Empowering Engineering Students to Engage Middle School Classrooms in Engineering Innovation and Design through Outreach Kits

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ABSTRACT

The University of Dayton recently received a grant from the Engineering Information Foundation (EiF) and National Science Foundation (NSF) to work on a project entitled *Engineering Outreach to Middle School Girls.* The main objective of this project was to increase female participation in engineering by providing exposure to engineering for girls during a critical time of their academic development, the middle school years. One of the easiest and most effective ways to provide this exposure is through outreach at local schools. However, sometimes engineering students and faculty are reluctant to engage in this outreach because they do not have the time or resources to develop an appropriate activity. To address this issue "pick up and go" engineering activity modules that can be used for engineering outreach were developed and piloted in mixed gender classroom and afterschool programs.

Modules were developed and piloted by teams of undergraduate engineering and teacher education (pre-service teachers) students with guidance from the project principal investigators. Furthermore, they were developed to incorporate research based best practices and principles that have been found to be successful in attracting girls to engineering. The modules focused on engineering design and innovation, such that the activities encouraged team work, creativity and problem solving. Additionally, scenarios were provided as part of the activities to demonstrate the social relevance of engineering. The pre-service teachers mapped the activity modulus to the Ohio Academic Content Standards to encourage the participants to incorporate and apply topics they have learned in their science, math and language arts classes and to serve as a resource for the classroom teacher. Handouts and a website are being created to provide useful information and support to parents to help them understand how to encourage their female children to consider engineering as a possible career field. This website will also house the instruction sheets for all of the activity modules developed through this project.

The efficacy of the kits were assessed using the *Assessing Women and Men in* Engineering (AWE) tools, through activity observation and through facilitator and teacher feedback forms. Through this project "pick up and go" activity kit concepts were developed and piloted in six classrooms and through an after school program. Teachers were very receptive to having the activities facilitated in their classrooms. The engineering student volunteers found the kits useful and easy to facilitate. Although no quantitative data is currently available from the AWE too, initial results suggest that the kits were effective in helping children gain a more positive perception of engineering and science and a better understand the field of engineering and the engineering design process.

Introduction

Engineering innovation in the United States (US) is the backbone of economic growth and sustainability. Cook, et al. (2003) state, "Industrial innovation and its effective diffusion play a vital role in the economic development and competitiveness of nations, regions and enterprises" (cited in Guan, Yam, Tan, and Lau, 2009).[1] Furthermore, engineering innovation is required to solve some of the world's greatest challenges such as depleting natural resources, increasing population and global climate change.[2, 3] The critical role that innovation plays in the US economy and in addressing critical issues of our time has been recognized by top administrators including President Obama.[4] As a result, innovation has been one of the top government policy agendas for the past several years.[1, 5]

In order for the US to remain as a leader in innovation, it needs to have a strong workforce trained in science, technology, engineering and mathematics (STEM). Unfortunately, the number of students in the US who choose STEM fields continues to decline.[6] Furthermore, this STEM workforce needs to be diverse as diversity is the driving force for innovation and provides for a wider range of solutions to problems and more creative designs.[7, 8] Engineering continues to be a field that lacks both racial and gender diversity.[9, 10] Despite the fact that a majority of college graduates are women, women still remain underrepresented in the field of engineering.[11]

Research suggests that teachers and counselors have a significant influence on a student's desire to pursue a particular career path.[12, 13] As such, one issue that contributes to the lack of K-12 student interest in engineering is that many K-12 teachers do not have a good understanding of engineering practices, applications or careers.[14] Currently, most undergraduate teacher education programs do not include engineering concepts or engineering design practices in their curriculum making it unrealistic to expect teachers to teach or promote engineering. Furthermore, research suggests that students, specifically females are "turned-off" to STEM during the informative middle school years.[15-19] If our nation is to maintain its edge in innovation, and diversity is a key component of successful innovation, then it is vital that the participation of diverse (females and under-represented) populations in STEM career fields be increased.[7, 5, 20] Therefore, the role that the middle school experience plays in sparking an interest among our youth in STEM fields, particularly females and other underrepresented groups, is critical to meeting our workforce needs and to the US maintaining its leadership in innovation.

