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Old Dominion University's Engineering Summer Camp's Effect on Students Interest in Engineering

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OLD DOMINION UNIVERSITY'S ENGINEERING SUMMER CAMP'S EFFECT ON STUDENTS INTEREST IN ENGINEERING

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APPROVAL PAGE

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Clair Dorsey

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INTRODUCTION

Engineering is a diverse subject with many career fields for exploration. Almost any product or process that can be imagined involves an engineer at some point. Engineering is the application of scientific fundamentals into designs, inventions, and processes that can be used by people and businesses. The diversity of engineering is vast: civil engineering relates to structures such as buildings, bridges and roads; mechanical engineering relates to the interaction of objects and their motions; electrical engineering involves the flow of electricity by circuit boards, numerical controls, and computers. These are only a few examples of how engineering affects our ever increasing technological society.

In the United States, there are grave concerns for the future of our countries' economy which forms our high standard of living. According to the report *Rising above the Gathering Storm (2010),* without a renewed effort to strengthen the foundations of the United States' competitiveness, we cannot maintain our position as a world leader. The report stated that to remain competitive we must have an adequate supply of scientists and engineers who can innovate - that is be creative, be imaginative, and perform leading-edge work (National Academies of Science, National Academies for Engineering & Institute of Medicine, 2010).

The need for future engineers in various fields differs by discipline and has also been affected by globalization and the outsourcing of engineers to other countries (National Research Council, 2012). It is estimated by the Bureau for Labor Statistics from 2010 to 2020 the STEM (science, technology, engineering, and mathematics) jobs for mathematics and computer science will increase by 50% and the number of jobs for engineers will stay close to the national averages of job growth of 14-15% (National Research Council, 2012). This seems to indicate that our country does not need to encourage more kids to be engineers; however a number of factors contradict that notion. One factor is that baby boomers will be retiring in substantial amounts in the next ten years in industries dependent on engineers, such as oil and gas, manufacturing, and utilities (U.S. Congress, 2008). A bill was introduced to Congress in January 2013 that plans to increase H1-B VISA's for skilled foreign workers, mainly engineers, from 65,000 to 115,000 a year to work in the United States (Gannes, 2013). At the same time that U.S. companies want to hire foreign workers for engineering jobs, U.S. society has pushed many of its best and brightest into business careers (Gordon, 2009). The U.S. is not alone, Japan has coined a term "the flight from science" to represent that many in K-12 schools are choosing less demanding careers than those of engineering and science (Gordon, 2009). With some of these factors in mind, Old Dominion University's (ODU) Professional Development Center began to offer engineering summer camps in 2009 to increase young people's interests in becoming future engineers.

Problem Statement

The problem of this study was to determine parents' perceptions of their child's experience in Old Dominion University's engineering summer camps to determine if their child generated an interest in engineering as a career choice.

Research Objectives

The following research objectives were established to direct this research and to address the problem statement:

$RO_{1:}$ Identify the parental and family prior influences on the student in engineering prior to attending the engineering summer camp.

RO_2: Identify other STEM experiences effect on student interest in engineering.

RO_3: Rate the self-efficacy of the child in STEM and engineering.

RO_4: Establish the effect professional role models have on the student.

RO_5: Discover the effect the enjoyment/fun level of the engineering activities has on the student interest in engineering.

Background and Significance

Engineering and technology fields are listed consistently by career ranking systems as top choices with respect to salary and opportunity, and students need to be informed of this (Massiha, 2011). Political realities like immigration restrictions and the declining academic performance in the sciences and mathematics of our nation's youth justifies the development of new strategies designed to encourage United States youth to realize their abilities and begin careers in these fields (Bachman, Bischoff, Gallagher, Labroo, & Schaumloffel, 2008). Many hands on engineering camps exist across the country to increase student's awareness of engineering (Yilmaz, Jianhong, Custer, & Coleman, 2010).

For the past four years, Old Dominion University (ODU) has offered summer camps to middle school students in the Hampton Roads area. These camps have consisted of hands on engineering activities. The camps are run by career K-12 teachers who understand grade level comprehension and discipline. Some activities are conducted by ODU engineering faculty and each day "real" working engineers show the campers what they do for a living. The timeline of the camp is one week and each day is dedicated to a different engineering discipline. Monday is mechanical engineering day, Tuesday is electrical, Wednesday is civil, Thursday is marine, and Friday is a review and contest day. There is one large project that the campers work on each afternoon in which they build bridges from popsicle sticks in groups and have a bridge breaking contest to see which bridge will hold the most weight before breaking.

Many campers enjoy the camp so much they have returned for multiple summers. ODU charges a $350 fee for the camp. Many engineering professional organizations such as SAME, ASHRAE and National Naval Officers Association, and Norfolk Southern have provided scholarships for a small amount of campers with a financial need.

By providing an awareness and enjoyment of engineering through the camp experience, it is theorized that more campers will choose engineering as a career. This might help reverse the impression of aversion to science and engineering in students. This camp was not designed to teach complicated principles of engineering; it incorporated hands on activities to make students aware of what engineers do and to show students that engineering as a career can be fun. It has been shown that extensive hands on practices can be an effective method to increase STEM educational interest

(Yilmaz, Jianhong, Custer, & Coleman, 2010). In support of this, research has shown that the most popular activities in engineering summer camps were the collaborative hands on activities and interaction with professionals in engineering (Elam, Donham, & Solomon, 2012).

In a study of students who live in rural areas, it has been shown that lack of exposure to professional and technical careers can affect students' career choices (Haller & Virkler, 1993). This research study will extrapolate this theory to determine if the general student's exposure to engineering will not only increase interest and enjoyment but will affect their career choices.

In one study of engineering camps' effects on students with learning disabilities, the researchers recommended that more hands on activities be incorporated (Lam, Doverspike, Zhao, Zhe, & Menzemer, 2008). The ODU camp contains no lecture, only introductions to subject matter that relates directly to the hands on activities. The ODU campers are involved in hands on activities during the entire five days of camp.

Many references were found to evaluate the camps immediate effects on the students' desire to on go to college and how the camp increased campers desires to become an engineer. All of these surveys were conducted during the camp. Knowledge gaps exist because no existing research was found to follow these students as they mature and begin to make career choices. This study will indirectly determine if the students interest in engineering increased by surveying their parents. Parents will be encouraged to talk with their child and include their opinions in completing the survey.

Limitations

The limitations of the research are as follows:

1. The population is limited to parents of campers in the Hampton Roads region of Virginia.
2. Because of the cost of the camp the population is mostly limited to families of middle to high income families with the exception of a few scholarship campers.
3. All campers were in middle school from 6-8 grades when attending camp
4. Role models are limited to Hampton Roads engineers willing to volunteer their time.
5. Parent's opinions may not entirely represent their child's opinion.

Assumptions

There are aspects in this study that are assumed to be constant and true. The assumptions are as follows:

1. In the United States there is a need for more engineers.
2. Most middle schoolers do not understand what an engineer does for a living (Massiha, 2011).
3. Most of the campers come from middle class families.
4. Parents of the campers understand their children's college/career aspirations.
5. Campers will be interested in many different engineering disciplines.
6. If a camper decides to go to college for engineering, this camper has decided upon engineering as a career.

