
AC 2011-1323: ENGINEERS ON WHEELS

Kauser Jahan, Rowan University

Dr. Kauser Jahan is an Professor of Civil and Environmental Engineering at Rowan University, Glassboro, New Jersey. She completed her Ph.D. studies in the Department of Civil and Environmental Engineering at the University of Minnesota, Minneapolis in 1993. Dr. Jahan is a registered Professional Civil Engineer in Nevada and is actively involved in environmental engineering education and outreach for women in engineering. Her research interests include sustainability and teaching pedagogy.

Krishan Kumar Bhatia, Rowan University

ENGINEERS ON WHEELS

Introduction

There is a growing concern among educators that the science and mathematics knowledge of K-12 students needs to be made exciting and relevant [1-3]. Most school districts are faced with financial constraints especially in providing students enriching experiences via field trips and teachers with opportunities for educational workshops for STEM (Science Technology Engineering Mathematics) exposure. As such there is a dire need to reach out to the teachers and students on site to offer exposure to STEM careers via innovative hands on learning activities. One such way would be to take engineering workshops onsite to school districts. This would eliminate the expenses for field trips and allow engineering students and faculty to promote engineering careers to a huge cohort of K-12 prospective students.

The Engineers on Wheels project is aimed at bringing engineering concepts into K-12 classrooms and extracurricular activities, as well as providing an opportunity for college-level engineering students to reinforce their own knowledge of engineering and share their excitement about the subject with the next generation of engineers. A van has been outfitted with modern technology and engineering displays on which educational activities take place. Engineering activities are also demonstrated outside the vehicle at scheduled school locations. The hope is that the Engineers on Wheels program will be a highly visible national model that will generate excitement in engineering education.

This project is unique in that the activities are developed or selected entirely by engineering students and delivered to school districts by students/faculty. The College of Engineering at Rowan University currently has six professional engineering student chapters. These are IEEE, ASCE, ASME, AICHE, SWE, and EWB. Engineering students develop and pilot the activities, lesson plans, and handouts, for the Engineers on Wheels project. The professional chapters travel to select school districts throughout the academic year to expose the challenges and excitement of engineering to K-12 students and educators. Travel is conducted in colorful vehicles that represent the institution name and bring engineering alive for the select audience.

Program Description

Engineers on Wheels is an outreach program offered by Rowan University to interest students from grades K-12 in math, science and engineering. This is an important program because more and more students in our country are following the misconception that engineering careers are too difficult and require a certain rigor. The program provides students with an interactive experience with activities that can be transported from the University to various schools in the area.

The purpose of the project is to develop and demonstrate a set of activities that will spark enthusiasm in students K through 12 in the field of engineering. The different activities have been designed to be fun, hands-on, and interactive to demonstrate an engineering principle or engineering methodology. The central theme is sustainability. All engineering disciplines are represented via these activities to give students a well rounded idea of what different engineering

involves. Samples of activities include Solar, Wind and Water Power, Biodiesel and Lip Gloss Processing, Bridge Building, Strength of Materials etc. The goal of the project is to use these activities to mitigate some of the issues that prevent girls and boys from understanding engineering and its specialty areas, thus preventing consideration of engineering as a career choice.

The EW Van

A Chevrolet Express Cargo Van was selected for the program because of the added space available so that activities could be carried out within the van. Images of the purchased van are presented below in Figure 1.



Figure 1: The EW van before wrap and retrofit for engineering activities

Work was conducted to develop a brilliant van exterior depicting engineering. A vehicle wrap was developed through a number of iterations that allowed input from students, K-12 educators, engineering faculty, benefactor and university administration. Colors on the van represented the institution. The wrap consists of a collage of different pictures of products and processes related to engineering. Engineering students modeled for images that made engineering look appealing and futuristic. Care was also taken to portray engineers as people who care about the environment.

The van wrap process was lengthy as there had to be consensus on the images, font styles, colors, permission for images etc. Images of the finished van are provided in Figure 2.