It is anticipated that the Next Generation Science Standards will eventually address some of the issues associated with a lack of broad K-12 student exposure to engineering careers and principles as well as teacher preparation to facilitate this understanding.[21, 22] Current efforts and resources such as Project Lead the Way (PLTW) and PLTW Gateway, STEM Schools and Centers and Teach Engineering Digital Library exist to help infuse engineering into the K-12 curriculum.[23-25] Additionally, many universities and professional societies have stepped up to address this issue through a variety of engineering outreach programs.[26] For example, Pawlowski, et al, describe a partnership among K-12 schools, Grand Valley State University and local Industries to provide financial support and engineering faculty and graduate support to high school students to participate in the Science Olympiad and First Robotics Competition. Through this partnership, student participation in these events increased by a factor of four. These competitions have a long history of providing students with a fun and stimulating opportunity to apply STEM concepts.[27] Bergh describes an informal engineering outreach program that was developed and facilitated by undergraduate engineering students at University of Wisconsin – Madison.[28] Sundaram, describes an annual outreach event held on the Campus of Gannon University where four, hands-on electrical engineering activities were facilitated for 60 high school students by university faculty. Assessment results suggest that these activities were effective at showing how STEM concepts and principles can be applied to solve real-world problems.[29] Similarly, many universities offer engineering summer camp opportunities or other on-campus activities to promote interest in engineering. Regardless, most outreach programs have been found to be an effective tool for engaging K-12 students in STEM and for helping to increase their interest in STEM career fields, particularly engineering.

Despite the fact that outreach programs can be a very effective tool for engaging K-12 students in STEM and for helping to increase their interest in engineering, some outreach activities and programs are not equally effective for all populations. Outreach that promotes negative stereotypes regarding engineers or the profession can be counterproductive to encouraging females to pursue that career path.[30, 31] That being said, significant research has been done that has established some best practices for outreach programs or activities to enhance females' interest in engineering. Hubelbank, et al, summarize these best practices as activities and programs that engage the female students in hands-on, collaborative, team based, real-world problem solving that emphasize engineering as a helping profession, demonstrate the breadth of opportunities in the field and are effective at building the participant's self confidence in her skills.[32] As an example, Plant et al reported an increase in middle school girls' interest in engineering after these girls were exposed to a 20-minute narrative delivered by a computer-generated female agent describing the lives of female engineers and the benefits of engineering careers.[33] Similarly, in the NSF sponsored extension service project, ENGAGE, the use of every day examples (examples that are relevant to students' lives) in introductory university engineering courses has been found to be highly effective at helping students learn the engineering concepts while also promoting female student retention in the major.[34, 35] Other research suggests that engineering projects that show the humanitarian side or social relevance of engineering have been effective at attracting and retaining females.[36-38]

One issue regarding engineering outreach is that there are numerous barriers that make it difficult for universities to offer effective outreach to a large number of K-12 students, particularly at the lower grades. Some of these barriers include money and time, but faculty teaching and research requirements for promotion and tenure can also serve as a disincentive to faculty to engage in K-12 outreach.[39] Undergraduate and graduate engineering students are a great and energetic resource on college campuses and can serve as effective role models for K-12 students. Unfortunately however, many college students do not have the resources or the time to develop effective engineering activities to facilitate in the K-12 classroom. Although there are numerous engineering activities on the web, the time and money required to purchase materials and to vet these activities can still be a stumbling block for both faculty and students. Other issues such as insuring the activities will effectively promote engineering to females and other underrepresented populations in engineering and are age/grade level appropriate and coordinating visits with schools can also make it difficult for engineering faculty and students to engage in engineering outreach. Furthermore, engineering outreach activities could be further leveraged to increase their impact and effectiveness. This can be done by linking them to academic content standards so that the teacher can further build upon these activities in their classroom and by providing information to parents about engineering so they are empowered to further engage their children in engineering.

In 2014, the University of Dayton (UD) received funding through the Engineering Information Foundation and National Science Foundation for the *Engineering Outreach to Middle School Girls* project. The primary goal of this project was to remove some of the barriers that exist for universities to engage in effective engineering outreach by developing engineering activity “pick-up and go” kits that could be facilitated by engineering undergraduate students or faculty in a variety of outreach programs. The activity kits were developed for the target audience of middle school girls, but were appropriate for both male and female students ranging in age from third grade to eighth grade. The activities developed for the kits focused on engineering design and innovation and incorporated some of the researched based, best practices for encouraging females in engineering as described above. Another goal of this project was to develop resources to support parents and teachers that would allow teachers to connect the activities to the academic content standards and help both the parents and teachers understand how to encourage their female children or students to consider a STEM field, particularly engineering. These resources included hand-outs for parents and teachers as well as a website. The activity instructions and supplementary materials would also be housed on the website so that they could be freely accessed and used by anyone wishing to engage in engineering outreach.

