This report is compliments of Ray Holt, President and Founder of STEM Advancement Inc, dba Mississippi Robotics. Mississippi Robotics reaches into the rural communities of Mississippi and brings the excitement of science, technology, engineering, math and robotics to the students.

Mississippi Robotics conducts two state-wide STEM/Robotics Competition each year that is open to every 3rd – 12th grade student. This is the only time that most of these rural students have been able to compete against others in their state. Please take a look at our website and feel free to communicate through our Contact Us page.

I would love to get your feedback on this e-book and on your efforts to reach rural students.

Ray Holt

Robotics: Does it motivate rural students to go to college?

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University of Mississippi

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Introduction

Off the beaten path education in rural Mississippi is struggling to survive. School buildings are falling apart, textbooks are missing, lab supplies are scarce, and money never seems to be enough. Quality teachers have little resources to work with and after many long days of dealing with behavior issues most are not up to bringing the students to a higher level. For state tested classes, preparing students for state testing consumes most of the teaching time. Little time is left for being creative.

Students have little reason to be motivated. Many of their parents did not complete high school, did not go to college, are unemployed or underemployed, and do not have the ability to help them with homework. Many parents provide encouraging words such as “You need to study in order to get a good job,” but sometimes that is just not enough. What does a job mean to these students? A job at the local market that is threatening to close, maybe at the Wal Mart 10 miles away, or maybe at the corner drug that has been around for over 75 years. Most of the other business employment opportunities are gone. By observation, it is apparent that half the town business buildings are empty.

According to the Mississippi Center for Public Policy ("MCPP reports," 2011-12) 37.5% of school districts in Mississippi are rated “D” and “F” on the state “A-F” grading scale. Most of these schools are along the Mississippi River,, and several of them are well off the two or three main highways that cross the state. School districts administrators are locally elected and are often undereducated or inexperienced to run the school district or to bring it up from the bottom. Status quo seems to be the norm.

What reason would a student stay in school when they have many other choices, such as, part-time jobs, drugs, off-shore high paying job promises, GED and Workforce jobs that are attractive? Students drop out at the rate of 20% and hope for a better solution to their life than sitting and struggling in a classroom all day. High school is boring and provides little hope to most students.

A little over three years ago I was introduced to this exact situation and was offered to be a part of the solution, whatever that meant. As an out-of-state experienced engineer and computer scientist I had little real experience of the conditions facing local rural towns and schools. A pastor, his wife, and several leaders have struggled tirelessly and with little resources to find a better solution, to make positive changes, and to provide hope for the local kids and promises that their life will not be like their parents. Few successes have come to this small town of 900+. After much discussion over possible and realistic solutions to a new type of educational offering, it was decided we would introduce robotics to a few students and see if that would do anything to motivate them towards a better education. Of course, we did not expect any type of immediate change, only the slim glimmer of hope that the students wanted to learn about robotics.

The Robotics and Engineering program used in this study started in August 2010 with 18 students. The program runs on Saturday's with several 2-3 hour classes from August – May. Students from 4^{th} – 12^{th} grades attend. During the summer of 2011, we ran one week robotics camp for 10 middle-school students. The following two years we ran the Saturday program with 32 students (2011-12) and 44 students (2012-13). During both these years, we formed middle-school and high school competition teams and entered in the For Inspiration and Recognition of

Science and Technology (FIRST) First Lego League (FLL) and First Tech Challenge (FTC) competitions.

Obvious success rates (not measured with this study) of the Robotics and Engineering program were that 100% of the students have remained in high school and attendance rates at this program was and continues to be 95%. It was clear to the author that the students attending the program were motivated. This study attempts to dig a little deeper and try to surface the factors that motives the current students. The 11 students selected for this study are those that are members of the high school FTC competition team. All of them have been in the program for 2-3 years and were willing to be surveyed and questioned about their participation. All the parents also agreed to participate in the study.

Classroom Used in this Study

The program used in this study is not a public classroom. It is a non-school related program that mostly meets on Saturday's at the sponsored ministry organization. This Robotics and Engineering program teach basic classes in science, technology, engineering and math (STEM). No particular curriculum was followed but using the knowledge of the instructor and his extensive engineering and computer experience a set of lessons and courses were developed to introduce students to the fundamentals of mechanics, robot building, and robot programming as well as incorporating the concepts of teamwork and cooperation. Projects were assigned that allowed the students to create and design, illustrate, build, and program their own robot. Written and oral presentations were also required as part of the projects.

As the program developed and matured classes were added in air and water rockets, bridge and tower building, solar cars, and advanced robotics. Local competitions were organized in solar car races, robot races and sumo robot competitions. During the 2nd year, a middle school competition team was entered into the FIRST FLL competition. They placed 1st in Project Presentation and 5th in Robot Challenge in the State. During our 3rd year, we entered two younger teams and even though they did very well they did not place. Also, during our 3rd year we entered one team into the FIRST FTC high school level competition and won 1st Place in Robot Design and 2nd Place in Inspire allowing this team to be invited to the World Robotics Competition. At the World Robotics Competition, (FIRST FTC World Robotics Championships, n.d.) this team placed 13th out of 64 in their division winning 6 of 8 matches. They were also ranked the highest 1st year team in their division.

From students being possible drop-outs enrolled in a failing school to team members in the World Robotics Competition; these students have accomplished a major feat. They were given an opportunity to learn new and technical challenges in an optional program, and they excelled beyond what anyone could have imagined. College and engineering and technical careers are in the future for these students that otherwise might not have even known of these opportunities.

