impacts the quality of everyone's life and since many transportation careers require science, technology, engineering, and mathematics (STEM), grouping STEM and transportation education together makes sense. This transportation social context for STEM education also has international exposure.

A recent international Delphi study, with a follow up expert panel meeting, gathered 32 engineering, technology and education experts from nine different countries and concluded that the curriculum used to support K-12 engineering and technology education be brought into *social concepts* in specific contexts such as: food, shelter, water, energy, *mobility/transportation*, shelter, and health⁵.

Approach

To counter the gender gap and to encourage careers in transportation, the university introduced transportation in STEM to girls in grades 7-12, by continuing an existing multi-year outreach series. This program focuses on providing three weekend events for specific age groups with each program (grades 7th-8th, 9th-10th, and 11th-12th). These programs, held during the academic school year, are collectively known as the *Sky's the Limit* Programs. The particular program that this paper discusses is the 11th-12th *Sky's the Limit* program called "Reaching the Sky" held from Friday, December 2 through Sunday, December 4, 2011. The 11th-12th grade outreach program was offered earliest in the school year, to allow participants time to take STEM coursework in high school the following semester and/or explore STEM careers as they near high school graduation.

The curriculum for the outreach program strove to be different than others in that it is deliberately context focused (mobility/transportation, as identified in the Roussouw et al. study⁵) In addition, the curriculum was developed by industry partners – practicing female engineers working within and developing curriculum based on their engineering passions. Also, a university physics instructor and transportation engineering graduate student also developed

curricula. These industry partners, university partner, and graduate student worked with a transportation university faculty leader in transportation during the curriculum development. Finally, this outreach program occurred in a weekend event, shorter than most week-long outreach programs.

It was a goal of the program to develop age appropriate (7th-12th graders) curricula shaped to the personal and social concepts of the attendees in that it will provide creative hands on activities that relate engineering to their daily lives and show social relevance to the world, those concepts identified in the Roussouw et al. study⁵. Additionally, the curricula allowed for creativity and involved disciplines outside of engineering such as art, communication, and physical education; thus having a multi-disciplinary approach. This philosophy is also consistent with the Liberal Education and America's Promise (LEAP) in higher education. The curricula developed for this program not only included STEM concepts, but also integrated liberal arts value in "real-world contexts," all within the context of the transportation area⁶. Finally, this focus on social context has also been noted in the National Academy of Engineering Study: Changing the Conversation: Messages for Improving the Public Understanding of Engineering. The new positioning statement about the messages regarding engineering professions illustrates the importance of engineering in our society:

No profession unleashes the spirit of innovation like engineering. From research to real-world applications, engineers constantly discover how to improve our lives by creating bold new solutions that connect science to life in unexpected, forward-thinking ways. Few professions turn so many ideas into so many realities. Few have such a direct and positive effect on people's everyday lives. We are counting on engineers and their imaginations to help us meet the needs of the 21st century³.

Product

This paper details the work of the recently completed 11th-12th grade outreach program, the first in the three weekend programs. The context-focused curriculum development framework is presented, along with an explanation as to how the background support of the existing Women in Engineering, Math and Science Program freed up the time/resources of the curriculum development team to focus on creating the context-focused engineering curriculum. The transportation curriculum leaders from industry and the university are introduced along with a brief summary of their transportation projects and comments about their experiences. Additionally, a sampling of leader and attendee comments from the 11th-12th grade program are identified, highlighting possible areas for future inclusion into the upcoming 7th-10th grade weekend programs. Preliminary assessment results of outreach outcomes are provided and finally, areas of future work are identified.

Applications

Other engineering outreach programs can use this outreach model as a way to deliver targeted context-focused engineering outreach, which includes industry leaders.

University Background

The University of Wisconsin Platteville is home to approximately 2,200 students and approximately 140 faculty and staff. Seven ABET accredited engineering programs, mathematics, computer science, and chemistry degrees are granted to approximately 3-400 students each year. The engineering programs include: civil engineering, electrical engineering, engineering physics, environmental engineering, industrial engineering, mechanical engineering, and software engineering. An eighth engineering program, Microsystems and Nanotechnology was recently approved. All engineering students are first admitted to general engineering and after completing a set of required courses are admitted into one of the engineering programs.

