Will Exposure to Math Related Careers Make a Difference?

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Abstract

Mathematics is a school subject many students struggle with. They often struggle with it because it may be difficult for them, or they do not see the relevance to real-life applications. Motivating students to learn and want to learn math has been a struggle for teachers. Teachers often have difficulties getting students to understand the importance math will have on their lives. With the advancements in technology and the global economy, there is a larger need for employees to have knowledge in science, technology, engineering, and math. This project tries to promote the need and uses of math through various careers.

This study used a pre-survey to get a baseline of students' thoughts and opinions using a 5 point Likert scale and through short answer responses. The students researched math related careers, wrote short papers, and presented their careers to the rest of class. A post-survey was conducted to determine if there were any changes in the means from the pre-survey results. The data was analyzed as a whole and was also broken down into gender, year in school, and class. There were a number of significant increases and decreases in the means of the pre-survey results compared to the post-survey results.

In conclusion, students enjoyed researching some of the different math related careers. It is unclear whether exposing students to these careers was solely responsible for any of the changes, but it is important for students to be aware of the opportunities a strong math background allows students to pursue. A student can never set a goal to pursue a career they do not know exists.

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Chapter 1

Introduction

There is nothing like standing in front of a classroom filled with students eager to learn while you are deriving the quadratic formula, after spending days on solving quadratic equations by completing the square, when you stop midway through the process to ask the class what the next step is and a hand waves in the air. You are pumped due to fact that a student has been following along and is about join in on the beautiful derivation. You call upon the student who asks, "When are we ever going to use this?" Your excitement is deflated like the air rushing out of a snow tube that just got torn open by a thorny bush. I hear this question more than any other question in all my math classes. I have given numerous explanations and examples in an attempt to satisfy students' inquiries. Every example I use to answer this question always meets a similar response like, "I will pay someone else to do that for me."

Networking with other math teachers is a great way to gain techniques and strategies to improve instruction and understanding for students. This question of when are we ever going to use this has been discussed on numerous occasions while networking. A few of the responses of colleagues include: you need it for your next math class; you need it to get into college; you need to use specific real life examples; you need to give examples of specific and general careers that use math to stress the importance of math. Every example I have ever used has never fully satisfied the inquiring student or class. Attempting to come up with examples to answer this common question is like putting a bucket under a leaking roof. The bucket may keep the floor dry,

but it certainly does not fix the leaking roof. A wonderful real life example may satisfy the student or class for the initial period, but the question will appear again in the near future. For this reason, it is necessary to get at the root or source of the problem to truly make a difference.

There have been a number of other instances throughout my teaching career that have made me question whether there is something else I should be trying to improve students' understanding of math. One of these instances occurred when I came across an article in my Methods of Research course. Rock (2000) reported that the majority of middle school students thought mathematicians spent the day solving math problems. Every response given by the students was school related, and there were no real life examples of what mathematicians did. Students' responses showed they know little to nothing about the work of mathematicians.

Devlin (2001) states students see mathematicians as bald, overweight males who are unmarried and wear glasses. These mathematicians also have little to no social life. This is a major reason why the number of students pursuing a math related career is so low. Students do not want to grow up to be nerds with no social life.

After reading these articles, I could see many reasons why students would not choose to go into a math related field. With the perception students have of mathematicians, why would students choose this as a career option? This misconception of what a mathematician is and what mathematicians do could also have a large impact on students' efforts and attitudes in their math classes. Students could be thinking about why they should put much effort into a subject they are not going to pursue due to their

perceptions of what a mathematician does day in and day out. Could I change my students' perspectives on who mathematicians are and what they do?

During part of the teacher in-service in my school district, we watched a video that was posted on YouTube. The title was, "2 Million Minutes." The film was created by Bob Compton who is an American venture capitalist. Compton (2007), points out how much better students in China and India are performing on standardized tests than students in the United States. This video compared and contrasted the high school experience for six students consisting of two students from the United States, two students from China, and two students from India. The documentary discusses how students allocated their time during their four years of high school. This included time in school, time studying outside of school, time spent socializing with friends and family, and time spent on weekends. Students from China and India spent a great deal more time on academics in the classroom and more time on academics outside of the classroom than the two students from the United States. Watching these video clips was eye opening to me. It sure looks to me like American students are more involved in sports, music, and other social activities compared to students in other countries. I do not see students from America striving to do better than what their parents are doing. I see students in America content with their lives because they have the freedoms and possessions that students in other countries do not have. It is astounding to see how much emphasis parents from other countries are putting on the educations of their children compared to the United States. Parents from China and India are pushing their children to do well in school so that they may have a better life. Now that we have a global economy, students that I am currently teaching will be competing with students from other countries for high paying

jobs. I don't see the motivation of students in the United States striving for success academically as they should be doing. America needs to modify what it is doing to remain competitive.

A 20/20 documentary titled "Stupid in America" was aired one evening and it caught my attention. Stossel (2006) stated that graduation rates and achievement scores have not increased while school spending has increased by 100 percent from 1971 to 2001. An international test was given to high achieving students in New Jersey and to students in Belgium. The students from Belgium did much better on the test than the students from New Jersey and the students from Belgium called the students from New Jersey "stupid." The students from New Jersey who were considered to be some of the top students at one of the top schools in the nation acknowledged how advanced the students from Belgium were. American students performed about average on the international test at age 10, but they did not fare too well on the international test at age 15 where they placed 25th out of 40 countries. Why are American students between the ages of 10 and 15 falling behind in comparison to these countries in math? Most young students are eager to learn and have many applications that they come into contact with in their lives where they can apply what they have been taught in school. As students begin junior and senior high school, it is difficult for them to see the importance of the material being presented to them is. How is this material going to be useful to them? Many students may see the importance to society but determine that some content areas and material are not necessarily important to them. Somehow students need to be intrinsically motivated to learn the material being presented. Can the images seen on this documentary be a true example of what most schools are like? Are the test scores from

students in the United States truly lower than the scores from students in a number of other countries? What can I do to better the education of the students I come into contact with?

I have been a math teacher for ten years now. I enjoy my profession. I enjoy the interaction with students and the ability to give them guidance for their futures in and out of school, in addition to teaching math. It gives me great satisfaction knowing that I have made a positive influence on their lives. Throughout these ten years, I have had many experiences. These experiences have been used to modify my instruction to improve student learning. Reading the article about students' perception of mathematicians, watching "2 Million Minutes," watching "Stupid in America," and being asked, "When are we ever going to use this," have raised a red flag for me. I ask myself if there are other things I could be doing to make a greater positive influence on students. Many of the examples I give to students of why math is important are specific to what we are currently learning. If students can see that the example given shows how math is important, then they respond by saying they will pay someone else to do it for them. How are these students going to be able to pay someone to do the services? Students may not see the example as the reasoning to how math content and processes being presented is useful or important to them. The challenge is not to necessarily show that math is important to society as it is to show how important and useful math can be to them. Students feel very strongly about their personal desires. Students need to see how math will affect or influence them directly. What do students feel strongly about while growing up? They want a great deal of material goods and/or they want to be famous. Money is usually a significant factor when choosing a career.

Students want good jobs that pay lots of money. There are a few students who know what they want to do when they grow up well before they get into high school. They usually have some knowledge about their chosen careers. These students work hard in school in the classes that are required for their career paths. They may work hard because they just need to do well overall, they see the importance for their career goals, and/or they see the importance of the class or task towards their lives in general. A majority of these students who have a career picked out early in high school have some exposure to the career. This exposure may come from a parent, aunt, uncle, grandfather, grandmother, family friend or another acquaintance that may be working in this career. Maybe I can expose students to a career that uses a great deal of math or at least exposes students to how math is used in a variety of careers. Students' perspectives help mold their opinions and the decisions they make in life. My hope is that my research will prove that exposing students to careers that use math will improve students' perspectives on how important math is to them and to our society.

Chapter 2

Literature Review

According to The Winston Group (2006), a majority of Americans, 62 percent, feel the United States is a major factor in the global economy. The same group of Americans making up less than 49 percent believes the United States will still be a major factor in the global economy in twenty years. There is a strong consensus, 70 percent, of Americans who believe general math and science skills will be necessary for all college graduates while only 31 percent of Americans feel math and science are vital for students not majoring in math and science. Typically there are reasons for Americans to place importance on math and science. Right now 85 percent of Americans believe highly skilled workers are being hired from China and India because the highly skilled laborers from these countries are willing to work for a lower wage than Americans. This could explain why the importance on math and science for all college graduates is low. Why would students major in math and science if graduates from other countries will be hired over them due to their willingness to work for less money? Very few Americans, 12 percent, feel the reason for hiring skilled workers from China and India is the lack of skilled workers from the United States. There is still a strong belief on the importance of science, technology, engineering, and math due to the fact that 85 percent of Americans support the idea of offering scholarships for students majoring in these fields. A large portion of Americans, 87 percent, support the idea of offering scholarships to those students who pass the Advanced Placement test in math and science as well.

Atkinson et al (2007) stated the economy is relying more and more on science and technology. The problem is the United States is not keeping up with economic trends. From the year 1985 to 2002, non-science and non-engineering graduate degrees rose 64 percent while there was only a 14 percent increase in the number of graduate degrees in science, technology, engineering, and math. During the same time period, students from other countries increased the number of graduate degrees in science and technology by more than 110 percent. The United States was ranked 29th of 109 countries in the percentage of 24 year old students with a math or science degree as of March 2007. There are fewer students earning doctorate degrees in non-biological sciences and engineering than in 1996. There are 23 percent fewer bachelor degrees in engineering as of 2007 compared to 1985. So far, the United States has been able to utilize students from other countries to fill necessary positions. This is becoming more difficult with the global economy and the tremendous increase in science and technology. One of the difficulties is that more foreign students are returning home after being educated in the United States. There are also fewer foreign students entering the United States for higher education. This could be significant since more than half of all students under the age of 45 earning a Ph.D. are born outside the United States. This means universities and companies are finding it more difficult to find highly skilled professionals in science, technology, engineering, and math.

Kadlec and Friedman (2007) express a growing concern that the United States will not hold its position in science and technology unless students start gaining stronger skills in math, science, and technology. There are way too many students taking the basics for math and science. Students not only need to take advanced classes in math,

science, and technology, but they need to master the skills in order for America to remain competitive in the international market. In a report, only 42 percent of ACT-tested students are at the level they need to be for college math courses. Only 32 percent of parents feel that schools should be teaching more math and science, but most employers and professors are not satisfied with the skills in math, science and technology students currently possess. A large concern is that the percentage of parents who worry about the amount of math and science has decreased from 52 percent in 1994 to 32 percent in 2006. Many employers are challenged in finding and retaining high quality employees in the areas of life sciences, biotechnology, financial services and advanced manufacturing. Careers in these fields which require the skills learned from math and science classes are in large demand and offer some of the greatest economic opportunities.

Kadlec and Friedman (2007) do not believe parents understand the need for improvements in math, science, and technology, and students do not see the relevance. Parents and students are happy with the status quo and are not looking for advancement.

> "As we outline in some detail in the report, parents are, generally speaking, complacent about the need for improvements in higher-level math, science and technology education, in large measure because they have the sense that their children's schools are doing a bang-up job already. Most students, meanwhile, experience these subject areas as profoundly uninteresting and largely irrelevant to their futures. They pay some lip service to the notion that one can get a good-paying job with these skills, but very few seem to have a real appreciation for the range of

opportunities that are enabled by mastery of these subjects or envision themselves pursuing them. In short, while parents and students have a measure of appreciation for the role science, math and technology will play in the future world of work, this appreciation remains thin, and relatively few seem to absorb the implications in a personal sense. Most parents do not see improving math, science and technology education as a top challenge facing their local schools, and most students do not come to these subjects with a strong sense of motivation and interest" (p. 7).

Kadlec and Friedman (2007) also asked students whether the following statements would encourage them to take advanced math and science courses a lot or a little. See figure 1.

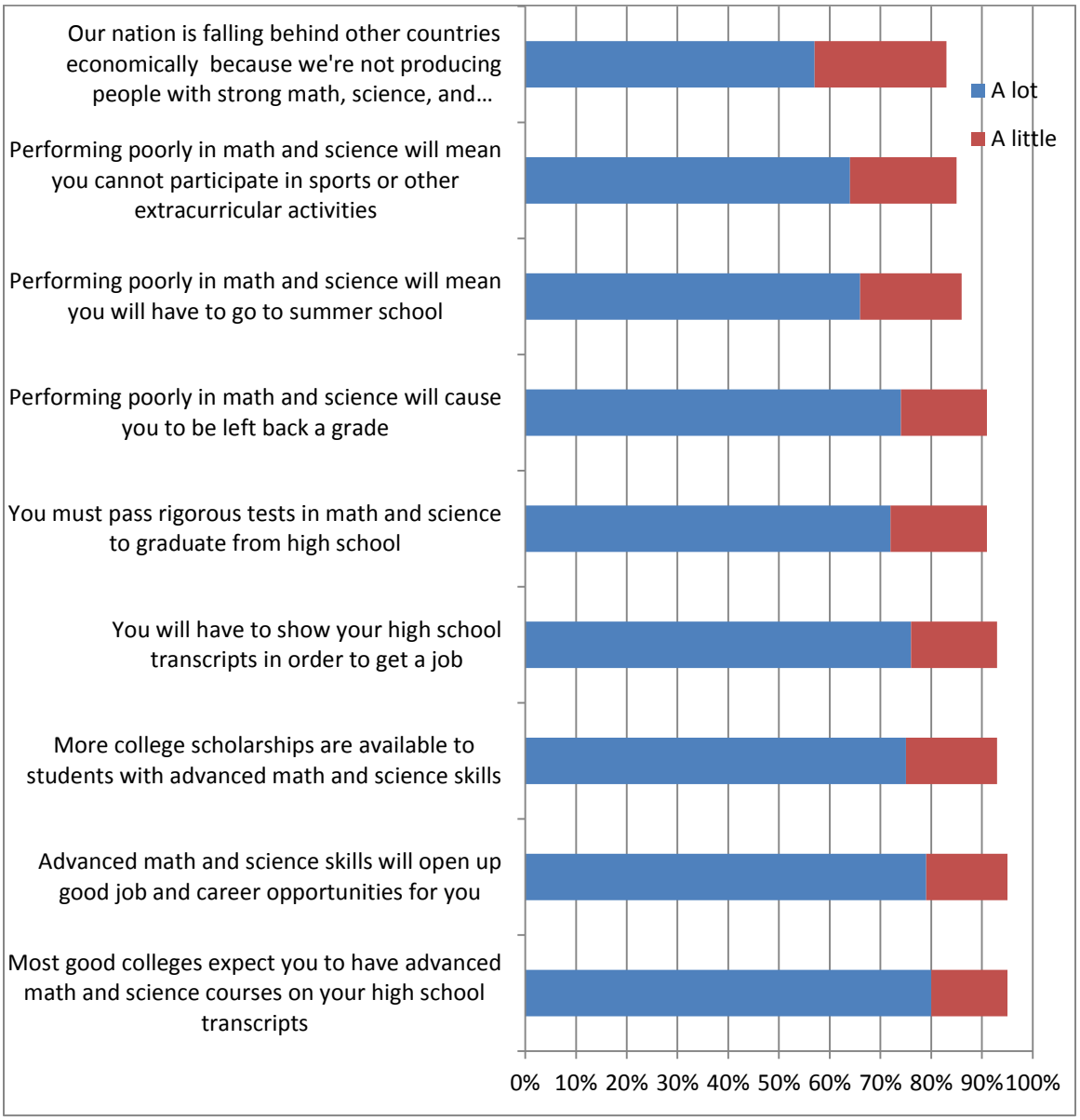

Figure 1

Parents feel math, science, and technology are important but are still satisfied with the current education. Many parents feel schools are doing a fine job with math, science, and technology while administrators believe many highly qualified math and science

teachers are taking advantage of higher pay in the private sector and leaving schools below ideal levels. Sixty-nine percent of parents stated math is more difficult today than when they took math. This explains some of the reasons why 31 percent of parents feel schools are doing a fine job of raising levels of math, science, and technology rather than stressing the increased importance the experts are calling for in order to meet the needs of our future demands.