Focus of this Study

There are many areas to study in a program like this, however, for this study I have concentrated on the factors that encourage and motive the students to attend and stay in a program like this. I would like to know if their academic grades have been affected and I would like to know if this type of program helps them to consider college. Students and parents were surveyed and interviewed.

The research questions to be answered are: a) What are the factors that encourage each student to come and continue in the program? b) Does this program encourage each student to consider college and an engineering career in college? c) What, if any, academic changes have occurred with these students during their time in the program? Each student was asked to rate, from 1 – 10 (1=not motivating, 10=very motivating) several areas of the program and how it motivated them to continue the Robotics and Engineering program and to consider college options. Parents were asked similar questions pertaining to their student. Also, a second survey was sent to the students to wrap up unanswered questions.

Parents were asked to provide academic records for their student. From these and previous existing records collected by the program conclusions were made on the academic progress of these students.

This action research study will provide a formalized way to collect data and provide answers to some of the key questions on what motivates rural students to perform well. The researcher used a variety of data sources and peer review to eliminate researcher bias.

It is also important to mention that this study was conceived before these students participated in the FTC Robotics State Competition and that the study instruments were executed after the students heard they were invited to attend the World Robotics Competition. This well-deserved excitement and emotional joy most likely influenced the results of this study; it certainly, made the purpose of this study even more meaningful. As author, I take all responsibilities for errors and omission in the preparation, execution, and results of this study that may not be clearly presented or accurately measured or calculated. However, I certainly do not make any excuses for the tremendous accomplishments of these students who have pulled themselves out of a situation where little opportunity existed to excelling beyond their own dreams.

Review of Literature

Using robots in education has been envisioned for over 30 years. (Papert, 1980), albeit ahead of his time, believed that children programming robots would give them power over technology. This process of controlling a real machine would help children understand real-world problems. (Papert, 1980) Believed that children need real-world examples to demonstrate learning concepts. He stressed that children learn from their experiences and that robots help children to see failure as information to a correct solution. Even though, robots were not practical for children because of their cost and size the idea of using a real-world, hands-on robot continued to be studied. Universities were the first to fully implement robots as tools in a classroom for learning technical disciplines.

(Papert, 1980), through his MIT Media Lab, worked closely with LEGO and in 1988 introduced an introductory programmable construction product. Graduate student Fred Martin (Martin, 1994) tested the technology with classroom students as part of his master's thesis. This early research led to LEGO's programmable consumer product in 1998 called, Mindstorm (named after Papert's book title). This was a true robotic invention system. Mindstorm has become the basis for many project-based and hands-on training courses for elementary students through college graduates. (http://www.media.mit.edu/sponsorship/getting-value/collaborations/mindstorms)

(Martin, 1994) focused on "a model class experience for undergraduate engineering students that address the deficiencies in the traditional education." (p. 3). (Martin, 1994) Wanted to find "specifics way to build empowering experiences into the undergraduate curriculum." (p. 4). Martin's concern was that graduated engineers could analyze problems but had little or no experience in design. His work has directly affected and encouraged a plethora of research studies, robot designs, and classroom curriculums which has trained 10,000's of students in the joys of a robotic system design and development (i.e. creating a toy and making it do what I want).

The concept of teaching through constructivism has been very intriguing to researchers and teachers for decades. Building and hands-on training has always been used in training for a trade but rarely used in teaching early education students. (Beer, Chiel, & Drushel, 1999) designed a college-level course around robot building and programming. His Autonomous Robotics course developed at Case Western Reserve University was based on technology developed at MIT for K-12 education as well as an undergraduate course. This course was unique in that it addressed a broad set of engineering disciplines and offered building and programming, as well as, a technically challenging final competition.

(Beer et al., 1999) stated "Engineering and science students often find the transition from student to professional difficult for four major reasons: (1) students are not trained to deal with problems that require an integrated approach; (2) they are rarely exposed to the real-world issues that such problems pose; (3) they are rarely encouraged to solve problems through teamwork, or to bring to bear information from multiple disciplines; and (4) they rarely have an opportunity for critical thinking." (p. 86). (Beer et al., 1999) believed that it was important for students to be able to come up with creative solutions to problems and that there was usually more than one solution.

(Richardson, 2003) provided a critique of constructivism pedagogy and its relationship to constructivist learning theory. Richardson was particularly concerned with the "difficulty in translating a theory of learning into a theory or practice of teaching, a conversion that has always been difficult and less than satisfactory." (p. 1). This work concentrated on the theory and development of teachers skills in translating constructivism pedagogy to effective teaching. The process and methods of putting programmable machines in front of kids is more than giving them a toy to play with, it involves a complex system design and development of teaching and learning methods translated into effective curriculum and teaching all the while keeping it fun and enjoyable for the kids.

Teaching with robots has permeated all levels of education. Studies and experiments have been performed at the elementary, middle-school, high-school, and college levels. Most of the studies have developed and analyzed curriculum material and have used robot kits or assembled units to teach some form of robot that can be built and programmed by the student. Subjects from all aspects of science, technology, engineering and mathematics (STEM) have been taught. (Fagin & Merkle, 2003) during their study of over 800 college students mentioned that words like " "interesting," "fun," "challenging," and "relevant" kept recurring in the discussions" (p. 310) in the analysis of their focus group transcripts. Enjoying learning and having an enjoyable learning environment helps motivate students. (Waddell, 1999) stressed that a practical reason to teach robotics is that the field is growing rapidly and that we need talented and experienced workers in this field. This is a great reason to develop and teach robotics-based courses at all ages.

