

THE PENNSYLVANIA STATE UNIVERSITY WEP “GIRL SCOUT SATURDAYS” (GS²) PROJECT: COLLABORATIVE OUTREACH TEAMING WOMEN ENGINEERING STUDENTS WITH PATHWAYS PROSPECTS

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Abstract — *The WEP Girl Scout Saturday (GS²) outreach project addresses both retention and recruitment challenges. GS² project mentoring opportunities strengthen engineering career choices for first-year students, enhance leadership opportunities for older students, and create a hands-on learning environment for pre-college girls. Approximately 400 pre-college girls ages 6-17, and 300 undergraduate women engineer volunteers participate in WEP Girl Scout Saturdays annually. This innovative partnership provides undergraduate women engineers with leadership experience, establishes pathway girls with technical opportunities and role models, and facilitates an exciting environment to explore engineering. WEP GS² undergraduate women engineering students work to engage girls in hands-on engineering activities and to recruit them to engineering, thus expanding entry points on the engineering pathway. GS² project topics include robotics, computers, aerospace, acoustics, inventions, automobile design and mechanics. Assessment data indicates that the project is successful in reaching these goals.*

Index Terms — *Hands-on workshops, pre-college, recruitment, retention*

PENN STATE WEP GS² PROJECT GOALS

The Women in Engineering Program (WEP) Girl Scout Saturday (GS²) outreach project successfully targets pivotal program objectives including both retention and recruitment challenges for Women in Engineering Programs. WEP GS² project goals are to create a hands-on learning environment for pre-college girls, to strengthen engineering career choices for first-year students through mentoring opportunities, and to enhance leadership opportunities for older students.

This innovative partnership with the local Girl Scout Council provides undergraduate women engineering students with leadership experience, augmenting confidence necessary to succeed in an engineering curriculum. Simultaneously, it establishes pathway girls with technical opportunities and role models, and facilitates an exciting environment to explore engineering. Undergraduate women engineering students work with the Girl Scouts to engage them in hands-on engineering activities and to recruit them

to engineering, thus expanding the entry points on the engineering pathway.

Hands-on engineering activities are designed to dovetail with badge requirements set forth in Girl Scout merit guidelines. WEP GS² topics include robotics, computers, aerospace, acoustics, inventions, automobile design and mechanics. Each two-hour weekend GS² program serves thirty to seventy participants and historically achieves a minimum 1:1 ratio of woman engineer to Girl Scout.

The Penn State WEP Girl Scout Saturday project generates a positive response from undergraduate women who are eager to serve as volunteers, a valuable effect on pathway participants, and a significant endorsement from Girl Scout leaders and parent volunteers. Assessments from undergraduate women volunteers and Girl Scout participants are tabulated each session.

WEP GS² BACKGROUND AND DESCRIPTION

WEP GS² offers seven two-hour workshops to Girl Scout troops throughout the academic year. Each workshop targets a different engineering theme and dovetails with a Girl Scout merit badge. An important feature of this project is the leadership provided by undergraduate women engineering students. WEP students engage participants in hands-on engineering activities and provide important role modeling. Each workshop is populated by different troops and participants, thus enabling WEP GS² to serve 350-400 participants per academic year.

The WEP Girl Scout Saturday workshops were initiated in 1998 as a way to provide leadership opportunities for the undergraduate women engineering students, thus strengthening the retention of first and second year students. Since its inception, the WEP GS² project has grown dynamically; it was evident that the content of these workshops could be tailored to have a significant and far-reaching impact on the pre-college participants. Consequently, the WEP GS² project has evolved to become a significant pre-college activity teaming pathway prospects with undergraduate women engineering students. The girls experience engineering through hands-on activities, and benefit from the role modeling provided by the women volunteers.

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Through coordination of workshop activities with the Girl Scout USA merit badge guidelines, multiple purposes can be served. Pre-college girls can enjoy exposure to engineering while earning a Girl Scout program badge. The WEP GS² project successfully engages a wide population of 6-17 year old participants in engineering activities and concepts. Through the wide variety of GS² workshops, the pre-college girls are encouraged to participate in future WEP offerings. Finally, the undergraduate women engineers provide a critical component to the project as they impart essential leadership while mentoring the girls. First-year engineering students benefit from the mentoring opportunities provided by this project, and report that it strengthens their engineering career choices.