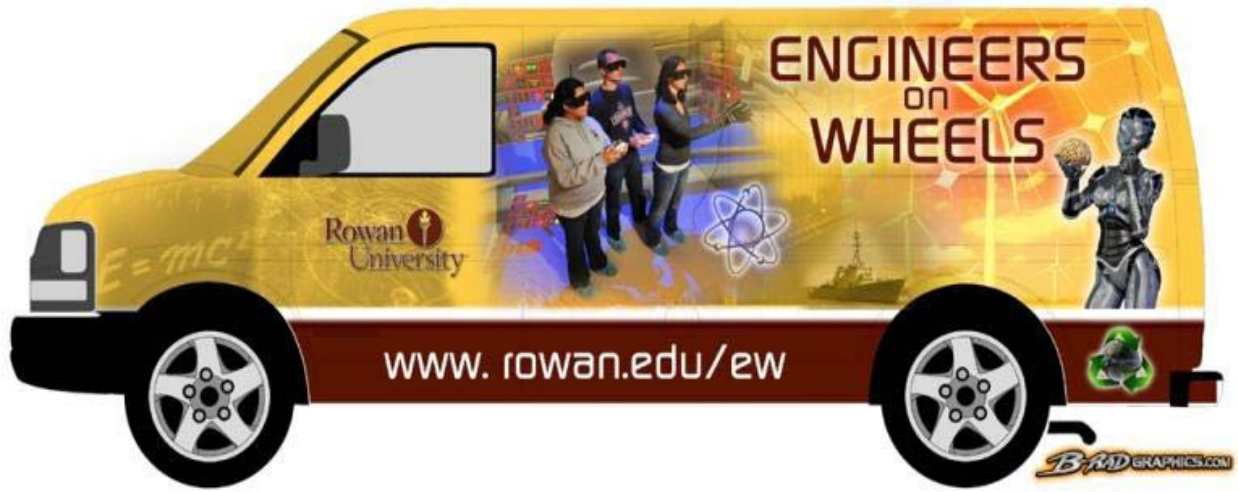


Figure 2: Images of the Engineers on Wheels Van

The van was also retrofitted with computers and display panels in the interior. The inside of the van's cab was covered in a black carpet material, given two benches for sitting, a 46'' flat screen television with Playstation 3, as well as a great deal of stereo equipment. The sliding door on the outside of the van has a 40'' flat screen 3-D television with a Playstation 3 and the Playstation Move Motion Recognition system.

These features allow students to recognize that a lot of engineering goes behind the games that they love and enjoy. Students can also use the computers to work on bridge construction, flight simulations, roller coaster design etc. This is a major popular feature of the van. A team of four to five students is allowed to explore the van and the activities in and around it. The computer simulations inside the van and the Playstation games are extremely popular. Images of school visits and students working in the van are provided in Figure 3.



Figure 3: Images of the Engineers on Wheels Van

Tables are setup around the van to demonstrate and allow participation of the students. Activities include water treatment using portable water filters, lip-gloss processing (Figure 4), constructing a mechanism using materials provided, racing solar cars etc.



Figure 4: Lip-gloss processing and water treatment outside the van

A Typical EW Trip

School trips free of charge are scheduled throughout the year almost every week to get children excited about science and engineering. The engineering faculty and student work with the school teacher for successful delivery of the activities. A typical planning schedule is as follows:

- Grade and class to be visited
- Number of students
- Allergy alerts and permission to be photographed
- Division of students in teams of 4-5 so that they can rotate through each activity in 10 minutes
- Parking spot for the EW van close to a classroom

- Setting up of computers ahead of time
- Knowledge of classroom technology available
- Information on current material being taught
- Identifying activities that the teacher would like

EW activities are threefold:

- Activities inside the van (weather permitting)
- Activities around the van (weather permitting)
- Activities inside the classroom (Activities are also conducted inside the school typically in the science classrooms or computer laboratories. A number of notebooks have been purchased and can be taken during a school visit in the event a school does have portable computers or a computer laboratory.)



Figure 5: Indoor Classroom Activities

The school visit duration depends on the nature of the request. Typical fifty minute classroom periods are popular. Multiple science sections maybe exposed to the activities on the same day. Visits are made to elementary, middle and high schools. The activities as such are chosen to be

age appropriate for the audience. Middle school visits are given priority as there is a need for students in sixth, seventh and eighth grades to focus on their math and sciences courses so that they can take upper level courses in high school. It is also the time when the students need to learn about career choices that they have. A general presentation on engineering is made at the start of the trip to make children understand what engineering is, who engineers are and what type of activities are they involved in.