There are several pedagogical approaches to designing and developing courses using robots. Robots have an amazing ability to fit into all levels of teaching. Most robot courses are not centered on the robot but are designed to teach another subject related to science, technology, engineering, or mathematics (STEM). Robots just happen to be a useful and flexible tool for learning. Robots often come as a disassembled set of parts, they need to be built to a specification and programmed to perform one or more tasks. This experience can demonstrate to the student many aspects of the engineering experience. Most notably, the aspect of design and troubleshooting is often the hallmark of this learning process. Many forms of the engineering experience are possible to teach and implement in a robotic-based course; constructing the mechanical parts, connecting the electronic components, designing the shape of any moving surfaces, using sensors to control movements and actions, and developing a software program to control the entire robot. Some courses include local, state and national competitions and some use robot simulators to enhance the learning experience. In the last decade, research studies seem to have a heavy concentration on developing, analyzing, and teaching these types of courses; for elementary age to college age.

(Moore, 1999) used robots as the main tool to teach her fourth grade class various science subjects. She stressed that assessing a student for a completed hands-on project is important in a balanced assessment. She also mentioned “Sometimes the best we can do is to simulate, but this, to is a valid and valuable learning experience.” (p. 21). Practice by doing has been an accepted teaching method since (Dale, 1946) introduced “The Cone of Experience” which showed that real-world hands-on learning resulted in the highest learning retention. (Ebelt, 2012) in her master’s thesis studied a 5th grade robotics program designed to interest students in STEM subjects. She said “My goal for this study was to determine what kind of impact robotics is making on students in the classroom, especially in the areas of problem solving, teamwork, the challenge topic of Food Factors, and attitudes towards science and robotics and STEM careers.” (p. 2). The results showed a greater interest in STEM, teamwork, and increased positive attitudes towards problem solving.

(Barker & Ansorge, 2007) took a science and technology curriculum based on robotics and measured the increase in achievement scores for ages 9-11. They showed that the intervention group had a significant increase in mean test scores over the control group. This study was centered on the Nebraska 4-H robotics program. (Rogers & Portsmore, 2004) took an existing elementary curriculum and incorporated engineering concepts. The purpose was to connect, apply, and reinforce math, science, and design. They used LEGO and RoboLab as a toolset for the students. The class incorporated programming and the use of sensors and actuators. They stressed project development steps such as identify, design, create, optimize, and communicate. Their results showed that children connected concepts when working with robotics elements.

(van Lith, 2007) designed a project-based educational class for young children as in an introduction to science and technology. The children designed, built and programmed robots to perform one of three projects: 1) Dancing robot, 2) Rescue Robot, 3) Soccer Robot. “The most important issue with the project is of course to interest young children to get involved with technology. It must be made very simple and yet interesting.” (p. 2). The need for a robot simulator was emphasized. (Attard, 2012) explored the use of simple robots in teaching elementary mathematics. She concluded that using robots makes “an excellent tool for mathematical problem solving and investigation, and provides work samples that can be used for assessment purposes.” (p. 31).

Building upon the LEGO Mindstorm robotics kits (Mauch, 2001) sought to improve the problem-solving skill of middle-school students. (Mauch, 2001) developed a course that teachers could implement in the classroom. The strength of this course was to teach students problem-solving skills. This course stressed learning from “failures” in the hands-on building and programming of projects. (Ansorge, 2006) in his master's thesis created and studied a robotics project called WebBot that used a robot over the Internet. This project is designed to be part of the Nebraska 4-H robotics program. The purpose of WebBot was to provide an on-line robotics experience for students that did not have an opportunity to use a robot. "Even if a few of these children are encouraged to choose to pursue STEM careers, WebBot could be considered a success." (p. 30). This project will lead the way to remote and rural robot curriculum development.

(Sullivan, 2008) held a summer camp for twenty-six academically advanced 11-12 year old middle-school students. She studied the relationship of robotics skills to the use of science literacy skills in middle-school students. Pre and post tests showed that the students increased their systems understanding. This study "provides a theoretical and empirical basis for the development of well-crafted curricular materials that emphasize the relationship of robotics learning to the thinking skills, science process skills, and systems understanding associated with science literacy." (p. 390). (Barak & Zadok, 2009) worked with middle-school students using a robotics projects to study the learning and problem solving process. "The study revealed that the pupils had often come up with inventive solutions to problems they tackled by intuitively using diverse kinds of heuristic searches. However, they encountered difficulties in reflecting on the problem solving process they had used." (p. 289).

(Hussain, Lindh, & Shukur, 2006) studied LEGO training on pupils' performance in a Swedish school. He concluded "pupils have different learning styles in their approach to LEGO training. The role of the teacher, as a mediator of knowledge and skills, was crucial for coping with problems related to this kind of technology." (p. 182). (Ortiz, 2011) researched using robots to support fifth grade students learning ratios and proportions in an extracurricular program. She studied 30 fifth graders in experimental and control groups using a LEGO-robotics program. This study concluded "all students were able to make significant progress in learning new concepts of ratio and proportion as a result of participating in the intervention program learning experiences." (p. 2).

At the high school level (Welch & Huffman, 2011) studied the impact of an after-school high school robotics competition on students' attitudes toward science. "The results imply that programs that engage students in authentic scientific problems can significantly improve students' attitudes and views of science." (p. 423). The competition used in this study was the FIRST Robotics Competition. (http://usfirst.org/frc).