The University has an award winning Women in Engineering, Mathematics, and Science (WEMS) program. This nationally award winning program, established in 1994 provides mentoring, educational support, peer interaction, employment support, and some financial support for college-age STEM women. These current students, along with the Senior Director, provide a variety of successful outreach/recruitment programs for middle and high school girls. In addition, the WEMS program also operates undergraduate scholarship and retention focused programs and hosts a student section of the Society of Women Engineers (SWE).

Overview of Sky's the Limit

The Sky's the Limit Program model was developed after two years of study, discussion and research regarding outreach/recruitment effectiveness. After consulting with other Women in STEM Program Directors and reviewing current literature, the Program Director decided to create a new model that focused on age-appropriate programs that offer new programs each year to maintain a connection with 7-12th grade students through high school graduation. This resulted in three programs: Reaching for the Sky (11th and 12th grade students), Exploring the Sky (9th-10th grade students) and Dreaming of the Sky (7th and 8th grade students). In the assessment of this model, the Director also concluded that a weekend event versus a week-long event may create the same amount of interest and excitement for STEM careers as compared to a week-long event. This was an attractive hypothesis, especially in an era of decreasing budgets in education. Preliminary results of the weekend model comparison are provided in the section titled Preliminary Results - Continuing Work. Each of the three programs occurs on a weekend, Friday-Sunday during the academic year. When creating the vision for this new model, it was necessary to evaluate the management and administration of the programs.

Key components evaluated regarding the implementation of the age-appropriate, weekend-focused programs included involvement of current students, involvement of faculty and industry professionals. The Women in Engineering, Math and Science Program has included current undergraduate students in both the implementation and program planning through both volunteers and paid employment. The new model with the Sky's the Limit Programs provided an opportunity to include more direct involvement from the undergraduate students. This created

an amazing opportunity to not only obtain additional staffing to support the programs, but also created an opportunity for current students to have significant impact on the program planning. Weekly meetings with student employees, along with careful mentoring and support from the Director and Faculty Leader, helped to create programs that are fun, enjoyable and full of energy. In addition, this created strong connections of these current students with the importance of outreach, helped them to develop real-world organizational skills, and added significant content to their growing resumes. In another sense, these students also seemed to have additional desire to persist in STEM because of being involved in the outreach programs.

The next component of the program management to address included the addition of faculty and industry partners to the process. Direct involvement from both industry and faculty provides a unique and well-balanced approach that assists in providing role models, creating real-world context and also assists in creating a true collaborative environment. The connections in this collaboration are many. For example, the pre-college participants and undergraduate student staff interact and engage with a college professor, helping to dispel fears about college professors and creating a supportive connection. This supportive connection may become very valuable to either type of student in a time of need during her academic career. The same type of collaborations and connections are created with the industry partners, plus all parties involved have the chance to see many real connections in industry as it relates to the program's curriculum content. This is evident in the comments provided by one of the industry leaders, Industry Curriculum Leader C, presented in the Detailed Curriculum section of this document. Having both pre-college participants and current college students see actual layout designs, actual computer simulations, as it relates to the academic concepts, are critical in creating context and application for learning.

Outreach Funding Background

This transportation outreach program is funded by Purdue University's NEXTRANS funding, a United States Department of Transportation (US DOT) Region V Regional University Transportation Center, of which the University of Wisconsin Platteville is a university partner. This outreach program is a continuation of an existing series of 7th-12th grade outreach programs run by the WEMS program. Next, a brief discussion about the use of the weekend outreach program format versus a week long program is provided.

Weekend Outreach Model

Fifteen years ago, the Women in Engineering program offered summer week-long female STEM outreach programs with success. Despite positive evaluations by the participants and their parents, the assessment of the program indicated a change was needed. In addition, based on small yield rates (participants who yielded to our university), increasing program expenses and decreasing participation rates, the Director assessed that different outreach models be addressed. After reviewing a study by Barbara Bogue, Women in Engineering Program Director at Penn State, that indicated weekend events could be just as effective as week-long events, the Director changed the outreach/recruitment model to focus on weekend-based programs⁷.

