

EXPLORING INTERESTS IN TECHNOLOGY AND ENGINEERING AT THE UNIVERSITY OF PUERTO RICO MAYAGÜEZ

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Abstract - EXITE! (Exploring Interests in Technology and Engineering) was a summer camp sponsored by IBM Corporation, the Chancellor's Office and the College of Engineering of the University of Puerto Rico, Mayagüez Campus (UPRM), designed to introduce girls from middle schools from the western area of Puerto Rico to the engineering and technological fields. The students participated in workshops applying scientific and engineering concepts, as well as on hands-on experiments in a laboratory environment. The workshops were designed to expose participants to engineering and computer sciences and to provide participants better understanding about the concept of working in teams, making hard engineering decisions, ethical behavior and problem solving. During these workshop activities, the students had the opportunity to interact with faculty, laboratory technicians, young professional engineers, scientists, and undergraduate and graduate engineering students who shared their experiences with them. A major component of EXITE! was a creativity and design competition. All these activities made EXITE! a way to make engineering come a reality as a career option for the girls. Assessment of the camp indicates that it was highly successful and had a great impact on the participants and their parents.

Index Terms – K - 12 programs, summer camps, team activities.

INTRODUCTION

EXITE! (Exploring Interest in Technology and Engineering) was a summer camp designed to introduce girls from middle schools to the engineering and technological fields. The main objective of the camp was to motivate girls early in their life to select and pursue careers in engineering or computer sciences. This was accomplished by exposing them to the engineering and computer sciences through a series of enhancing, unique and interactive activities.

This paper presents the EXITE! Camp at the University of Puerto Rico Mayagüez (UPRM). This camp was sponsored by IBM Corporation, the Chancellor's Office and the College of Engineering at UPRM, and was held during the week of July 16 to July 20, 2001. The camp had a total of 20 students, all girls from elementary and middle schools of western area of Puerto Rico. The camp ran from 8:00 a.m. to 5:30 p.m.. Most of the activities were held in the Industrial Engineering Building. The budget for the camp was \$10,000.00.

The program activities included an opening ceremony where the students and parents received a welcome and an overview of the camp and the university campus. During the week, the students participated in workshops applying scientific and engineering concepts and practices in laboratory environments. The workshops were designed to expose participants to engineering and computer sciences, and to provide participants better understanding about the concepts of working in teams, making hard engineering decisions, ethical behavior, and problem solving. During these workshops activities, the students had the opportunity to share experiences with different professors, laboratory technicians, young professional engineers and scientists, and undergraduate and graduate students.

Another interesting activity was a creativity and design competition in which the participants were divided in teams of four and given a problem description, a set of specifications, and a set of materials. The problem consisted in designing and building a solar car prototype that should run under different atmospheric conditions. Each team built a car based on detailed specifications and rules and used the provided materials. On the last day of the camp the team with the best scores based on their creativity and performance won the competition.

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PURPOSE

After participating in the program, the girls should be able to:

- Describe what engineers do
- Describe what computers do
- Make design decisions in order to meet a goal
- Describe what the internet is
- Build a web page
- Understand the importance of team work
- Solve a problem
- Understand the importance of ethics in engineering.

These specific project objectives were designed to meet the following goals:

- Increase participant knowledge of and exposure to engineering as a possible career by involving the students in hands-on workshops while letting them experience university life.
- Contribute to students' confidence in their ability to make career decisions by enhancing their understanding of the engineering profession.

SELECTION PROCESS

EXITE! was a nonresidential camp with participants recruited locally. The application forms and related information were sent to directors of local elementary and middle schools. The directors were responsible for informing the appropriate personnel who in turn informed students about the program. The participants were selected based on recommendation letters from their teachers and an essay that they wrote. The essay theme was: Suppose you are going to create a device to make life easier for you and your family. Describe what would it be and how you would build it. Sixty-seven students from nine schools in western Puerto Rico applied to participate in the summer camp. Five engineering professors from UPRM selected 20 students from the applicants. The 47 young students who were not selected were encouraged to apply again.

ACADEMIC ACTIVITIES

The 2001 EXITE! Summer Camp was structured around various academic activities, conferences, laboratory activities, hands-on workshops, and visits. The following list describes the activities offered during the 2001 program.

1. Opening Ceremony

During the formal registration, the students received a nametag, and a bag containing a folder with the camp rules. The Chancellor of the UPRM and the Dean of Engineering addressed the students and their parents. At the end of the ceremony, the EXITE! Director briefed the participants and their parents about the concept of the program, reminded of

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the rules and regulations that they had previously subscribed to, and presented with the schedule of activities.