Girl Scouts USA offers programming for each of five different pre-college age groups. WEP GS² is designed to target four of these populations including Brownies (Ages 6-8 yrs.), Juniors (Ages 8-11 yrs.), Cadettes (Ages 11-14 yrs.), and Seniors (Ages 14-17 yrs.), through hands-on workshops. Each category offers a broad spectrum of engineering and science-related merit badges with distinct requirements that the scout may earn. As each age level progresses, the degree of difficulty for badge activities becomes more challenging. As illustration to this, a Brownie scout earns "Try-its" and must complete four of the six stated activity requirements; a Junior scout earns "Badges" and must complete six of the ten stated activity requirements; and Cadette and Senior scouts earn "Interest Project Patches (IPP)" and must complete seven of the following activity requirements as stated in the GS USA book:

- Two Skill Builder Activities
- One Technology Activity
- One Service Project Activity
- One Career Exploration Activity
- Two Additional Activities in any of the above areas

Using these badge specifications as a reference, WEP GS² activities are designed thematically to satisfy level requirements while incorporating hands-on engineering opportunities that the girls enjoy.

WEP GS² PROJECT APPROACH

The WEP Girl Scout Saturday program annually organizes a calendar of activities that addresses each of the four aforementioned age groups. The 2002-03 Girl Scout Saturdays calendar highlighted seven workshops: one Brownie (B) level, five Junior (J) level, and one Cadette/Senior (C/S) level. Undergraduate women volunteers enjoy working with the youngest girls the most (Brownies), however WEP GS² project objectives are best accomplished by establishing a stronger focus on older girls. Therefore, the 2003-04 GS² calendar will highlight an intentional shift in the seven workshops designed to further

engage older pathway girls: one Brownie level, three Junior level, and three Cadette/Senior level.

The 2002-03 WEP GS² project featured the following workshop themes: "Point Click & Go" (B); "Computer Fun," "Making It Matter," "Toymaking" (Robotics), "Aerospace," "Car Care" (J); and "Inventions and Inquiry" (C/S). Offerings in 2003-04 will highlight all new workshops capturing the interest of past attendees as well as newcomers. The Brownie and Junior sessions are conducted within a two-hour Saturday timeframe during which the badge is completed. Cadette/Senior IPP sessions are designed to foster the interest of older girls and utilize a 3-4 hour timeframe conditional upon the topic covered and the activity complexity level.

Girl Scout Saturday program marketing and advertisement is successfully accomplished through coordination with the Girl Scout Council office. By posting the annual WEP GS² activity calendar and a brief abstract for each workshop in the annual Council Calendar Guide, every Girl Scout leader in the Council region will be able to access the information and consider participation in WEP GS² workshops. The annual GS² calendar is provided to Council five months in advance of the approaching academic year. Since volunteer participation is a critical parameter, it is recommended that the dates for each WEP GS² event be carefully established taking into consideration important University events, breaks, and significant sporting events which would limit parking and ease of guest mobility; these are obstacles that will diminish volunteer participation.

GS² workshop registration is handled through the WEP office. A nominal three-dollar registration fee per girl is required in advance of the program. This helps to defray the materials costs, and most importantly, solidifies a commitment on behalf of the scout troop.

WEP GS² registration in 2002-03 reached all-time highs and each program has had a surplus waiting list of 20 to 50 girls eager to participate if an opening becomes available. The optimal number of girls served by a program varies from workshop to workshop depending upon a host of limiting factors; resources are a vital consideration. For example, if the badge theme is computers, a University computer lab will define the number of eligible participants based on the number of machines available. Similarly, the number of women engineers who volunteer to assist with the instruction is a critical element. Some engineering badges require a 1:1 ratio while others offer more flexibility. Penn State served a total of 350-400 pre-college girls in the seven 2002-03 WEP GS² workshops, averaging about 50 participants per workshop. Cumulatively, more than 300 undergraduate women engineering volunteers attended these workshops to mentor the Girl Scout participants.

