

SEE for Kids: K-6 Outreach Efforts at Mississippi State University

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Introduction

As the land-grant institution in the state of Mississippi, Mississippi State University has historically been identified with activities focused on improving the education of Mississippi's citizens, both on the university campus and through a variety of outreach programs. Outreach activities in the College of Engineering have traditionally focused on students in grades 7-12. Summer camp offerings have been very successful in helping the College of Engineering to recruit bright high school students to campus to pursue degrees in engineering.

Since 1990, the College of Engineering and the student chapter of the National Society of Black Engineers have partnered to offer the University Familiarization Program for Minorities in Engineering (UFPME) program. Approximately 30 high school sophomores and juniors are brought to campus for a three-week period each year to explore the various opportunities available in engineering. In 1995, the Society of Women Engineers student chapter began offering a three-day camp for young women completing the 7th or 8th grades. This camp also focuses on exposing these students to the different careers available through engineering. During the summer of 2000, three sessions of this camp, each accommodating approximately 30 campers, will be offered in an attempt to satisfy the high demand for the program.

Efforts directed at outreach to the K-6 community have been limited in the past. The College of Engineering coordinates the regional Science Fair and helps science teachers throughout the state by offering training seminars and support activities for the Science Fair. Identifying mechanisms through which the College of Engineering can interact more extensively with the K-6 community has been the focus of more recent development efforts. The Summer Engineering Experience (SEE) for Kids program was conducted for the first time during the summer of 1999. In partnership with the Starkville Public School District (Starkville, MS), the College of Engineering exposed some 120 youngsters at the K-6 level to basic engineering concepts through hands-on activities.

Background

The Starkville Public School District offers a summer day-camp, the 'Extended Plus' program, to meet the day-care needs of the Starkville community for school age children during the summer vacation months. This program has been in existence for approximately 10 years and combines academic endeavors during the morning sessions with more conventional camp activities such as swimming and skating during the afternoons. As the College of Engineering began formalizing plans for the K-6 program, familiarity of the authors with the 'Extended Plus'

program provided the solution to logistics questions that arose. Questions such as how to publicize the SEE program, how to identify participants, siting the program, meals, snacks, etc., were all conveniently solved by the existence of the Extended Plus program. As a result, our efforts focused on design and implementation of activities that could be used to expose the children in the program to engineering.

Approximately 120 children participated in the three mornings of engineering activities. The children were divided into 3 groups by age/grade level. All activities could be completed in a one-hour to one and one half-hour period. The activities were selected so as to challenge, but not discourage, children at a particular level and also to expose to them to an engineering concept through a hands-on activity. Background for the engineering concepts was presented at the start of each activity. Activities were also selected which required the students to work together in teams.

Activities

In the youngest age group (kindergarten and 1st graders), students worked in teams of three. Three activities were conducted with this age group: the egg-drop competition [1], straw towers [1], and aluminum foil boats [1]. The egg-drop competition has been used at a variety of educational levels, but was particularly interesting when conducted with this age group. Each team was supplied with a plastic shopping bag that contained: tape, 3 balloons, string, cotton balls, card-stock. From these supplies, they were to fashion a vessel that would successfully protect the egg from breaking when dropped from a 2nd story window at the day-camp site. In this younger age group, designs were quite creative and a number of the eggs actually made the fall without suffering a hairline fracture or breaking.

In the second activity, students were asked to construct a tower using ordinary drinking straws and clay. The only guideline: the tower had to be freestanding. Students were given scissors to cut straws to whatever length they needed. Students made several attempts and, with some prompting, realized that they must have a larger base to build a taller tower. One group successfully built a tower taller than themselves.

Before the third activity, the basic concept of density and the phenomena of floating were discussed with the students. Then each team was provided with three sheets of aluminum foil (6" by 12"). Students were encouraged to experiment with various shapes of boats to test which could hold the most marbles. After a designated period of time, students were given a final sheet of aluminum foil and told to build their best boat. The ultimate goal was to design a boat from aluminum foil that could float the largest number of marbles.

In the second age group (2nd and 3rd graders), activities included the egg-drop competition, the construction of noodle towers and aluminum foil boats. In this older age group, more thought went into the design of the egg-protective devices. Given the same supplies as the younger age group, the older children were more likely to consider how to cushion the egg or lessen its rate of descent using the available materials.

For the noodle tower activity, the principles of tower construction (use of trusses to strengthen the structure) were presented to the students. Armed with an ample supply of mini-marshmallows and spaghetti, each team was to fashion two structures. One structure would be tested under the weight of marbles and one would be measured for the tallest freestanding tower.

For the boat activity with the second group, more advanced instruction regarding Bernoulli's principle formed the basis for the aluminum foil boat competition. The teams quickly realized that a number of design criteria were important. The volume of water displaced was critical as was the placement of marbles in the boat so as not to swamp the boat. Reinforcement of the sides of the boat by folding over the aluminum foil provided extra structural integrity. At the end of the activity, a head-to-head competition identified the superior boat design.

In the third age group (4th through 6th graders), the activities centered more on team-based exercises that required successful functioning of the team to achieve results. The three activities were the Polypopagon exercise [2] and the Waste Minimization exercise [3] and the straw tower activity. Mary Jasper, an Industrial Engineering faculty member at MSU, directed the students as they learned to manufacture Polypopagons (a three dimensional object constructed from cardstock and a rubber band). The students were divided into 6 teams, with each team given a different color of cardstock. The instructions for manufacturing a Polypopagon were provided and each team member built a few Polypopagons from start to finish. After each team member was familiar with each step of the manufacturing process, the steps were divided up amongst the team, with each team member responsible for at least one step in the manufacturing procedure. Each team then manufactured Polypopagons for a fifteen-minute period. At the end of the period, an independent judge determined how many of the Polypopagons satisfied the quality control criteria. The number manufactured by each team passing the quality inspection was recorded. The focus of this activity was two-fold: 1) students learn the importance of each step in a manufacturing process and that each step impacts the final manufactured product; and 2) students learn the importance of team work. They also learn that when each team member is responsible for 1 or 2 steps of the manufacturing process, the team can manufacture parts more efficiently. This was the first activity conducted with the 4th through 6th grade group and established the importance of teamwork for subsequent activities.