The overarching objective of this project was to increase female participation in engineering by providing exposure to engineering for girls during a critical time of their academic development, the middle school years, through activity kits that allow engineering students and faculty to more easily engage in effective outreach. Since the activities were designed to allow engineering students to go into classrooms during normal class times, the middle school students are not given the opportunity to “opt out” of the engineering activity. As such, these activities can reach a broader audience, particularly those that previously were not interested in engineering or do not know anything about engineering. During the summer and fall of 2014, nine kits were developed, piloted and partially assessed. The parent and teacher resources and accompanying website as well as additional activity kits will be developed in the winter of 2015. This paper will focus on the kit development, piloting and partial assessment.

Activity Kit Development and Piloting

A majority of the outreach activities and kits for this project were developed by teams of undergraduate engineering and teacher education students with oversight from two engineering faculty members and the program manager of Diversity in Engineering Programs (DEP). The two faculty members and DEP program manager all had experience with K-12 education and outreach. Educators were consulted in the early stages to get feedback on desirable content, approximate length of time for the activities, how to best reach the teachers, etc. The undergraduate students were provided with training on the goals of the project as well as some of the research related to best practices for engaging females in STEM. A template for the activity descriptions was created by the Dayton Regional STEM Center that incorporated some of the elements of the STEM Quality Framework.[40] The activity modules for the kits were developed to focus on innovation and the engineering design process as opposed to a series of laboratory experiments, as they were intended to pique interest in engineering and not necessarily support or teach specific academic content. However, each activity was linked to specific academic content standards to assist the teachers in selecting the most appropriate activities for their classroom and to provide an opportunity for the teachers to expand the outreach activity into classroom learning if desired. All of the activities were developed to be fun, team-based and hands-on, to foster creative thought and to show the social relevance and everyday applications of engineering. In some cases, the student teams modified existing activities they found on the web from a variety of resources such as Teach Engineering, while others were developed from scratch.[25]

Each activity kit was housed in a plastic container that could be easily carried and transported. The kits included all consumable supplies as well as reusable supplies and equipment. It was assumed that the children engaging in the activities would have common school supplies such as scissors, crayons and glue, so these were not provided in the kits. The kits also included a memory stick that contained a power point that was used to introduce the activity as well as hard copy of the presentation with suggestions that could serve as a facilitator resource should the facilitator not have access to a projector or laptop. Most of the power point presentations developed for the activity modules introduced the children to the engineering design process and included a video or image that was meant to present the scenario and serve as the hook and basis of the activity module. Also included in the kits were hard copies of the material list (including quantities), a facilitator guide and the engineering activity description. The electronic files for these resources were also included on the memory stick contained within the kit. The facilitator guide provided a concise summary of the activity and included hints and ideas for the facilitator whereas the engineering activity description was developed using the template provided by the Dayton Regional STEM Center. As such, the engineering activity description contained far more extensive information, including a detailed listing of the academic content standards related to the activity.

The kits also contained various assessment forms. These included a form for the facilitator to assess the activity with regards to clarity of instructions, kit completeness and overall perception of the activity. There was also an assessment form that the teacher filled out regarding facilitator preparedness, promptness and ability to interact with the children as well as their overall perception of the activity. Finally, the kit contained pre- and post-tests for the children participants that are described in greater detail below. Parent and teacher handouts will eventually be contained within these kits once these resources are completed. All of the information and files will be placed on the project website for wide distribution and access. The nine kits developed in the summer and fall of 2014 include:

ASSISTIVE DEVICE (Grades 6-8)
Mechanical Engineering, Human Services, Health Sciences
Pulling on a sock is difficult for people with limited hand and wrist muscle control. It is a struggle for their muscles to overcome the sock's elastic potential energy when stretched, and gravitational potential energy when lifted. The students take on a challenge of designing a solution by only using the materials available that can help people pull on their socks independently.