This change affected many aspects of the program. As a result, there was an increase in faculty participation and attendee participation. In addition, current undergraduate students were more directly involved in the program, budget constraints were more easily managed, and participants started to return year after year for the programs. Her experience has shown that these weekend outreach programs are just as effective as the week long programs and maybe even more effective because there is increased faculty involvement, undergraduate students are on campus during the academic school year to assist with the program, and because the young women are more likely and available and willing to attend a weekend event than competing with their busy summer schedules. Therefore, the University STEM outreach model has continued to focus on weekend long events, with success. In fact, a handful of our outreach weekend attendees have continued to participate during the continuing age appropriate weekends and events are currently enrolled as undergraduate STEM students at the University. In addition some of those students are even working or volunteering in the Women in Engineering, Mathematics, and Science Program. These successes may be presented in a future paper.

Outreach Framework

The framework of the outreach program is unique, as the team is made up of females including WEMS senior director, transportation engineering faculty member, a university physics instructor, undergraduate STEM students, recent alumni in graduate school and in industry, and a well experienced female industry professional who owns her own engineering consulting firm. Involving females in female focused outreach is a recommendation from the American Association of University Women report titled “Why So Few?” In their report, they quoted:

Exposing girls to successful female role models can help counter negative stereotypes because girls see that people like them can be successful and stereotype threat can be managed and overcome².

Each team member plays an important role. These roles are explained next.

Sky's the Limit Program Managers

The Women in EMS Senior Director and a transportation engineering faculty member in the Department of Civil and Environmental Engineering served as the Sky's the Limit program managers. Together they obtained funding through NEXTRANS for these programs. This relationship has developed over the last few years. The faculty member worked as a project leader, in conjunction with the Women in EMS Senior Director, for previous WEMS outreach activities. Table 1 shows the responsibilities of the program managers.

Table 1 Program Managers' Task List

Sky's the Limit Program Managers' Tasks
<ul style="list-style-type: none"> • Hold weekly meetings with the WEMS Student Leaders • Work with University Publishing on marketing brochure • Hire and supervise WEMS Student Leaders • Communicate and work with University Curriculum Leader A and Industry Professional Transportation Curriculum Leaders B, C, and D to answer curriculum questions • Reserve ropes course • Order supplies for outreach program • Make copies of handouts • Reserve hotel rooms and provide directions for leaders • Manage paperwork for outreach program funding • Attend each outreach activity • Introduce each session and add transportation connections to each session • Identify, hire, and coordinate with the assessment manager • Manage and Administer the Program Budget • Program documentation • Coordinate and communicate with key institutional leaders and offices (Dean, Provost, Prospective Student Services, etc) • Grant Administration

WEMS Student Leaders

Undergraduate science, engineering, and mathematics undergraduate students can apply to work for the WEMS Senior Director. One possible job opportunity involves working as STEM outreach student leaders for the Sky's the Limit 7th-12th grade outreach programs. These student leaders are key contributors to the program. The student leaders do not develop the outreach curriculum, yet fulfill important behind the scenes roles in the setup of the programs. This frees up time for the curriculum development professional leaders, discussed below, to focus on creating fun, hands on activities for the outreach participants. The student leaders develop valuable project management skills by performing the following tasks, shown in Table 2.