Procedures

This research study is a descriptive study that employs a survey to collect data from the parents of the ODU engineering summer camp students. A survey was created guided by the research objectives and the literature and administered to the parents of the campers. The population consists of 289 campers who participated in the camp when they were in middle school during 2009-2012. Parents were instructed to discuss the survey with their child as it was being completed.

The marketing software Constant Contact will be used. This will allow the researcher to see who has opened the email and if they clicked over to the survey. The data collected from each survey question will be tabulated indicating the number of responses and the mean of the Likert-scale ratings to closed-ended questions will be reported.

Definition of Terms

The following terms will provide the reader specific definitions that apply to this study:

1. Old Dominion University Professional Development Center - this center provides continuing education, professional development, and training for adult engineers and professionals. During the summer this center administers the ODU summer engineering camps.
2. Campers - the participants in the ODU engineering summer camps who were middle school aged.

3. Engineering - the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically the materials and forces of nature for the benefit of mankind.
4. STEM - science, technology, engineering, and mathematics
5. Engineering summer camp - an engineering camp held for middle school students on Old Dominion University's campus. The camp consists of hands on activities, professional engineers as role models, and lasts for one week. Three week long sessions are run each year.
6. SAME - the Society of Military Engineers is a professional society whose membership consists of architects, engineers, and construction professionals in the military and the private sector. Their mission is to promote engineering as a career and be involved in solving national security issues.
7. ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers is a professional society focused on heating, refrigeration and air conditioning who promote their profession as well as issue standards for their related fields such as building energy standards.
8. National Naval Officers Association - professional society comprised of naval officers mainly concerned with providing professional development for its members.

Overview of Chapters

The need for engineers in the workforce is important for the future of our country. The baby boomers will be retiring soon and most of those jobs will need to be replaced by qualified engineers. Old Dominion University began an engineering summer camp in 2009 to expose campers to engineering as a career. In the four years of the week long summer camp, 289 middle school students have participated in the camp.

The study will describe the parent's opinion of how other influences have affected their children's interest in engineering and STEM subjects. The study will look at the child's self-confidence in mathematics and science and any role model's influence on the child in science and engineering. It will also determine the effect of the ODU engineering camps influence on the children's interest in engineering as a career.

Chapter II will review the literature on other engineering summer camps and their effect of the career choice of the students who participated. It will also determine how parent's opinions relate to the actions of their children. The study will look at how career interest is typically generated and determine typical methods of interest in engineering as a career. The role models inclusion in the curriculum of the summer camp will be investigated to determine if this was effective and determine if multiple STEM experiences in middle school have an effect on interest in engineering. The question of if the "fun" level of the camps was highly influential on the choice of a career in engineering will be answered.

Chapter III will describe the procedures through which the survey was developed. It will describe in detail how the survey was administered and how data will be analyzed.

Chapter IV will present the findings of the data collected. Chapter V will provide a summary and conclusions from the research and make recommendations for future work.

CHAPTER II

LITERATURE REVIEW

The focus of this literature review is to determine if engineering summer camp had a role in students choosing engineering as a career. Each research objective will be addressed. The review will determine what prior influences impact middle school children to choose engineering as a career. Because numerous variables exist in influencing STEM careers, it can be challenging to identify clear pathways that affect these career choices. The literature confirms this study's five areas of influence stated in the research objectives: 1) parents, family and socioeconomic background; 2) formal and informal STEM experiences; 3) self-efficacy's affect; 4) effect of role models; and 5) interest and enjoyment.

A wide web of interrelated reasons were uncovered that affect a child's decision on a career in STEM or engineering. Many theories exist to explain student career decision making. Examples are Super's Career Development Theory, Possible Selves Theory, Social Cognitive Career Theory, Farmer's model of Career and Achievement Motivation, and Eccles model of Achievement Related Choices. Because of the application of Social Cognitive Theory to STEM career decisions, this search concentrates on this theory.

By the time students have reached middle-school, they have been exposed to concepts, experiences, and academics that have impacted their opinion of science, mathematics, and other STEM subjects. Each family and school interaction will have created a unique imprint on each child with respect to STEM and engineering. This review also addresses gender and minority differences in career choices.

Parental, Family, and Socioeconomic Influences

In general paternal and maternal educational attainment and paternal and sometimes maternal occupational status have been well documented as influencers on a child's career choice (Schulenberg, Vondracek, & Crouter, 1984). The influence of parents is not always the same for boys, girls, and minorities. For women, an open approach to the career decision was more important and involves having both an independence from and attachment to both parents (Blustein, Walbridge, Friedlander, & Palladino, 1991). However for boys the dependence on the father-son relationship is very important in career choice (Blustein et al., 1991).

Although the genders react differently, the commonality is that determining career outcomes is a social process and it is based on actions of both parents and children (Young et al., 2006). Parent and family variables are active, intentional, and ongoing processes that can enhance the development of the relationship and be a facilitating factor in student career development (Young & Valach, 1997).

The strongest influence on predicting a child's occupational status would be socioeconomic status, although weaker for girls than boys (Schulenberg, Vondracek, & Crouter, 1984). However, when looking solely at black students, the educational and career aspirations use a significantly different set of predictors than of the white population (Chung, Loeb, & Gonzo, 1996). For black students, the father's occupational socioeconomic status' influence on career choice is similar, but there are major differences such as the amount of time studying in high school, student liberal attitudes, and becoming independent (Chung et al., 1996).

STEM Experiences as Influencing Factors

Middle-school students have been exposed to formal math and science classes and optimistically been exposed to informal STEM activities such as science clubs or science museum programs. This review will show how various STEM experiences such as formal academic and informal experiences affect student STEM choices.

Crisp, Nora, and Taggart (2009) found that prior academic experiences in mathematics and science before high school and math achievement were influential in students choosing a STEM major. It was also shown that there was a higher statistical difference in the number of college preparatory courses taken by white students than minority students, and as a result whites scored higher on the achievement tests (Crisp, Nora, & Taggart, 2009). Gallagher (1994) found that major predictors for a student in middle school to place in higher science courses in 11th grade were based on teacher enthusiasm for science, inquiry based instruction in the classroom, and student achievement. Gender also plays a role in predicting science persistence in the 11th grade (Gallagher, 1994).

The combination of teenage aspirations with educational attainments is a major force in the occupational choices of young people. Parental social class plays a role in this area because of its influence on teenage aspirations. These attitudes can even lessen the strong effects of socioeconomic background (Schoon & Parsons, 2002). Engberg and Wolniak (2013) found that STEM majors had higher high school GPAs and completed higher level math/science courses. Today’s STEM professionals communicate that positive science experiences in childhood such as visiting a science museum influenced their decision to take STEM electives in high school. Attitudes towards science are typically formed in children through informal means by the age of nine before taking the first formal science class (Joyce & Farenga, 1999). Unfortunately other social affects such as classroom dynamics with teachers can negatively influence the attitude of children towards STEM, especially those in the minority groups (Brickhouse & Potter, 2001).

