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Final Report

Family Engineering Nights
(K-12 Workforce Development, MSU)



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ABSTRACT

In an effort to increase interest and understanding of the fields of engineering, with particular emphasis toward transportation, the College of Engineering at Mississippi State University sponsored five Family Engineering Night events. Each of these events were held at an elementary school and attended by families of the students. 585 families (parents and their children) participated in activities that simulate the work and ideas of engineering.

Activities spanned the fields of engineering in order to give a more broad perspective of the role of engineers in everyday life. During the activities, participating parents gave feedback on the activities and what they learned from completing the tasks in order to assess the learning that occurred. Additionally, at the conclusion of the events, parents were asked to identify their perceptions about the efficacy of the event. Analysis of the responses, the impact of these events on the understanding of both the parents and the k-6 students' understanding seems to have been significantly impacted. Many families commented that their understanding of the work of engineers was very limited prior to the event but they felt that they could explain at least some facets of their lives that were affected by the work of engineers

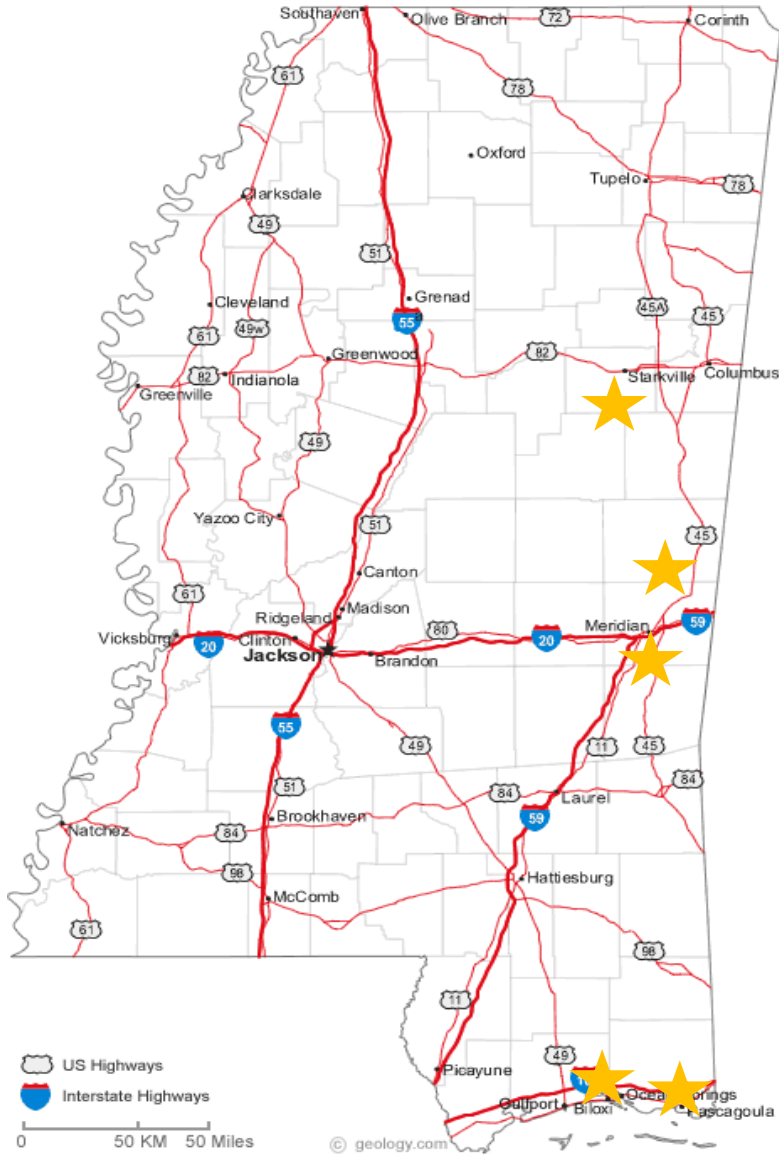
CHAPTER 1: BACKGROUND

The purpose of this project is to create a greater understanding of the field of engineering by the students and their parents across Mississippi. Across the United States (US) there has been rising concern about the seeming lack of interest by young people in pursuing degrees and careers in the Science, Technology, Engineering and Math (STEM) fields. This call for attention to be centered on STEM education improvement and recruitment has been led by professional and educational groups (AAAS, 1993; NSB, 2007; NAS, NAE, & IOM, 2007; DoEd, 2008; NAE, 2009). The number of high-school seniors who plan on careers in engineering has dropped almost 35 percent in the past 10 years, according to a survey by ACT, the standardized- test provider, of students who took its college-entrance exam (Brown & Linden, 2008; NSB, 2007). Women now account for only 18 percent of prospective engineers, and minorities 22 percent, according to the 2002 survey (Eisenhart, 2008; Field, 2004). Universities in the United States had 11 percent fewer engineering graduates in 2005 than in 1985 (Carroll, 2007; Becker, 2010) despite the fact that many high-tech companies in the US have been issuing warnings of engineer shortages for the past 2 decades (Brown & Linden, 2008)

In order to help combat this concern, the Bagley College of Engineering implemented the Family Engineering Program at five schools in the southern part of the state or “Gulf Coast Region”. Each event was arranged with the school personnel and was planned to host about 200 students in grades k-6 and their parents. Actual attendance at the events was 585 families with 365 parents and 924 children in grades k-6. Participant families completed a variety of activities representing a range of engineering fields that will allow for an

introduction to the work of engineers. Facilitators (school site teachers) assisted parents in guided discussions of the role of engineers in the daily lives of the students.

FIGURE 1-A Map of event venues



CHAPTER 2: RESEARCH APPROACH