Mirra (2004) states that the world needs to have a large number of people who are able to solve real world problems, identify and analyze data, and have the ability to use technology. It has been projected that the jobs these skills will be used in will grow the fastest within the eight professional and related occupational subgroups. It was projected that there were to be two million positions in this subgroup. It was predicted that 60 percent of all jobs will require these skills, but the problem with this is that only 20 percent of the current workforce possesses these necessary skills.

Mirra (2004) also states there are a number of reasons for students to take math courses in high school. Students who take Algebra and Geometry are more apt to go to college. In fact, 83 percent of students who take Algebra and Geometry go to college compared to 36 percent of students who did not take Algebra and Geometry. Most colleges and universities now require at least three years of math. Almost 90 percent of new jobs will require additional math skills above what was learned in high school.

According to Kadlec and Friedman (2007) 63 percent of students stated taking advanced math classes and 72 percent of students stated taking advanced science classes is vital for them to be successful in college and their careers. There were only 26 percent of students who thought that it was a must to understand Calculus as a high school

graduate. The issue is that 76 percent of students say that students do poorly in math and science because they feel math and science are irrelevant. How can students say math and science are important for their futures but on the same hand do poorly in them because they feel that they play no big role in their lives? Forty-one percent of students said they would be unhappy with a career that uses math and science, and students see no real opportunities in careers involving math, science, and technology. Students were asked to list careers available with a math and science background. It took students a bit before they listed the common jobs like a doctor and a scientist. Not only did students have a difficult time listing careers using math and science, but students did not see that math, science, and technology would be exciting or rewarding. A positive result from this study does show that 70 percent of students believe you can be good at math and science and still be normal as far as popularity goes. Eighty-five percent of students feel that math and science is something you can learn and not something that is genetic. Seventy percent of students say their math and science teachers are good at helping them learn.

Kadlec and Friedman (2007) also found many individuals who wished they would have known about the careers available for people with a strong math and science background. These individuals would have taken more math, science, and technology classes if they were aware of the opportunities while in high school.

> "We noticed a similar dynamic in one especially interesting 'general public' focus group that included several young adults, business-people and one working chemist. As the chemist began to rattle off a variety of

> career opportunities made possible by a strong math and science background, the other participants in the group perked up noticeably, and the entire tone of the conversation changed. The younger adults in the group began saying things like 'I wish I'd known about all those jobs when I was in school!' and many suggested they would have definitely taken more MST in high school had someone explained the real opportunities to them. It was striking to see how energized people became as they discussed concrete, real-world opportunities" (p. 19).

Many adults wish they would have known about possible careers that required a strong math and science background. We should learn from these adults and provide youth with a variety of career options in all discipline areas especially math and science. These career options need to be concrete to promote students' intrinsic motivation.

> "We found that 8 in 10 students said they would be motivated 'a lot' to take higher-level math and science if they knew 'most good colleges expect you to have advanced math and science courses on your high school transcripts,' while about the same (79 percent) said they would be motivated 'a lot' if doing so would 'open up good job and career opportunities for you'" (Kadlec and Friedman, 2007, p. 19).

Lucas and Fugitt (2007) rule out the preconceived notion that Americans are intimidated by mathematics. In a survey of 1000 adults, only 14 percent stated that they had a fear of math and 85 percent agreed that math skills are important to today's economy because of the amount of technology that we all use. A group of 31 out of 32 executives believes the math skills students possess are not as high as comparable countries. Roughly 66 percent of employers and professors rate the math skills of workers and students as fair or below. The United States has changed from a country that feared mathematics to a country that believes math is important, but the skills in math students need to have are not where they need to be.

Farmer (2009) writes that NASA and many other fields are finding a shortage of students wanting to become engineers. NASA has programs and materials for teachers to use in their classrooms to get students exposed to engineering. One important issue that is hurting the prospective students to become engineers is the lack of exciting career information. Summer programs and camps, competitions, more career strands, student tours of NASA sites, astronauts in the classroom, and better representation of careers in video are some of the ideas that are being implemented to gain student interest. There are six states that have engineering as one of their educational standards and there are 38 more states looking into adding engineering into their curriculum.

Mohr (2008) states there are many students who will choose to go into the workforce after graduating from high school. The U.S. Bureau of Labor Statistics in 2006 stated that there would be a 14 percent increase in construction from the year 2006 to 2016. Carpenters make up the largest portion of the construction labor. There are many math skills that are needed in order to have a career as a carpenter. Carpenters do

preparation work on the job site, foundation work such as cement footings, framing which is the basic structure of the building, and interior and exterior work which include doors, window, floorings, cabinets, roofs, siding, and decks. Skills broken down for carpenters include:

"1. Reading, writing and performing basic arithmetic using whole numbers, integers, fractions, decimals and percents.
2. Converting fractions, decimals and percentages.
3. Using equations and formulas to solve problems for unknown quantities and measurements.
4. Comparing quantities through the use of rates, ratios, and proportions.
5. Converting measurements of quantity and size.
6. Calculating basic geometric and trigonometric functions of areas, perimeters, volumes, and angles.
7. Summarizing calculations to make inferences through the use of logic" (Mohr, 2008 p. 35).

According to Saffer (1999) math is used in many everyday tasks like balancing a checkbook, grocery shopping, cooking, and creating a personal budget. Math skills such as problem solving, analysis, and estimating help more than 15,500 mathematicians employed in the United States. This number is small compared to the millions of other workers who need math in their careers on a regular basis. Almost every job requires

some level at math sooner or later. Carpenters measure lengths and angles for everything they put together. Machinists use precise measurements of angles and dimensions of objects to create parts which allow us to drive automobiles. Loan officers calculate a person's debt-equity ratio to determine what risk the bank will be taking on if they give individuals a loan.

Boland (1995) suggests students need to see the connection between school subjects and careers. Students need to see how math is relevant. They need to see that math will be utilized in their future careers. Teachers typically spend very little time informing students about the career options that require math. Students need to see how the math being taught is being used in real life. Teachers should bring in actual people who work in math careers for students to learn more about possible careers in math first hand.

There are a number of other jobs which require more advanced or theoretical math like Calculus and Linear Algebra. Actuaries require a bachelor's degree in math or statistics in addition to passing a number of actuarial exams. Actuaries calculate risks and/or probabilities of a person getting sick, becoming disabled, or dying. They use this information to determine the pricing on insurance, financial, and pension plans to protect individuals from possible future events and still make money for the company.

Mathematicians try to solve economic, scientific, engineering, and business problems using their mathematical theories and techniques. They often use computers to develop models. These models may be used to help forecast weather or other natural disasters. Mathematicians need at least a bachelor's degree in math.

Operations research analysts assist organizations to run more efficiently by applying mathematical principles. Many operations research analysts create building layouts, work schedules, forecasts, and distribution systems to help businesses complete tasks faster with the same or fewer resources.

Statisticians collect, analyze, and present numerical data. They also design, carry out, and interpret results of surveys and experiments. The data being collected may include economic conditions, population growth, quality control of products, and evaluation of political options which are then used to make predictions. The minimum requirement for a statistician is a bachelor's degree.

A number of other careers that require high level math include: agricultural scientists, architects, biological and medical scientists, chemists, computer scientists, computer engineers, computer systems analysts, economists and marketing research analysts, engineering, science, and data processing managers, foresters and conservation scientists, geologists, geophysicists, oceanographers, mathematics teachers, meteorologists, physicists, astronomers, and social scientists.

There are a number of other careers that do not require a mathematics degree, but do not require the need to understand mathematical concepts and applications. These careers may also require a background in statistics and trigonometry, but may not use the level of math needed in the advanced or theoretical mathematics. These careers include: accountants and auditors, administrative service managers, aircraft pilots, budget analysts, chiropractors, college and university faculty other than mathematics, computer programmers, construction and building inspectors, construction contractors and managers, cost estimators, dentists, dispensing opticians, drafters, education

administrators, engineering technicians, farmers and farm managers, financial managers, general managers and top executives, government chief executives and legislators, industrial production managers, insurance agents and brokers, insurance underwriters, loan officers and counselors, management analysts and consultants, optometrists, pharmacists, physician assistants, physicians, podiatrists, psychologists, real estate agents, brokers, and appraisers, respiratory therapists, school teachers, science technicians, securities and financial services sales representatives, surveyors and mapping scientists, urban and regional planners, and veterinarians.

There are numerous occupations that require Algebra and Geometry in an addition to the general math skills. These occupations include: air traffic controllers, aircraft mechanics, automobile mechanics, automotive body repairers, blue collar worker supervisor, boilermakers, broadcast technicians, carpenters, concrete masons and terrazzo workers, diesel mechanics, dietitians and nutritionists, electricians, farm equipment mechanics, funeral directors, general maintenance mechanics, heating and cooling technicians, refrigeration technicians, industrial machinery repairers, inspectors, jewelers, landscape architects, machinists and tool programmers, millwrights, mobile heavy equipment mechanics, small engine repairers, ophthalmic laboratory technicians, photographers and camera operators, sheet metal workers, stationary engineers, tool-and-die makers, water and wastewater treatment plant operators, and welders, cutters, and welding machine operators. There are a large number of career choices for students who have a math degree or a math background.

Math skills enable people to decipher data that is presented to them on a daily basis. It helps them make better financial decisions. Many entry level positions will

require more logical thinking due to the amount of technology that is found in our lives. It is important for parents to have a positive attitude towards mathematics because children tend to have the same perceptions as their parents. Math may become difficult at times for students. This is a good learning experience for students to see how persistence and hard work in math can be applied to numerous other experiences they will have later in life. Parents can help students can gain mathematical thinking skills from the strategies used in board games, puzzles, and brain teasers by encouraging them to take part in these activities.

Parents can research different careers in mathematics because it is a foundation to many interesting careers. It is important to see what math courses are recommended for these careers so students have the time and the ability to acquire the background needed. It is important for parents and teachers to have high expectations for students. Communicating high expectations and not just having high expectations will motivate students to achieve more which affords students more opportunities in their futures. It is important for parents not to show panic when the students struggle. It is also important not to do the work for the students because they will very easily give up or allow parents to continue to do the work on a more regular basis. Parents need to support and allow their children to take responsibility for the work the students do. Some things parents can do to apply math skills are to have their children read schedules, chart, tables, and graphs and have them explain what they mean. Parents can have their children read maps and calculate mileage, time, distance and costs on a trip. Children can be given a budget for purchasing school clothes for the year or groceries for the week. These activities foster

logical thinking skills as well as provide students with experiences they will find helpful in their futures.

There has been a perception that men are better at math and science than women. How true is this perception? Halpern (2007) gathered data on women's degrees. His findings show the percentages of women in math, computer science, physics, and engineering are below 50 percent which leads us to believe men are better at math and science. See figure 2.

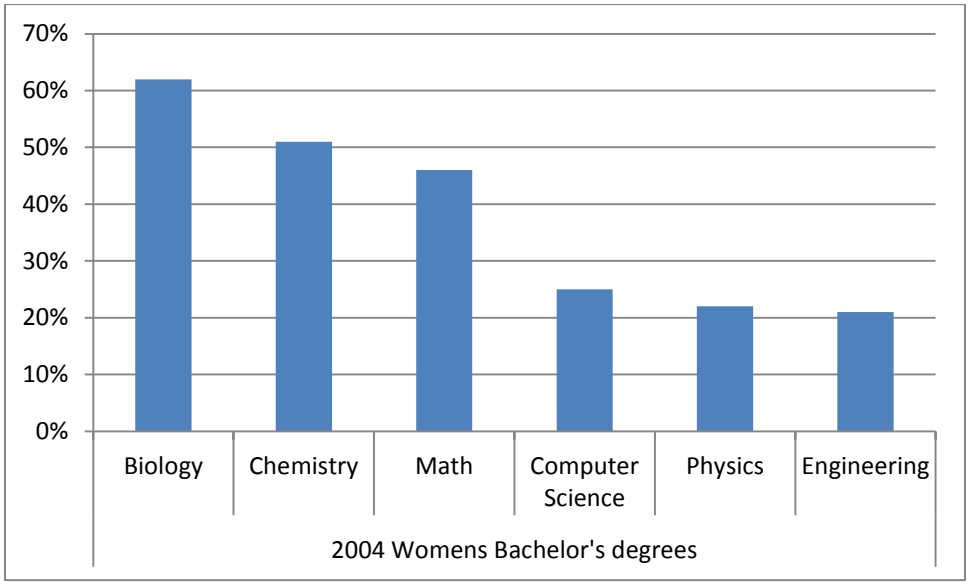

Figure 2

Now when it comes to master's degrees, women are still holding their own with 59 percent of the degrees. Women do drop in percentages of master's degrees a little in biology, chemistry, and math. Women did increase the percentages of master's degrees some in computer science, physics, and engineering. There is a much larger drop in percentages of doctoral degrees earned in these areas compared to the percentages of bachelor's and master's degrees. Women hold a substantial number of degrees in math

and science and make up about half of the work force, but women only make up 26 percent of the workforce in the areas of science and engineering.

Halpern (2007) believes students should be encouraged to mentally picture the math problem and/or draw a picture to build on spatial strategies. Students should be encouraged to give answers to problems both verbally and with spatial displays. Teachers should work on students' abilities to manipulate objects mentally. Thirty-three percent of the math questions on the SAT deal with Geometry. Geometry and spatial manipulation play an important role in engineering. Seventy-seven percent of female students who took a spatial visualization course stayed with their engineering program compared to only 47 percent of female engineering students who did not take the spatial visualization course.