Informal STEM activities are a way to increase the awareness of career options especially since students surveyed reveal that the relation of science topics to careers is not relayed by the teachers (Munro & Elsom, 2000). If a student is not aware of STEM careers, none of the career choice theories will be applicable. Studies have shown that students have a limited understanding of what STEM careers encompass and the qualifications needed for the work (Bieber, Marchese, & Engelberg, 2005).

Self-Efficacy's Influence

Self-efficacy is the self-belief of how successful a person will be at completing a task or goal. Among the different aspects of self-knowledge none is more significant in everyday lives than conceptions of personal efficacy. Self-efficacy influences choices, amount of effort expended, and thought patterns and emotional reactions (Bandura, 1986). The social cognitive theory, developed by Bandura, supports the idea that students may develop changing academic behaviors that are influenced more by their perceptions about their ability than influenced by past performance (Joyce & Farenga, 1999).

When it comes to taking STEM courses in high school or STEM careers, self-efficacy is a major factor in pursuing this field in middle school students (Fouad & Smith, 1996). According to Lent, Brown, and Hackett (1994), career interests and career intentions develop because of self-efficacy and outcome expectations. It has been shown that male students show higher mathematics related self-efficacy than females, but it is believed that these differences originate from interest differences and not achievement differences (Lent, Lopez, & Bieschke, 1993). Hackett (1985) shows that self-efficacy was the most highly correlated with math-related major choices.

Fouad and Smith (1996) applied the Lent et al. (1993) social cognitive model on middle school students, since previous research had mainly focused on college students. They used Lent's input variables (age and gender), interest, outcome expectations, and intentions and found these variables to correlate well to the middle school population. Significant findings were at middle school age; there was a significant negative relationship with interests and self-efficacy in math and science, suggesting a need for interventions in these areas (Found & Smith, 1996). The research also found positive relationships between self-efficacy and outcome expectations and between outcome expectations and intentions, thus showing a complex and indirect relationship between self-efficacy and intentions (Found & Smith, 1996).

Role Models Affect

There are many definitions in the literature on role models. Bandura's (1986) Social Cognitive Theory suggests that new skills are learned by observing role model behaviors and people will continue to produce those skills if reinforced. Lent et al.

(1994) expands on the Social Cognitive Theory and shows that career role models positively influence interests, self-efficacy, and outcome expectations.

Boundaries should be established between the terms mentor, role models, and public heroes and heroines. A mentor encourages students to develop a strong interest in an area and there is typically bonding between the mentor and the protégé. Role models are defined as adults who are worthy of imitation. Heroes are those who have achieved significance in some area and in today's world tend to be celebrities (Pleiss & Feldhusen, 1995). Nauta and Kokaly (2011) found that undergraduate students not only wanted role models to influence their career choices but also desired guidance and support. This could be interpreted that undergraduate students in Nauta et al. (2001) research desire a mentor relationship versus a role model.

Exposing students to successful nontraditional role models through print material and non-stereotyped information can change attitudes of ninth graders (Greene, Sullivan, & Beyard-Tyler, 1982). According to Savenye (1990) when using videotaped role models for nontraditional careers on a population of ninth graders, there was an immediate influence by a relatively brief exposure to the video, but this affect was not long lasting. This suggests a longer, more formal program is needed to bring about a change in career opinion (Savenye, 1990).

Career maturity is the development or readiness of a high school or a college student for making career choices. Role models in addition to having work related skills in adolescence better predicted career maturity than parental influence, academic achievement, self-confidence, and socioeconomic standing (Flouri & Buchanan, 2002).

Effect of Enjoyment of STEM and Engineering

Psychologists have found that there are strong, predictive relationships between enjoyment of science, interest in learning science, and student's interest in learning more about specific science topics (Ainely & Ainley, 2011). It has been found that 11 - 13 year olds with low ability on achievement tests, but with a well-developed interest for reading or math, were more likely to gain an understanding of the subject than students with high ability and a less developed interest (Hidi & Renninger, 2006).

There is a need for creative and fun learning experiences to generate more interest in science, math, and technology. A 4-H camp in Alabama showed that young students are interested in science but enjoy hands on experiments and use of information technology tools (Raju, Sankar, & Cook, 2004). In a Texas STEM camp the fun hands on engineering projects related to the real world were the key to the success of the program (Yilmaz et al., 2010). A North Carolina engineering technology camp survey results indicated that 95% of the students thought the instruction during the camp was fun and 89% rated the hands on activities as fun. Of these same participants 42% of the females, 40% of the African Americans, and 33% of the Hispanics said they planned to pursue a career in engineering (Kuyath & Sharer, 2006).

Summary

This literature review outlines contributing aspects that influence students to choose engineering as a career. These factors include parents, family, and socioeconomic background; formal and informal STEM experiences; self-efficacy's affect; effect of role models; and interest and enjoyment. The STEM community should better understand the indirect relationships, complexity, and importance these factors have on influencing students to choose a STEM career. Chapter III will outline the methods and procedures to be used in this study including the population of the study, instrument design, methods of data collection, and statistical analysis of the data.

CHAPTER III

METHODS AND PROCEDURES

Chapter III will give a summary of the population, instrument design, data collection methods, and the statistical processes used to determine if participation in the ODU's engineering summer camp made a difference in the career interest of the students. This is a descriptive research study.

Population

This study's population is comprised of parents of students who were in middle school at the time of participation in ODU's week long engineering camp during the time frame of 2009 to 2012. The total head count of students who attended the camp during this period was 312 and 83% were boys and 17% were girls. Of the 312, fifteen students attended the camp twice and three students attended three times making the actual population equal 286. The cities where the children lived at the time they attended camp were mainly Virginia Beach, Chesapeake, and Norfolk. See Figure 1 for the camper's city of residence.

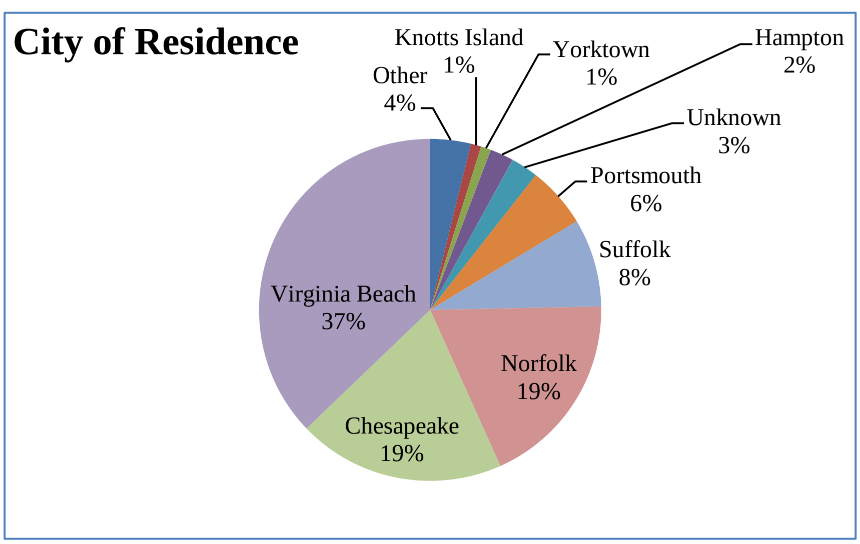

***Figure 1*. City of Residence**

This population participated in hands on engineering activities that were designed for enjoyment. The population was not exposed to exactly the same activities over the years of the camps, although the activities represented similar subject matter.