CRACKER CATAPULT (Grades 4-8)

Mechanical Engineering, Civil Engineering, Architecture, Construction
An earthquake in Hawaii has collapsed the only bridge leading into or out of a town. The town's people are stuck, and in need of supplies! In order to transport supplies over the collapsed bridge, the neighboring town built a catapult and is flinging materials from one side to the other! The students solve this problem by designing a way to protect supplies from being damaged as they are sent to the town in need using only the materials provided.

FILTRATION (Grades 4-7)
Mechanical Engineering, Civil Engineering
In Africa, two out of five people do not have clean water. A source for clean water would help solve these problems and improve the lives of thousands of people. The students' challenge is to design, build, and test a filtration system that could be used for removing harmful pollutants/contaminants from water.

MARBLE RAMP (Grades 4-8)
Mechanical Engineering, Transportation, Distribution & Logistics, Architecture & Construction
The students' challenge is to design a more efficient system to help flight crew members in transporting luggage straight from the airplane to the conveyor belt where passengers pick up their belongings. The design must transfer marbles from an elevated cup (symbolizing the airplane) to a cup on a lower level (symbolizing the baggage claim area) using only provided materials and must finish in the time allotted.

SAVE MAX! (Grades 6-8)
Mechanical Engineering, Chemical Engineering, Anatomy, Geology
The students' challenge is to use supplies to create a life vest that will keep Max, the family dog who fell overboard, afloat. The vest must be able to be put on quickly and easily to save the dog. Students can only use the provided materials and must follow all time restrictions.

SAVE THE BUILDING (Grades 4-8)
Chemical Engineering, Civil Engineering, Architecture and Construction
Mount St. Helens is erupting shortly. The students' task is to create a structure that will save the surrounding building before the lava places the civilians in danger. They have around 15 minutes to complete the task and save the building from the flow of lava from the volcano.

SMOOTH OPERATOR (Grades 4-8)
Mechanical Engineering, Biomedical Engineering, Medical Care
The students' challenge is to build a surgical instrument that can safely remove an object from a goat's stomach. The design cannot hurt the goat or damage the objects. The dominoes represent the goat's stomach, so the students need to be careful not to hurt the goat by knocking over dominoes.

THREE LITTLE PIGS (Grades 5-8)
Civil Engineering, Architecture and Construction
The challenge is to build three different houses, each constructed with a material similar to what The Three Little Pigs used. Straw, stick, and brick houses, built by The Three Little Pigs, were tested for their ability to withstand the destructive force of The Big Bad Wolf's

huffing and puffing. Your drinking straw, Popsicle stick, and card houses will be tested for their ability to withstand the destructive forces of a hurricane's wind, rain, and hail.

ZIP LINE (Grades 3-8)
Civil Engineering, Mechanical Engineering, Transportation, Distribution & Logistics, Human Services
A recent earthquake has collapsed a bridge, which was the only way out of an island. The islanders are running out of resources quickly, and need help. The only means of transportation remaining is the island's famous zip line, which includes a section leading from the island to a neighboring city. The students are to design and build a cradle that will safely transport one islander at a time across the zip line from the island to the neighboring city.

Piloting of the kits occurred in a few different stages. In a few cases, the student teams tried out the activities on children of faculty from the school of engineering as the activities were being developed. The teams of undergraduate students that were developing the kits met weekly as a large group. As such, these student development teams tried out the activities on other teams of students during their normal weekly large group meeting time. Feedback and input from these sessions was used to modify and improve the activities prior to them being piloted in a school setting.

Arrangements were made with the Kroc Center in Dayton, Ohio to pilot these activities in an afterschool program. Although the kits were developed so that essentially any undergraduate engineering student could facilitate the activity with little to no preparation, a lead student facilitator was hired to pilot the activities once a week for the eleven week Kroc Center after school program. This was done to ensure that the children participating in the program were provided with a high quality experience as the lead facilitator was chosen because of her demonstrated ability to work well with children. As such, should the activity not work out as planned, she could improvise so that the children still gained something from the experience and had fun during their after school session.