Table 2 WEMS Student Leader Tasks

WEMS Student Leader Tasks
<ul style="list-style-type: none">• Create agendas for weekly meetings• Work with University Publishing on marketing brochure• Market the program through mailings, emails, websites, brochure placement in schools and communities• Organize and manage program applications and communication with pre-college participants and parents (health and permission forms).• Purchase general supplies for the program• Arrange food, housing, and local transportation for attendees• Recruit and train counselors for the weekend programs• Design and order t-shirts for attendees and leaders• Design and print booklet of professional leader biographies and activities for attendees• Work with Office of Information Technology to setup computer guest logins and printing capabilities• Train and coordinate volunteers• Program documentation• Organize registration the day of the event• Serve as assistants during the outreach weekend• Itemize risk assessment scenarios for the outreach weekend: contact information for food, lodging, transportation• Serve as back-up counselors, in case of an emergency• Serve as student engineer panelists at panel discussion during weekend – to answer questions from attendees about engineering, student life• Handout and collect outreach evaluation• Record leaders' and attendees' feedback in the days following the event

These tasks are key to the programs' success and are reasonable jobs for junior and senior undergraduate students. Since the students get paid hourly, they are willing to help, can earn money, can help encourage other females in STEM, and allow the curriculum writers to focus on developing curriculum. The project management skill that these women acquire through this experience has proven to be very valuable skill sets. Two of the leaders obtained summer

internship programs in construction management/engineering for a major general contractor during the past summer. There are many other WEMS student leaders that have had similar success stories.

Curriculum Leaders

One on-campus professional and three off campus professional curriculum leaders were also hired. A brief summary of their backgrounds and curriculum presented below.

University Curriculum Leader

The on-campus curriculum leader teaches physics and co-teaches with the WEMS Senior Director a humanities class titled “Women in Science” and had worked with women in STEM outreach programs in the past. From that previous outreach experience grew her outreach session titled “Ropes Course Physics”.

- University Leader A – Ropes Course Physics: a physics lecturer and instructor of Women in Science humanities class

Industry Professional Transportation Curriculum Leaders

The program managers hired industry professional transportation engineers to develop transportation curriculum for the 11th-12th grade outreach program, again, a recommended practice to STEM outreach by the American Association of University Women². Three transportation engineers were included:

- Industry Leader B – Driver distraction project: a transportation engineering graduate student, instructor of civil engineering technology, and also an alumna from the UW Platteville civil engineering, mathematics, and physics programs
- Industry Leader C – Trip Generation/traffic modeling: a female professional transportation engineer who owns her own transportation and civil engineering consulting firm
- Industry Leader D – Roundabout exploration: a recent UW Platteville graduate in transportation engineering, working at an international transportation engineering consulting firm

The Sky’s the Limit transportation faculty program manager knew each of these leaders and communicated with them on a steady basis via phone conversations and emails.

In determining the specific project that each industry leader would focus on, the program manager asked each of them the types of projects they enjoyed working on – as she felt it was likely that their passion would show to the attendees and that the leaders themselves might then enjoy developing the curriculum.

Brief Curriculum Session Summaries with Age Appropriate, Personal, and Social Context Explained

There were a total of four curriculum sessions, each presented by the four curriculum leaders identified above. A brief summary of each curriculum session, along with its social and personal/age appropriate relevance to the attendees, is provided here. A more detailed description of each of the four sessions is provided in the Detailed Curriculum section near the end of the document. That section also includes feedback from two of the curriculum leaders (university and industry) on their involvement in the program.

The weekend's overarching theme was transportation. This was determined due to the NEXTRANS US DOT funding and through discussions of the Program Managers. Since transportation impacts the lives of people in a community and research shows that women are attracted to careers that have a clear social purpose, transportation was selected as the outreach theme². In addition, safety plays a significant role in transportation and society and was also identified as a concept to include when developing engineering and technology curricula⁵. Therefore, the curricula incorporated transportation with safety for the weekend. Finally, transportation and safety have a very personal context to this age group. 11th-12th graders are typically seasoned transportation users and most recently received their own driver's license, giving high personal relevance to transportation and its connection to STEM. It is hypothesized that having this themed outreach exposure will result in attendees "exposing" engineering within their social settings,

Table 3, Table 4, Table 5, and Table 6 provide the session titles, leaders, topics discussed, personal age-appropriate relevance and social relevance connections used for the 11th-12th grade curricula.