Instrument Design

A survey was developed to collect data for this study. The survey was designed to address each major area of the literature review and the study's research questions. Twenty-five questions formed the survey and had both open-ended and closed-ended questions. Some of the closed-ended questions provided multiple response options with a Likert-scale of strongly disagree, disagree, undecided, agree, or strongly agree.

The questions covered the following areas:

- parents, family and socioeconomic background
- previous formal and informal STEM experiences
- parent's opinion of their child's self-efficacy
- effect of role models on their child
- their opinion of the interest and enjoyment of the camp

See Appendix A for a copy of the survey.

Methods of Data Collection

The survey was sent to the parents of the campers via the Constant Contact email program. A cover letter provided the introduction explaining the purpose, protection of human subject methods, and the results would be held in confidence and the reporting will be in aggregate. A link was embedded in the cover letter for the parents to access the survey. The link is programmed to ensure the survey will be anonymous. To encourage parents to participate, the timing of response was also addressed in the cover letter and explained that it would take no more than fifteen minutes to complete. The request was also made that they complete the survey within 10 days. Seven days after the initial email of the survey was sent, a reminder email was resent to the entire population because due to the anonymous nature of the survey, it was not known who had completed it. After another seven days, another reminder email was sent because a 60% response rate had not been achieved. One final email was sent to the population fourteen days after the last survey was emailed because only 52 people had completed the survey.

At this point, it was decided to start making phone calls to improve the response rate. At the end of the following month there were 108 completed surveys.

Statistical Data

The responses to the survey questions were tabulated and analyzed to determine if the summer camp played a role in developing an interest in engineering. The number of respondents, percentage, and the mean and median were calculated of each survey question and reported in the findings section of this study. Standard deviations were also computed to see the variance in the responses.

Summary

This chapter defined the population, instrument design, methods of data collection, and how the statistical analysis was conducted. The population was described as the parents of middle schoolers who attended the ODU engineering summer camp from 2009-2012. A survey was sent to the entire population and the responses were analyzed to determine the influence the summer camp had on their child's interest in engineering and STEM. The survey used, data collection, and statistical analysis was described in this chapter. The findings from the surveys will be reported in Chapter IV.

CHAPTER IV

FINDINGS

The purpose of this study was to determine parents' perceptions of their child's experience in Old Dominion University's engineering summer camps to determine the effect on their child in developing an interest in engineering as a career choice. The study was guided by the following research objectives:

$RO_{1:}$ Identify the parental and family prior influences on the student in engineering prior to attending the engineering summer camp.

RO_2: Identify other STEM experiences effect on student interest in engineering.

RO_3: Rate the self-efficacy of the child in STEM and engineering.

RO_4: Establish the effect professional role models have on the student.

RO_5: Discover the effect the enjoyment/fun level of the engineering activities has on the student interest in engineering.

Findings are determined from the results of a twenty-five question survey emailed to the parents of the participants via the Constant Contact email program. This consisted of various forms of questions, including: open ended questions, multiple choice, and five point Likert scale questions defining levels of attitude toward a statement (strongly agree=5, agree=4, neutral=3, disagree=2 and strongly disagree=1). The raw data from the Constant Contact program was downloaded into Microsoft Excel and manipulated to find the mean, median, and standard deviation using Excel formulas. Data are reported as frequencies, percentages, mean, median, and standard deviation where appropriate.

Central tendency measures are used to describe and interpret the data. Mean, median, and standard deviation are reported together to describe the data as symmetrical or skewed. When a data set is symmetrically distributed the data is stable and the mean and median are the same. When the data is skewed by outliers, the data can be described by reporting the mean and the median which are different. The standard deviation is reported to determine the variance in the data and can show how well the data clusters around the mean. The population was the parents/grandparents of 286 attendees of ODU's engineering camp between 2009 and 2012. The response rate was 38% of parents/grandparents. This chapter will discuss the findings of the research and summarize the observations.

Findings

The survey addressed the five established research objectives. The first research objective was to identify the parental and family prior influences on the student in engineering before attending the engineering summer camp. Three questions focused on this area. Four questions addressed if the students had been exposed to other STEM experiences that could affect their interest in engineering. Three questions had the parents rate the self-efficacy of the child in STEM and engineering. Three questions addressed if the camper had role models. Four questions looked at the effect the enjoyment/fun level of the engineering activities has on the student interest in engineering. Four additional questions specifically asked about the effect of the engineering camp on the child's interest in engineering before and after the camp.

To investigate Research Question 1, questions were asked to determine the socioeconomic status and other family demographic information. Survey Question 1, was to obtain the individual's consent. Question 2 asked "What is your Ethnicity?" The results of this question show that 79.6% of the campers were white, 14.8% were African American, 3.7% were Asian, 1.8% indicated other, and less than 1% were Hispanic or Latino. These results compare to the percentages of the Hampton Roads population in 2010 as follows: White population was 59%, Black or African American population was 32.0%, Hispanic or Latino were not reported as a race, Asian population is 3.0%, and Other was answered as 2.0% (Hampton Roads PDC, 2010). See Table 1 for a summary of these results.

Table 1

Ethnicity

Survey Choice	n	%	HR Stats
White	86	79.6%	59.0%
Black or African American	16	14.8%	32.0%
Hispanic or Latino	1	<1.0%	NR
American Indian or Alaskan	0	0.0%	0.0%
Asian	4	3.7%	3.0%
Native Hawaiian or Other Pacific	0	0.0%	0.0%
Other	2	1.8%	2.0%
Total	108	100.0%	

Note. n = number of responses; % = percentage; HR=Hampton Roads; Stats=% of Region; NR=Not reported

Question 3 asked "What grade is your child in now?" Parents reported that 11.1% are in the 6th grade, 21.2% are in the 7th grade, 21.2% are in the 8th grade, 15.7% are in the 9th grade, 11.1% are in the 11th grade, 3.7% are in the 12th grade, and 5.5% answered other. These results indicate that 42.5% of the children were in high school when their parents answered this survey. See Table 2 for the tabulated data.

Table 2

Camper's Current Grade

Grade in 2013	n	%
6th	12	11.1%
7th	23	21.2%
8th	23	21.2%
9th	17	15.7%
10th	12	11.1%
11th	13	12.0%
12th	4	3.7%
Other	6	5.5%
Total	108	100.0%

Note. n = number of responses; % = percentage

Question 4 asked parents to indicate their socioeconomic status. Working class was reported at 8.3%, 74% reported they were in the middle class, and 14.8% reported they were upper class. Three parents answered "other." The common theme to the "other" answers was poverty. Table 3 summarizes this data.