Women engineer volunteers provide an essential resource to the program. Therefore, enlisting the assistance of these women is never left to chance. Optimally, volunteers are sought approximately two weeks in advance

of the program. Confirmations and reminders are strategically sent to keep busy students informed. The women engineering students thoroughly enjoy the WEP GS² events. The program draws between 30 to 50 undergraduate women on a typical Saturday morning, which enables the participants to enjoy a 1:1 mentor relationship with a woman engineer. The benefits to both are obvious. Through partnership with the mentors, participants have a measurably high degree of success with hands-on activities. Further, PSU student mentors take pleasure in the opportunity to serve as role models for the pre-college girls, thus enhancing confidence vital to the pursuit of an engineering career.

A key factor in attracting the women volunteers is carefully limiting volunteer time requirements. One hour prior to the event, the WEP GS² project coordinator hosts a training session for the women volunteers with a continental breakfast. WEP leaders provide a description of events, volunteer assignments, and a volunteer t-shirt at the training. Upon conclusion of the workshop, selected comments from the participant assessments are forwarded to student volunteers in a “thank you” email the week following the event. The women are as excited to receive these emails laden with feedback as they are to participate in the program.

WEP GS² ACTIVITIES AND AGENDAS

It is important that the activities chosen for the WEP GS² workshop are age appropriate and able to be understood by the participants. Overly complex activities can confuse and frustrate both the participants and the volunteers; therefore it is vital to choose activities that will provide successes for all. Workshop activities employ both team and individual efforts, encouraging students to explore engineering in a number of capacities.

A typical WEP GS² program agenda is designed to begin instruction at 10:00 am and conclude by noon, however, a significant amount of preparation is required before that time. Specific agenda activities will dictate the preparation needed and pace required for each workshop. Workshops for the older girls necessitate a three to four hour timeframe to complete the IPP. When constructing the agenda, it is also important to account for the mechanics of moving participants from one room and/or activity to another. If the program is designed with several different rooms being utilized, it will take 5-10 minutes of agenda time to move participants from one location to another depending on the age group. Therefore, it's best to minimize participant movement. Pre-event communications with women engineer volunteers and Girl Scout leaders are vital and will ensure a well-orchestrated workshop and post-event assessment.

As participants start to arrive, the workshop pace accelerates significantly. Since only one hour is allotted to training, it is imperative that all set-up and coordination has been completed prior to that time.

Table I represents a workshop agenda for the “Point, Click, & Go” Brownie Try-it. The agenda addresses the four “try-it” requirements for completion of the merit badge, and allows ample time for 6-8 year olds to navigate from activity to activity. In addition, workshop activities were successfully designed to capture the interest of 6-8 year olds, while keeping in mind the limited attention span of this age level. This workshop served 72 Brownie Girl Scouts and almost 50 volunteers in two computer lab sessions run concurrently.

TABLE I
“POINT, CLICK, & GO” BROWNIE TRY-IT PROGRAM

Time	Activity
9:00 am	Volunteer Training Session <i>Information handouts & assignment review</i>
9:45 am	Participant Registration
10:00 am	Welcome & Introduction of Volunteers <i>Panel discussion of computer engineering</i>
10:20 am	SPLIT into CONCURRENT SESSIONS
10:25 am	“Making Computers Work” (Requirement 1) <i>Learn how to turn on the computer and start a program, use a mouse, handle floppy disks and CD-ROMs, save, print, & turn off the computer.</i>
10:35 am	“Writing a Story” (Requirement 3) <i>Use a computer to write your own poem. Correct any spelling errors with Spell/Check. Illustrate your poem with MS Paint!</i>
10:50 am	“Playing a Game” (Requirement 4) <i>Play a computer game on the web site. What did you like, and how would you change it?</i>
11:00 am	Snack and Bathroom Break!
11:15 am	“Learning Computer Words” (Requirement 2) <i>Group discussion: Learn the meanings of some computer words to help you understand communication in a world of technology. (Words: Font, Memory, Software, Icon, ...)</i>
11:25 am	“Creating” (Requirement 5) <i>Use a computer to make your own thank-you note on your own stationary. Correct spelling errors with Spell/Check. Add colorful drawings!</i>
11:40 am	Share Your Stories with the Group! <i>Group discussion: Take turns reading the stories & poems you have created! Was it easier or harder to write them on the computer? Why?</i>
11:45 am	Clean-up and Evaluations
Noon	Program concludes