Halpern (2007) also reported that there are higher percentages of girls taking Geometry, Algebra 2, Trigonometry, Pre-Calculus, Biology, AP/Honors Biology, and Chemistry in high school than boys. There are larger percentages of girls taking more advanced math and science courses in high school. Girls also tend to score better than boys on daily assignments in these courses, but when it comes time for standardized tests that are timed, boys scored higher than girls on average. Researchers have determined though that SAT scores in math do not predict a girl's success in college accurately. Girls typically do better in college than the SAT predicts they will. It has been found that girls are less confident in their abilities in math than boys. Girls have also shown less interest in pursuing a career in math or science. There is a great deal of research that suggests children's abilities are linked to their beliefs about their abilities.

Halpern (2007) has five strategies teachers should follow to stimulate girls to perform better in math and science. These strategies will also improve girls' beliefs about their abilities in math and science.

> "1. Teachers should explicitly teach students that academic abilities are expandable and improvable in order to enhance girls' beliefs about their abilities. Students who view their cognitive abilities as fixed from birth or unchangeable are more likely to experience decreased confidence and performance when faced with difficulties or setbacks. Students who are more confident about their abilities in math and science are more likely to choose elective math and science courses in high school and more likely to select math and science-related college majors and careers.
>
> 2. Teachers should provide students with prescriptive, informational feedback regarding their performance. Prescriptive, informational feedback focuses on strategies, effort, and the process of learning (e.g., identifying gains in children's use of particular strategies or specific errors in problem solving). Such feedback enhances students' beliefs about their abilities, typically improves persistence, and improves performance on tasks.
>
> 3. Teachers should expose girls to female role models who have achieved in math or science in order to promote positive beliefs regarding women's abilities in math and science. Even in elementary school, girls are aware of stereotype that men are better in math and science than women are. Exposing girls to female role models (e.g., through biographies, guest

speakers, or tutoring by older female students) can invalidate these stereotypes.

4. Teachers can foster girls' long-term interest in math and science by choosing activities connecting math and science activities to careers in ways that do not reinforce existing gender stereotypes and choosing activities that spark initial curiosity about math and science content. Teachers can provide ongoing access to resource for students who continue to express interest in a topic after the class has moved on to other areas.

5. Teachers should provide opportunities for students to engage in spatial skills training. Spatial skills training is associated with performance in mathematics and science" (Halpern, 2007, p. 7)

These strategies and ideas were developed to assist girls in math and science. These strategies and ideas are valuable not only for girls but for all students. Students need to learn that hard work promotes higher performance and that their minds grow stronger with continued effort. This will make understanding future material easier and improve grades and test scores. Research has shown that the brain grows new synaptic connections when new material is learned. Practice makes perfect is often used by coaches and can also be used for math and science content as well. The more you use your brain, the better it gets. Researchers have found that cab drivers have larger portion of the brain that deals with performing spatial tasks. The number of years spent driving a cab is positively correlated with the size of the right posterior hippocampus.

Jayaratne (1983) determined that math achievement of students is greatly impacted by parents' perceptions of math which includes parents' own abilities and attitudes. These perceptions have been more influential than their own children's past accomplishments in math. Parents were asked about their own abilities and attitudes towards math. When surveyed, fathers' responses showed they enjoyed math more than mothers. The survey also showed that fathers believed they were better at math than mothers. This is consistent with the stereotype that males are better at math than females. Parents also stated that males and females have the same math ability, but they declared that males perform better in math than females. Parents of sons responded more optimistically on their sons' attitudes and achievements in math than parents of daughters. Parents also thought trigonometry and calculus were not as important to children of parents of daughters as it was to parents of sons. By looking at actual math achievements of males and females, scores actually show females are outperforming males.

Motivating students to take advanced math classes in high school and looking at earning a degree in math or a math related field is not as easy as showing students what jobs are out there with a math background. Parents usually have more influence over students' choices for their future, but teachers can have a positive influence on students' careers by guiding them towards fields where the students possess an interest or a talent. Students may be attracted to a career because that is a career a parent or relative currently holds or one that a parent suggests. Parents like students may also not be aware of the possibilities for individuals with a math background. It is important for teachers to offer support and encouragement to all students. Parents and teachers need to have high

expectations for students because students will tend to only live up to the expectations that are put on them.

Blecker and Jacobs (2004) indicated that a person's own belief in his/her ability is more influential than one's actual ability. It was found that parents' belief in how well their son or daughter does in math is indirectly related to the child's belief in how well he/she performs in math. In 1999, girls in the 10th grade were significantly less likely to state math as a career option than boys, even though the math scores and grades for boys and girls were similar. In 1992, girls were only two-thirds as likely to state science or engineering as a career option than boys from a group of 1,990 seniors scoring in the 90th percentile on the SAT's math portion.

> "The most important findings from this study are the enduring links between mothers' early expectations for their children and the children's later career decisions. As expected, the interaction of an adolescent's gender and a mother's prediction of her child's ability to succeed in a math career was a direct indicator of whether a young adult chose a career in physical science-computing, as opposed to a non-science or life science-business career. In fact, regardless of whether they attended college, female adolescents whose mothers reported low perceptions of their abilities to succeed in math careers were 66% less likely to choose careers in physical science-computing than in non-science. In addition, college-bound female adolescents whose mothers reported these low perceptions were almost four times more likely to choose careers in life-

> science-business than in physical science-computing. Interestingly, mother's perceptions had only minimal relation with male adolescents' chances of choosing non-science and life science-business careers, as opposed to careers in physical science-computing. It is clear that mothers' perceptions are differentially related to career choice, depending on the gender of the child" (Blecker and Jacobs, 2004, p. 107).

Research has shown that parents' perceptions are indirectly influential on children's perceptions that math is a male's career. Students state that parents have the largest influence on which career to go into and what classes they will be taking. A student's mother when asked to make a prediction on her child's success in math was strongly related to whether or not the child entered a physical science or computing career than a non-science career. Mothers who predicted success of their children in math careers had children who believed they were more capable of a math or science career.

> "Despite the fact that girls have higher teacher ratings than boys, girls report lower self-perceptions of math ability, are less likely to indicate plans to pursue math and science careers than boys, and are ultimately less likely to choose careers in physical science-computing, if their mothers reported low perceptions of their abilities" (Blecker and Jacobs, 2004).

Emphasis needs to be communicated with students that high test scores in math and science on standardized tests does not always correlate with success in math and science careers. It is important to give students feedback. This feedback needs to happen numerous times. Feedback is import to help identify where gains, gaps, and errors are made in the processes. Much learning can be made from knowing where one made one's mistakes. The feedback needs to be specific on what the student is doing well on versus just general praise. Feedback should occur when students were correct or when students make mistakes so they can learn from their mistakes and fix any misunderstandings. Students receive feedback for overall performance through test scores and grades. The feedback students receive from specific tasks like factoring, effort exerted, and procedures and strategies have a larger positive influence on their beliefs of their ability than the feedback on test scores and grades. Students are also less likely to have self-defeating behaviors when teachers give feedback on specific issues with errors. Self-defeating behaviors include procrastination and avoiding getting assistance from teachers and peers. Students who are praised for being smart will associate any failures with ability while students who are praised for working hard will associate any failures with their effort. It is important to make sure students have the ability to be successful and that it is usually based more on the amount of effort than ability. Teachers need to give praise on effort when deserved; otherwise, they may be giving false praise that may undermine motivation.

A student's achievement and attitudes also improve when focused on the specific items at hand. Teachers can expose students to possible careers using females who are in the advanced careers, and teachers can bring to students' attention the achievements

made in math and science to help promote interest. Students need to be exposed to careers in math and science by using biographies and inviting guest speakers. Students should be informed about mentoring opportunities. Parents play a vital role in a child's future and need to be involved in helping expose students to careers in math and science. Teachers can encourage parents to get students signed up for activities in math and science related careers. There are many organizations that offer conferences geared towards math and science related careers which students could participate in. Interesting real-world word problems and activities can foster long-term interest in math and science. Having students learn using projects that include group work, innovation, and technology can improve motivation. These projects should be used to deepen students' understanding and knowledge of the content or to broaden the understanding of math and science. It is important to connect activities done in class with tasks that are done in math and science careers.

There is a great deal of concern about our educational system in the media. This has been the case for years and it started to be huge after Russia launched Sputnik. With the use of technology, we have been able to compare data easier than ever before. We can see the trends in the percentages of graduates obtaining degrees in science, technology, engineering, and math. These trends can be compared with data from other countries to see how we are progressing. The data is showing that America is not turning out the number of highly skilled workers that it needs and will be relying too heavily on other countries to meet these needs. The current state of the economy is fragile. The unemployment rate has been higher than eight percent for the past three years yet Farmer (2009) states

that NASA and many other fields are finding shortages of students wanting to become engineers. Kadlec and Friedman (2007) express a growing concern that the United States will not hold its position in science and technology unless students start gaining stronger skills in math, science, and technology.

Parent perceptions of the quality and quantity of math and science is worrisome. Kadlec and Friedman (2007) found that most parents do not see improving math, science, and technology education as a top challenge facing their local schools, and most students do not come to these subjects with a strong sense of motivation and interest. The largest contention is the motivation and interest of the students.

Jayaratne (1983) determined that math achievement of students is greatly impacted by parents' perceptions of math. This perception of math could have a great influence on a child's choice on whether or not to pursue a math related career but could be positively influenced be teachers who may guide them towards areas where students have an interest or a talent. Farmer (2009) states that one large issue with students becoming engineers is the lack of exciting career information.

Exposure is a powerful tool. Children are exposed to their parents' perceptions and opinions from an early age and this sets precedence for the children's believes. Parents have a significant influence on their child's perceptions of education and possible career paths with the exposure parents provide. I see a lot of negative perceptions towards math with comments parents and students make. From the literature, it seems that more emphasis should be

put on why math is important and where it is used. I hope that exposing students to careers that use math will allow students to see the importance it has on our society and will see that math is used everywhere. I hope that students will put forth more effort in math classes because they see the importance math has. I also want students to be aware of careers they may want to pursue with a strong math background. I want to find out if exposing students to math related careers will have an influence on their attitudes towards mathematics.

Chapter 3

Design

Education is important to me as an individual and as a teacher. I am always reflecting on my own instruction to see if I am preparing students to the best of my ability. As discussed in Chapter 1, the film "Two Million Minutes" and the documentary "Stupid in America," questions whether I am doing everything in my power to provide the best guidance and math instruction possible. There is more to teaching math than just providing the best math instruction.

The main purpose of this paper is to promote a larger positive impact on students' learning and interest in math. I could be the most knowledgeable math teacher around but this doesn't mean my students will be more successful in math. "You can lead a horse to water, but you can't make him drink," is a phrase that comes to mind. I have to motivate students to want to learn math. Why do students want to learn particular information? Students may want to learn a subject because it is interesting to them, but math is typically not the most exciting subject for most students. It may be difficult to change their opinions on this without intervention. Many students take an interest in a subject because it directly relates to the career in which the students are interested in pursuing. Why do students choose the career they are pursuing? Many students choose a career that a family member has chosen, based on the exposure.

Exposing students to math careers is very valuable. Why would students continue to take additional math courses in high school and college if they were not pursuing a career in math? Most students do not know what careers are available for someone with

a math degree other than being a math teacher at some level. Teaching math probably is not a very exciting idea for most students. Students will be exposed to a wide variety of careers which use math on a regular basis or require a math degree to show the importance of math and the amount of math that is used. Students will be more motivated to learn math due to the exposure to more careers that use math.

The research question this study intended to answer was whether or not exposing students to math related careers will make a difference. Would this exposure to math related careers have an impact on students' perceptions on the importance and usefulness math has in the real world? These perceptions were measured using a Likert scale and analyzed quantitatively to determine any benefits. Qualitative data was also gathered using a few short answer questions. These short answer responses were designed to see what students learned by being exposed to these math related careers.

I discovered numerous job opportunities for someone with a math major as I researched for possible careers my students could investigate. While researching the careers and ideas for this project I noticed there were a few other examples of projects similar to what I was envisioning as well. Many of these other projects included not only careers that required a degree in math, but they included careers that use math on a regular basis such as chemistry and agronomy.

I am teaching math to a wide range of students with a wide range of math abilities. This should allow me to see any effects to the typical high school student and not just a select group. Many of these students do not have or will not have the desire to pursue a career in math or a math related career. My objective is for students to see the importance of math in their everyday lives especially in their future careers. In order to

reach students with less mathematical success, many other careers were included as options for the project, such as carpenters who still use math daily.

The make-up of the courses taught were one section of Pre-Algebra, three sections of Algebra 2, one section of College Transition, and one section of Pre-Calculus. The make-up of the individual classes according to the grade is shown in figure 3. Pre-Algebra students tend to be younger students mainly freshmen and sophomores. They also tend to be students who have lower math skills than their peers. The Algebra 2 classes contained the largest range of students according to their grade. These students are typically college bound. The students in College Transition are all seniors. These students are college bound but have chosen to build on their Algebra 2 skills instead of advancing to the higher level math course of Pre-Calculus. These students may have felt their math skills are not strong enough to advance to Pre-Calculus. These College Transition students tend to be less motivated in math; do not want to put the extra effort required to be successful in Pre-Calculus. The makeup of the Pre-Calculus class was one sophomore, eight juniors, and eight seniors with eight females and eleven males.

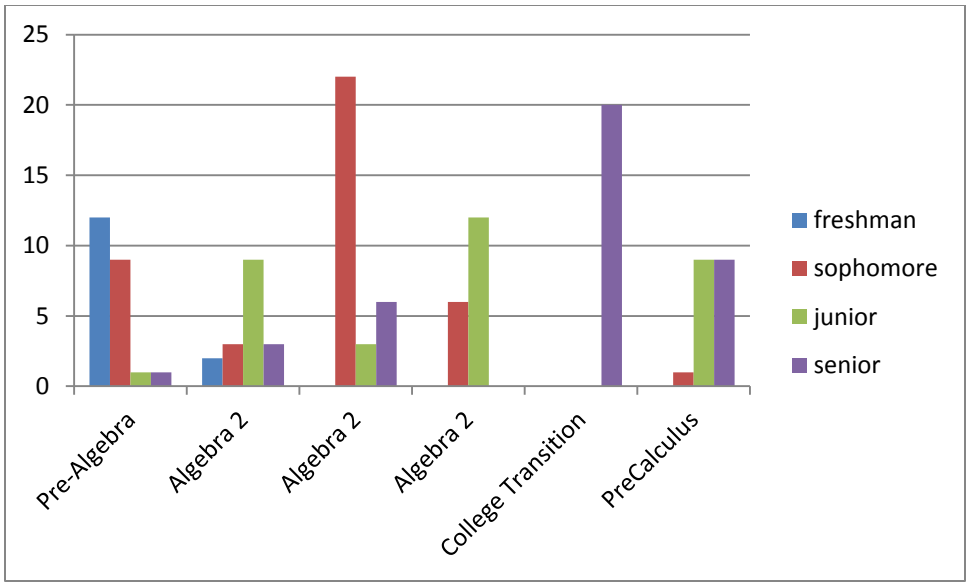

Figure 3

Figure 4 shows the make-up of males and females for the individual classes. The make-up of males to females is fairly even except for two of the Algebra 2 classes, but is very close to the same when looking at the total.