Using the Family Engineering Night protocols and activity plans published in Family Engineering: An Activity and Event Planning Guide published by Foundation for Family Science and Engineering (2011) each event was scheduled in cooperation with the school site. The program is very prescribed by the designers of the guide – for the purpose of this study, these directions were followed. Registration of attendees was handled by school personnel. At each location, the school-site coordinator determined the number of attendees in each grade level or classes. Because of this, the researchers were not involved in the sample selection but can assume that all those who attended self-selected to participate. In regards to survey data, all event participants were encouraged to complete the survey. On the date of the event, College of Engineering personnel set the short activities (those that take less than 5 minutes to complete) in a large multi-purpose room that allowed participants to circulate and participate in small centers. These “short activities” are best described as interactive displays similar to those seen in a children’s museum. At each station, the activity supplies were set up with a set of instructions and an explanation of how the activity represented the work of engineers. Activities explored topics such as: cantilevers, bridge length/strength, 3-D Shape volumes, and substrate comparison for construction. School site teachers served as “docents” during this time in order to encourage family conversations and interactions with the activities. This stage of the event lasted about forty minutes in order to accommodate late arrivals and give the families adequate time to work at each of the twenty stations. For those events that had larger participant groups, additional stations (repeated sets) were set up so that engagement levels remained high.

After a suitable time, the College of Engineering staff met with the whole group to welcome the participants to the event and recognize the contributions of the STRIDE program and the school site personnel. They also conducted some large group activities to help the participants ‘break the ice’ and become more familiar with each other. This part of the event lasted about 15 minutes. Families were then assigned into activity groups of about 10 families and each of these groups was assigned to a nearby classroom. These classrooms were then introduced to a “long activity” or challenge.

These long activities/challenges are designed for family groups to participate in a more complex activity. Each of these is fully embedded in an engineering topic and the engineering design process is taught and then implemented in the design of a solution to a problem. Individual families were each provided with a set of supplies and an instructional card. A brief introduction to the particular field of engineering was given by the facilitator followed by safety instructions and an overview of the activity itself. Sample long activities include:

Mining for Chocolate: Participants are shown a variety of images depicting mining techniques and the environmental impact of each. Using a limited set of tools (plastic spoon, toothpick, paperclip, etc.) family teams were tasked to remove chocolate chips (in whole or part) from cookies. Teams are rewarded for their harvest based on the number of whole chips and parts. They are then assessed a penalty for the amount of damage to the cookie (in simulation of environmental impact).

Bus Route Mania: Participants are instructed in the challenges of creating a bus route for their school. Road maps are distributed along with data tables of intersections with a number of passengers who use that intersection as a bus stop. Teams must formulate

routes (up to 3) that can transport all passengers to the school within the time constraints. For simplicity, teams assume that each city block traveled will take 10 minutes to traverse.