Table II depicts a WEP GS² workshop agenda for the “Making It Matter” Junior Badge. The activities are notably more challenging and complex. In addition, the agenda addresses the required six badge elements while allowing ample time for 8-11 year olds to steer from activity

to activity. The messy hands-on activities were successfully designed to capture the interest of 8-11 year olds, while incorporating their ability to stay on task for longer periods of time. It was also possible to bring deductive reasoning into activity discussions as participants examined reactions in each experiment. This workshop served 48 Junior Girl Scouts in team environments and featured 40 volunteers.

TABLE II
“MAKING IT MATTER” JUNIOR BADGE PROGRAM

Time	Activity
9:00 am	Volunteer Training Session
9:45 am	Girl Scout Registration
10:00 am	Welcome & Introduction of Volunteers
10:10 am	“Engineering in Action” (Requirement #6) Panel Discussion: <i>Interview women engineering students and explore engineering careers! Find out the roles that civil, mechanical, aerospace, electrical, chemical, ceramic, industrial, and architectural engineers play in their jobs!</i>
10:25 am	“Making a Polymer” (Requirement #1) <i>Many of the products you use every day are made of plastics. Make your own polymer from Borax, water, and glue.</i>
10:35 am	“Polymer Possibilities” (Requirement #2) <i>By adding different ingredients, engineers can change polymer look, feel, & behavior. Make different polymers with different properties using Borax, water, glue, salt, sugar, corn meal & baking powder.</i>
10:50 am	“Materials & Structures” (Requirement #5) <i>Civil engineers design highways and bridges. Build a structure from which you will hang a cup using old newspaper, tape, string, & a cup full of rocks and gravel.</i>
11:10 am	Snack and Bathroom Break!
11:20 am	“Label Check” (Requirement #7) <i>Examine 10 different products found around the home. What chemicals are listed as ingredients of the products? Which products require you to take special safety precautions when handling them and disposing of them? What precautions you should take?</i>
11:25 am	“Base-ic Facts” (Requirement #8) <i>Is it an acid or a base? Find out by making your own pH tester!</i>
11:35 am	“Reverse Engineering” (Requirement #9) <i>Reverse engineering is dissecting something to see how it works. Take apart old appliances and explain how the appliance works. Try to reassemble your appliance!</i>
11:50 am	Clean-up and Evaluations
Noon	Program concludes

Table III illustrates a significantly more challenging WEP GS² workshop agenda for the “Inventions & Inquiry” Cadette/Senior IPP and highlights engineering design. Activities utilize team efforts and are notably more complex. This agenda addresses the seven required IPP elements, although in hindsight, the workshop should have extended another hour to afford more comfortable team deliberations and design. The hands-on design activities and team presentations enhanced participant experience. This workshop served 30 Cadette and Senior Girl Scouts working in design teams, and utilized 25 volunteers.

TABLE III
“INVENTIONS & INQUIRY” CADETTE/SENIOR IPP PROGRAM

Time	IPP Activity
9:00 am	Volunteer Training Session
9:45 am	Cadette Registration
10:00 am	Welcome & Introduction of Volunteers
10:05 am	“Inventions” (SB #1) <i>Brainstorm a list of 10 inventions you’d like to see. Take 2 and list all their uses. Visualize them combined and list new uses.</i>
10:10 am	“Panel Interview” (Technology #5) <i>Ask women in five different engineering fields what they foresee as the most valuable inventions in the future. What are the most important problems that need solutions? Take one and brainstorm to “invent” a solution.</i>
10:25 am	“Invention Career Exploration” (CE #3) <i>Think about the kinds of careers that may relate to inventing & learn more about two of them. New panel highlighted. (Engineer, designer, researcher)</i>
10:35 am	“Changing Inventions with Technology” (Technology #2) <i>Explain how changes in technology have altered two inventions in terms of function & design. Compare old & current models. (Soda can tabs, slinky toy)</i>
10:55 am	“Create an Invention” (SB #3) <i>Make a detailed sketch of the invention and label all parts. Develop a 3-dimensional working model. Brainstorm & give it a catchy name! (See “The Big Cover Up” design problem statement & specifications.)</i>
11:45 am	Snack/Bathroom Break
12:00 pm	“Advertising Campaign” (SB #5) <i>Develop an advertising campaign for your invention. Write a radio/TV advertisement.</i>
12:15 pm	“Invention Convention” (SP #1) <i>Invent & Present! (Each group presents inventions & ads)</i>
12:45 pm	Clean-up/Evaluations
1:00pm	Program concludes