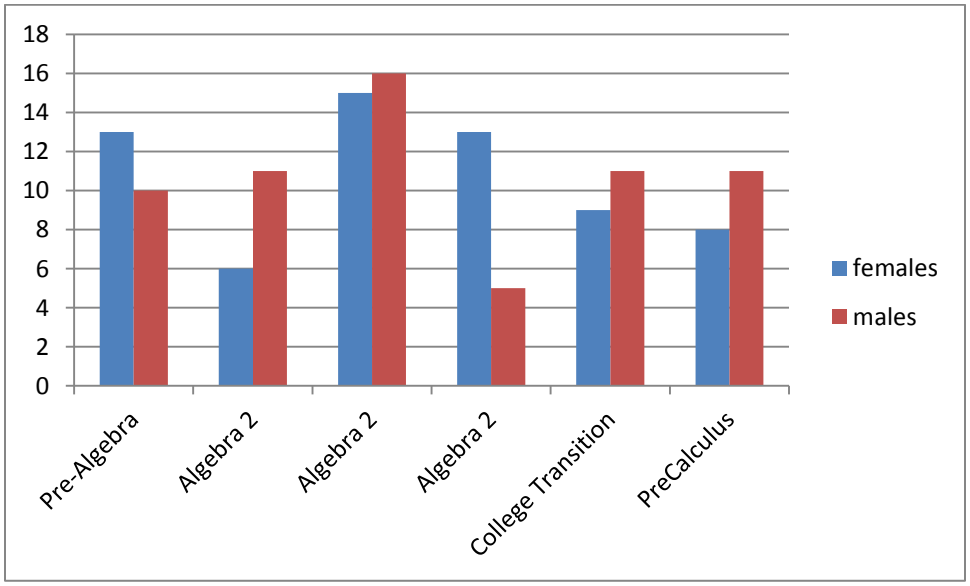

Figure 4

Figure 5 shows the total number of students, total number of males and female, and the total number of students for each grade level. I have a roughly the same number of sophomores, juniors, and seniors, but fewer freshmen as a whole.

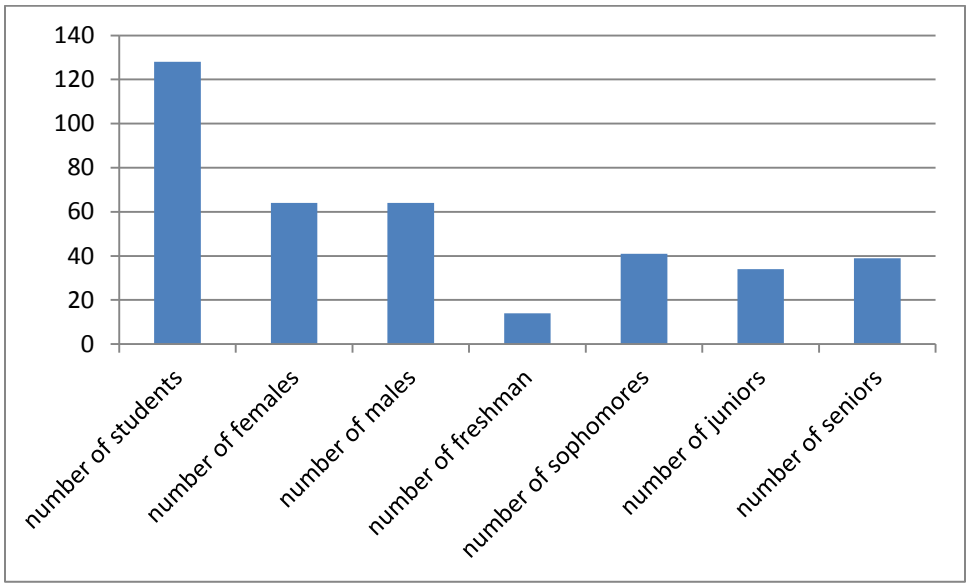

Figure 5

Students will be analyzed as a whole group. They will also be analyzed according to gender, math class, and grade level to see if any one category is influenced more than another. There are three Algebra 2 classes. The results for these three classes will be grouped together rather than three different classes.

Students in each class were asked to complete a pre-survey (Appendix 1). The survey included basic questions like age, gender, what math class they are currently taking and the grade they typically earn in math. The students were also posed with statements which they ranked on a Likert scale from 1 to 5 with 1 being the student strongly disagrees and 5 being the student strongly agrees with the statement. The statements were used to get a perception of how students felt about math. The pre-survey also asked a few open ended questions: what kinds of jobs require a math degree, where

will you use math outside of school, and what kinds of jobs use math on a regular basis? These questions were used to gather the amount of information students had on possible careers in math.

Students were given the math career project requirements (Appendix 2). The project requirements included interview and/or biography notes. A copy of the rubric (Appendix 3) was distributed to the students for them to see how they were going to be assessed on the math career project. Students were allotted five class periods in the computer lab to work on their projects. They were not limited to using class time, but this time allowed students to have access to a computer for researching their careers, typing their papers, and possibly working on the presentations that would be given the following week in place of their final exam. Students needed to type a three to five page paper. The paper was to be doubled spaced with a title page and works cited page which were not part of the three to five pages. The paper needed to include a summary of the profession which met all of the bulleted points. The students had to include an introduction and a conclusion in their papers.

Students were presented with a list of careers (Appendix 4) that contain a variety of math skills. There were careers which required advanced mathematical skills, applied mathematics, practical applications of math, and careers which use general math skills. Algebra 2 and Pre-Calculus students were given the list of careers which required advanced mathematical skills since these are the students who would be more apt to pursue these careers. Since the students in Algebra 2 and Pre-Calculus are higher achievers, they were presented with the careers requiring the most math skills first and encouraged to pick from these only. The students in Pre-Algebra were allowed to pick

careers that required less math than those chosen in the other classes. I did not want to overwhelm the Pre-Algebra students with the level of math required in the careers requiring higher levels of math. Exceptions were made if the student made a logical explanation for choosing a different math related career.

The students were given a few days including the weekend to finalize their decisions on which careers they chose to research. The purpose for allowing several days to select a career was to allow students the opportunity to switch to a different career if they were unable to locate and/or arrange a meeting time to interview a person in the desired career field. Students also read a biography about a person in the desired career field. To make sure there was an assortment of careers chosen, there was a limit of three students per career.

The project also required students to present their career choices to the rest of the class. The presentation needed to be between two to five minutes. The presentation needed to have a visual aid or a PowerPoint. The presentation was to highlight interesting and important information from their papers. The goal of the presentations was to give other students a brief summary of a variety of careers and show how math is used within many different careers. Students were to take notes on the presentations. By taking notes, students were more focused on the presentations and would take full advantage of the opportunity to learn about how math is used in a career that may interest them.

A post-survey (Appendix 5) was handed out for the students to fill out after the completion of the project. The post survey was exactly the same survey as the pre-survey except for the last question, "What did you learn from this project and the presentations?"

The purpose of having the same questions on the post survey as the pre-survey was to determine any differences in students' thoughts and opinions of math. Using the Likert scale will allow me to see if there are any significant increases of feelings towards the value of math. The open ended questions will hopefully give me some additional insight to why students feel the way they feel towards math.

In this section, the design of the research project was laid out. All of my classes were given a pre-survey to get a base-line of my students' perceptions of math and how it is used in the real world. Students were given a list of math related careers from which to choose, and they were assigned to research and present pertinent and interesting information about their chosen career. A post-survey was completed by the students to measure any affects the career project had on their perceptions of math and how it is used in the real world. These results were analyzed to determine if any change had occurred in the perceptions of the students and will be discussed in the next chapter.

Chapter 4

Results

The first step was to look over the data for all of my students as a whole. Data was analyzed using a t test with un-pooled variances, two tailed, and at the 5% significance level. The t-test was used versus a non-parametric test since the data collected was on an interval scale and the data appeared to be close to normal rather than being skewed (Winter 2010). Data was first gathered and entered into Microsoft Excel and later imported into Fathom. There was an increase in the mean of the students' responses to *math is enjoyable and stimulating to me*, but it was not large enough to be significant shown in table 1. I hope that having students research and present these math related careers did have some positive impact on making math stimulating.

Math is enjoyable and stimulating to me		
All students	Pre-Survey	Post-Survey
Sample size	103	120
Mean	2.42718	2.625
Standard Deviation	1.12548	1.14541
Test statistic	1.298	
p-value	0.2	

Table 1

In table 2, the pre and post-survey means for *my parents expect me to do well in math*, changed very little which was expected. The presentations of the math related careers should not have had any impact on students' opinions of parents' expectations. This helps show reliability in the data.

My parents expect me to do well in math		
All students	Pre-Survey	Post-Survey
Sample size	103	121
Mean	4.16505	4.17355
Standard Deviation	0.8413	0.72661
Test statistic	0.08024	
p-value	0.94	

Table 2

There was an increase in students' thoughts on how much their parents and/or guardians use math in table 3. Even though there was not a large enough increase to be significant, the data was eye catching. I would have liked to believe that students realized that their parents and/or guardians use math more frequently than what the students originally thought. The students would be more apt to see how much math and where it is used on a regular basis with the presentation of the math related careers. There were a number of students who chose to research a career in which a family member was employed. The more exposure students have, the more they will realize the importance and widespread uses of math in the real world.

My parents/guardians use math frequently		
All students	Pre-Survey	Post-Survey
Sample size	102	120
Mean	3.52941	3.70833
Standard Deviation	0.989608	0.999124
Test statistic	1.337	
p-value	0.18	

Table 3

The research project had very little to no impact on the statement, *I have never liked math and it's my most dreaded subject* shown in table 4. The project was never intended to improve the students' feelings on whether they liked math or not and, therefore, I did not expect to see any changes here. This does strengthen the notion that the students were consistent and honest when completing the pre and post-surveys.

I have never liked math and it's my most dreaded subject		
All students	Pre-Survey	Post-Survey
Sample size	103	121
Mean	2.91262	2.92562
Standard Deviation	1.30502	3.36116
Test statistic	0.07284	
p-value	0.94	

Table 4

Students have always wondered when math content is ever going to be used in life. The responses from, *Mathematics is important for everyday life*, does show a significant increase in table 5. This tells me that students realize that math is an important part of our everyday lives. This was one of the statements that I was anticipating and hoping for a significant increase in the mean of students' perspectives.

Mathematics is important for everyday life		
All students	Pre-Survey	Post-Survey
Sample size	103	120
Mean	3.6699	3.925
Standard Deviation	0.974056	0.861526
Test statistic	2.056	
p-value	0.041	

Table 5

Throughout my ten years of teaching, I have noticed a number concerns. One of the concerns is that students feel that mathematicians sit and work out math problems all the time. It is not surprising to me that students will not want to pursue a math career if sitting around a desk working out math problems is what they think they will be doing. The research and presentations of math careers allowed students to get a better understanding of what individuals with a math related career do with the math they have learned and how it is used. The numbers from table 6, *There is nothing creative about math and it's just memorizing formulas and things*, suggested that the exposure to these math related careers may have some impact on the students' perceptions of math related

careers. It was nice to see that students may see a math career as more than just crunching numbers.

There is nothing creative about math and it's just memorizing formulas and things		
All students	Pre-Survey	Post-Survey
Sample size	102	121
Mean	3.01961	2.73967
Standard Deviation	1.15167	0.996032
Test statistic	-1.923	
p-value	0.056	

Table 6

When students ask, "When are we ever going to use this?" it is may be a good idea to inform the students that you will need the information to go onto college. I say "may be" a good idea because I do not think just informing students that you need it to go on to college by itself will work. Students need to know math is needed for college and other classes. It can be emphasized by exposing them to a research project like this one where the students can see the benefits, instead of being told. There are a number of logical thinking and problems solving skills you gain from having a strong math background. The data from the surveys show a significant increase in students' perspective that the skills they learn in math will help them in other classes shown in table 7.

The skills I learn in math will help me in other classes		
All students	Pre-Survey	Post-Survey
Sample size	102	120
Mean	3.56836	3.86667
Standard Deviation	0.990148	0.909181
Test statistic	2.32	
p-value	0.021	

Table 7

The careers students researched and presented covered a wide spectrum including medicine, finance, education, agriculture, construction, and technology. The project

should have shown that math is everywhere and is important for everyday life, but the increase in the mean from table 8 was not significant.

Mathematics is important for everyday life		
All students	Pre-Survey	Post-Survey
Sample size	103	120
Mean	3.57143	3.8125
Standard Deviation	0.866025	0.95997
Test statistic	1.298	
p-value	0.2	

Table 8

The skills I learn in math will help me in other classes and *mathematics is important for everyday life* were two statements that showed significant increases in students' opinions. This was great news to see statistical improvements due to this career project. Would the career project have different impacts when filtering attributes like gender, age and course of my students?

Data was broken down into categories to determine if there was any one group that was more impacted than another. It was surprising to see females showed virtually no change in a number of statements namely: *math is enjoyable and stimulating to me*, *my parents/guardians expect me to do well in math*, *my parents/guardians use math frequently*, *I have never liked math and it's my most dreaded subject*, and *using the web or a computer is a good way for me to learn math*. The one statement that was not promising to my results was *the skills I learn in math will help me in other classes*. The one area that showed the most change but wasn't significant was *math is important for everyday life*.

We all know that men and women think and act differently. How would the results of male students compare to the results of female students? Female students showed no change in their opinion of *math is enjoyable and simulating to me* while male students had a large increase in *math is enjoyable and stimulating to me*, but the increase

in males was not statistically significant shown in table 9. It was interesting to see that the means of the males were larger than the means for the females here in addition to the larger increase. This would seem appropriate knowing there are more males who go into STEM fields than females.