2. Group Dynamics

The participants and the tutors sat in a row and the first participant said her name and an object that she really liked or an adjective that described her. The challenge in this dynamic is that the second person has to say the name and object or adjective of the first person and that of their own. The third one has to remember what the first and second person said and mention their name and object/adjective. This becomes harder for persons at the end of the row. This activity helped the participants and the tutors to learn the names of the players making the introduction between them easier and creating a comfortable environment.

3. Engineering and Sculptures

This activity created a comfortable environment in which the participants felt free to express their thoughts and feelings and have the opportunity to know a little better the other participants. The participants listened to a song which described several situations in life and chose to which situation they were most likely related. Then the participants that related to the same situation had to create a sculpture with their bodies describing that situation. The resource in charge helped the participants to express the different situations. The participants were then challenged to add life and movement to their sculptures.

4. Workshop: What is the Internet?

This activity familiarized the participants with the basic principles and technology needed to look for information on the Internet. This workshop presented basic concepts related to the World Wide Web communication. It illustrated some frequently visited web sites and the use of different search engines.

5. Design your Web Page Seminar

This activity taught the participants to create their own web site and post it on the net. This seminar helped the participants to feel comfortable using computer software and the Internet. Students were guided in the creation of their own web site and were able to open a free email account.

6. Problem Solving Techniques Seminar

At the end of this activity, students were able to walk through the major steps in the engineering problem solving techniques. This seminar focused on the creative process and how it related to the engineering problem solving process. Participants were introduced to the brainstorming process and shown the importance of the type of information received and its value. Major emphasis was placed on the fact that many of science and engineering's greatest discoveries were made in unexpected ways. A major aspect

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of this seminar was its attempt to unleash the ingenious side of the students in the creation of a methodology.

7. Team Building Seminar

Participants were able to identify commonly used team-building and consensus-reaching concepts, and to apply the concepts in real life situations. This seminar introduced to team building concepts as applied in a real life situation with a metaphorical comparison between the behavior of geese and team work. The workshop included a team activity that presented the participants with knowledge as to difficulties, sacrifices, and satisfaction that come with operating in a team-conscious environment. The activity served to prepare the participants to work in teams to solve the problems they confronted in the design of their solar car.

8. Engineering Ethics Workshop

Students were able to identify various philosophical positions behind the concept of ethics. Also, students were capable of identifying the implications that certain decisions they may be called upon to make will have on society as a whole. This workshop included a lecture on the principles of ethics and a group discussion on different case studies that dealt with engineering ethics.

9. Digital Movie Workshop

Participants learned to record video and sound and reproduce and edit both using the computer. They integrated all the images and sound in a digital film that could be easily edited. During this activity, the participants learned through a conference about the different types of multimedia equipment. After a brief lecture on the theme, the students were able to play four different stations: digital videos, sound, digital photo, and editing. Also, they made their own multimedia creations which were presented at the closing ceremony.

10. Working with Materials Workshop

Here the participants learned to identify the different types of materials and understand some common processes that the alloys suffer to determine their characteristics. The presenter lectured about different types of materials, the structures of different materials, and how these structures affected the properties of the materials. Finally, the participants were able to create Silly Putty by a chemical reaction in a laboratory. Once they created the Silly Putty, they had the opportunity to color it.

11. Construct your own Electronic Doorbell Workshop

Participants learned to analyze and interpret simple electric circuits. Also, they learned to build an electric circuit. This activity included a formal lecture to introduce them to the basic concepts of electricity, circuits, types of materials and basic electrical equipment required to form a circuit like

resistors, transistors, switches and diodes. During the workshop, the students constructed doorbells for their room. Also, the participants visualized the difference between an electrical diagram and the real circuit.

12. Workshop: How to make a presentation?

The participants learned to prepare presentations using computers and were made aware of the importance of some factors like gestures, vocabulary, and appropriate clothing during a presentation. This seminar taught the participants to prepare a presentation using Power Point. Through this workshop, the participants learned to present the objectives, the methodology, and the conclusions of their design project. The workshop was divided in three parts: a lecture about practical advice to prepare a presentation, a team discussion about the project, and finally the preparation of the audiovisual material. Some even learned to animate their presentations.

13. Visit to the Department of Civil Engineering

The purpose of this visit was to let the participants understand the types of projects and areas in which Civil Engineers are involved. They were lectured about the different types of soils and the difference soils make when building a structure in each one of them. The lecturer showed the participants the different materials used to make concrete. Also, saw a simulation on how an earthquake can move a building of several floors and how important are the foundations of the structures.