At the conclusion of the evening, parents (one per family) were invited respond to a short written survey using a Likert scale. They were asked to measure the impact the activities had on their own understanding and that of their child(ren). Surveys were collected without any identifiable information and the data analyzed. Questions asked parent participants to rate the impact that participation had on their understanding of engineering (pre- versus post-), their children's understanding of engineering (pre- versus post-), and the value they perceived in participating in the event.

CHAPTER 3: FINDINGS

At the conclusion of the five events, the parent survey data was analyzed. Since each school represented a very diverse population/community with members of differing socio-economic status, race, educational background, and school performance ratings, the data was not disaggregated by schools. In total, there were over 500 families affected. Of the attendees, there was one survey returned for each family – a 100% return within the population. Please see Table 1 for a breakdown of the attendance at each event.

Table 3-1 – Attendance numbers for events and surveys received

Location	Number of Families	Number of surveys received
Jackson County Schools	89 families (233 individuals)	60
St. Martins Elementary	132 families (355 individuals)	45
Ackerman Elementary	100 families (224 individuals)	70
Neshoba Central Elementary	78 families (226 individuals)	54
Meridian Public Schools	186 families (251 individuals)	127
Totals	585 families (1289 individuals)	356

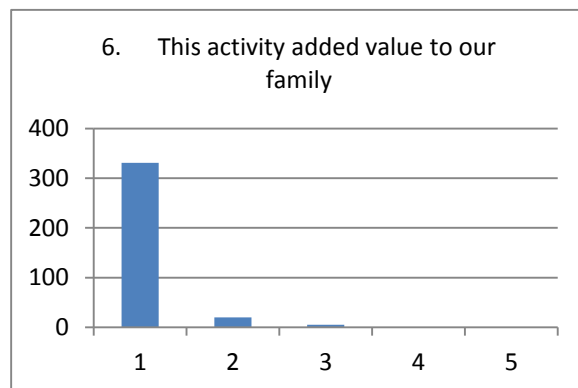
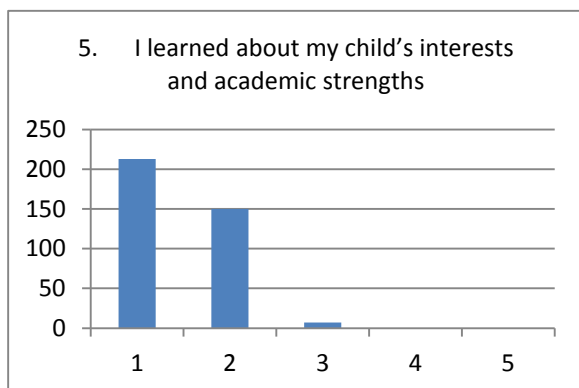
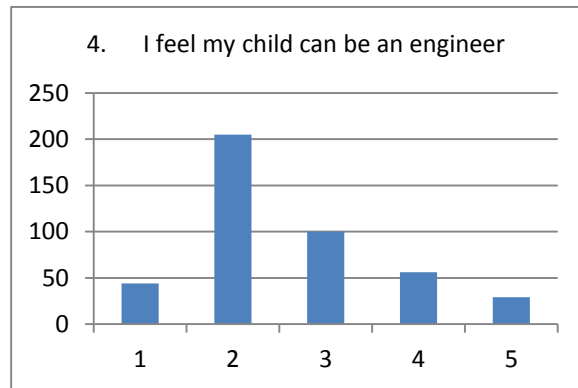
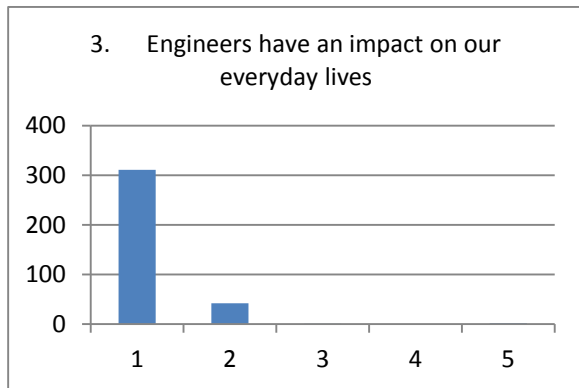
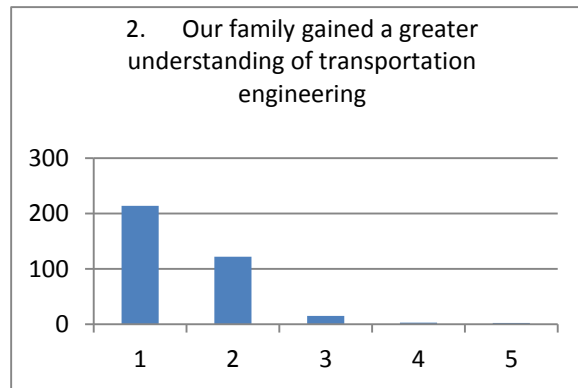
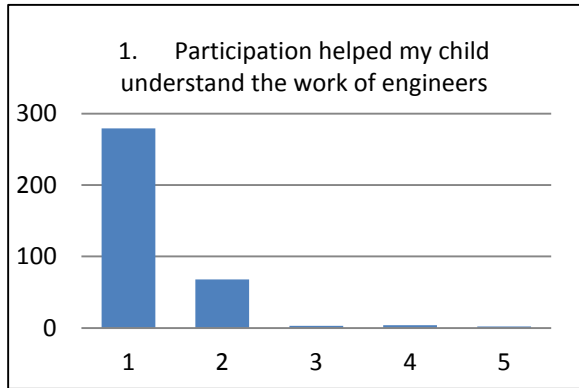
Data from each question on the surveys completed by parents is listed in table 2 below.