Math is enjoyable and stimulating to me					
Female	Pre -Survey	Post-Survey	Male	Pre-Survey	Post-Survey
Sample size	49	49		52	51
Mean	2.38776	2.38776		2.46154	2.86275
Standard Deviation	0.931315	1.11461		1.30552	1.18355
Test statistic	0			1.635	
p-value	1			0.11	

Table 9

The results from table 10, *I am good at math* caused me to think for a bit. It seemed strange at first that the mean from the post-survey appeared to decrease slightly. I suppose students may feel overwhelmed about the amount and level of math that is required in these careers. I hope students understand they have a lot more to learn and will not be turned away from pursuing a math related career. This may be a benefit for students. For students to know they are deficient, may motivate them more to achieve their career goal. Being aware of their deficiencies would be better to know in the early stages of their education so they have more time to work towards their goal(s).

I am good at math					
Female	Pre-Survey	Post-Survey	Male	Pre-Survey	Post-Survey
Sample size	49	49		52	52
Mean	3.12245	2.89796		3.38462	3.30769
Standard Deviation	0.992317	1.27875		1.30089	1.14684
Test statistic	-0.9709			-0.3199	
p-value	0.33			0.75	

Table 10

Math is important to me was very close to being a significant increase in males while the mean decreased a little with females with no significance revealed in table 11.

This result is supported by the literature review. Halpern (2007) states girls are less confident in their abilities in math than boys and girls show less interest in pursuing a career in math or science.

Math is important to me					
Female	Pre-Survey	Post-Survey	Male	Pre-Survey	Post-Survey
Sample size	49	49		52	52
Mean	3.28571	3.16327		3.28846	3.69231
Standard Deviation	0.790569	1.17878		1.21003	0.852642
Test statistic	-0.6039			1.967	
p-value	0.55			0.052	

Table 11

In table 12, there was a non-significant increase in the means of males for *my parents/guardians use math frequently*. Male students may have not realized the amount of math their parents actually do on a regular basis. The presentations and research may have brought some insight of where math is used.

My parents/guardians use math frequently					
Female	Pre-Survey	Post-Survey	Male	Pre-Survey	Post-Survey
Sample size	48	48		52	52
Mean	3.54167	3.5625		3.5	3.82692
Standard Deviation	1.0097	1.1468		0.995086	0.90144
Test statistic	0.09446			1.756	
p-value	0.92			0.082	

Table 12

Female students did not feel that the skills in math would help them in other classes shown in table 13 after completing the career project while male students showed a significant increase of the mean in their perception. This data may also relate back to Halpern (2007) who states girls are less likely to pursue a career in math and science and therefore feel that math will not be helpful in their other classes. Male students may see how math is used in numerous careers whether the career requires a math degree or not.

The skills I learn in math will help me in other classes					
Female	Pre-Survey	Post-Survey	Male	Pre-Survey	Post-Survey
Sample size	49	48		51	52
Mean	3.7551	3.77083		3.41176	3.86538
Standard Deviation	0.933754	0.103224		1.16921	0.929449
Test statistic	0.09267			2.177	
p-value	0.93			0.032	

Table 13

Male students increased their feelings significantly that *real math problems could be solved by common sense instead of the math rules you learn in school*. Female students on the other hand felt somewhat the opposite. Females felt you needed to use more of the math rules in school and less on common sense. This would have been a great statement to have students respond to an open question to understand the results better. Female students could have taken the statement to mean that you need more math with all of the careers that use math while male students may have thought the ideas and concepts behind everything were more common sense.

Real math problems can be solved by common sense instead of the math rules you learn in school					
Female	Pre-Survey	Post-Survey	Male	Pre-Survey	Post-Survey
Sample size	49	48		51	52
Mean	3.15306	2.95833		2.94118	3.36538
Standard Deviation	0.817797	0.966642		1.15606	0.908108
Test statistic	-1.07			2.068	
p-value	0.29			0.041	

Table 14

We have seen some variations in the data between male and female students. There were significant increases in the means with some of the statements for the males and little to no changes for female students. There were four different classes that I taught. If gender differences gave different results, I would assume that the difference between classes would also provide me with different results as well.

When looking at *math is enjoyable and stimulating to me* in table 15, the one class that showed a large difference was College Transition. College Transition had a 1.996 test statistic which was significant. This class is made up of only seniors with relatively the same math background. Most of these students had taken three credits of math prior to this class but did not want to push themselves to take Pre-Calculus which would be more mathematically intensive. The pre-survey mean was much lower to start with than the other three math courses. Since these students chose not to challenge themselves by taking Pre-Calculus, they are more likely to be frustrated in math. This project may have stimulated these students enough to increase their mean perspective.

Math is enjoyable and stimulating to me				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	48	18	17
Sample size Post-Survey	19	47	18	17
Mean Pre-Survey	2.78947	2.33333	1.88889	2.94118
Mean Post-Survey	3.05263	2.40426	2.61111	2.76471
Standard Deviation Pre-Survey	1.13426	1.13613	1.07861	0.826936
Standard Deviation Post-Survey	1.17727	1.07662	1.09216	1.39326
Test statistic	0.7017	0.3124	1.996	-0.4491
p-value	0.49	0.76	0.054	0.66

Table 15

People who are gifted in an area typically gravitate towards activities which use their skill, like students who tend to be athletic. These students tend to play sports. This also seems to be the case with math. The students I taught with the highest math skills were in Pre-Calculus. These students would have an initial opinion that they are good at math which shows up with their high pre-survey mean seen in table 16. The interesting finding here is that the Pre-Calculus students had a significant decrease in their opinion of how good they were in math. I am assuming that this result is from the students realizing there are an abundance of careers that use a great deal of math and that they have a lot of

math they can learn yet. Most of the students in my Algebra 2 classes tend to be in the advanced track where they too would have an initial opinion that they are good at math. The Algebra 2 students may have been overwhelmed at the amount of math that is still required for them to learn to achieve a career in some of these math related careers.

I am good at math				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	48	18	17
Sample size Post-Survey	19	48	18	17
Mean Pre-Survey	3.15789	3.14583	3	4.11765
Mean Post-Survey	3.26316	2.89583	3.33333	3.23529
Standard Deviation Pre-Survey	1.01451	1.23753	0.970143	0.781213
Standard Deviation Post-Survey	1.09758	1.25883	1.18818	1.30045
Test statistic	0.307	-0.9812	0.922	-2.398
p-value	0.79	0.33	0.36	0.024

Table 16

Math is important to me showed some of the same characteristics as *I am good at math*. The Pre-Calculus students' opinions decreased again but were not low enough to be significant, as seen in table 17. I am a little worried about the Pre-Calculus students. These are supposed to be the students going into a math related field and their opinions dropped some. This is very similar to the 20/20 documentary where Stossel (2006) reported how much better the students from Belgium performed on the international test than the high achieving students from New Jersey.

The pre-survey mean of the College Transition students shown in table 17 was much lower than the other classes, just like it was with *math is enjoyable and stimulating to me*. The reason for this may be the fact that many of the students in this case were near the top in their grade for math ability coming into high school. Along the way, some of these students have seen setbacks in their success in math classes. The College Transition students did show a significant increase in the mean from the pre-survey

results to the post-survey results. These students were exposed to a number of math related careers that they are able to pursue. All of these students are seniors and are all planning on pursuing post-secondary education.

Math is important to me				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	48	18	17
Sample size Post-Survey	19	48	18	17
Mean Pre-Survey	3.47368	3.20833	2.77778	3.82353
Mean Post-Survey	3.78947	3.29167	3.55556	3.23529
Standard Deviation Pre-Survey	0.964274	0.988408	1.16597	0.727607
Standard Deviation Post-Survey	0.787327	1.18426	0.855585	1.09141
Test statistic	1.106	0.3743	2.282	-1.849
p-value	0.28	0.71	0.029	0.075

Table 17

In table 18, there were significant increases in means of student opinions for *my parents expect me to do well in math* for both Pre-Algebra and College Transition while there was a significant decrease in Pre-Calculus. The pre-survey means for the Algebra 2 and the Pre-Calculus students' means were higher than the Pre-Algebra and the College Transition students. The students in Pre-Calculus and Algebra 2 tend to be higher achievers in the area of math. This may be the reason for the higher initial mean. This would have been an area where I thought the results would remain unchanged. I would have assumed that parent expectations would not have changed, but this survey was not gathering parent responses. It was gathering students' opinions of these statements. Another explanation for the possible differences in data could be the different careers that were selected in each class.

My parents expect me to do well in math				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	48	18	17
Sample size Post-Survey	19	48	18	17
Mean Pre-Survey	3.78947	4.375	3.72222	4.47059
Mean Post-Survey	4.42105	4.1875	4.44444	3.64706
Standard Deviation Pre-Survey	0.854982	0.761438	0.826442	0.799816
Standard Deviation Post-Survey	0.507257	0.733869	0.51131	0.931476
Test statistic	2.769	-1.228	3.153	-2.766
p-value	0.0097	0.22	0.0038	0.0094

Table 18

I have never liked math and it's my most dreaded subject showed no significant decreases in table 19, but there was a significant increase with the Pre-Calculus students. Pre-Calculus students started out with a lower mean for the pre-survey than the other courses and ended up being the highest mean of the post-survey. I would not expect to see a significant decrease with this attribute with students in my highest level math course.

The College Transition students decreased some but not significantly. This class did start out with the highest mean on the pre-survey of the four different courses.

I have never liked math and it's my most dreaded subject				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	48	18	17
Sample size Post-Survey	19	48	18	17
Mean Pre-Survey	2.68421	3.0626	3.38889	2.17647
Mean Post-Survey	2.68421	3.10417	2.83333	3.23529
Standard Deviation Pre-Survey	1.10818	1.4315	1.14475	1.0146
Standard Deviation Post-Survey	1.33552	1.41781	1.24853	1.48026
Test statistic	0	0.1433	-1.391	2.433
p-value	1	0.89	0.17	0.022

Table 19

The College Transition class was close to showing a significant decrease in the mean for the attribute *there is nothing creative about math and it's just memorizing*

formulas and things shown in table 20. There were a number of careers in which the College Transition students showed an interest in. One girl who was going into meteorology presented her career with some passion and good examples. Student B chose a nurse practitioner who she interviewed at a local hospital. This is a career most students have had or will have had an experience with during a health issue. This makes the presentation a little more meaningful since this individual uses math on a regular basis and is someone who is local. Student C interviewed her dad who is an automotive mechanic. The math he uses is quite different from the math used by a meteorologist or a nurse practitioner. His community ties allowed for student buy-in because of his real world examples of how math is important to his job within our community. There were careers these students could relate to and possibly see themselves pursuing. This was a good project for the seniors to complete since many of them were undecided on a career path. These College Transition students needed to see the applications of math at this critical point in their lives than the other courses. They took this project more seriously than the students in other courses since they would be graduating soon, and they realized they would be in the real world soon.

There is nothing creative about math and it's just memorizing formulas and things				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	47	18	17
Sample size Post-Survey	19	48	18	17
Mean Pre-Survey	2.73684	3.08511	3.05556	3.05882
Mean Post-Survey	2.89474	2.88542	2.5	2.70588
Standard Deviation Pre-Survey	0.871914	1.31595	1.05564	1.08804
Standard Deviation Post-Survey	1.10024	1.03779	0.707107	1.0467
Test statistic	0.4903	-0.8201	-1.855	-0.9639
p-value	0.63	0.41	0.074	0.334

Table 20

In table 21, the Pre-Algebra students showed some increase but not significant for the attribute *math is needed in designing practically everything*. Students in Pre-Algebra were allowed to research some careers which required fewer math skills. These students realized how many careers use math on a regular basis and how math could be applied to a number of situations toward which they may be gravitating. Pre-Calculus students showed a significant decrease. Once again the Pre-Calculus students responded with data which was opposite from what was expected. Their initial or pre-survey mean was larger than the other courses, but still showed a significant decrease in the mean.

Math is needed in designing practically everything				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	47	18	17
Sample size Post-Survey	19	47	18	17
Mean Pre-Survey	3.84211	4.06383	3.88889	4.52941
Mean Post-Survey	4.21053	3.95747	4.16667	3.82353
Standard Deviation Pre-Survey	0.60214	0.869889	0.6764	0.624264
Standard Deviation Post-Survey	0.630604	0.750578	0.618347	1.23669
Test statistic	1.842	-0.6348	1.286	-2.101
p-value	0.074	0.53	0.21	0.046

Table 21

The skills I learn in math will help me in other classes in table 22 showed a significant increase with the Pre-Algebra students. It was great to see the increase in the mean for the Pre-Algebra students. These students typically struggle with math and do not see themselves ever using math outside of school. I hope that this will have a positive impact on these Pre-Algebra students academically in math and in other courses. There was a significant decrease in the mean for Pre-Calculus students. I question the decrease in their opinion for *the skills I learn in math will help me in other classes*, but I do notice that the mean for the pre-survey was quite high compared to the other courses.

The skills I learn in math will help me in other classes				
Math Class	Pre-Algebra	Algebra 2	College Transition	Pre-Calculus
Sample size Pre-Survey	19	47	18	17
Sample size Post-Survey	19	47	18	17
Mean Pre-Survey	3.42105	3.40426	3.44444	4.35294
Mean Post-Survey	4.26316	3.65957	3.77778	3.76471
Standard Deviation Pre-Survey	0.606977	1.19163	0.783823	0.492592
Standard Deviation Post-Survey	0.82274	1.02738	0.732084	0.83137
Test statistic	3.59	1.113	1.319	-2.51
p-value	0.0011	0.27	0.2	0.019

Table 22

The results from the Pre-Calculus students seem to go against what I would have liked to see for a number of the attributes. Maybe the pre-survey data was higher or lower than what it should have been and was then compensated for in the post-survey giving me the results that it did. College Transition students produced some positive data.

The students in College Transition are all seniors. The makeup of the Pre-Calculus class was one sophomore, eight juniors, and eight seniors. Maybe some of the results were a result of mixed grades. What do the results show when grade level of students are analyzed?

Sophomores showed a significant decrease for the attribute *I am good at math* according to table 23. The majority of sophomores were advanced students in my Algebra 2 classes. These students had a higher pre-survey mean than the other grades. They may have been a little arrogant about their math ability. Most of these students were researching careers which required a great deal of math and they may have felt overwhelmed at the amount of math that was still left to learn to obtain these math related careers.

I am good at math				
Grade	9th	10th	11th	12th
Sample size Pre-Survey	12	28	28	34
Sample size Post-Survey	12	28	28	34
Mean Pre-Survey	3.16667	3.60714	3.14286	3.08824
Mean Post-Survey	2.91667	2.92857	3.25	3.23529
Standard Deviation Pre-Survey	1.11464	1.22744	1.1455	1.11104
Standard Deviation Post-Survey	1.08362	1.2745	1.32288	1.15624
Test statistic	-0.5571	-2.029	0.324	0.5348
p-value	0.58	0.047	0.75	0.59

Table 23

Seniors showed a significant increase in the mean for their opinion of *math is important to me* shown in table 24. Many of the seniors in the study were in my College Transition class. The results from College Transition and seniors were very similar. The post-survey mean for the seniors is very close to the post-survey results of the other grades. Seniors are nearing the end of their high school career. All of these seniors are planning on pursuing post-secondary education and they may realize how valuable math will be for their future.