In the Waste Minimization activity [2], students were given a brief introduction to the concepts of recycling, waste minimization and pollution prevention. Not surprisingly, most of the students in this age group were familiar with recycling, but few had heard of waste minimization and pollution prevention. These common industrial practices and companion topics such as waste segregation (toxic and non-toxic) were presented. The importance of process control on the final manufactured product was also discussed, as was the ultimate fate of manufactured product that did not pass the quality control inspection. In this exercise, out-of-spec product must be disposed of as waste. In practice, it might be possible to recycle out-of-spec product. Thus, the importance of manufacturing parts to meet performance criteria established during the Polypopagon activity was reinforced with the Waste Minimization activity. Each team of 4 students was given a Play-Doh Fun Factory, two containers of Play-Doh (one container labeled toxic, one labeled non-toxic), a list of parts to be manufactured and a list of specifications the manufactured parts should meet. The Waste Management Team was comprised of 4 roles, each role taken on by a team member. The 4 roles were: 1) line operator;

2) line superintendent; 3) materials and warehouse manager; and 4) quality assurance manager. At the conclusion of the activity, the collected waste (both toxic and non-toxic) was weighed and recorded. The teams producing the least amount of toxic waste and minimum amount of combined waste were declared winners of this activity.

For the straw tower activity, students were asked to design and fabricate a tower using ordinary drinking straws as the basic building material. Students were asked to draw and design their tower on paper to meet certain dimensions. Then students constructed their tower to meet those specifications. Students were judged on the adherence to the stated specifications and the similarity of the structure drawn on paper to the actual structure as well as the amount of weight the tower held.

As a fill-in activity, the 'Famous Engineers' matching game was greeted with great enthusiasm. Aided by the ASEE Pre-college web site and the text Studying Engineering: A Road Map to a Rewarding Career [4], a matching game was prepared. The list of famous engineers included: 1) widely known present-day personalities such as David Robinson, Montel Williams and Donald Sutherland; 2) historical personalities including many astronauts (John Glenn, Neil Armstrong, Mae Jemison, Guion Stewart Bluford); 3) former presidents of the U.S. and other figures from the world of international politics; and 4) other recognizable figures including Karl Benz, Frank Lloyd Wright, and Stephen Dolby. A number of the famous engineers included on the list were of African-American heritage or were women. Inclusion of a diverse group of engineers allowed all student participants to realize that a career in engineering was an option available to them. This activity was presented on the 30th anniversary of man landing on the moon, and so students recognized many of the notable figures from the space program. The students were able to match about 50% of the names to descriptions that were provided. However, most of the matching was accomplished using other facts describing the individuals rather than their engineering accomplishments. For example, almost everyone was able to match up David Robinson to his description that began "Now an NBA basketball player, . . ." Each student was able to take home a hard copy of the matching game.

Awards

At the end of the week, an awards ceremony was held. Teams that had placed in the various contests were recognized with ribbons and small prizes. Each student also received a certificate of participation and a coloring book about pollution prevention. Awards citing 'Outstanding Teamwork' and 'Most Creative Engineering Design' were also awarded in each age group. In addition, four \$100 scholarships to pursue studies in the MSU College of Engineering were awarded to students from the oldest age group (4th through 6th graders). A. Wayne Bennett, Dean of the College of Engineering at Mississippi State University, presented the awards to the elementary students during the ceremony.

Assessment

Students were given a survey to assess the effectiveness of the program. The three most favorite activities were the egg drop, the aluminum foil boat, and the noodle activities. The most telling statistic was that 63 percent of the students said the SEE program changed their ideas

about science, engineering, and mathematics. Table 1 shows a summary of the participant responses.

Table 1. Assessment Questionnaire Completed by SEE Participants

Questions	Percentage of Responses		
	Agree	Neutral	Disagree
I am interested in science, engineering, or mathematics.	84	6	10
The SEE Program changed my ideas about science, engineering, and mathematics	63	29	8
I liked the activities that were done in the SEE program	88	10	2
I would like to participate in this program again.	88	7	4
The instructors were very helpful	93	7	0

Conclusion

The SEE for Kids program was very successful in accomplishing its end goal: exposure of elementary school children to engineering. Planting the seed early in their academic career is certainly the start of nurturing these children as they continue their academic pursuits. The use of an existing day-camp program to facilitate our inaugural offering of the camp allowed us to focus on developmental activities rather than logistical planning. Many communities/school districts in the state of Mississippi have similar camps available to elementary school children during the summer and use of these venues for engineering exploration activities is planned. All activities carried out during the three-day camp could also be conducted during an after-school care program. Current plans are to expand the program during the coming summer to other school districts in the state of Mississippi.

Bibliography

- [1] Future Scientists and Engineers of America web site, <http://www.fsea.org>
- [2] Ms. Mary Jasper, Department of Industrial Engineering, Mississippi State University, Mississippi State, MS 39762
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- [4] Landis, R.B., Studying Engineering: A Road Map to a Rewarding Career, (1st edition, 7th printing, Discovery Press, Burbank, CA: 1995)

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