Table 3

Socioeconomic Status

Classification	n	%
Working Class	9	8.3%
Middle Class	80	74.0%
Upper Class	16	14.8%
Other	3	2.7%
Total	108	100.0%

Note. n = number of responses; % = percentage

Question 5 asked the parents to describe if any one in their family was an engineer. The response of mother was an engineer was 6.4%, 29.6% reported the father was an engineer, and 18.5% reported that a close family member was an engineer. Therefore 54.5% reported that there was an engineer, or more than one, in the immediate family. The questionnaire allowed more than one answer, so approximately seven families had more than one engineer in the immediate family. Fifty-one point eight percent answered that there was no engineer in the immediate family. Table 4 shows this data.

Table 4

Engineers in the Family

Classification	n	%
Yes- Mother	7	6.4%
Yes- Father	32	29.6%
Yes other close family member	20	18.5%
No	56	51.8%
Total	108	106.3%

Note. n = number of responses; % = percentage

Question 6a was the first Likert scale question on the survey and the rankings are assigned a numerical value as follows: strongly agree = 5, agree=4, neutral=3, disagree=2, strongly disagree=1. Question 6a asks the parents to rate the statement: You have a very close relationship with your child. Eighty-two percent of parents strongly agreed, 15% of parents agreed, 2% were neutral, 0% disagreed, and 1% strongly disagreed. The mean of this question was 4.78 (strongly agree), the median was 5, and the standard deviation was 0.57. Table 5 tabulates this data.

Table 5

Parent's Rating of Parent/Child Relationship

Question	Key	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean/Median /Standard Deviation
6a. Do you have a close relationship with your child?	Number	88	16	2	0	1	4.78
	%	82%	15%	2%	0%	1%	5.00
							0.57

Note. % = percentage

Therefore for Research Objective 1, the ethnicity of the families of the campers are 80% of the families are white which was 21% higher than the white population in Hampton Roads. Blacks are represented at almost 15% which was 17% lower than the Hampton Roads statistics. The self-reported socioeconomic status of the group was 89% either middle or upper class. The parent's careers were reported as 36% of the parents are engineers, and additional 20% had a close family member as an engineer, resulting in 51% of the students not having a close family member with a career in engineering. An additional question was asked to determine the current grade of the students and 42.5% were in high school.

The next section of questions addressed Research Question 2, if the campers had been exposed to other STEM experiences prior to attending camp. Question 6b asks the parents to rate the statement: Your child has taken high level math and science classes. Forty-four percent strongly agreed, 36% agreed, 11% were neutral, 7% disagreed, and 2% strongly disagreed. The mean of question 6b was 4.14 (agree), the median was 4.00, and the standard deviation was 0.98. Table 6 summarizes this data. Question 6c asks for the rating of the statement: Your child has high performance in all subjects. Fifty-two percent strongly agreed, 24% agreed, 12% were neutral, 10% disagreed, and 1% strongly disagreed. The mean of question 6c was 4.17 (agree), the median was 5.00, and the standard deviation was 1.05. Table 6 summarizes this data. Question 6d asks the parents to rate the statement: Before age 9 your child was exposed to science such as science museums or science kits. Seventy-six percent strongly agreed, 16%, agreed, 5% were neutral, 2% disagreed, and 2% strongly disagreed. The mean of question 6d was 4.68 (strongly agree), the median was 5.00, and the standard deviation was 0.77. Table 6 summarizes this data. Question 6e was also about STEM experiences and asked if your child has had teachers who are enthusiastic about science and math. Fifty-three percent strongly agreed, 35% agreed, 9% were neutral, 3% disagreed, and 0% strongly disagreed. The mean of question 6e was 4.38 (agree), the median was 5.00, and the standard deviation was 0.77. Table 6 summarizes this data.

In summary for Research Objective 2, the results indicated that 80% of the campers had taken high level math and science courses, 76% had a high performance in all subjects, and 92% had been exposed to science before the age of 9, and 88% had had a teacher who was enthusiastic about science. 76% of the campers had been exposed to organized STEM activities outside of school prior to this camp.

Question 7 was an open ended question and asked, “Please list other STEM experiences your child has participated in, such as other camps, after-school clubs, robotics competitions, etc.”   Of the 102 answers 42 had not attended another summer camp, six mentioned Boy Scouts, 32 mentioned after school STEM clubs, 11 mentioned Lego robotics, seven mentioned science fair competitions, two mentioned 4H. Twenty-three percent did not mention any STEM related activities other than exposure in school, meaning that 77% of these children were exposed to some STEM outside activities.

The following three questions will answer Research Objective 3 which addressed the self-confidence in math and science of the campers. Question 8 was an open ended question and addressed areas such as self-confidence, perceived success in STEM subjects, motivation, and other attitudinal aspects. Question 8 asked: “Please describe your child’s attitude towards STEM subjects. Please address areas such as self-confidence, perceived success in STEM subjects, motivation, and other attitudinal aspects. Please indicate if there was a difference before and after camp." Of the 102 comments, 30% indicated there was a significant difference in self-confidence and interest in STEM, or students were more motivated after the camp. Fifty-five percent were neutral and 15% indicated there was no difference before and after camp.

Table 6

Other STEM Experiences Effect on Student Interest in Engineering

Question	Key	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean/Median /Standard Deviation
6b. Your child has taken high level math classes	Number %	47 44%	39 36%	12 11%	7 7%	2 2%	4.14 4.00 0.98
6c. Your child has high performance in all subjects	Number %	56 52%	26 24%	13 12%	11 10%	1 1%	4.17 5.00 1.05
6d. Before age 9 your child was exposed to science such as science museums or science kits	Number %	81 76%	17 16%	5 5%	2 2%	2 2%	4.68 5.00 0.77
6e. Your child has had teachers who are enthusiastic about science and math	Number %	57 53%	37 35%	10 9%	3 3%	0 0%	4.38 5.00 0.77

Note. % = percentage

The next section addressed questions on the self-confidence and self-efficacy of the campers, but in a Likert scale format of strongly agree=5, agree=4, neutral=3, disagree=2 and strongly disagree=1. Question 6f asks the parents to rate the statement: Your child is self-confident in math. Fifty-two percent strongly agreed, 30% agreed, 8% were neutral, 8% disagreed, and 1% strongly disagreed. The mean of Question 6f was 4.21 or agree, the median was 5.00, and the standard deviation was 1.07. The data are summarized in Table 7.

Question 6g asks the parents to rate the statement: Your child is self-confident in science: 61% strongly agreed, 36% agreed, 1% were neutral, 2% disagreed, and 1% strongly disagreed. The mean of Question 6g was 4.53 (strongly agree), the median was 5.00, and the standard deviation was 0.70. These data are summarized in Table 7.