Math is important to me				
Grade	9th	10th	11th	12th
Sample size Pre-Survey	12	28	28	34
Sample size Post-Survey	12	28	28	34
Mean Pre-Survey	3.25	3.67857	3.32143	2.94118
Mean Post-Survey	3.5	3.21429	3.53571	3.5
Standard Deviation Pre-Survey	0.965307	0.983327	0.772374	1.15316
Standard Deviation Post-Survey	0.522233	1.31535	1.0707	0.92932
Test statistic	0.7891	-1.496	0.8588	2.2
p-value	0.44	0.14	0.39	0.031

Table 24

Table 25 shows there were non-significant increases for *my parents expect me to do well in math* for freshmen and seniors, but a non-significant decrease for juniors. The

means for the post-survey were all above four signifying that students feel their parents have high expectations for them in math.

My parents expect me to do well in math				
Grade	9th	10th	11th	12th
Sample size Pre-Survey	12	28	28	34
Sample size Post-Survey	12	28	28	34
Mean Pre-Survey	3.83333	4.28571	4.46429	3.97059
Mean Post-Survey	4.33333	4.14286	4.07143	4.29412
Standard Deviation Pre-Survey	0.834847	0.93718	0.637248	0.834313
Standard Deviation Post-Survey	0.492366	0.803432	0.978607	0.523937
Test statistic	1.787	-0.6124	-1.78	1.915
p-value	0.091	0.54	0.082	0.061

Table 25

Mathematics is important for everyday life contained a significant increase for seniors in table 26. Seniors are obviously the oldest and more than likely the ones with more exposure to the real world. They are nearing the end of their high school career and are applying for colleges. The career presentations should have been beneficial for these students knowing the choices they are making at this stage in their lives and the implication these choices have on their lives.

Mathematics is important for everyday life				
Grade	9th	10th	11th	12th
Sample size Pre-Survey	12	28	28	34
Sample size Post-Survey	12	28	28	34
Mean Pre-Survey	3.75	3.82143	3.67857	3.5
Mean Post-Survey	4	3.74074	3.89286	4
Standard Deviation Pre-Survey	0.621582	1.12393	0.904866	1.02247
Standard Deviation Post-Survey	0.738549	0.944319	0.956045	0.778499
Test statistic	0.8971	-0.2886	0.8614	2.269
p-value	0.38	0.77	0.39	0.027

Table 26

The juniors showed some decrease while the seniors showed a significant decrease in *there is nothing creative about math and it's just memorizing formulas and*

*thing*s shown in table 27. This indicates that exposing students to math related careers shows older students that math is very applicable in the real world. These students are thinking more about their futures since many of these students are currently holding jobs, looking towards employment after graduation, and considering what areas of post-secondary schooling they will be pursuing.

There is nothing creative about math and it's just memorizing formulas and things				
Grade	9th	10th	11th	12th
Sample size Pre-Survey	12	28	27	34
Sample size Post-Survey	12	28	28	34
Mean Pre-Survey	2.91667	2.5	3.22222	3.35294
Mean Post-Survey	3.08333	2.98214	2.67857	2.55882
Standard Deviation Pre-Survey	0.900337	1.03638	1.31071	1.06974
Standard Deviation Post-Survey	0.996205	1.12614	0.983327	0.859569
Test statistic	0.43	1.667	-1.735	-3.374
p-value	0.67	0.1	0.089	0.0013

Table 27

In table 28, the junior and seniors had non-significant increases for the attribute *the skills I learn in math will help me in other classes*. The freshmen also had non-significant increases but were very close to being significant. It would appear that there may be some positive benefits for students to explore math related careers. If students truly believe math will benefit them in other classes, students should be more motivated to do well in math and take additional math courses.

The skills I learn in math will help me in other classes				
Grade	9th	10th	11th	12th
Sample size Pre-Survey	12	28	27	34
Sample size Post-Survey	12	27	28	34
Mean Pre-Survey	3.5	3.71429	3.55556	3.47059
Mean Post-Survey	4.125	3.64815	3.85714	3.82353
Standard Deviation Pre-Survey	0.522233	1.18187	0.800641	1.10742
Standard Deviation Post-Survey	0.907669	0.917928	1.04401	0.833779
Test statistic	2.068	-0.2322	1.205	1.485
p-value	0.054	0.82	0.23	0.14

Table 28

There were three questions at the end of the pre-survey asking students what kinds of jobs require a math degree from college, where will I use math outside of school, and what kinds of jobs use math on a regular basis. These questions were used to determine what types of jobs required and used math in the students' opinions. The pre-survey responses for the types of jobs that use math received numbered 210 while the post-survey responses numbered 233 listed in figure 6. There were fewer responses on the post-survey than the pre-survey for a number of careers including being an accountant, bank teller, construction worker, nurse, and teacher. The careers which increased in the number of responses included being a welder, veterinarian, statistician, psychologist, pharmacist, and doctor. There are a few careers which were listed on the post-survey that were not mentioned on the pre-survey like a pharmacist, paleontologist, optometrist, forester, forensic scientist, art designer, and chef. Students do realize that there are a large number of jobs that require math. There were 35 students who stated almost every job in the pre-survey while 54 students stated almost every job on the post-survey.

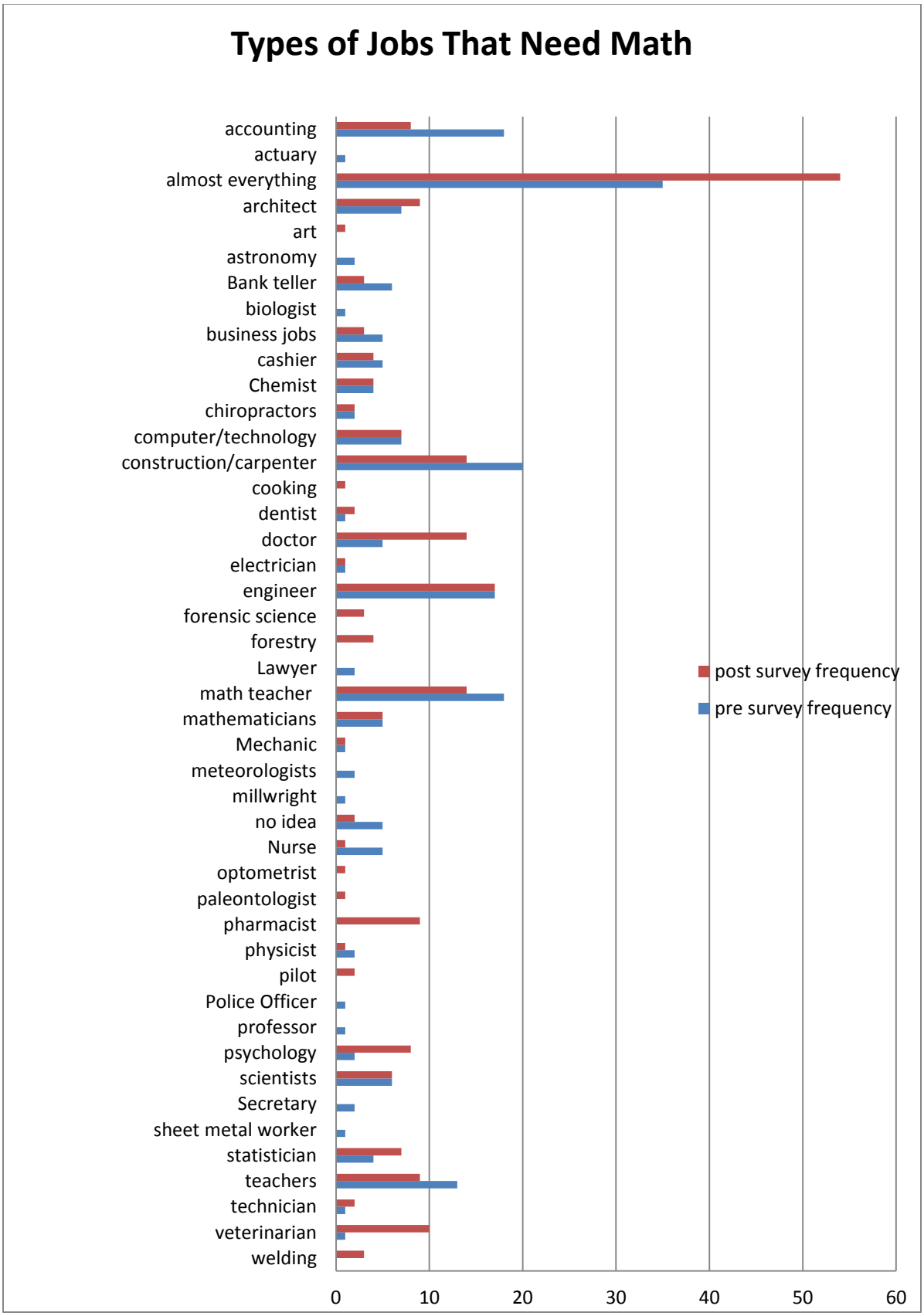
Types of Jobs That Need Math
accounting
actuary
almost everything
architect
art
astronomy
Bank teller
biologist
business jobs
cashier
Chemist
chiropractors
computer/technology
construction/carpenter
cooking
dentist
doctor
electrician
engineer
forensic science
forestry
Lawyer
math teacher
mathematicians
Mechanic
meteorologists
millwright
no idea
Nurse
optometrist
paleontologist
pharmacist
physicist
pilot
Police Officer
professor
psychology
scientists
Secretary
sheet metal worker
statistician
teachers
technician
veterinarian
welding
post survey frequency
pre survey frequency
0
10
20
30
40
50
60

Figure 6

When will you use math outside of school received 140 comments on the pre-survey and the post-survey received 181 comments portrayed in figure 7. The number of students reporting work as an area where they would use math outside of school increased from 36 to 52 comments. There was an increase from 22 to 45 responses in students saying they will use math everywhere.

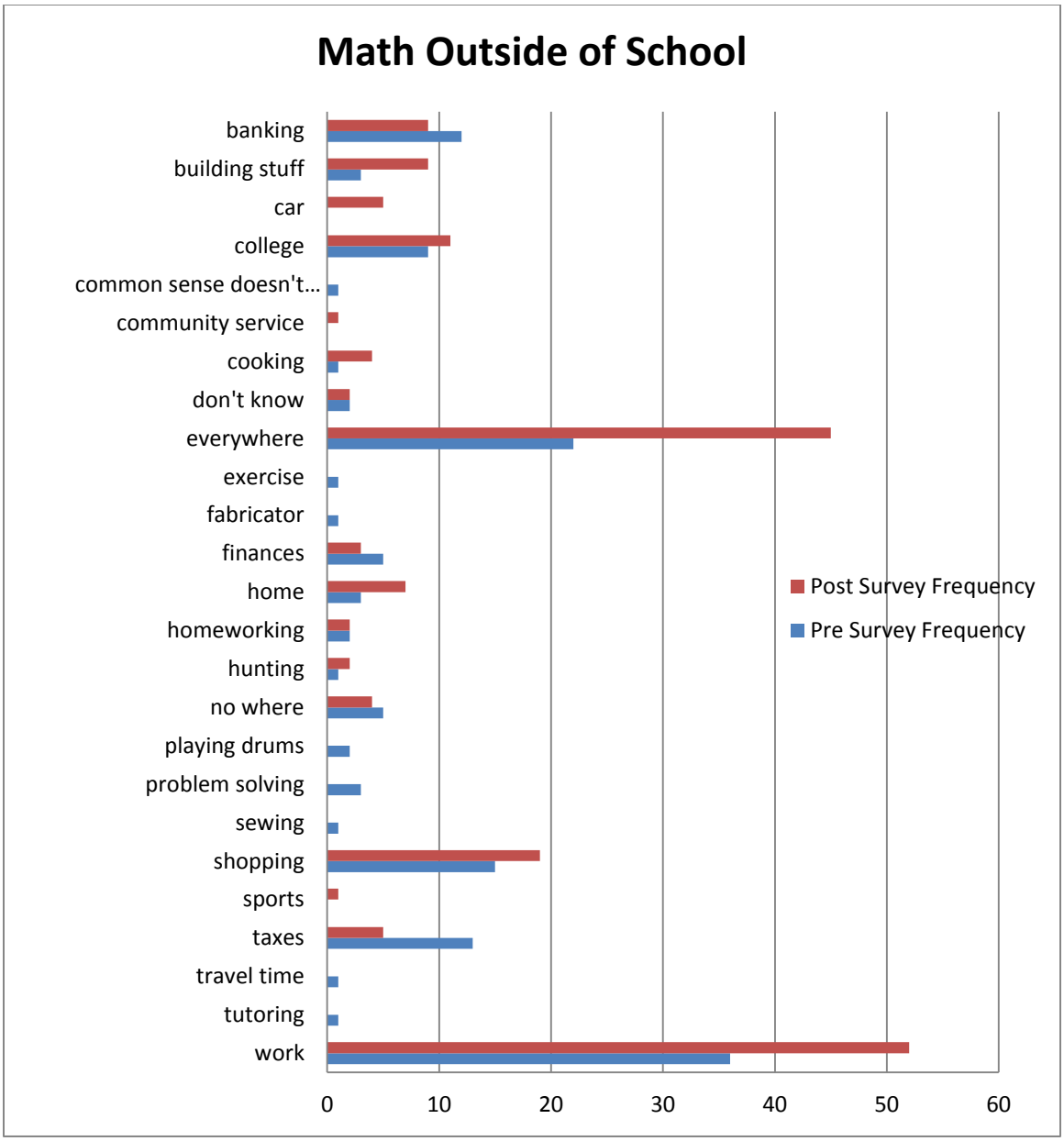

Figure 7

Careers that use math had a great deal of similarity to the responses students had for the careers that required math for the career as seen in figure 8. The number of responses from the pre-survey to the post-survey increased from 201 to 241. There were 35 students who stated a lot of jobs use math compared to the 54 students who responded on the post-survey. The number of students who listed architect dropped from 11 to 0 which was a little puzzling due to the fact there were a few students who researched and presented information about architects. This is a career that uses a lot of math but did not get any responses on the post-survey. The pre-survey did have a few students who stated a doctor and dentist, but the careers in the medical field increased in quantity as well as additional occupations like optometrist, pharmacist, and chiropractor. The number of students who reported math teacher dropped from 16 to 10. Hopefully this was due to the fact that students were aware of more careers that they did not state some of the obvious ones.

