

**2006-1107: INTEGRATION OF MATHEMATICS, SCIENCE AND COMPETITION  
TO PROMOTE ENGINEERING EDUCATIONAL DEVELOPMENT**

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## **Integration of mathematics, science and competition to promote engineering educational development**

### **Abstract:**

As high school sports have a vast following of students and parents, so should science club competitions attract similar audiences to develop math and science education. The Mesilla Valley Christian School (MVCS) Science Club has competed in numerous events promoting teamwork in designing, building and operating robots, internet science projects and chemical remediation equipment against schools around the country. The key to developing math and science skills is to put the passion of competition in with the discipline of acquiring and applying knowledge. The club has a solid foundation of an elementary extra-curricular math and science program and a secondary pre-engineering course. Mid and High school students will surprise you with their talents and creativity if put in the right motivational package. The MVCS Science club has successfully integrated math and science into several applications involving engineering. They have applied their skills in several competitions and have won the Boosting Science, Engineering and Technology (BEST) robotics competition at New Mexico State University(NMSU) and gone to the SW region competition in Dallas at Southern Methodist University. The club won trips to Washington DC in the US Army's eCybermission for science problem solving and placed in NMSU's international environmental design contest. It was also recognized as the Association of Christian Schools International science program of the year for 2005. This paper will give the details of the program, including the interaction of MVCS and NMSU, and the integration of math courses, science courses and the pre-engineering course at MVCS into the program. It will also include statistics on how many of the student participants entered university level engineering programs after their graduation from high school.

**Introduction:** As some high school sports and community events have a vast following of students and parents, so should science club competitions attract similar audiences to develop math and science education. Why do sports and county fairs have such a big following and science fairs do not? The key to developing math and science skills is to put the passion of teamwork and competition in with the discipline of acquiring and applying knowledge. This paper will attempt to explore the elements of events that motivate young people to learn and excel at more academic endeavors.

**Background:** The Mesilla Valley Christian Schools (MVCS) Science Club has attempted to motivate students to enjoy and excel at science and math. By analyzing the successes of the club, the elements that may be gleaned, summarized and applied to other schools and settings around the country. This paper will give the details of the program, including the interaction of MVCS and New Mexico State University (NMSU), and the integration of math courses, science courses and the pre-engineering course at MVCS.

The Mesilla Valley Christian School Science Club has competed in numerous events promoting teamwork in designing, building and operating robots, internet science projects and chemical remediation processes against schools around the country. The club has a solid foundation of an elementary extra-curricular math and science program and a secondary pre-engineering course. The MVCS Science club has successfully integrated this math and science into several applications involving engineering. It was recognized as the Association of Christian Schools International science program of the year for 2005.

The MVCS science program matured over several years with nurturing from Dr. Gary Eiceman (NMSU Chemistry Professor), Pastor John Powell and Lt. Col. Alan Fisher (USAF retired), the current advisor, as well as the current faculty and administration. Making science interesting in and out of the classroom as well as making it competitive has been the main idea of the Son Blazer Science Club. The club's guiding ideology is that the universe is full of excitement ready to be discovered and explained to the world. Starting in 1995, hands on demonstrations were brought into the elementary classes at MVCS. The demos included chemistry, physics and biological concepts with a student participation time in each 30 minute session. The students were urged to think and guess what would happen in various circumstances, then try and verify their predictions.

As students moved up into mid high, their interest followed, yet classroom time would not allow the chance for hands on investigations. Lunch time in the science room became the place to hang out because they enjoyed looking into science phenomenon and brought their own 'show and tell' items. Both mid school boys and girls will surprise you with their talents and creativity if put in the right motivational package. As more students showed up over several months, the idea of starting a club occurred and events planned out.