Table 7

Self-Efficacy's Effect on Interest in STEM

Question	Key	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean/Median /Standard Deviation
6f. Your child is self-confident in math	Number %	56 52%	32 30%	9 8%	9 8%	1 1%	4.21 5.00 1.07
6g. Your child is self-confident in science	Number %	65 61%	38 36%	1 1%	2 2%	1 1%	4.53 5.00 0.70

Note. % = percentage

For Research Question 4, three questions were asked. Question 6h asks the parents to rate the statement: Your child has a science/engineer role model-such as a family friend or teacher. Forty-five percent strongly agreed, 30% agreed, 12% were neutral, 7% disagreed, and 6% strongly disagreed. The mean of this question was 4.01

(agree), the median was 4.00, and the standard deviation was 1.17. Question 6i asks the parents to rate the statement: Your child has identified a famous role model in areas such as Albert Einstein, Marie Curie, or other more modern figures. Twenty-five percent strongly agreed, 21% agreed, 30% were neutral, 19% disagreed and 6% strongly disagreed. The mean of this question was 3.41 (neutral), the median was 3.00, and the standard deviation was 1.21. Question 6j asks the parents to rate the statement: Your child has been inspired by someone in STEM areas. Thirty-one percent strongly agreed, 26% agreed, 28% were neutral, 10% disagreed, and 5% strongly disagreed. The mean of this question was 3.68 (agree), the median was 4.00, and the standard deviation was 1.15. All three of these question's data are summarized in Table 8.

To summarize for Research Question 4, the parents agreed that their child had a science/engineer role model and if someone in STEM inspired their child. Parents were neutral on if their child had identified a famous role model such as Albert Einstein or Marie Curie.

The next set of questions addressed Research Question 5, the effect of enjoyment or fun level of the camp. Question 9a asks the parents to rate the statement: Your child enjoyed the hands on activities in the camp. Seventy-two percent strongly agreed, 24% agreed, 2% were neutral, 1% disagreed, and 1% strongly disagreed. The mean of this question was 4.66, (strongly agree), the median was 5.00, and the standard deviation was 0.65 Question 9f asks the parents to rate the statement: Your child was excited about what he/she did that day in camp and talked with you about it. Fifty-one percent strongly agreed, 41% agreed, 6% were neutral, 3% disagreed, and 0% strongly disagreed. The mean of this question was 4.36 (agree), the median was 5.00, and the standard deviation was 0.67. Question 9g asks the parents to rate the statement: Your child had fun at the camp. Sixty-two percent strongly agreed, 33% agreed, 2% were neutral, 3% disagreed, and 0% strongly disagreed. The mean of this question was 4.55 (strongly agree), the median was 5.00, and the standard deviation was0.67. Table 9 summarizes the data from Research Question 5.

Table 8

Effect of Professional Role Models on STEM interest

Question	Key	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean/Median /Standard Deviation
6h. Your child has science/ engineer role model-such as a family friend or teacher	Number %	48 45%	32 30%	13 12%	8 7%	6 6%	4.01 4.00 1.17
6i.Your child has identified a famous role model in STEM (Science, Technology Engineering and Math) areas such as Albert Einstein, Marie Curie or other more modern figures.	Number %	27 25%	22 21%	32 30%	20 19%	6 6%	3.41 3.00 1.21
6j. Your child has been inspired by someone in STEM areas	Number %	33 31%	28 26%	30 28%	11 11%	5 5%	3.68 4.00 1.15

Note. % = percentage

In summary the parents strongly agreed that their children enjoyed the hands on activities in the camp. They also agreed that their children were excited about what they did in camp and strongly agreed that their children had fun at the camp.

Table 9

Effect of the Enjoyment/Fun level of the Engineering Activities

Question	Key	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean/Median /Standard Deviation
9a. Your child enjoyed the hands on activities in the camp.	Number %	78 72%	26 24%	2 2%	1 1%	1 1%	4.66 5.00 0.65
9f. Your child was excited about what he/she did that day in camp and talked with you about it.	Number %	55 51%	44 41%	6 6%	3 3%	0 0%	4.36 5.00 0.83
9g. Your child had fun at the camp	Number %	67 62%	36 33%	2 2%	3 3%	0 0%	4.55 5.00 0.67

Note. % = percentage

Additional Analysis

The remainder of the questions on the survey purpose was to conduct additional analysis. This section considers before and after questions on the effect of the camp the parents have noticed. Question 9b asks the parents to rate the statement: Your child mentioned a career in engineering before the camp. Thirty-six percent strongly agreed, 28% agreed, 23% were neutral, 7% disagreed, and 6% strongly disagreed. The mean of this question was 3.81 (agree), the median was 4.00, and the standard deviation was 1.16. Question 9c asks the parents to rate the statement: Your child mentioned a career in engineering after the camp. Fifty-one percent strongly agreed, 23% agreed, 17% were neutral, 6% disagreed, and 3% strongly disagreed. The mean of this question was 4.13 (agree), the median was 5.00 and the standard deviation was 1.08. Question 9d asks the parents to rate the statement: This camp changed your child's attitude about science, technology, engineering, and math. Eighteen percent strongly agreed, 31% agreed, 38% were neutral, 10% disagreed, and 3% strongly disagreed. The mean of this question is 3.47 (neutral), the median was 3.00, and the standard deviation was 1.04. Question 9e asks the parents to rate the statement: Your child is more motivated to perform well in the STEM subjects since camp. Twenty-four percent strongly agreed, 31% agreed, 35% were neutral, 8% disagreed, and 1% strongly disagreed. The mean was 3.69 (agree), the median was 4.00, and the standard deviation was 0.96. Question 9h asks the parents to rate the statement: Your child can now relate math and science to real world issues. Thirty-six percent strongly agreed, 36% agreed, 24% were neutral, 3% disagreed, and 1% strongly disagreed. The mean of this question was 4.04 (agree), the median was 4.00, and the standard deviation was 0.89. Table 10 summarizes the last five before and after questions.

Summarizing the additional questions, 64% of the parents had heard their child mention a career in engineering before the camp, while 74% heard a career in engineering from their child after the camp. The parents were neutral on the question if the camps changed their child's attitude about engineering and agreed that their child was more motivated to perform well in STEM functions. Seventy-two percent agreed or strongly agreed that their child could now better relate engineering to real world issues.

Table 10

General Before and After Questions on Effect of Camp

Question	Key	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean/Median /Standard Deviation
9b. Your child mentioned a career in engineering before the camp	Number %	39 36%	30 28%	25 23%	8 7%	6 6%	3.81 4.00 1.16
9c. Your child mentioned a career in engineering after the camp.	Number %	55 51%	25 23%	18 17%	7 6%	3 3%	4.13 5.00 1.08
9d. This camp changed your child's attitude about science, technology engineering and math	Number %	19 18%	34 31%	41 38%	11 10%	3 3%	3.47 3.00 1.04
9e. Your child is more motivated to perform well in the STEM subjects since the camp.	Number %	26 24%	34 31%	38 35%	9 8%	1 1%	3.69 4.00 0.96
9h. Your child can now relate math and science to real world issues.	Number %	39 36%	39 36%	26 24%	3 3%	1 1%	4.04 4.00 0.89

Note. % = *percentage*

Parents offered comments on their children's experience in the camp. The following quotes discuss high achieving students and the effects of the camp.

1. "High confidence in Math. More positive to STEM after camp because of hands on activities. Being on the campus made her more confident."

2. "Before camp he was very good in math and science and I feel after camp he pushes himself to do better and exceed expectations so that he was able to take advanced math and science courses."