Responses were coded using a Likert scale of: 1 – Strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – Strongly Agree.

Table 3-2 – Likert scale ratings from surveys

Question	5	4	3	2	1
1. Participation helped my child understand the work of engineers	279	68	3	4	2
2. Our family gained a greater understanding of transportation engineering	214	122	15	3	2
3. Engineers have an impact on our everyday lives	311	42	1	0	2
4. I feel my child can be an engineer	44	205	100	56	29
5. I learned about my child's interests and academic strengths	213	150	7	0	0
6. This activity added value to our family	331	20	5	0	0

FIGURE 3-A – Distributions of survey responses by question



Analysis of responses indicates that in all areas, except question 4, there was a positive perception of the program and its' impact on the attendees. By interpreting each of the questions on the survey as the goals of the program, it appears that the program is a success. The data from question 4 is of concern – there may still be a disconnect for parents between the traits of a successful engineer in comparison to those of their own children. This could also be an indicator that the age groups attending (grades K-6) may still be younger than parents are willing to start encouraging career choices.

CHAPTER 4: CONCLUSIONS, RECOMMENDATIONS, AND SUGGESTED RESEARCH

Based on the apparent impact of this program on the perceptions of the attending parents and their children, this program has accomplished the purpose for which it is designed. The greatest recommendation to be made at this time is that these programs should be repeated annually or bi-annually in order to continue to increase and retain interest. By rotating the long activities with each event in order to expose the participants to new activities each time, the likelihood of retention is increased.

It may also be of interest to gauge parent interest in encouraging their children's career choices by age. For instance, at what age do parents begin directing their children's identification of careers? If this can be ascertained, the program may be revised to meet this age grouping more accurately. Fantz, T., Siller, T., & DeMiranda, M. (2011) have researched the impact of parental encouragement on children's self-efficacy toward engineering. Jacobs (2005) has also sought to identify the factors influencing career decisions in math and science career based on gender which may be at play in these findings as well. The effect of parental impact and understanding of engineering is being studied and has been found to have effect on the self-efficacy on adolescents but is still in question on younger children due to longitudinal study impacts (Novakovic & Foud, 2013).

The efficacy of the individual activities was not a part of this study as they had already been tried and tested in beta testing by the authors of the event guide. The College of Engineering staff had participated as a test site and felt that the activities were already vetted for effectiveness. Future research may wish to evaluate these activities with a specific variable such as gender or age.

Finally, this program should be revised to meet the level of middle school aged students as well. Implementation of this type of exploration event in grades 6-9 could yield a more direct and more easily tracked impact on enrollment in engineering programs at Universities.

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