(Sklar, Parsons, & Azhar, 2007) and (DeLuca, 2003) studied the undergraduate level. (Sklar et al., 2007) designed five undergraduate computer science courses around educational robots. Evaluations were presented on student attitudes toward a robotic-based curriculum. Courses discussed were taught at Brooklyn College, a campus of the City University of New York. (DeLuca, 2003) master's thesis designed an undergraduate course aimed towards pre-service teachers focusing on robotics in education.

Robots in all sizes and shapes will be studied and used as a learning tool in the future. Most studies have shown that the uses of robots are effective in motivating students in some form or another. The best teaching methods, the best projects to build, and the best programming language for all of the age groups is yet to be determined. From my experience, the excitement of being able to design and control your own robot supersedes any form of learning I have experienced.

Robotics and Engineering Program: An Overview

This Robotics and Engineering Program started in 2010 with 18 students. Five of the students in this study were in this group. The next summer we ran a week long Robotics Camp. The other five students in this study were in this camp. This group of students attends three different high schools in three different adjacent counties. The furthest being about 20 miles from the teaching location. The students did not all know each other at the beginning. In 2013, the program had grown to over 30 students of which these ten were selected to be on the first high school competition team. Two students are in 11th grade, one in 10th, four in 9th, two in 8th and one in 6th grade. All of these students showed promising performance in class exercises, assignments, and attendance, although, not all of them particularly wanted to be on this team. The strong bond for being on the team was social friendship. One of the 8th grade students was added last when I realized he was part of the group of friends and was not included. He had the least experience, and I was thinking he needed another year before joining this level of competition. He proved me wrong and was one of the most aggressive participants for accomplishing individual and team tasks.

The method I chose to motivate and encourage this team was a series of Performance Tasks. Over the seven months, the team was together they each had the option to perform over 100 tasks for points. Tasks included watching robotic videos, writing essays, responding that they read emails, team tasks, encouraging each other tasks, reading articles, knowledge-based tasks based on the competition, etc. Those that reached the three goals of 1000, 2500, and 5000 points were the honorary captains of the team. Two were 9th graders, and the other was in 8th grade. This system of assigning tasks for points proved to be a strong competitive motivation among the team.

The three year program consisted of a curriculum of eight week (16 hours total) courses on various engineering and robotics subjects. The purpose of the curriculum was to offer a variety of subjects to introduce students to science, technology, engineering and mathematics. All courses were optional to attend; however, most of the members of this team participated in all of the courses. Some of the courses include rocket building, bridge building, solar cars, building robots, programming robots, robot projects, sumo wrestling robot, robot game design, RobotC programming language, and competitive teams.

Data Analysis

Data for this study was collected using several methods; student survey, parent survey, and academic report cards. Each of the 10 students was interviewed with a survey. Some participated in groups of two or three. Much care was taken so the students did not influence each others answers. This process generated many more questions and those questions were given to the students in a follow-up email survey.

The first student survey asked the students to rate 12 factors that motivate them or not to be in the program. Other questions were asked concerning the student's motivation in school, mathematics, college, engineering, and other activities. See Appendix A. The second survey added 9 additional factors based on additional responses from the first survey as well as 11 additional factors for a future team. See Appendix B. The parent survey included the 12 factors as on the first student survey. See Appendix C.

One parent in each family was asked to complete the survey. Except for two parents it was difficult to get them to return the survey. I think the reason for this was they did not completely understand the survey questions as they were related to the course subject matter. Most parents do not attend the classes and were not familiar with some of the factors in the survey. I had to call eight of the parents and take their survey over the phone. All of them were more than willing to answer the questions.

Each parent was asked to submit their student's report card for the first semester their student joined the program and their student's current report card. Some of the report cards were already on file with the program as we ask for them each grading period. All students and parents were surveyed and all report cards were made available. These report cards were analyzed for academic achievement before and after the program.

I used an Excel spreadsheet for analyzing the data. For the rating of the factors, I created a matrix of students and factors. I did this for the student and parent survey answers. For the YES/No/Comment answers I manually analyzed them. In analyzing the ratings of the factors I looked at the data the following ways,

a) All current program factor ratings were averaged over all the students.

b) All current factor ratings were grouped as a whole and also by my own grouping of technical or social factors.