3. "My son is completely self-confident in all these areas and this camp was the beginning for him that tipped the scales. This is where it really all started blooming for him. It is an awesome experience and I feel blessed that he had the opportunity to participate in it."

4. "My child excels in math and science. The engineering camp allowed him to visualize practical application of his STEM knowledge in a fun, "cool" environment. It got him thinking about how he might make a career in STEM fields."

5. "Mostly positive, generally confident, feels successful. After STEM camp a career in an area of STEM-particularly engineering has been a topic of discussion. It was his choice for a research paper this school year on what career you would like to pursue. He even stated in the paper that the camp at ODU inspired his choice."

Summary

In this chapter, the researcher reported the findings of the parent's perceptions of their child's experience in Old Dominion University's engineering summer camps to determine if their child generated an interest in engineering as a career choice. Chapter IV included the population response rate and reported the findings each of the research questions in order. The resultant data collected through the Constant Contact email program was interpreted and reported using descriptive statistics. The data were analyzed to determine what other STEM influences the campers had prior to camp, and the affect the engineering camp had on their attitudes towards engineering.

In Chapter V, Summary, Conclusions, and Recommendations, a summation of the data are presented using the aggregate data reported. In addition, conclusions will be drawn based on reported answers of the five research questions and the before and after questions. Finally, recommendations will be made for future research.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This research paper's purpose was to understand the affect the ODU engineering summer camp had on the participants. When reviewing the literature and establishing the research objectives the researcher wanted to establish what other STEM influences these campers had prior to attending the camp to establish a baseline and then determine the camp's effect on the campers. This chapter summarizes the research findings, makes conclusions, and offers recommendations for future research.

Summary

This study was designed to determine parent's perceptions of their child's experience in Old Dominion University engineering summer camps to determine if their child generated an interest in engineering as a career choice due to the camp. The following research objectives were established to direct this study:

$RO_{1:}$ Identify the parental and family prior influences on the student in engineering prior to attending the engineering summer camp.

RO_2: Identify other STEM experiences effect on student interest in engineering.

RO_3: Rate the self-efficacy of the child in STEM and engineering.

RO_4: Establish the effect professional role models have on the student.

RO_5: Discover the effect the enjoyment/fun level of the engineering activities has on the student interest in engineering.

A review of literature indicated that there is a need in our country for more interest in the STEM fields, engineering specifically.   Some believe that our best and brightest students are choosing business as a career rather than the sciences. Companies are asking for more green cards to be issued for foreign engineers to work in the United States. According to the report, *Rising above the Gathering Storm* (2010), without a renewed effort to strengthen the foundations of the United States' competitiveness, we cannot maintain our position as a world leader.

Many references were found on engineering camps immediate effects on students' desire to go to college and the camp increased campers desire to become an engineer. However, knowledge gaps exist since the students were asked their immediate opinions, and not surveyed with any passage of time after attending the camp. This study surveyed the parents of the campers to determine an interest in engineering.

The limitations of the research are as follows: 1) the population is limited to parents of campers in the Hampton Roads region of Virginia, 2) because of the cost of the camp the population is mostly limited to families of middle to high income families with the exception of a few scholarship campers, 3) all campers were in middle school from 6-8 grades, when attending the camp 4) role models are limited to Hampton Roads engineers willing to volunteer their time, and 5) parent's opinions may not entirely represent their child's opinion. To determine the percentage of campers that were affected by the camp, a survey was designed for the parents of the campers to characterize the average campers' prior influences of STEM/engineering before the camp and after attending the camp.

Of a population of 289, 108 responses to the survey were obtained for a 38% response rate. The survey consisted of twenty-five questions that asked the campers' parents background questions, questions addressing the other type of STEM exposure their child had, questions on their self-confidence, and if their child enjoyed the camp. Data were collected first by emailing the parents of the campers. After a series of emails, this method generated a response rate of approximately 17%. To increase the response rate, phone calls were made and the survey was either conducted over the phone or another email was sent to the parent with a link to the survey. If the survey was conducted over the phone, the researcher entered those answers into the online survey so the data would be located in one repository.

This research was done through a survey and heavily uses the Likert scale to rate the parents' opinions. The Likert scale is interval data and therefore descriptive statistics were used. The numerical system for the Likert scale is Strongly agree=5, Agree=4, Neutral= 3, Disagree=2 and Strongly Disagree=1. Based on these findings, the researcher was able to draw conclusions and make recommendations.

Conclusions

This study was designed to determine parent's perception of their child's experience in Old Dominion University's engineering summer camps to determine if their child generated an interest in engineering as a career choice. There are many documented reasons for children to develop an interest in STEM/engineering. The research questions address some of these reasons and characterize the child's STEM baseline prior to the camp. Finally, the parents are asked about their children's attitudes towards engineering before and after the camp.

Research Objective 1 was to identify the parental, family and socioeconomic status prior influences on the student in engineering prior to attending the engineering summer camp. For this group of campers, 89% of the families classified themselves as either middle or upper class. This indicates that this group is highly likely to attend college. In general paternal and maternal educational attainment and paternal and maternal occupational status are well documented as influencers on a child's career choice. In this group, 36% of the camper's parents were engineers and 51% of the children had parents or a close family member that was an engineer. This suggests that 50% of the campers are highly influenced to become an engineer. Ninety-five percent of parents said that they had a strong relationship with their child. This reinforces that the children will be influenced by their parent's socioeconomic status. Since the strongest influence on predicting a child's occupational status is socioeconomic status, this group is primed to attend college and around half of them are already positioned to choose engineering as a career.

Research Objective 2 identifies other STEM experiences effect on student interest in engineering. The overall results of this research question indicate these children have a myriad of additional STEM experiences. The results indicated that 80% of the campers had taken high level math and science courses, 76% had a high performance in all subjects, 92% had been exposed to science before the age of 9, and 88% had had a teacher who was enthusiastic about science. Seventy-six percent of the campers had been exposed to organized STEM activities outside of school prior to this camp. Since prior academic experiences in mathematics and science and exposure to informal STEM activities early in life are influential in student's choosing STEM careers, the high percentages of the campers were exposed to these positive influences and indicate that these campers have had significant exposure to STEM subjects prior to attending camp.

Research Objective 3 asked the parents to rate the self-efficacy of the child in STEM. The parents agreed that their child was self-confident in math with a mean of 4.21. Parents also strongly agreed that their child was self-confident in science with a slightly higher mean of 4.53. Only 30% indicated there was a significant increase in self-confidence and interest in STEM after the camp. When many middle school students only perform at the 51% proficiency rate in math (Center on Education, 2009) the fact that 82% of the parents either agreed or strongly agreed that their camper was self-confident in math was significant. Since self-efficacy or self-confidence in STEM subjects was a major factor in pursuing a STEM field, the survey results indicate that the majority of this group has this trait prior to attending camp.