14. Visit to the Center for Research & Development, Department of Mechanical Engineering

The purpose of this visit was to show the participants the type of projects and areas in which the Mechanical Engineers are involved. During this visit, the participants saw different solar car prototypes built by UPRM students to compete on a national level. Also, they received a lecture on how solar cells work and on the major problems this technology is now facing.

15. Design Competition

A major aspect of the summer camp was a Design Competition in which the participants had the opportunity to show their inventiveness. The Design Competition started the first day, with a problem description and ended the last day with the competition and interviews of the teams by the judges. Participants were organized in five groups. Each group chose a name, and after receiving the problem description, the set of specifications and the materials required to construct the solar car, each group began to work. Every day they had one or two hours to work on their car and on the project presentation. Participants built their cars and then started working with modifications to reach maximum performance. Some modifications were changes in the angle of the solar cell, in the speed of the flat gear, and

in the weight over the car. They also prepared a presentation using the knowledge gained in the workshop “How to Make a Presentation”.

The final competition took place Friday afternoon. Each team had two opportunities to run the car using solar power and battery power. Two professors from the Industrial Engineering Department evaluated the project presentation of each group based on the final poster and an interview with each team. The first three teams received awards; all teams received recognitions for their participation.

16. Recreational Activities

On Tuesday and Wednesday, the participants swam in the UPRM Olympic Pool under the supervision of the pools lifeguards and the camp staff.

17. Closing ceremony

The closing ceremony took place on Friday, July 20, 2001 at 6:00PM and included a dinner for the students and their parents. During the ceremony, the Chancellor of the University of Puerto Rico, the Dean of the Engineering Faculty, and the Director of the Industrial Engineering Department addressed the group. Then, the EXITE! Director gave a slide show and video presentation about the experiences of the week.

The winners of the Design Competition were awarded medals for first, second and third position; and given scientific calculators. At the end of the ceremony, each participant received a certificate and a photo of the group.

CONCLUSIONS

EXITE! established a variety of criteria to judge the success of the summer camp. These criteria sought to measure the quality of the camp's activities and resources, the camp's success in conveying information regarding engineering and computer sciences. Formal evaluation of the program was conducted through evaluation forms performed daily by the participants. Each participant rated each activity at the end of that day. The evaluation consisted in answering for each activity if they considered it adequate, if the instructor was effective in conveying the message and transferring knowledge, and if they recommended the activity be continued in future camps.

EXITE! was a success for the Faculty of Engineering of UPRM. This was the first k-12 activity for middle school age girls, sponsored by the faculty. Many parents at the closing ceremony expressed their gratitude for showing their daughters new career opportunities.

ASSESSMENT

The results obtained for EXITE! Summer Camp are shown in Table I and they show that the camp was a success.

BIOGRAPHICAL INFORMATION

Sonia M. Bartolomei-Suárez

Sonia M. Bartolomei-Suárez is Associate Professor of Industrial Engineering and Director of EXITE! Camp. She obtained her PhD in Industrial Engineering from The Pennsylvania State University. Dr. Bartolomei-Suárez is an active consultant to manufacturing facilities in Puerto Rico, and specializes in facility planning and simulation. At UPRM, she works with the pre-college programs to introduce engineering to junior and high school students.

Silvana Tarazaga

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Table I
Results of the Evaluations

Activity		Adequacy of Topic		Instructor Effectiveness		Usefulness	
Number	Description	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
1	Engineering and Sculptures	0.85	0.366	4.00	0.000	3.45	0.686
2	What is the Internet? Designing Our Web Page	1.00	0.000	3.60	0.754	3.85	0.489
3	Project Outline	0.95	0.224	3.70	0.733	3.75	0.716
4	Problem Solving Techniques	0.67	0.485	3.17	0.618	3.44	0.784
5	Team Working	0.83	0.383	3.83	0.383	3.78	0.428
6	Constructing a Doorbell	0.94	0.236	3.89	0.471	3.94	0.236
7	How to prepare a Presentation	1.00	0.000	3.85	0.489	3.90	0.447
8	Working with Materials	1.00	0.000	3.90	0.308	4.00	0.000
9	Engineering Ethics	0.85	0.366	3.40	0.995	3.30	0.865
10	Civil Engineering Overview	1.00	0.000	3.90	0.308	3.85	0.489
11	Digital Movie	1.00	0.000	3.95	0.224	4.00	0.000
12	Visit to CID – Mechanical Engineering Overview	0.89	0.315	3.47	1.020	3.42	0.961
13	Solar Car Project	1.00	0.000	3.95	0.229	3.95	0.229
14	Car Competition	1.00	0.000	3.79	0.918	3.79	0.918
Overall Mean		0.93		3.74		3.74	