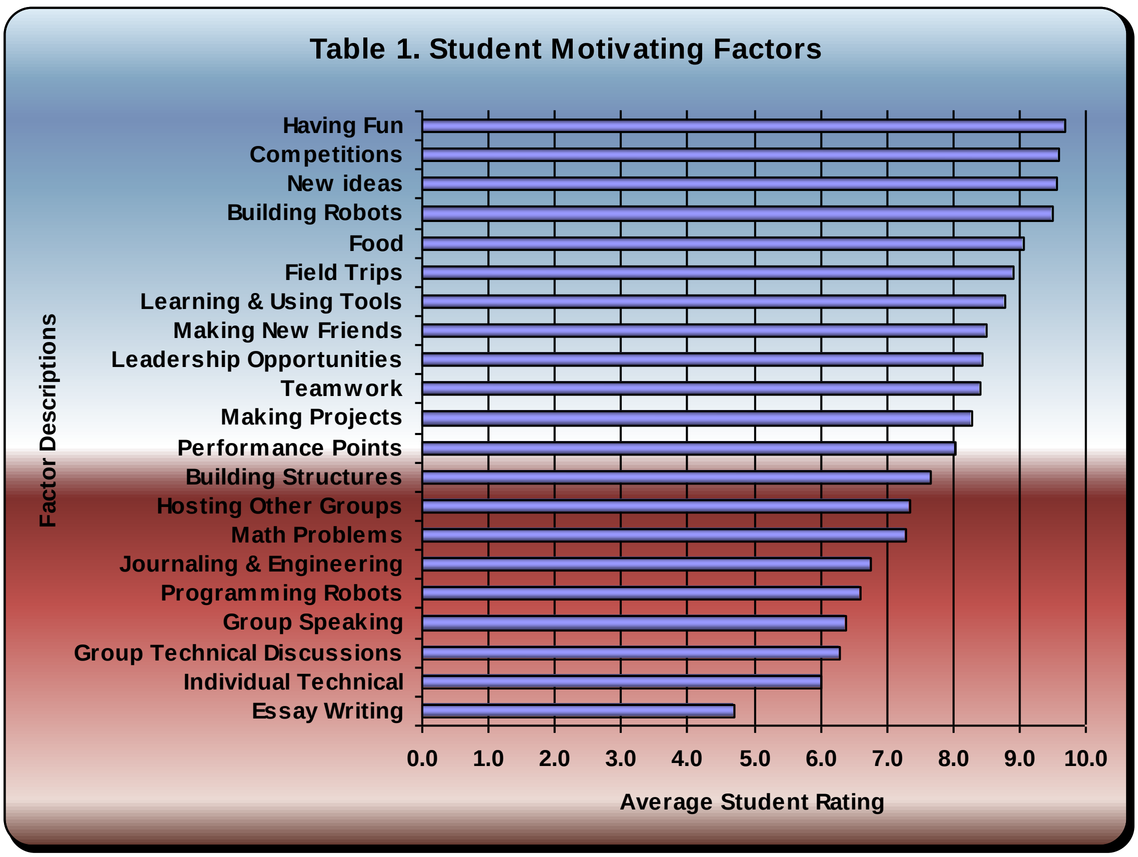
c) All new program factors (from the 2^{nd} student survey) were analyzed the same way as (a) but were kept separate from the current program factors.

d) All parent answers were kept separate and analyzed by averages.

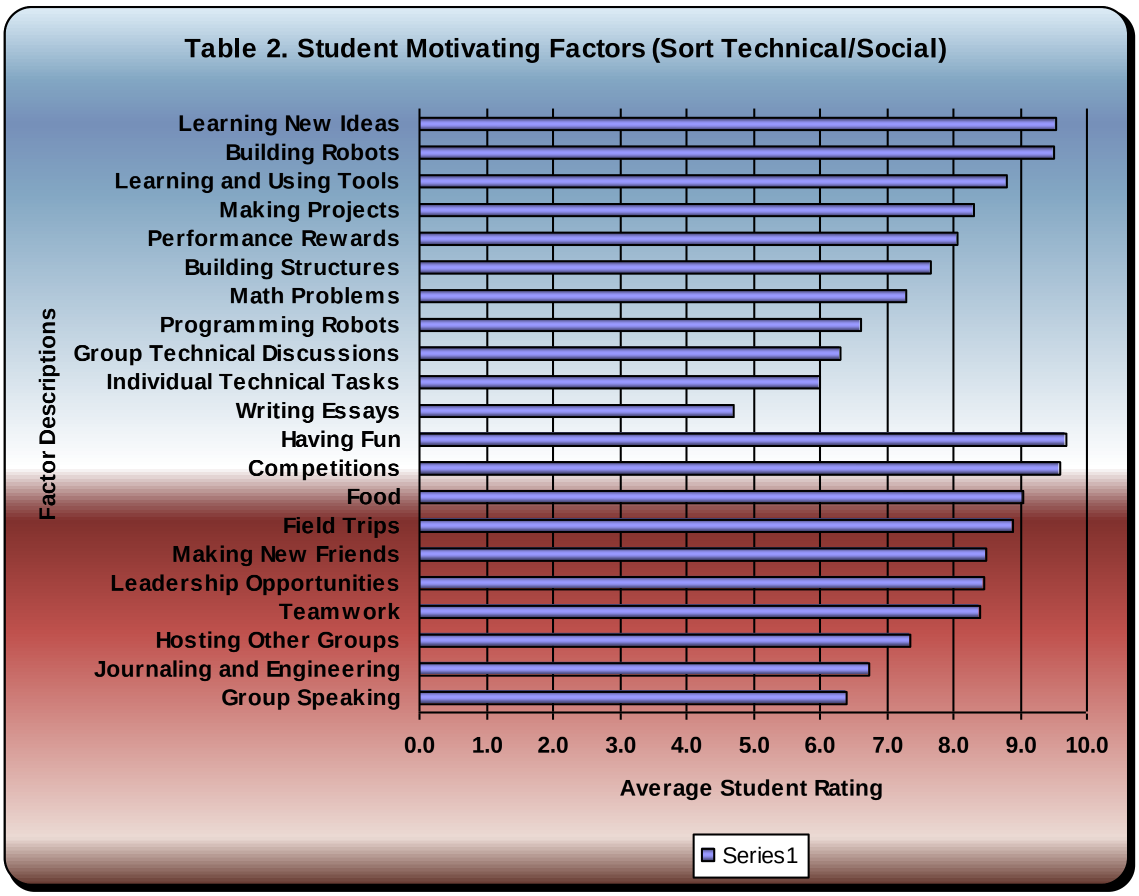
Results

Table 1 shows the factors that motivate these students to come and continue in this program. The greatest factor was just having fun. Being a rural area there are not many, if any, places where kids can hang out and just have fun. This program serves that need. The second highest factor was having competition. This reflects the internal team competitions we have between random groups or between boys and girls. Most of our competition time has to do with the robot but at times I will create a fun game for them to play. Good healthy competition is motivating and fun. New ideas, building robots, food and field trips also rated high on what motivates these students to attend.