Table 3 Ropes Course Curriculum Session and Leader, Topics, Personal Relevance, and Social Relevance

Curriculum Session and Leader	Topics Discussed	Personal Relevance/ Age Appropriateness (11 th -12 th grade)	Social Relevance Connection(s)
Ropes Course Physics University Curriculum Leader A	<ul style="list-style-type: none"> • Kinetic energy • Potential energy • Conservation of energy • Acceleration 	<ul style="list-style-type: none"> • Attendees may have taken/may be taking/may be considering taking physics as STEM course(s) • Likely have heard the terms kinetic energy, potential energy, conservation of energy, and acceleration before • Ropes course provides physical activity, personal challenges, and teamwork, all in supportive and non-competitive way • Lab work involved computers, which they have experience with • Physically and mathematically connecting with basic physics concepts may help them to be more successful when they take the course 	<ul style="list-style-type: none"> • Roadside safety devices use these physics principles • Because of these experiences, attendees are more aware of physics– they may see, understand, and apply physics contexts in social and personal settings

Table 4 Distracted Driving Curriculum Session and Leader, Topics, Personal Relevance, and Social Relevance

Curriculum Session and Leader	Topics Discussed	Personal Relevance/ Age Appropriateness (11 th -12 th grade)	Social Relevance Connection(s)
<p>Distracted Driving</p> <p>Industry Curriculum Leader B (Transportation engineering alumna, transportation engineering graduate student)</p>	<ul style="list-style-type: none"> • Reaction time/distance • Stopping sight distance • Dangers of texting and cell phone use and driving 	<ul style="list-style-type: none"> • Teens text, teens use cell phones, teens drive • Media and local/state laws present dangers of driving and texting and cell phone use • 11th-12th graders can perform basic lab work and mathematics calculations, allowing them to calculate reaction distance and stopping sight distance for various speeds 	<ul style="list-style-type: none"> • Reaction distances and stopping sight distance are used in roadway design for safety • Mathematical computation of reaction time/distance/stopping sight distance may help them see the connection between mathematics and engineering

Table 5 Trip Generation/Traffic Modeling Curriculum Session and Leader, Topics, Personal Relevance, and Social Relevance

Curriculum Session and Leader	Topics Discussed	Personal Relevance/ Age Appropriateness (11 th -12 th grade)	Social Relevance Connection(s)
Trip Generation/Traffic Modeling Industry Curriculum Leader C (Transportation engineer and Woman owned transportation engineering consultant)	<ul style="list-style-type: none"> • Select land use types • Trip generation • Traffic assignment • Apply trips to traffic model and see resulting queues 	<ul style="list-style-type: none"> • Experience with traffic, as a user experiencing driving and delay due to increases in traffic • Lab work involved computer modeling, they likely have computer experience and have likely heard the term “computer model”, this gave them some experience and exposure to a computer model, as it relates to STEM 	<ul style="list-style-type: none"> • Trip generation and traffic modeling allow transportation designers to create safe and efficient transportation for its users • Awareness that different land uses generate more traffic and seeing how this traffic data is inserted in the traffic model may result in the attendees projecting that with population increases, vehicle demand may likely outpace roadway infrastructure.

Table 6 Roundabouts Curriculum Session and Leader, Topics, Personal Relevance, and Social Relevance

Curriculum Session and Leader	Topics Discussed	Personal Relevance/ Age Appropriateness (11 th -12 th grade)	Social Relevance Connection(s)
<p>Roundabouts</p> <p>Industry Curriculum Leader D (Transportation engineer alumna, industry transportation engineer)</p>	<ul style="list-style-type: none"> • Identify intersection conflict points • Identify roundabout conflict points • Compare traditional intersection and roundabout conflict points • Roundabout facts 	<ul style="list-style-type: none"> • Experience seeing and driving in roundabouts in regional area • Statewide media highlight roundabout use 	<ul style="list-style-type: none"> • Roundabouts are safe and efficient intersections used in the transportation network within a community

Poster Session

It was important to the program managers that the attendees summarize their experiences at the end of the event that they could also take with them. To accomplish this, each attendee created a half-sheet poster. These posters, along with additional work the young women completed during the previous sessions, were organized at work stations around the lab room. When families arrived in the afternoon to greet their girls, they were able to view their work and ask attendees questions about their weekend activities.