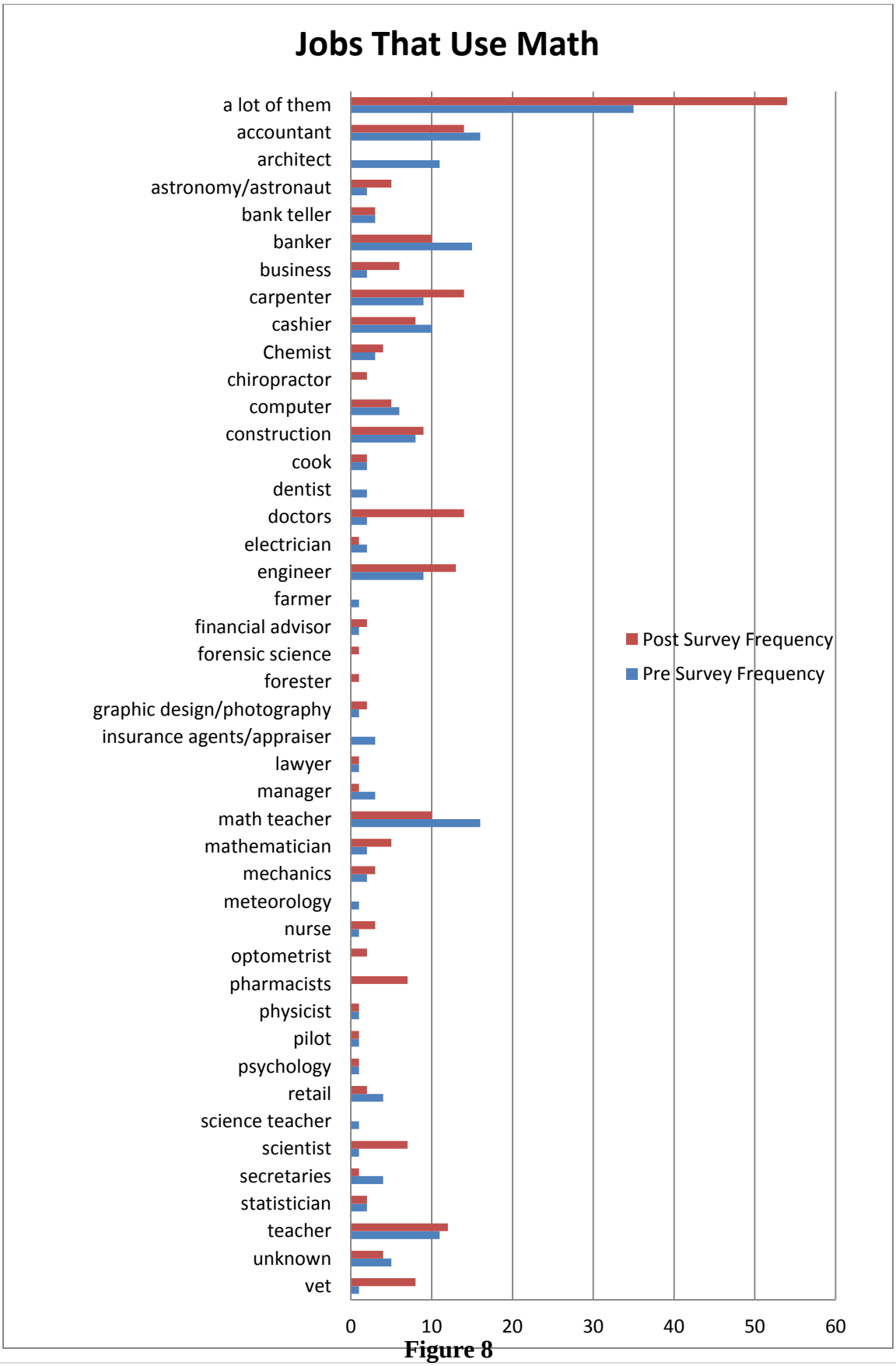
Jobs That Use Math
a lot of them
accountant
architect
astronomy/astronaut
bank teller
banker
business
carpenter
cashier
Chemist
chiropractor
computer
construction
cook
dentist
doctors
electrician
engineer
farmer
financial advisor
forensic science
forester
graphic design/photography
insurance agents/appraiser
lawyer
manager
math teacher
mathematician
mechanics
meteorology
nurse
optometrist
pharmacists
physicist
pilot
psychology
retail
science teacher
scientist
secretaries
statistician
teacher
unknown
vet
0
10
20
30
40
50
60
Post Survey Frequency
Pre Survey Frequency

Figure 8

The last question on the post-survey asked students what they learned from this project. This question was only on the post-survey to get a feeling of what students thought about the career project. Most of the responses were very basic and can be seen in figure 9. I was hoping to get more specific responses to see how this project may have been beneficial. There were 74 students who did state that math is used a lot. Some students stated they learned something about a specific career that they were interested in while other students just said they learned about some careers that use math.

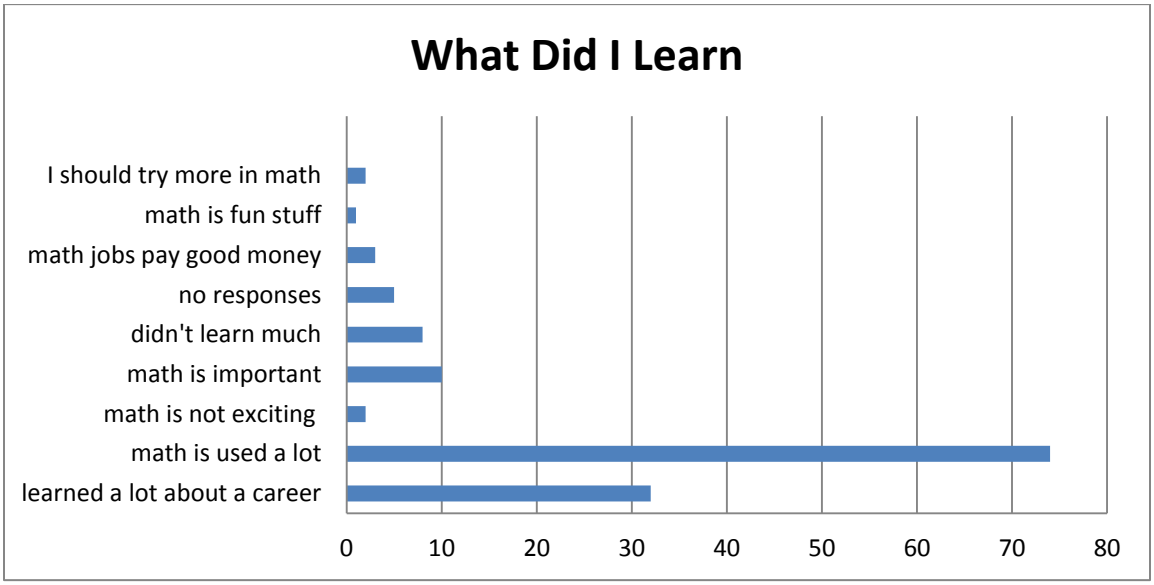

Figure 9

Data from the pre-survey and post-survey was analyzed to determine whether or not any affects from exposing students to math related careers had on their perceptions of math and the importance math has in the real world. The data was analyzed as a whole, and the data broken down into categories of age, gender, and math class. There were some significant changes calculated for a number of attributes from the surveys. Some of the results were promising and was what I was hoping to see, but there were a few undesired results that were obtained as well. These results will be summarized in the next chapter.

Chapter 5

Conclusion

The math career project was a hit for a number of students according to some of the verbal responses. Many of the students have asked if they could do another project like this in the future. Whether the students truly enjoyed the project and found it valuable or whether they were happy to have a project versus a comprehensive final, I think it was valuable for the students to be exposed to career options in math. Education is about exposing students to valuable life skills. As a math teacher, it is not only my job to teach math but to prepare my students for what is to come or a math related career.

The results for all students showed two significant increases of the means from the pre-survey to the post-survey. *Mathematics is important for everyday life* had a significant increase in the pre-survey mean of 3.6699 to a post-survey mean of 3.925, *the skills I learn in math will help me in other classes* had a significant increase in the pre-survey mean of 3.5684 to a post-survey mean 3.8667. These are some positive results from students as a group due to the significant increases. This shows students did gain some perspective on the importance math has on everyday life and that math will benefit them in other classes.

When data was broken down into categories according to gender, results from female students showed very little alteration. There has always been a stereotype that males are better than females in math. According to Halpern (2007), girls are less confident in math and show less interest in math than boys. This reality is partly due to the current low number of females in math related careers compared to the number of

males. Parent expectations also have an influence on a girl's view of math. Jayaratne (1983) also found related results in that parents' beliefs play a significant role in a girl's ability to do math. Girls do not feel they have the skills necessary to earn a career in a math related career due to the perceptions placed on them. Parents believe that upper level math courses are not as important for girls to take as it is for boys. Female students have a great deal to overcome in order to be successful gaining employment in math related careers. Females are overwhelmed at the gender makeup of math related careers and the perceptions and stereotypes about their abilities in math. It will take a great deal of exposure and positive encouragement to fix this issue and make females believe they are equals.

The data for males revealed more promising results. Male students presented results that were statistically significant for *Math is important to me* with a with a pre-survey mean of 3.2885 to a post-survey mean of 3.6923, *real math problems can be solved by common sense instead of math rules you learn in school* with a pre-survey mean of 2.9412 to a post-survey mean of 3.3654, and *the skills I learn in math will help me in other classes* with a pre-survey mean of 3.4118 to a post-survey mean of 3.8654. Male students seem to realize that math is important and that math will be able to assist them in other classes. Jayaratne (1983) found that fathers enjoyed math more than mothers and fathers also believed that they were better at math. Halpern (2007) revealed that parents have higher expectations for boys than girls. Since males are typically more confident in their math abilities and they have higher expectations put on them by their parents, I would expect males to have higher perceptions of their own math ability.

When data was analyzed for the different courses, significant decreases were calculated for Pre-Calculus students for the attributes of *math is needed in designing practically everything* with a pre-survey of 4.5294 to a post-survey mean 3.8235, *I am good at math* with a pre-survey mean of 4.1177 to a post-survey mean of 3.2353, *the skills I learn in math will help me in other classes* with a pre-survey mean of 4.3529 to a post-survey mean of 3.7647, and *my parents expect me to do well in math* with pre-survey mean of 4.4706 to a post-survey mean of 3.6471. A significant increase was found for *I have never liked math and it's my most dreaded subject* with a pre-survey mean of 2.1765 to a post-survey mean of 3.2353. The results for the Pre-Calculus students go against the desired outcomes. I would be curious to find out why these students responded the way they did and how this could have affected the results.

College Transition students had significant increases for *math is enjoyable and stimulating to me* with a pre-survey mean of 1.8889 to a post-survey mean of 2.6111, *math is important to me* with a pre-survey mean of 2.7778 to a post-survey mean of 3.5556, and *my parents expect me to do well in math* with a pre-survey mean of 3.7222 to a post-survey mean of 4.4444. The data does lead me to believe that these students were able to see where and how math is used in a number of careers. All of these students are seniors and are seriously thinking about their future especially when looking at further education and careers.

Pre-Algebra students revealed significant increases for *my parents expect me to do well in math* with a pre-survey mean of 3.7895 to a post-survey mean of 4.4211 and *the skills I learn in math will help me in other classes* with a pre-survey mean of 3.4211 to a post-survey mean of 4.2632. These students typically struggle with math and would

be the students who would shy away from a math career. The data portrays that these students do see math as a valuable tool especially in being more successful in other classes. I would be curious to find out why students perspectives of their parents expectations of them in math has changed. I would not have assumed this attribute would have changed much less be significant.

Algebra 2 students showed no significant increases or decreases in any of the attributes. Out of my four different courses taught, Algebra 2 is the course with the most diversity. There are some seniors taking this course to gain the minimal math requirements to apply for colleges. They tend to struggle more than the other students in class. There are a large number of juniors taking the course who are the middle of the road students. There are also a large number of sophomores. These sophomore students are on the advanced track and are slotted to take Calculus as seniors. In addition to these advanced sophomores, there are two freshmen taking Algebra 2. Since there is such diversity in the make-up of the Algebra 2 classes, analyzing data based upon grade level may provide more information about these outcomes.

Seniors delivered significant increases for *math is important to me* with a pre-survey mean of 2.9412 to a post-survey mean of 3.5000 and *mathematics is important for everyday life* with a pre-survey mean of 3.5000 to a post-survey mean of 4.0000. There was one attribute *there is nothing creative about math and it's just memorizing formulas and things* that had a significant decrease with a pre-survey mean of 3.3529 to a post-survey mean of 2.5588.

Juniors showed no significant increases for decreases in the results.

Sophomores had a significant decrease for the attribute *I am good at math* with a pre-survey mean of 3.6071 to a post-survey mean of 2.9286.

Freshmen had a significant increase for *the skills I learn in math will help me in other classes* with a pre-survey mean of 3.5000 to a post-survey mean of 4.1250.

In order to provide a more complete picture of the results, qualitative data was also collected in order to better understand student quantitative responses. The open ended questions showed an increase that *almost every job uses math, math is used everywhere outside of school, math is used outside of school at work* and *there are a lot of jobs that use math*. I wanted to gather as much information as possible by not limiting students' responses, so my open ended questions were broad. This led to broad results of the open ended questions; therefore not providing me much insight in to how specifically the career project may have benefited the students. To give me more understanding in the future, I would write additional questions that would require more detail on the specific careers that require a college education and what specific jobs use math on a regular basis. I did not feel I obtained much substantial information by having the open ended questions so broad. On the post-survey, I would have asked them what specific career did they find the most interesting, and why. I would ask students what specific career they would consider pursuing and why. I would also ask them why this project should or should not be assigned in the future.

One question that needs to be asked is whether the results could be reproduced. What would happen if I were to assign the career project again in a year or two? Would similar results be obtained if this career project was carried out at another location? What would the data reveal if the project was assigned to all of the math classes in the high

school and even the middle school? Did socioeconomic status of my district or geography have any impact on my data?

Some of the reports students typed were extremely well written and met all of the guidelines in the rubric. With other reports I could tell that the student only put a couple of hours into the project, and that was when they had class time. Therefore it may not have been as beneficial to them as it would have been if they would have put in more time. This project was important for me to stress that even math minded individuals need to be able to write reports. It is important for students to be able to portray their thoughts and ideas in all academic areas including math.

Did the research project have any positive impact on students' motivation to perform better in math knowing that math is necessary and important for the daily operations of the world? This project could be assigned again with a control group and a test group to see if there are any effects on students' grades. There could also be a longitudinal study to see if there are any long term advantages of students participating in the career project.