Looking at the bottom end is essay writing. Even though I only asked this group write three essays most of them did not or did a very brief essay. The requirement was usually to answer 2-3 questions with a paragraph each. Writing, especially creative writing, is not a skill stressed in the local school system.

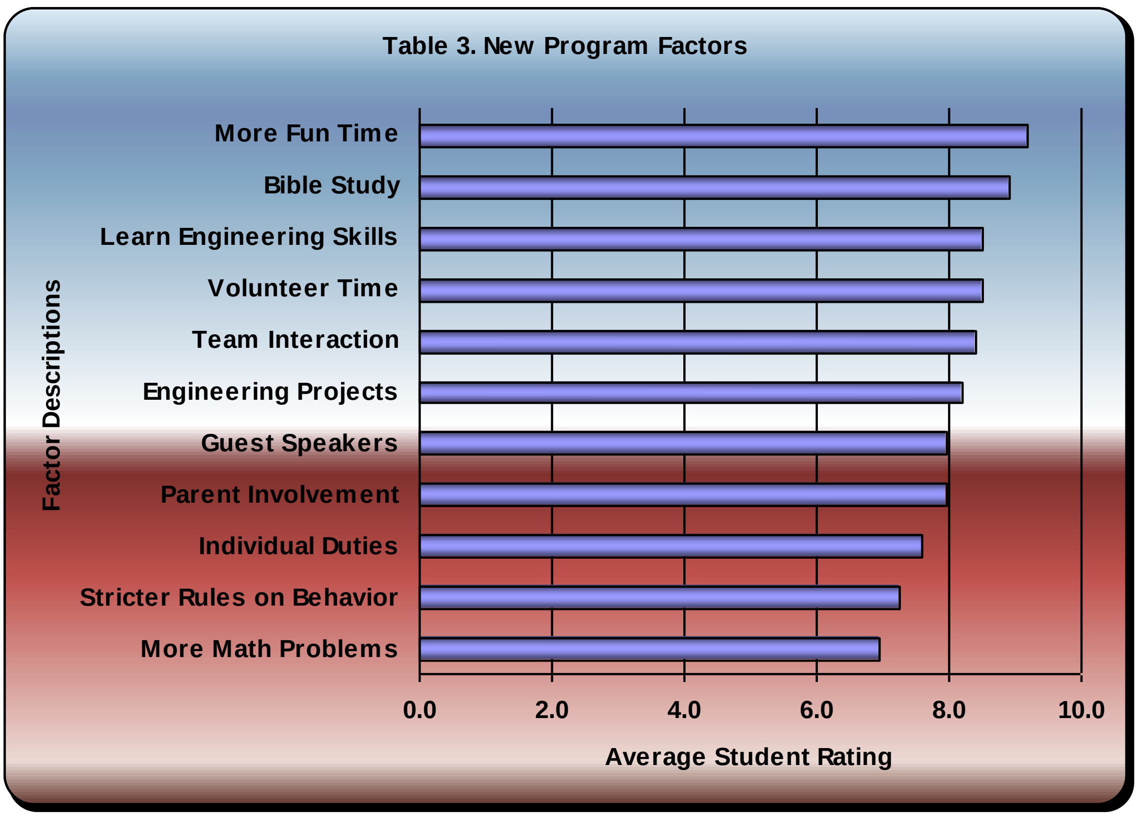


In Table 2, I grouped the factors into two groups; technical and social. The top technical factors were learning new ideas, building robots, and learning and using tools. All of these are basic to science and engineering. All of these also involve hands-on learning. By observation, all students in this program love to work with their hands. Some are better than others, but all of them like hands on because they do not get to do it any other times. In the social group, having fun, competitions, and food topped the list. Middle and high school students are very social. Several of the students have shared with me they come because of friendships and the program time is the only time they get to see each other. Appealing to the social needs of the students while teaching them hands-on science, technology, engineering and math is a very powerful combination. One attracts the



other.

Table 3 shows the factors that resulted in rating new ideas for the program. Top on the list was more fun time, however, it was expressed to me that they wanted to start our meetings with a fun activity before we get to the serious tasks. This was a great, and maybe obvious, comment from then students. Currently, I schedule very little fun time since we always had so much technical work to do. I can see that spending 15 minutes at the beginning would allow students to bond and just have some fun before spending 2-3 hours on technical tasks. Next on the list was Bible Study. This is not surprising since we are a Christian ministry and the students are expecting some time set aside to study the Bible. Learning new skills shows their desire to continue to increase their knowledge in the technical area. Volunteer time is helping others outside the program. All the students want to help others in need and said they would like to spend time as a group helping others.



Does this program encourage the students in school, to consider college, and to consider an engineering career? The answer was 100% from all the students on all three questions. Some of the student comments considering school, college, and engineering are:

"This program brings out the best in me."

"This program has helped me increase my math scores."

"I want to build something bigger in college."

"I like visiting the colleges."

"If I can do this I can do anything."

"I like being competitive and learning new ideas."

"The program has helped me to understand early that I need to go to college."

"I learned I can combine medical and engineering."

"This program has helped me perform at a higher standard."