Establishing the effect professional role models have on the student was Research Objective 4. The parents agreed that their child had a science/engineer role model with a mean of 4.01. Parents also agreed someone in STEM inspired their child with a mean of 3.41 and neutral on if their child had identified a famous role model such as Albert Einstein or Marie Curie. Role models help predict readiness to make career decisions. Agreement with two of the three questions indicates that the average camper has been exposed to the effects of role models in STEM. This again, was highly unusual for the average student and was predictive that these campers have the advantage again for going into a STEM career.

Research Objective 5 uncovered the effect the enjoyment/fun level of the engineering activities had on the student interest in engineering. Ninety-six percent of the parents said that their child enjoyed the hands on activities of the camp and 92% said their child was excited about what they did in camp. Ninety-five percent of them said their child had fun at the camp. Psychologists have found that there are strong, predictive relationships between enjoyment of science and an interest in learning science; therefore these campers' interest in STEM/engineering should have increased because of enjoyment of the camp.

The before and after questions asked the opinion of the parent of the effect the camp had on the camper. The parents relayed that 64% of the children had mentioned a career in engineering before the camp while 74% agreed that they mentioned engineering as a career after the camp. Forty-nine percent said that the camp changed the child's attitude about STEM. Fifty-one percent of the children were more motivated to perform well in STEM subjects after the camp. Seventy-two percent said the child could better relate math and science to real world issues. The results of the research objectives showed that the average camper had many prior STEM influences before attending camp. However the results show that the enjoyment level of the camp was very high and students seemingly on the path to STEM careers can be influenced by this. It was significant that half of the camper's attitude towards STEM changed and their motivation improved. The most significant statistic was that 72% reported that the child could better relate STEM to real world issues after the camp. This suggested that even with a high baseline of STEM, these children still really do not understand what engineers do.

Based on the quotes in the findings, where the parents described their children as high achieving, self-confident children it was evident that camp had an influential effect engineering career choices. This suggests that even students that have a high STEM baseline need to become more aware of engineering careers and enjoy informal engineering activities to actually consider a career in engineering.

Recommendations

Based on the results and conclusions of this study, the following recommendations were made:

- The findings could be implemented in middle school gifted math and science curriculum by using similar enjoyable activities and having working engineers come into the classroom.   This would ensure students with a high STEM baseline would become fully aware of what engineering careers are about.
- A camp with the same curriculum should be conducted with children who are of a lower socioeconomic level and this same survey administered to the parents of these children. The results should be compared to this study when the campers are not as primed for the STEM fields. This could isolate the effect of enjoyment from participating in the camp on interest in engineering. This could also increase the percentages of people going into STEM careers, which is a national economic issue today.
- Continue to follow this group of students to determine which field of STEM they will choose. The literature review revealed studies on math and science, but this

camp was focused on specifically engineering. The percentages of students who actually become an engineer would be interesting to note.

- For other engineering camps with hands on activities, do not only ask before and after questions on whether the child now wants to be an engineer, also look at their STEM baseline prior to camp. If the baseline is low, and the children become interested in STEM for high-school and beyond, it will confirm the influence of the camp for choosing a STEM career.
- The participation rate of women in engineering continues to be an issue. Conduct this same curriculum with equal attendance for girls and boys, or conduct a camp for only girls. Conduct the same parental survey to determine interests in STEM.

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APPENDIX A

RESEARCH STUDY

Engineering Summer Camp Survey

*Required Question(s)

*1. I consent for the data collected in this survey to be used for the research study to determine if the summer camp influenced my child to have an interest in engineering/STEM. (please enter the date of consent in the comments box)

- [ ] Yes
- [ ] No

Comment:

*2. What is your Ethnicity? Please check all that apply.

- [ ] White
- [ ] Black or African American

- [ ] Hispanic or Latino
- [ ] American Indian or Alaskan native
- [ ] Asian
- [ ] Native Hawaiian or Other Pacific Islander
- [ ] Other ____________

*3. What grade is your child in now?

- [ ] 6th
- [ ] 7th
- [ ] 8th
- [ ] 9th
- [ ] 10th
- [ ] 11th

☐ 12th

☐ Other ______

Comment

*4. What is your family's socioeconomic status?

○ Working Class

○ Middle Class

○ Upper Class

○ Other ______

*5. Is either parent or close family member an engineer? If so, please indicate the relationship.

☐ Yes- Mother

☐ Yes- Father

☐ Yes other close family member

☐ No

*6. Please rate these statements to indicate your child's status before attending the engineering summer camp.

*7. Please list other STEM experiences your child has participated in, such as other camps, after-school clubs, robotics competitions, etc.

*8. Please describe your child's attitude towards STEM subjects. Address areas such as self-confidence, perceived success in STEM subjects, motivation and other attitudinal aspects. Please indicate if there was a difference before and after camp.

*9. Please rate the statements about your child during and after participating in the camp.

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Your child enjoyed the hands on activities in the camp	○	○	○	○	○
Your child mentioned a career in engineering before the camp	○	○	○	○	○
Your child mentions a career in engineering after the camp	○	○	○	○	○

This camp changed your child's attitude about science, technology, engineering and math (STEM)	○	○	○	○	○
Your child is more motivated to perform well in the STEM subjects since the camp	○	○	○	○	○
Your child was excited about what he/she did that day in camp and talked with you about it.	○	○	○	○	○
Your child had fun at the camp.	○	○	○	○	○
Your child can now relate math and science to real world issues.	○	○	○	○	○

Finish

APPENDIX B

COVER LETTER

June 25, 2013

Dear Parent/Grandparent of an ODU Engineering Camp Student(*(Contact First Name)*):
(if you have already completed the survey, please disregard this email. Due to the anonymous nature of the survey, we can not remove you from the list)

The Professional Development Center at Old Dominion University hosts the engineering summer camps at Old Dominion University. *(Contact First Name)* participated in our camps held from 2009 through 2012. I am the Director of the Professional Development Center and also an ODU graduate student who is conducting research to determine if the camp has had an effect on your child's interests in engineering. With a projected need of a strong STEM/engineering workforce this data is extremely important in determining if these types of activity based camps are changing student's minds to pursue a degree in engineering.

If you could please take the time to complete the customized survey (link provided below) it will help achieve highly valid and trusted results. Your participation is voluntary and you may choose not to take part in the survey.

If you wish to participate, please click on the link provided below for access to the survey. The survey should take no more than fifteen minutes to complete. Please ensure that you select the informed consent box (Question 1) as your responses cannot be included if the box is not checked.

Click here to take anonymous survey

There are minimal risks involved in completing the survey and the only benefit is that I will share the results with all parents of the campers. Your responses are anonymous as the software settings have been automatically set not to record your email address. Survey responses will be reported in cumulative numbers and will include nothing that can recognize you as a participant.

Thank you for your consideration in completing this survey. It will provide information for ODU's Batten College of Engineering and Technology who sponsors our camps. If you have questions, please contact me at cdorsey@odu.edu or 757-683-5508.

Sincerely,

Clair Dorsey	John Ritz
4111 Monarch Way	5115 Hampton Boulevard
Suite 106	Norfolk, VA 23529
757-683-5508-Office	(757) 683-4305
757-406-1191-Cell	jritz@odu.edu
cdorsey@odu.edu	

PS: If you had more than one child participate in camp, please complete a survey for all of them.