About this time, the New Mexico State University (NMSU) Boosting Science, Engineering and Technology (BEST) competition started and seemed an ideal event to get involved in to keep the interest up and focus the student energy. BEST Robotics Incorporated (BRI) is the sponsor of the competition which has expanded from Texas to New Mexico and states in the southeast. The contest is composed of a 6 week brainstorming and production phase followed by local and regional competitions. Over 500 schools are involved with funding and resources are provided by large companies and universities. The competition encourages creative thinking, teamwork, performance under time & rule constraints and presentation skills. The theme of each competition was also key in motivating students such as challenges like: “Rad to the Core” (disarming a runaway nuclear reactor), “Transfusion Confusion” (saving a patient by transferring blood cells), and “Hubble Trouble” (using a space robot to re-energize the Hubble telescope).

The MVCS Science club got involved and came in 2<sup>nd</sup> in the local competition for 2 years and then won the next 2 years and went to the SW region competition at Texas A&M and then to Dallas at Southern Methodist University. Tours of the campuses were included and gave much insight into what college academics and life was like. The competitions brought out many skills and qualities that were learned in the classroom, but made them so much more motivating and applicable. The student’s math skills were challenged by the specifications the robot had to operate under and also the point scoring strategies that had to be developed. The team’s design creativity and engineering production were put to the test by only having a specific set of given hardware that could be used. It was amazing at the end of 6 weeks when all the varieties of models came to compete – same materials and mission, but so many different ways to accomplish the same goal! Getting parents and other mentors with professional skills and equipment is also vital.

The club also got involved in the US Army’s eCybermission for science problem solving. The main strategy was using the internet to submit a solution to a technical need in the community. Mentors volunteered from the local college and community to provide advice to help the students along in identifying and dealing with problems. Data taking and analysis was important and students used their math skills to interpret and make conclusions. The student’s love of being on the computer and actually contributing to their community in a practical way was very motivating. The internet format and use of video games as learning tools provided creative incentives for the younger students. One major hurdle our school had to overcome was getting enough computers and high speed connections to allow them to work. Initially most of the inputs were from home computers, until the school saw how useful and important the computer stations were to student development (parents were also reassured that abuse of the internet would not occur by young students getting into the wrong areas on the net).

Several MVCS science club teams were region winners receiving trips to Washington DC, winning a total of over \$50,000 in savings bonds and were among the top schools in the country for the 1<sup>st</sup> two years of the competition. The boys 7<sup>th</sup> grade team designed a laser dust detector that could help save motorist lives in dust storms of the southwest and

our 6<sup>th</sup> grade girls showed how pets could help lower heart rate and blood pressure reducing the risk of heart disease for people. Many other projects received recognition.

Since the eCybermission was only for the 6<sup>th</sup> – 9<sup>th</sup> grades, the 10<sup>th</sup>-12<sup>th</sup> high school students looked for another project. They found that NMSU put on an international environmental design contest (WERC). The team’s task was to mitigate an environmental problem in the community and build a bench scale model along with a presentation to the judges. The method for cleaning up the environmental hazard was an exercise in research, scientific reasoning, and economic efficiencies. Even though the MVCS team didn’t win 1<sup>st</sup> place, the experience of working through a problem and seeing what other teams had come up with was well worth the effort. Their interaction with college teams was also valuable to see the level of effort a college engineering design task entailed.

**Findings:** The overall impact of such activities the MVCS club participated in is hard to quantify, but student feedback and graduation statistics show there has been some effect. On student surveys, a majority indicated that these activities had increased their interest in pursuing science or engineering fields after they graduated from high school. Many said just participating in such endeavors had at least made them aware of what these fields were all about. As far as actually influencing students to go into college majors in the science, math and engineering (S, M & E) areas, the following table shows on how many of the student participants entered university programs after their graduation from high school.