After the initial pilot at the Kroc Center, the activities were then open for facilitation at other schools. One of the faculty members involved in the project offered students in two sections of her course, extra credit if they facilitated an activity at an area school. This faculty member worked with a fifth grade teacher at Edison PK-8, a neighborhood school center that is part of the Dayton Public School system, as well as several suburban schools. Activities were facilitated on a reoccurring basis at Edison, whereas they were facilitated during a single session at the suburban schools. The faculty member coordinated placement of the student volunteers in the classrooms and assigned the activities that would be facilitated to ensure that a single activity was not repeated at Edison. Student facilitators were provided with a brief introduction to their activity via a confirmation e-mail approximately 48-72 hours prior to the time they were scheduled to facilitate. They were allowed to pick up the kits approximately 24 hours prior to their scheduled facilitation date. Approximately 50% (38 out of 79) of the students enrolled in the two sections of the course took advantage of this extra credit opportunity and facilitated an activity in a classroom. Student teams facilitated activities on ten separate occasions at Edison in two different classes of fifth graders. The activities were also facilitated at two suburban schools in a gifted class, a third grade class as well as multiple as classes of seventh graders.

Assessment

As mentioned above several forms of assessment were identified or developed for this project. Facilitator and teacher assessment forms were developed using a five point Likert scale. Additionally, there was space on these forms for the teacher and facilitators to provide information regarding timing of the activities and demographics of the class and to provide qualitative feedback. The objective of the facilitator form was to get feedback and input on the activity kit with regards to clarity of instructions, kit completeness and overall perception of the activity. This information would be used to modify and improve the kits accordingly. The purpose of the teacher form was to get feedback on both the facilitator and the activity. In an effort to assess the efficacy of the activity in changing the activity participants' perceptions of engineering and engineers, the AWE (Assessing Women and Men in Engineering) Pre- and Post- Upper Elementary Survey was modified slightly for visual appeal and to fit on one sheet of a double sided piece of paper and was facilitated.[41, 42] Unfortunately, some issues were encountered in the facilitation of the modified AWE survey during these initial pilots, so no meaningful data is currently available. Among these issues included a lack of time to facilitate the surveys and failure of the activity participants to put a participant identification number on their survey making it impossible to compare the pre- and post- survey information. The issue with time constraints may not be able to be resolved, but steps have been taken to ensure the participants put a participant identification number on their surveys.

A summary of the information obtained from the teacher and feedback facilitator forms is provided in Table 1. As indicated previously a five point Likert scale was used in the assessment with 5 being strongly agree and 1 being strongly disagree. Averaged values obtained from the forms is provided in Table 1 with the standard deviation indicated in parenthesis. Additionally, the demographics of the student participants is also summarized in Table 1. Data was generated for only five of the nine activities developed so far. The remaining activities as well as any new activities that are developed will be assessed in the spring of 2015.

As can be seen from Table 1, both the facilitators and teachers had a positive response to the activities and kits. The facilitators generally felt the kits were complete and the instructions were clear and easy to follow. For activity kits such as the Zipline and Smooth Operator, where the scores related to clarity of instructions were not as high, the instructions were edited and modified to make them easier to follow. The facilitators did not encounter any major issues with access to technology. Therefore, the facilitators were able to make use of the power point presentations included on the memory sticks provided in the kits. The teachers agreed with the facilitators regarding kit completeness. Both teachers and facilitators felt that the kits had the necessary supplies required for the activity. The teachers also felt that the student facilitators did a good job at facilitating the activities and interacted with the K-12 students, faculty and staff at the schools. Both the teachers and facilitators felt that the student participants had fun with the activities and learned a great deal about engineering.

Table 1. Summary of Data Obtained from Feedback Forms

Facilitator Feedback	**Activity**				
Question	**Save Max**	**Zipline**	**Assistive Device**	**Three Little Pigs**	**Smooth Operator**
Number of students	29	50	58	68	48
Total number of female	11	26	33	30	25
Total number of minority	28	48	43	46	46
The kit had all of the necessary supplies	4.0 (0)	4.1 (0.78)	4.8 (0.37)	3.9 (1.17)	2.9 (0.83)
The activity instructions were clear and easy to follow	5.0 (0)	3.1 (1.27)	4.5 (0.50)	4.0 (0.87)	3.6 (0.73)
The students had fun with this activity	5.0 (0)	4.8 (0.43)	4.6 (0.49)	4.5 (0.50)	4.1 (0.35)
There was sufficient time to complete the activity	5.0 (0)	4.5 (0.71)	4.3 (0.62)	3.4 (0.86)	4.6 (0.49)
The classroom had adequate technology to use the power point and any video links	5.0 (0)	4.9 (0.33)	4.6 (0.49)	4.4 (0.48)	4.6 (0.49)
I feel the students learned a great deal about engineering through this activity	5.0 (0)	4.3 (0.66)	4.4 (0.64)	4.1 (0.78)	3.7 (0.70)
The teacher was helpful in organizing and facilitating this activity	4.0 (0)	3.3 (1.03)	4.3 (0.75)	4.3 (1.03)	4.5 (0.50)