Figure 1 and Figure 2 highlight the creative posters made by the attendees. The attendees seemed to enjoy making the posters, allowing their creativity to link in with their STEM experiences.

Figure 1 Example poster created by attendee

Figure 2 Example poster created by attendee

Preliminary Results

From the transportation program manager's perspective, the curriculum presented provided an age appropriate introduction to transportation engineering and preliminary results show that the attendees were able to identify important transportation and STEM career facts, as well as key statements on personal and social relevance.

To aid in assessment of the program, an outside assessment manager was hired and attendees filled out evaluations. A preliminary glance of the results of the evaluation and comments received by the attendees is shown in Table 7 and

Table 8. Specifically, the results of two outcomes are presented:

- Outcome 1: Participants left with new, correct knowledge of STEM fields
- Outcome 2: Participants are more likely to pursue a STEM career as a result of the activity

Table 7 Outcome 1 results: Participants left with new, correct knowledge of STEM fields⁸

Question Text	11 th -12 th Grade Results
My participation in this program helped me understand STEM fields better	65% (sum of “moderately” to “to a great deal”)
People in STEM careers mainly work on machines and computers	12% “agreed”
People in STEM careers mainly work with other people to solve problems	100% “agreed”
People in STEM careers can choose to do many different kinds of jobs	100% “agreed”
People in STEM careers have lots of choices about what they can do in their jobs	94% “agreed”
People in STEM careers mainly work on things that have nothing to do with me	0% “agreed”
I don’t know what people in STEM careers do	6% “agreed”
People in STEM/transportation careers impact the quality of life for people in a community	100% “agreed”
People in STEM/transportation careers impact the quality of design of the community	100% “agreed”

Table 8 Outcome 2 results: Participants are more likely to pursue a STEM career as a result of the outreach program⁸

Question Text	11 th -12 th Grade Results
If you go to college, do you think you will pursue a career in a STEM-related field?	76% “yes”
In your future, do you think you want to be a scientist?	47% “yes”
In your future, do you think you want to be a mathematician?	24% “yes”
In your future, do you think you want to be an engineer?	43% “yes”

Attendees were also asked to:

- List three new *facts* related to STEM that you learned this weekend.
- List three new *facts* related to transportation engineering that you learned this weekend.
- List two new *skills* that you gained from this weekend’s activities.

Table 9 shows some of the comments received, with the author's categorization of how the comments help show the value of the weekend program with respect to social and personal relevance and STEM/transportation careers.

Table 9 Attendee's direct comments about personal and social relevance, STEM and transportation careers from 11th-12th grade outreach weekend⁸

Personal Relevance	Social Relevance	STEM Careers	Transportation Careers
<ul style="list-style-type: none"> • "Confirmed my confidence in going into the engineering field" • "Applying physics/math/science to everyday activities" 	<ul style="list-style-type: none"> • "Benefits the community" • "Why it's important" • "They can save lives through new innovative designs" 	<ul style="list-style-type: none"> • "The disciplines intermix" • "You actually apply what you learn in workplace" • "Engineering is an even bigger field than I thought" • "That they all are extremely related" • "It is fun" • "There are so many kinds of engineers" • "Growing at a steady rate" 	<ul style="list-style-type: none"> • "That there is such thing as transportation engineering" • "Bigger field than I thought" • "Much more complicated than I thought" • "They can save lives through new innovative designs" • "Takes more 'behind the scenes' than I thought" • "A ton of thought goes into road planning" • "There are a lot of different positions available"

The preliminary results and comments of the first outreach weekend tend to show that the two outcomes were achieved. A thorough assessment of the entire outreach program will be completed after the three weekend events are completed.

Industry and University Leader Involvement Comments

It is important to the assessment team that to explore the program from the curricula developer's perspective, specifically for this paper, the impacts that outreach has on them personally. A few weeks after the program, Industry Leader A and University Leader C were interviewed. Highlights from that discussion are presented here.