"Being in this program makes me feel like I should do well."

"I have learned I need good grades to get into college."

"I now work harder in math to figure out the problems."

When asked separately which area of the program provides the greatest motivating factor the answers were:

"Building and programming robots."

"Competitions and friendships."

"Building teamwork."

The results of the parent's survey closely mirrored the answers of the students. However, since I interviewed all but two parents, I observed I had to spend considerable time explaining and making sure they understood the factors I was asking about. Most of the parents had not spent time involved with the students and thus did not understand exactly what was being asked. Only 2 or 3 parents have attended our meetings, and so they were not familiar with all that we did. The students would like for their parents to help out more, but because they understand work or distance prevents it they did not rate this as a high factor. Some comments from the parents are,

"He thinks at a higher level and has focused on engineering more. His leadership ability has increased."

"He is now interested in keeping his grades up."

"Her interested has greatly increased in school since joining this program. She now studies to success and strives for 100% in all classes now."

"This program has helped her decide she likes engineering."

"This program has motivated him to try harder and now he can see a career."

"He has improved a lot with working with equations."

"His engineering interest has become a reality. Now he knows he can do it."

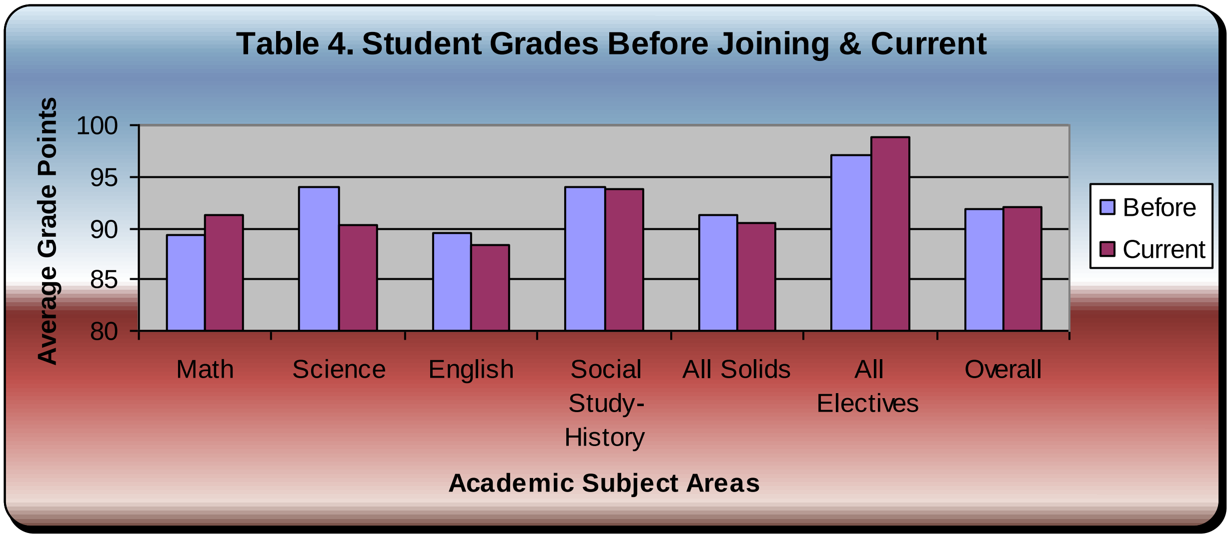
"Kids treat each other like family."

"Robotics has helped her develop as a leader."

"Now she can see that medicine and engineering can work together."

"She had little engineering interest before this program, and now she seems to be warming up to the idea of studying engineering."

The third area I wanted to study is the student's academic progress. (See Table 4). I was able to obtain report cards from all the students and analysis their grades when they entered the program and at the last completed semester (December 2012). The grades the students entered the program are: 1 in 4th grade, 4 in 6th, 3 in 7th and 2 in 8th grade. Currently, the students are: 1 in 6th, 2 in 8th, 4 in 9th, 1 in 10th and 2 in 11th grade. The average length of time in the program for this group of students is 2.5 years.



The courses taken by the students in their entering year were: Art, Band, Career Discovery, Health, Language Arts, Math, Reading, Science, Social Studies, Spelling, Trans Algebra, US History, Writing Composition. The average grade for all students in all courses was 91.8%. The current year shows a significant increase in the level of difficulty in courses with: Algebra, Band, Biology, Chemistry, English, Geometry, Health, History, Human Anatomy, Language Arts, Math, MS Studies, Music, Psychology, Reading, Science, Social Studies, Spanish, Speech, World Geography, World History, Zoology. The average grade for all students in all current courses was 92%.

Basically, it appears that the level of difficulty of the courses greatly increased and the grade average stayed about the same. The subject area that increased the most was Math with a 1.98% increase. The subject area that decreased the most was science with a decrease of 3.7%. Even with the decrease, most likely due to solid science courses such as Biology, Chemistry, Human Anatomy, and Zoology the average was still at 90.3%. Math, science, and history all were over 90% while English was at 88%. In all, as a group, the students entered the program with an “A” average in elementary and middle school and maintained an “A” average in high school while taking solid courses and while maintaining 3-5 hours a week in this program. Even with what appears to be very good grades the school districts continue to have very low state rated averages. With a strong motivation from this program, lots of encouragement, real-world experience, hands-on modeling of projects there just might be a chance that students in this Robotics and Engineering program will stay motivated and will attend college and break the family cycle of dropping out and not attending college. Most of these students are 2-3 years from college, and if their motivation and good grades continues they have a very good chance of scholarships and opportunities not normally available to rural Mississippi students.