Teacher Feedback	**Activity**				
Question	**Save Max**	**Zipline**	**Assistive Device**	**Three Little Pigs**	**Smooth Operator**
The facilitator arrived on time	4.0 (0)	4.5 (0.50)	4.3 (0.47)	4.0 (0)	4.0 (0)
The facilitator was well prepared	4.0 (0)	4.5 (0.50)	4.0 (0.82)	4.0 (0)	4.0 (0)
The facilitator interacted well with my students	4.0 (0)	4.5 (0.50)	4.3 (0.47)	4.0 (0)	4.0 (0)
The facilitator was courteous and respectful to faculty and staff in my school	4.0 (0)	4.5 (0.50)	4.3 (0.47)	4.0 (0)	4.0 (0)
The facilitator had all necessary supplies to complete this activity	4.0 (0)	4.5 (0.50)	4.3 (0.47)	4.0 (0)	4.0 (0)
My students had fun with this activity	4.0 (0)	4.5 (0.50)	4.3 (0.47)	4.0 (0)	4.0 (0)
There was suffcient time to complete the activity	4.0 (0)	4.5 (0.50)	4.3 (0.47)	3.3 (0.94)	4.0 (0)
I feel my students learned a great deal about engineering through this activity	4.0 (0)	4.0 (0)	4.3 (0.47)	4.0 (0)	4.0 (0)
The teacher handouts will be/have been helpful	4.0 (0)	4.0 (0)	4.0 (0.82)	4.0 (0)	4.0 (0)
The activity connects well with what we are doing in the classroom	4.0 (0)	4.0 (0)	4.3 (0.47)	4.0 (0)	4.0 (0)

In addition to the Likert scale assessment, the teacher feedback forms provided space for qualitative responses to three questions: What did you like most about the activity? What did you like least about the activity? What suggestions do you have to improve the activity? Some of the feedback provided by the teachers with regards to what they liked about the activities included:

"Teamwork, problem solving, developing patience when design didn't work out as planned"
"Student facilitators were well prepared."
"Loved to see my students being hands on creative and forced to work outside the box."
"Creativity it allows for students"
"The ability to learn how engineering helps people in our community"
"The ability for my students to learn that engineers build more than cars and buildings"

Some of the feedback provided by the teachers regarding things they did not like about the activities or recommendations for improving the activities included:

"Very Mess" – Three Little Pigs
"Length of time to test the houses" - Three Little Pigs

"Took too long to get started lost attention of students" – Assistive Device
"Too many student facilitators. Keep groups small. Three works well, but four is too many."

Summary

During the summer and fall of 2014, nine "pick-up and go" engineering outreach activity kits were developed and piloted. The purpose of the kits was to remove some of the barriers that make it difficult for engineering undergraduate students and engineering faculty to facilitate effective outreach to K-12 students. The kits were designed using researched based best practices regarding keeping females engaged in engineering. As such, it is hoped that more, effective engineering outreach can be done at the K-12 level to encourage students, particularly females to pursue engineering. Through the pilots, approximately 300 middle school students from urban and suburban schools were exposed to engineering. Of these 300 students approximately 49% were female students and 83% were underrepresented minority students.

Although no data is currently available to assess the efficacy of these activities at increasing students' interest in or perception of engineering, initial feedback from teachers and facilitators suggest that the student participants had fun with the activities and learned a great deal about engineering through these activities. Furthermore, favorable feedback was received with regards to the "pick-up and go" quality of the kits in that the instructions were easy to follow and the kits had all of the necessary materials. Currently, additional kits are being created, piloted and assessed. It is a goal of the project team, that by the end of this project in the summer of 2015 to have developed twelve to thirteen engineering activity modules; have assembled 24 - 30 fully equipped kits, have piloted these kits to over 1800 middle school students, have completed the evaluation of these kits and have a fully functioning website that includes resources and hints for parents and teachers on how to encourage their children/students in engineering.

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