WEP GS² PROJECT ASSESSMENT

Upon completion of each event, assessment is conducted to ascertain whether the objectives were met, and to improve future workshops. A one-page assessment is given to measure the extent of success with the Girl Scout participants and student volunteers.

Participant assessments incorporate questions the depth of which are tailored to facilitate understanding of the specific age group being evaluated. Inquiries are made as to the quality of the participants' experiences, their current career interests, and whether they would like to learn more about similar topics.

Since a prime objective of WEP GS² is to provide leadership experience for the undergraduate women, it is equally important to assess the impact of the experience on them. Following each WEP GS² program, the women volunteers completed assessments that collected comments on their experiences and thoughts on the activities that were planned.

CONCLUSIONS

The Girl Scout Saturday initiative effectively serves a number of important WEP program objectives including both recruitment *and* retention. Since launching the program in 1998, the popularity and far-reaching effects can be measured and verified. WEP GS² is now well institutionalized and continues to attract girls, some from distances exceeding 100 miles. A typical WEP GS² program serves an average of 50 participants and has a waiting list of 20-50 additional girls.

Assessment results from the participants highlight the success of the program. When asked whether the Penn State students were helpful, 100% of "Point Click & Go" Brownie participants (6-8 year olds) responded "yes." When asked what they would like to be when they grow up, 33% responded "an engineer." When asked, "*would you like to learn more about engineering,*" responses included:

- ❖ "I'd like to learn more because I want to be one."
- ❖ "I want to learn what they do."
- ❖ "I like to learn how to help people with computers."
- ❖ "Yes, because I like engineers!"

When asked whether the Penn State students were helpful, 100% of "Making It Matter" Junior participants (8-11 year olds) responded "yes," some adding additional phrases such as, "I want to be an engineer too!" When asked, "*would you like to learn more about engineering,*" some responses included:

- ❖ "It is awesome and you can use your imagination."
- ❖ "I found out I like building things."
- ❖ "Engineers do fun things!"
- ❖ "It would be interesting to learn about engineering!"

Similarly, the 2003 Cadette/Senior "Inventions & Inquiry" workshop successfully captured the interest of its participants (11-17 year olds.) When asked whether the women engineers helped them understand the activities, 96% of the Cadette/Senior participants responded, "absolutely" (5/5 on a Lykert scale.) When asked whether they "*would like to learn more about engineering,*" these older participants responded:

- ❖ "I wanted to be an architect to begin with, but now I really want to go into an engineering career!"
- ❖ "I would because I like to invent."
- ❖ "Possibly because it is pretty neat, but science isn't my favorite subject."
- ❖ "Maybe. It's more interesting than I thought."

When asked what *the "best part of the program was,"* these 13-17 year old girls responded:

- ❖ "I liked working with the older girls!"
- ❖ "Listening to the explanations of each type of engineering from the panel."
- ❖ "Designing and making the product."
- ❖ "The fact that we made a new invention."
- ❖ "I enjoyed working in groups to solve a problem."
- ❖ "Building the prototype because we got to make a bizarre thing that was interesting."

Assessment results from the women volunteers gauge the significance of the experience from the vantage point of an undergraduate engineering student. When asked whether they thought WEP GS² "*activities were valuable to the girls,*" volunteer responses from the Cadette/Senior "Inventions & Inquiry" workshop included the following:

- ❖ "It gave them a chance to see what engineers do and gave them more insight into what they could do in the future."
- ❖ "They learned about teamwork and combining ideas and that engineering is FUN!"
- ❖ "They were able to go through the design process."
- ❖ "They really had fun with the hands-on approach and had the freedom to explore."
- ❖ "They became more interested in engineering."

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