The Physics Ropes Course University Leader A was asked two questions. First, why did she get involved in the outreach program and whether or not she felt outreach is important. In response she stated the following:

I got involved because I want to encourage young women interested in science and engineering any way I can. Having majored in physics myself, I know how it feels to be one of just a few women in a program, and I want to help change that. I felt like this was a good opportunity because it would be engaging to the students – not just a boring lab, but something connected to the real world, and something fun. Also, I love teaching and thought I'd enjoy it.

Outreach is very important to me. Only so much can be done once students arrive at college. I think reaching community members and younger students and positively influencing their opinions of engineering and physics is needed if any real change is going to happen⁹.

After the weekend, industry curriculum leader C was asked why she chose to participate in the program and if the experience was personally satisfying. Here are her comments:

I chose to lead a unit because I felt that I had the experience and knowledge to do a good job, and I am sincerely interested in promoting STEM careers to young females. As a potential employer of these future graduates, I am interested in exposing them to some of the careers in transportation. Also, I felt it was good visibility for my company. Maybe someone will remember us down the road when we are trying to employ summer interns or new grads. I think it is part of my obligation to the profession to help in any way I can.

I obtained a very high level of personal satisfaction from participating in this outreach program. It renews my faith in the engineering community to see programs put together that are really trying to expose young woman to STEM careers, in a fun way. Our country needs more females in engineering careers, and showing them what we do for careers, and how they can express their creativity and help the world, is a great step towards generating interest. The girls asked thoughtful questions and were sincerely interested in details of the program. When I was trying to make choices regarding my career path in the mid-1970's, there wasn't much encouragement towards engineering careers. Since I have graduated, I have become active in trying to promote interest for females to consider technical careers. As this program was sponsored by FHWA, I was particularly interested because I have spent my entire career in transportation related fields. I feel that it has provided many opportunities to me, and I would like to share my experience and knowledge with others¹⁰.

It was refreshing to work with university and industry leaders who valued STEM outreach and rewarding to see them personally satisfied by it.

Upcoming 7th-10th Grade Outreach Activities

This transportation focused outreach program was the first of three weekend outreach programs to occur during the 2011-2012 academic school year. With this first program complete, the outreach framework can simply be followed again for the next two programs, using the leader and attendee comments as possible ways to improve the upcoming outreach programs.

Some items identified on the leader and attendee comment list include:

- Not all session objectives should be academic – there are competing factors between an outreach providing “what is engineering” vs. “make it fun”. Attendees noted the importance of:
 - Meeting others with similar STEM curiosities
 - Being on campus and learning/experiencing college life/going in the classrooms/seeing the labs/eating in the commons
- Fun and physical activity was very important to the attendees and they wanted more of it
- Provide more multi-disciplinary projects. In reviewing the preliminary assessment, some attendees stated that they were not interested in transportation and would have rather experienced a variety of STEM projects/contexts. This idea is identified and recommended in the Roussouw study “The idea is that by teaching concepts in a variety of contexts gradually the learner will start to recognize the generic nature of the concepts and be able to apply it in new contexts”². Yet, the funding of the outreach program has transportation backing and one program manager wanted to provide real-life transportation activities during the outreach program so that the participants to use their current life experience, as drivers, and to show them how engineering impacts the design of transportation facilities. Also, perhaps since this is a short weekend outreach program it is very important for program managers to of explain the context of the program, transportation in this case, as a way to explore engineering, not that the program necessarily had the goal of creating only transportation engineers.
- Have all three marketing brochures completed in the very beginning, allowing more marketing opportunities earlier in the academic year
- Student leaders were interested in knowing curriculum activities ahead of time, so they could assist the attendees better. This was difficult due to time constraints with industry leader volunteers

Future Work

Many opportunities for future work have been identified through this process and may be presented in future papers:

- The detailed physics ropes course and transportation curriculum used
- Assessment of the weekend outreach model
- Assessment of the context driven outreach
- The importance of outreach participation to and on:
 - industry leaders
 - university faculty and staff
 - undergraduate students

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