After looking at the literature review along with the results of the data, I realize there are some modifications I would consider when assigning this project again. Since females are less likely to pursue a career in math and science, I would make sure there are female biographies for girls to read. Having students research information on the internet is great, but I would attempt to have guest speakers from nearby businesses share what math they use on a daily basis and why math is important to their career.

Another modification I would make is to allow students the opportunity to make comments on any of the statements in the pre-survey and post-survey dealing with the

Likert scale to get a better understanding on why they responded the way they did. The statement from table 17 *real math problems could be solved by common sense instead of the math rules you learn in school* had male students with a significant increase for their feelings while female students felt somewhat the opposite. Was this difference because males and females feel the opposite after the project, or is their understanding of the statement different? Allowing students to add comments to the statements may give me some insight to why males and females responded the way they did. Could this difference in opinions be a gender difference, where teachers need to accommodate accordingly when instructing? Maybe students from different classes respond differently for some circumstance as well.

There were a number of significant changes in the student responses from the pre-survey to the post-survey as you can see in table 29. Seniors did show a number of significant changes in the attributes I was hoping to see changes in like *math is important for everyday life, there is nothing creative about math and it's just memorizing formula and things,* and *math is important to me.* Students as a whole group also showed desirable changes in *math is important for everyday life, there is nothing creative about math and it's just memorizing formulas and things,* and *the skills I learn in math will help me in other classes.* Pre-Algebra students had pleasant results for *the skills I learn in math with help me in other classes* and *my parents expect me to do well in math.*

The Pre-Calculus students responded significantly for a few attributes that were not desirable namely: *the skills I learn in math will help me in other classes, I am good at math, my parents expect me to do well in math, I have never liked math and it's my most dreaded subject,* and *math is needed is designing practically everything.* The

students in Pre-Calculus were all seniors and juniors except for one sophomore. Many of these students may have a career path all planned out and this project may have served little importance to them. I would like to see how the results from another Pre-Calculus class would compare.

	Category	Pre-Survey Mean	Post-Survey Mean
Math is important for everyday life	Seniors	3.5000	4.000
	All	3.6699	3.9250
There is nothing creative about math and it's just memorizing formulas and things	All	3.0196	2.7397
	Seniors	3.3529	2.5588
The skills I learn in math will help me in other classes	Pre-Algebra	3.4211	4.2632
	All	3.5684	3.8667
	Males	3.4118	3.8654
	Freshmen	3.5000	4.1250
	Pre-Calculus	4.3529	3.7647
Math is important to me	College Transition	2.7778	3.5556
	Seniors	2.9412	3.5000
	Males	3.2885	3.6923
Real world math problems can be solved by common sense instead of the math rules you learn in school	Males	2.9412	3.3654
Math is enjoyable and stimulating to me	College Transition	1.8889	2.6111
I am good at math	Sophomores	3.6071	2.9286
	Pre-Calculus	4.1177	3.2353
My parents expect me to do well in math	College Transition	3.7222	4.4444
	Pre-Algebra	3.7895	4.4211
	Pre-Calculus	4.4706	3.6471
I have never liked math and it's my most dreaded subject	Pre-Calculus	2.1765	3.2353
Math is needed is designing practically everything	Pre-Calculus	4.5294	3.8235

Table 29

The males and the younger students did show desirable outcomes. The career project may be better suited for students who are younger or who are undecided about their career paths. Being able to influence younger students is a great plus since these

students will be more motivated to learn in the math classes and therefore will be more enjoyable to teach because of that.

Female students showed no significant changes. There has been a big push to get females involved in STEM (science, technology, engineering, and math) in the recent years. The results from this project reiterate the need to help promote STEM to female students. I would like to see if bringing in local females working in math related fields for future career projects would have any desirable and significant changes in the responses from female students.

Overall, the math career project was a success. Statistically speaking, there were significant decreases and increases that were desired by all students as a whole and as a group based upon the different categories whether it was gender, class, or grade. There was some data that went against the desired outcomes. Better questioning and open ended questions may have assisted in understanding why students responded the way they did. We all know that every student is different and every year of teaching is different. How would the results obtained here compare with a different year, different location, younger students, and/or all students within a school?

Math is a tool that can be used in a variety of careers and life situations. Students need to be aware of these careers and life situations in order to understand the importance of math and where it is used. Without knowing this, why would students spend the time and effort into learning something they feel is irrelevant to them and their future? The exposure students received from this math related career project should have at least opened some of their eyes. If this math career project exposed a few students to a career

which they were unaware of and are now interested in finding out more information, then this was valuable lesson for my students.

Chapter 6

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Appendix 1

Math Career Pre-Survey

Grade: ☐ Age: ☐ Gender: ☐

What math class are you currently taking?

What grade do you typically receive in math?

A A- B+ B B- C+ C C- D+ D D- F

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
Mathematics is enjoyable and stimulating to me	1	2	3	4	5
I am good at math.	1	2	3	4	5
Math is important to me.	1	2	3	4	5
My parents expect me to do well in math.	1	2	3	4	5
My parents/guardians use math frequently.	1	2	3	4	5
I try to learn math because it helps develop my mind and helps me think more clearly in general.	1	2	3	4	5
I have never liked math and it is my most dreaded subject.	1	2	3	4	5
Mathematics is important for everyday life.	1	2	3	4	5
There is nothing creative about mathematics; it's just memorizing formulas and things.	1	2	3	4	5
Using the web or a computer is a good way for me to learn math.	1	2	3	4	5

Everything important about math is already known by

mathematicians.	1	2	3	4	5
Math makes me feel uneasy and confused.	1	2	3	4	5
Math is a solitary activity, done by individuals in isolation.	1	2	3	4	5
Math is less important to people than art or literature.	1	2	3	4	5
Math is needed in designing practically everything.	1	2	3	4	5
Real math problems can be solved by common sense instead of the math rules you learn in school.	1	2	3	4	5
The skills I learn in math will help me in other classes.	1	2	3	4	5

What kinds of jobs require a math degree from college?

Where will I use math outside of school?

What kinds of jobs use math on a regular basis?

Appendix 2

Mathematics Career Project
We all use math everyday but some more than others. In this project, you will examine the use of mathematical concepts in a common (or uncommon) career. You will interview a professional within the given profession or read a biography of a professional individual, examine math concepts used within the occupation and compile a written summary of your investigation.

Due Dates

- Interview/Biography summary notes must be handed in no later than the end of class on **Wednesday January 12th 2011.**
- Final papers must be handed in electronically or as a hard copy no later than the end of class on **Monday January 17th 2011**.
- Presentation to class will occur during the scheduled final times. You must email me the presentation or bring a copy of the presentation to me by the end of class time on **Monday January 17th 2011**.
- Evaluation must be turned in **Thursday January 20th 2011**.

Paper topics
Each paper will address all of the following topics:

1. Introduction
2. Career investigation. Interview with a professional working in the career selected or find/read a biography of a person who works in this field (note: If you choose to use a biography, a copy of the biography must be provided with the final project paper). From the interview or biography, answer the following topics:
    a. A brief biography of the professional (including, but not limited to, a brief background, schooling, and basic job description).
    b. An explanation of what drew this person to their occupation or what they were doing before they began this occupation.
    c. How this person uses math in their career?
    d. What mathematical concepts they use on a regular basis?
    e. Where did they learn the math they needed to be successful in their career?

3. Career Concepts Explained. Answer the following questions about the career. Use the interview or Biography as part of your reference. You may also need to look up further information about this occupation.
    a. What is the nature of the work (job responsibilities, day to day activities)?
    b. What are the working conditions (outside, inside, office, managerial, solitary, team)?
    c. What qualifications are required (schooling, training, certifications, and/or tests)?
    d. What opportunities for advancement are there?

    e. What is the job outlook (how might this job change in the future)?
    f. What are the potential earnings?
4. Conclusion
5. Resources
    a. List any text, magazines, articles used by professionals in this field on a separate reference page in your report.
    b. If you use a biography, include a copy of the entire article.
    c. Here are some links that may be helpful
        i. http://www.ams.org/careers/archived.html
        ii. http://www.maa.org/careers
        iii. http://stats.bls.gov/oco/ocos043.htm

Guidelines

- Project will be completed in three parts: interview/biography summary, final paper, and presentation.
- The paper must be approximately 3-5 pages in length (not including the cover or reference page).
- The paper must be typed and include a cover page.
- The typed paper should be double spaced, 12 font with 1 inch margins.
- Paper must contain an introduction and a conclusion.
- Papers must be the original creation and not plagiarized from other resource materials.

Presentation

- Must provide a visual aide during presentation or make a short PowerPoint.
- You must speak clearly and have good eye contact.
- Presentation should be between 2-5 minutes.
- You must include interesting or valuable information about the career.
- You need to be respectful of your classmates while they are presenting

Evaluation

- Pick a few careers you thought were interesting and write a few comments about each of them.

Appendix 3

Rubric

Interview/Biography summary notes:

-	Brief summary of profession:	5	4	3	2	1	0
-	What brought them to occupation:	5	4	3	2	1	0
-	How do they use math:	5	4	3	2	1	0
-	What math concepts are used:	5	4	3	2	1	0
-	Where did they learn their math:	5	4	3	2	1	0

Paper

-	Introduction/Conclusion:	5	4	3	2	1	0
-	Cover page/resources attached:	5	4	3	2	1	0
-	3-5 pages/typed/font 12/margins 1in:	5	4	3	2	1	0
-	Complete Sentences:	5	4	3	2	1	0
-	Brief summary of profession:	5	4	3	2	1	0
-	What brought them to occupation:	5	4	3	2	1	0
-	How do they use math:	5	4	3	2	1	0
-	What math concepts are used:	5	4	3	2	1	0
-	Where did they learn their math:	5	4	3	2	1	0

Presentation

-	Visual aids/power point:	5	4	3	2	1	0
-	Spoke clearly/eye contact/ 2-5 min:	5	4	3	2	1	0
-	Listened to others/asked good ?'s:	5	4	3	2	1	0
-	Presented important information:	5	4	3	2	1	0

Evaluation

-	Picked a few careers to comment on:	5	4	3	2	1	0
-	Are the comments meaningful?:	5	4	3	2	1	0

Appendix 4

Advanced or theoretical mathematics

Actuaries
Agricultural scientists
Architects
Biological and medical scientists
Chemists
Computer scientists, computer engineers, and systems analysts
Economists and marketing research analysts
Engineering, science, and data processing managers
Engineers
Foresters and conservation scientists
Geologists, geophysicists, and oceanographers
Mathematicians
Mathematics teachers (secondary school and college)
Meteorologists
Operations research analysts
Physicists and astronomers
Social scientists
Statisticians

Applied mathematics

Accountants and auditors
Administrative services managers
Aircraft pilots
Budget analysts
Chiropractors
College and university faculty (nonmathematics)
Computer programmers
Construction and building inspectors
Construction contractors and managers
Cost estimators
Dentists
Dispensing opticians
Drafters
Education administrators
Engineering technicians
Farmers and farm managers
Financial managers
General managers and top executives
Government chief executives and legislators
Industrial production managers
Insurance agents and brokers
Insurance underwriters
Loan officers and counselors
Management analysts and consultants
Optometrists
Pharmacists
Physician assistants
Physicians
Podiatrists
Psychologists
Real estate agents, brokers, and appraisers
Respiratory therapists
Science technicians
Securities and financial services sales representatives
Special education teachers
Surveyors and mapping scientists
Urban and regional planners
Veterinarians

Practical application of mathematics

Air traffic controllers
Aircraft mechanics, including engine specialists
Automobile mechanics
Automotive body repairers
Blue collar worker supervisors
Boilermakers
Broadcast technicians
Carpenters
Concrete masons and terrazzo workers
Diesel mechanics
Dietitians and nutritionists
Electric power generating plant operators and power
distributors and dispatchers
Electricians
Electronic equipment repairers
Elevator installers and repairers
Farm equipment mechanics
Funeral directors
General maintenance mechanics
Heating, air-conditioning, and refrigeration technicians
Industrial machinery repairers
Inspectors, testers, and graders
Jewelers
Landscape architects
Machinists and tool programmers
Millwrights
Mobile heavy equipment mechanics
Motorcycle, boat, and small-engine repairers
Ophthalmic laboratory technicians
Photographers and camera operators
Purchasers and buyers
Sheetmetal workers
Stationary engineers
Tool-and-die makers
Water and wastewater treatment plant operators
Welders, cutters, and welding machine operators

General mathematics

Bank tellers
Billing clerks and billing machine operators
Bindery workers
Bookkeeping, accounting, and auditing clerks
Bricklayers and stonemasons
Brokerage clerks and statement clerks
Cashiers
Counter and rental clerks
Drywall workers and lathers
Glaziers
Interviewing and new accounts clerks
Library assistants and bookmobile drivers
Loan clerks and credit authorizers, checkers, and clerks
Manufacturers' and wholesale sales representatives
Medical assistants
Metalworking and plastic-working machine operators
Order clerks
Payroll and timekeeping clerks
Plasterers
Postal clerks and mail carriers
Precision assemblers
Prepress workers
Printing press operators
Private detectives and investigators
Reservation and transportation ticket agents and
travel clerks
Roofers
Secretaries
Stock clerks
Structural and reinforcing ironworkers
Taxidrivers and chauffeurs
Teacher aides
Tilesetters
Traffic, shipping, and receiving clerks

Appendix 5

Math Career Post Survey

Grade: ☐ Age: ☐ Gender: ☐

What math class are you currently taking?

What grade do you typically receive in math?

A A- B+ B B- C+ C C- D+ D D- F

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
Mathematics is enjoyable and stimulating to me	1	2	3	4	5
I am good at math.	1	2	3	4	5
Math is important to me.	1	2	3	4	5
My parents expect me to do well in math.	1	2	3	4	5
My parents/guardians use math frequently.	1	2	3	4	5
I try to learn math because it helps develop my mind and helps me think more clearly in general.	1	2	3	4	5
I have never liked math and it is my most dreaded subject.	1	2	3	4	5
Mathematics is important for everyday life.	1	2	3	4	5
There is nothing creative about mathematics; it's just memorizing formulas and things.	1	2	3	4	5
Using the web or a computer is a good way for me to learn math.	1	2	3	4	5

Everything important about math is already known by

mathematicians.	1	2	3	4	5
Math makes me feel uneasy and confused.	1	2	3	4	5
Math is a solitary activity, done by individuals in isolation.	1	2	3	4	5
Math is less important to people than art or literature.	1	2	3	4	5
Math is needed in designing practically everything.	1	2	3	4	5
Real math problems can be solved by commons sense instead of the math rules you learn in school.	1	2	3	4	5
The skills I learn in math will help me in other classes.	1	2	3	4	5

What kinds of jobs require a math degree from college?

Where will I use math outside of school?

What kinds of jobs use math on a regular basis?

What did you learn from this project and presentations?