**Graduation data from MVCS over 10 years showing number and percentage of students entering Science, Math and Engineering(S, M & E) fields verse total class size.**

Class	‘95	‘96	‘97	‘98	‘99	‘00	‘01	‘02	‘03	‘04	‘05
SM&E/tot	4/13	4/10	7/21	5/14	8/24	3/21	2/16	6/33	13/27	8/24	6/19
%	30%	40%	33%	31%	33%	14%	12%	18%	48%	33%	31%

The graduation statistics show a dip in science, math and engineering majors/fields being entered by students from MVCS from ’00 to ’02, but that was corrected as the science club started to have more influence on students from ’03 to ’05. There may have been a greater drop if the club had not been in existence. Also a very influential science and math teacher left the school in 2000 which may have affected the interest of students in the following few years. Now with this cohort of students with the club experience, we expect this trend of more graduates into the S, M & E fields continue.

So, what elements of the MVCS science club endeavors and events can be duplicated or applied to other areas in the country? The main premise of the club was to explore the exciting world around them and help overcome problems facing mankind. The best way to make learning exciting is to include the elements that sports and community events have. Even better is to make the events provide significant benefits to the welfare of people in those communities. By improving the educational level of the students and solving problems, everyone wins. We cannot afford to lose the game of educating our

next generation because the outcome is so critical to our nation's future and its role in the world!

The following is a list compiled from the MVCS science club experience that has been seen to help our students become more interested in science, math and engineering fields.

- 1) Start early in the educational process, even in grade school: It is important to have an elementary curriculum to comprehensively cover the areas of math and science. This plants the seed and starts it growing to be well rooted for the branches, such as the area of engineering, to come. A well rounded academic foundation with practical application allows a variety of technical interests to emerge.
- 2) Get parents involved so students can get reinforcement at home: Parents are critical for reinforcing the lessons at school and providing the support needed to motivate their children in academic pursuits. Just as they take extra time to take their children to sports practices, they should take the time to root on their kids in science competitions. They support athletic booster clubs and county fairs, so they could help raise funds for science resources. Even as technology is advancing, parents can learn from their children what the next innovation is going to be and how to use it. The whole family needs to stay involved with education from grade school to college and beyond.
- 3) Hire good teachers/advisors to provide the right environment for learning: Many teachers only have time to teach theory in the classroom, but not time for club activities after school. School's hire coaches to train teams, run practices and organize leagues, but seldom pay extra for science advisors to do the same. There is a sports section in most school newsletters, but not much devoted to academic club achievements. The school, community, and nation needs to put more emphasis and incentives for students, parents and teachers to pursue S, M & E fields. College and university faculty and students are a valuable link back to their communities to reinvest the knowledge gained and advances made.
- 4) Enter competitions to motivate students in teamwork and overcoming challenges providing social benefit: Science clubs must have a goal or mission to accomplish just as sports teams do. Well planned and organized competitions are a wonderful way to motivate learning. The events sponsored by colleges and other institutions that MVCS has entered, greatly increased the club's numbers and further interests. The school is indebted to these and wishes to applaud them now and hope more will follow in the future. There seems to be a trend to expand these activities, but putting all these elements to use must occur to make the events expand and be successful. The rewards and benefits must also be promoted by the media so more students will be attracted.
- 5) Provide sufficient resources and current technology to keep students interested: A significant investment of time, talent and equipment is needed to make science clubs viable and effective. The gear to equip a sports team is expensive, but supporting a science team can benefit far beyond the initial cost by solving community problems and building technological leaders for tomorrow. The accessibility of resources at research facilities on college campuses is also important to enlighten students to what's ahead. Lab equipment, computers,

advisors salaries are all needed to have a fertile environment to challenge young people to higher levels for our future.

**Conclusion:** From the experience of the Mesilla Valley Christian School Science Club, it is possible to make science, math and engineering a motivational and rewarding endeavor. Several elements were critical to make this happen. By starting early, involving parents, having the right mentors and resources, along with the key catalyst of teamwork and competition, our future generation will be better equipped to keep the nation is the forefront of modern innovation and technology.