Dissemination

Information dissemination about the program is through a website, a brochure and databases containing area school contact information. A brochure was developed about the Engineers on Wheels program that contains general information about the program and its goals. It describes what types of activities that will be performed and how they relate to the science and engineering fields.

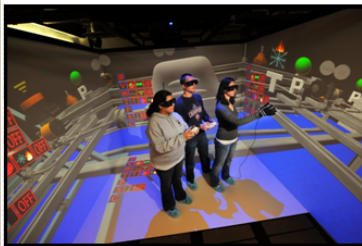
Outside Of Brochure:

<p><u>SCHEDULE A VISIT</u></p> <p>Mail to: Dr. Kauser Jahan Rowan University College of Engineering 201 Mullica Hill Road Glassboro, NJ 08028-1701</p> <p>School Name: _____</p> <p>School Phone Number: _____</p> <p>School Address: _____ _____ _____</p> <p>Your Name: _____</p> <p>Your Email: _____</p> <p>Date and Time of anticipated visit: _____ _____</p> <p>Number of students: _____</p> <p>Type of School (Circle one): Public Private Other (Explain) _____</p> <p>Elementary Middle High Other _____</p> <p>Class type (Circle one): Math Science Other (Explain) _____</p> <p>Grade(s) of students: _____</p> <p>Please attach/email any questions or comments.</p> <p><i>Form available online at www.rowan.edu/ew</i></p>	 <p>Project Director</p> <p>Kauser Jahan Professor and Chair Civil and Environmental Engineering 201 Mullica Hill Rd. Glassboro, NJ 08028</p> <p>For more information:</p> <p>Web: www.rowan.edu/ew Phone: (856) 256-5823 E-mail: jahan@rowan.edu</p> <p>To become a sponsor contact:</p> <p>Ronald J. Tallarida, Director of Development Campaign Manager Rowan University 201 Mullica Hill Road Glassboro, NJ 08028</p> <p>Engineers on Wheels sponsored by the Edison Venture Fund www.edisonventure.com</p> 	 <p>ENGINEERS ON WHEELS</p> <p>A mobile workshop to inspire K-12 students to pursue engineering.</p> <p><i>Preparing Future Engineers</i></p> 
--	---	---

Inside of Brochure:

Engineers on Wheels

Engineers on Wheels is an outreach program desired by Rowan University to interest students from grades K-12 in math, science and engineering. This is an important program because more and more students in our country are following the misconception that engineering careers are too difficult for them to pursue. The program will provide students with an interactive experience with activities that can be transported from Rowan University to various schools in the area. A van has been redesigned and modified to fit the specific needs of this program.



Fun Inside the Van

Inside of the Engineers on Wheels van, there will be a 46" LED Samsung TV, a Playstation 3 and an HP Touchsmart PC. On these devices, multiple activities can be run. Some of these activities include:

- The Playstation 3 game Need for Speed Shift will be used as a driving simulator. Used along with a steering wheel, it has an extremely realistic feel.
- A bridge building simulator will also be run on the HP Touch. The bridge simulator will provide the students with a better understanding of the civil engineering aspects that are involved with bridge construction and design.
- A baseball pitch and hit simulator from NASA's website will be run on the HP Touch. This will allow the students to see the motion of a pitched or hit baseball and the effects of drag, lift, wind, gravity, and aerodynamics.

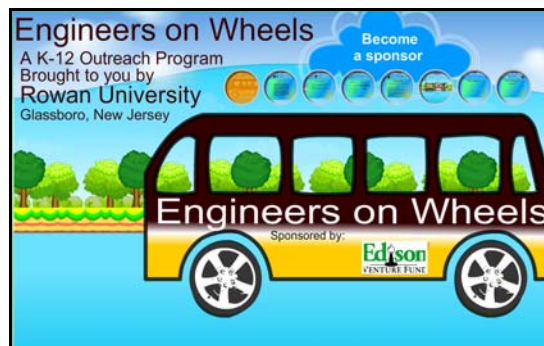
Activities Outside The Van

Outside of the van, multiple tables will be set up as stations which the students will visit to complete the hands on activity provided. These activities aim to enable the students to get a better understanding of the fabrication and manufacturing processes involved after the design and calculation processes have been completed. These activities will include:

- Newton's Law juggling demonstration
- A water filtration system
- A chemistry lesson on how to make your own lip gloss



Another way Engineers on Wheels is keeping interested schools and students updated is through a website. This website is dedicated entirely to the Engineers on Wheels program and is geared towards young students. It is very user friendly and contains information about the program, engineering, activities the program runs, and pictures from previous visits. The website also contains a form for scheduling a visit. Below is a screenshot of the homepage of this website located at: www.rowan.edu/colleges/engineering/k-12/ew/



Teacher Training

A complementary program titled Engineering Clinics for Teachers [4-6] is offered for teacher training every summer for middle school math and science teachers. The overall objectives of the program are to:

- *Provide* exposure to engineering careers and make engineering more relevant to middle school educators,
- *Ensure* that teachers are academically prepared to successfully integrate engineering content into their existing curriculum,
- *Support* teachers and students in exploring and understanding engineering content in K-12 education through professional development activities, and
- *Serve* as a national model for other undergraduate institutions in integrating engineering content in K-12 education.

This initiative to integrate engineering content in the middle school curriculum and train teachers regarding engineering concepts has been extremely successful as evidenced by participant feedback [4-5].

Clinic Modules: Four engineering clinics are included in the workshop. These clinics represented the four engineering disciplines at Rowan University namely Chemical, Civil and Environmental, Mechanical and Electrical and Computer Engineering. The Bridge module allows participants construct different types of bridges using Jenga blocks and a Computer software the *Bridge Builder*¹⁰ to design a truss bridge. Participants were presented with an individual Jenga block set for instructional purposes in their classrooms. Participants are also involved in discovering what makes a device or machine a ‘robot’. They build a few robotic Lego™ vehicles (‘cars’) and program them to complete specific tasks. Fundamental skills and concepts in mechanical engineering, such as computer programming, gearing, structural stability, and sensors is discussed. The session culminates in a mini-competition in which teams of participants built a robot and compete in head-to-head competitions to achieve a given goal.



Teachers building bridges using Jenga™ Blocks



Teachers building Lego™ Robots

Other modules include biodiesel processing and designing wind turbines. Teachers attending this workshop also actively participate in the Engineers on Wheels Program.

Assessment

The Engineers on Wheels Project is assessed by acquiring feedback from participating teachers and students. In order to keep the survey process simple few questions are asked before and after the program. These questions are indicated below.

I now understand clearly what an engineer does.
I understand the importance of math and science.
I enjoyed the hands-on activities.
The activity I enjoyed the most was.
I want to be an engineer.

The students indicate whether they strongly agree, agree, are neutral, disagree, or strongly disagree. Students are also asked to comment on the engineering feat in another 25 years to spark their imagination.

The Engineering Clinics for Teachers program is assessed via use of surveys daily during the program [4-5].

Conclusions

The Engineers on Wheels program is an innovative effort to make engineering come alive for K-12 students and educators. It allows the delivery of engineering activities via engineering students who are the best mentors. They can easily relate to the younger generation and excite them about careers in engineering. It provides much needed support to the K-12 educators who currently are struggling for funds that promote field trips, enhanced learning activities etc.

Acknowledgement

We are grateful to Edison Venture Funds for providing support for this program.

References:

[1] Connant, J.B. (1959) The American High School, McGraw-Hill, New York.

[2] <http://www.nsf.gov>

[3] [http://www.engineeringk12.org/Engineering in the K-12 Classroom.pdf](http://www.engineeringk12.org/Engineering%20in%20the%20K-12%20Classroom.pdf)

[4] Jahan, K. and K. Sernak (2007) Engineering Clinics for Middle School Teachers, Proceedings of the WEPAN Annual Conference, Orlando, FL.

[5] Jahan, K. and K. Sernak (2007) Engineering Clinics for Teachers, Proceedings of the ASEE Annual Conference, Honolulu, HI.

[6] http://users.rowan.edu/~7Ejahan/ECT_06_08/Ect/index.htm