Action Plan

Based on the results of the student and parent surveys and the academic grades there are several plans of action that I can take. I will divide these into Program Plans (Technical and Social) and Academic Plans.

Technical Program Plans: At least every month I would introduce a new engineering idea as a short project to be completed in pairs. I would also use these ideas to incorporate new tools. Even though Math was not high on the list I would definitely continue to incorporate math skills into any new idea. At the bottom of the technical factor list is Writing Essays. Even though students would not volunteer to write more essays I think there is a place to help them organize technical writing in smaller forms as related to the new engineering ideas. Obviously budding engineers and scientists need to be able to express themselves and document well in writing.

Social Program Plans. Having fun topped the social list. The change I would make would be to start off our meetings with a group game that they all enjoy. I would rotate this game every few weeks and eventually let one of the team members select which game to play. More competitions will not be difficult to incorporate. There are always lots of competition learning situations I could do with the team. Having food at the meetings is extremely popular, however, it becomes costly. I could make a rotating schedule where each family provides the refreshments each meeting. Field trips are also extremely popular and right now we take 2-3 a year. I will continue scheduling as this rate as long as I can find appropriate and willing companies to have us visit. We are 60 miles from most large companies so transportation sometimes becomes a problem.

As far as an Action Plan based on student academic records I want to monitor the few students that are making low “B’s” and “C’s” in their courses and work with them to find a tutor and to encourage students to increase their grades. My goal is that all of the program students have “A’s” and “B’s” with “A’s” in Math and Science.

Influences and Disclaimer for this Study

The author of this study is the organizer and teacher for this Robotics and Engineering program. Even though he tries to stand back and let his students succeed and fail on their own sometimes he steps in too early or even too late for optimal learning. He also carries a clear bias for this program and spends unending hours analyzing its ups and downs. He made every effort possible to listen and carefully encourage the students in providing thoughtful and meaningful survey and interview answers without changing the purpose or meaning of what they wanted to say.

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Appendix A

Student Survey
for the
Robotics Program & Competition Team

1. At what grade did you enter this program? ______
2. How many years have you participated? _____
3. Which type of learning do you think has motivated you the most?

   Rate each area from 1 – 10 with 1 being least motivating and 10 being most motivating. Rate each area on its own and not against each other.

   a. Technical discussions _____
   b. Individual technical learning _____
   c. Building structures _____
   d. Building robots _____
   e. Programming robots _____
   f. Mathematics problems and challenges _____
   g. Team cooperation _____
   h. Projects _____
   i. Field Trips _____
   j. Competitions _____
   k. Group public speaking opportunity _____
   l. Essay and report writing opportunity _____
   m. Other ______________________ _____
   n. Other ______________________ _____

4. Has this program motivated you to perform at a higher level in school? YES NO

   Comments: ____

5. Has this program motivated you to perform better in math in school? YES NO

   Comments: ____

6. Has this program increased your interest in attending college? YES NO

   Comments: ____

7. Has this program increased your interest in studying engineering in college? YES NO

   Comments: ____

Appendix A (con't)

8. Are you actively involved in other school clubs, organizations, or activities? YES NO

   Is yes, which ones: ____

9. Are you actively involved in any other activities outside of school? YES NO

   Is yes, which ones: ____

10. Which area of this program provides the greatest motivating factor for you?

    Comments: ____

11. What changes and improvements would you like to see in this program?

    ____

    ____

Appendix B

(These questions were emailed to each team member)

Please rate these areas of the robotics program with 1 = not motivating to 10=very motivating. Any number between 1 and 10 is ok based on your opinion. Place your number after each line and send back to me.

Meeting and making new friends
Rewards/Performance Points
Food
Learning new ideas
Learning to use tools
Having fun
Hosting groups (like our robotics workshop)
Leadership Opportunities
Keeping a journal or engineering notebook

You would like to see the following: 1 = probably not, 10=for sure (any number between 1 and 10 is ok based on if you would like to see it added)

Parents involvement
Stricter rules on behavior
Volunteer Opportunities
Bible Study time
More on engineering skills
More individual duties
More team interaction
More math challenges and problems
More engineering projects
More guest speakers
Start meetings with "fun" activity

Appendix C

Parents Survey
for the
Robotics Program & Competition Team

1. At what grade did your student enter this program? ______
2. How many years has your student participated? _____
3. Which type of learning do you think has motivated your student?

Rate each area from 1 – 10 with 1 being least motivating and 10 being most motivating. Rate each area on its own and not against each other.

a. Technical discussions _____
b. Individual technical learning _____
c. Building structures _____
d. Building robots _____
e. Programming robots _____
f. Mathematics problems and challenges _____
g. Team cooperation _____
h. Projects _____
i. Field Trips _____
j. Competitions _____
k. Group public speaking opportunity _____
l. Essay and report writing opportunity _____
m. Other __________________________ _____
n. Other __________________________ _____

3. How would you describe your students' interest and performance in school before and after entering this program?

____

____

4. How would you describe your students' interest in mathematics before and after entering this program?

____

____

Appendix C (con't)

5. How would you describe your students' interest in attending college before and after entering this program?

____

____

6. How would you describe your students' interest in studying engineering before and after entering this program?

____

____

7. Please describe areas of the program that could be changed or improved? Any comments would be appreciated.

____

____

8. Please provide any other comments concerning your student that you feel might be important to assessing the benefits of this program. Please describe the benefits your student has received in this program.

____

____