
AC 2011-1098: USING THE PRINCIPLES OF MANUAL TRAINING TO PERFORM S.T.E.M. OUTREACH FOR URBAN YOUTH

Greg Murray, Pittsburg State University

Greg Murray is an Assistant Professor in the Mechanical Engineering Technology Department of Pittsburg State University in Pittsburg, KS. He received his BSET in 1993, and his MST in 1995 from Pittsburg State University, and his MBA in 2002 from Wake Forest University. Professor Murray worked in industry for over 11 years in various product development, process engineering and management roles. He currently teaches subjects based in Engineering Graphics, Computer-Aided Design, Capstone, and Fluid Mechanics.

Prof. Randy Winzer, Pittsburg State University

Randy Winzer is an associate professor in the Electronics Engineering Technology program at Pittsburg State University in Pittsburg, KS; he served as the program coordinator from 2002 until 2007. He holds both BS and MS degrees in Engineering Technology and has several years of experience supporting various information technology infrastructure projects; primarily those in support of educational content delivery and K-12 education. The past nine summers Professor Winzer has conducted a STEM outreach effort titled 'Adventures in Robotics' which has had over 500 participants.

Using the Principles of Manual Training to Perform S.T.E.M. Outreach for Urban Youth

Abstract

For the past three years Pittsburg State University has been teaming up with the Ewing Marion Kauffman Foundation located in Kansas City to offer a college experience to urban youth. The Kauffman Scholars program is a college preparation and access program whose goal is to increase the number of college graduates from the urban school districts in the greater Kansas City area. This paper will detail an outreach effort that has been conducted by Pittsburg State University for the past three summers using the LEGO Robotic Invention System, as well as hands-on activities dealing with applications in the fields of Construction and Plastics Manufacturing.

Kauffman Scholars

The Kauffman Scholars is a program funded by the Ewing Marion Kauffman Foundation of Kansas City Missouri. The foundation, created in 1966, with its first major project the funding of advanced research into the prevention and treatment of coronary disease and to increase the number of people in the U.S. trained in cardiopulmonary resuscitation. The resulting organization provided training which resulted in 20 percent of the U.S. population being trained in CPR. The Kauffman's were long time business leaders in the Kansas City area with ownership interest in the Kansas City Royals Major League Baseball team and Marion Laboratories among others. They have funded multiple philanthropic interests supporting a variety of causes including the Kauffman Foundation.

The Kauffman Scholars program is for less advantaged urban youth who show college potential but might not make it to college without additional support. The program is open to Kansas City area youth beginning in the seventh grade. Specifically the program is open to all students in the Kansas City, MO school district or the Kansas City, KS USD #500 boundaries. It provides opportunities for enrichment activities as well as scholarships for higher education upon successful completion of the program and graduation from high school. To participate in the program, an application must be submitted in the 6th grade. The student must earn a C or better in each of their core courses (math, science, social studies, reading and English), and have no more than one out-of-school suspension or two in-school suspensions during their first semester of 6th grade.

Students are assigned mentors, academic and life coaches to help guide them through adolescence and towards successful completion of their secondary education. In addition to access to these resources; students participating in the Kauffman Scholars program are given opportunities to attend summer institutes for academic enrichment among other topics. These

summer institutes provide an opportunity for students to leave the city for several days at a time to participate in activities designed to strengthen their academic ability, character, social skills, and awareness of career opportunities available to them upon high school graduation.

Program proposals are solicited by the Kauffman Scholars management each year from institutions of higher education, museums and other organizations. These proposals must include a rough outline of the pedagogy and academic plan the students participating in the particular summer institute will follow and other details such as transportation, housing and meal arrangements. A specific budget must be submitted along with the plan for funding of the summer institute. Once a specific proposal is selected for funding, Kauffman management works with the hosting organization to adjust any details and finalize all logistical concerns.

Involvement of Pittsburg State University with the Kauffman Scholars Program

The Department of Engineering Technology first became aware of the Kauffman Scholars program in late 2007. The Department had already been holding a series of summer workshops for area middle school students in Construction, Plastics and Robotics. The Adventures in Robotics summer workshop was the most mature offering having been in existence since 2003 with several hundred having participated in the program.

A proposal was developed and submitted to the Kauffman Scholars program to host a 3 day summer workshop at the Kansas Technology Center on the Pittsburg State University campus. The workshop would include approximately 210 instructional minutes in the areas of Construction, Plastics and Robotics with hands-on activities. Additionally students would participate in team building and communication exercises on the first day and a wrap-up session on the final day with some friendly competition including a robotic Tug-O-War demonstration of the robots they had each built earlier in the week.

The Department of Engineering Technology was notified in the spring of 2008 that our proposal was accepted and that we would host our first Kauffman Scholars summer institute. Planning got underway in earnest at the close of the Spring Semester in May for the arrival of the Kauffman Scholars later that summer.

Activities at the PSU Kansas Technology Center

The three day event on the campus of Pittsburg State University allows students to see what college life is all about for Engineering Technology majors. From the moment the students arrive on campus their days are filled with fun activities that focus on different topics within the Engineering Technology field. Robotics, Plastics, and Construction are the three main areas of interest for the students while at the Kansas Technology Center (KTC) at PSU. Groups of 8-10 students spend four hour blocks learning about each of the Engineering Technology topics. Some form of STEM concept is taught within each of the areas, and these concepts are reinforced with a hands-on activity.

The first activity that the students are involved in is a team-building activity. Teams are challenged to build the tallest paper tower using limited resources. They are provided 5 sheets of paper and a 4 foot piece of masking tape. The teams are allowed 10 minutes to build their tower, which must remain free-standing for at least 10 seconds. After the first trial teams are given a second chance to improve upon their original design. They are given the same materials, but only 5 minutes to complete the task. Teams are judged on overall height of the free-standing tower, uniqueness of design, quality of construction, and overall team involvement. After the team-building exercise the groups are sent off to the various engineering activities.

The Robotics rotation introduces several STEM topics and demonstrates the importance of teamwork. Scientific Method is introduced to show the importance of following step-by-step procedures in order to collect data. Mathematical calculations are performed using this data in order to create competitive robots. The Lego system itself is the technology component of STEM that helps drive this project. Engineering concepts such as the design process ties all of the STEM components together. Students in each rotation group are divided into teams of 3-5 students and build a robot using the Lego Robotic Invention System. The first part of this module allows students to become familiar with the Lego system through a series of online tutorials. The students learn how to follow instructions, build a robot, and how to program the computer that will drive their robot. After successfully completing the tutorials, students will use their new found knowledge to design and build a robot that will compete against other teams in categories of precision and power. The first objective for each team is to have their robot travel a short distance and stop as close as possible to an object without knocking it over. Students are familiarized with the Scientific Method and are asked to run multiple trials to determine an average distance their robot will travel for a set time. This information allows them to calculate more accurate speeds of their vehicles. The second objective for each team is to build a robot that will be competitive in a tug-o-war competition versus other robots. The concepts of power, weight distribution, and the design process are covered prior to assembly of the robots. All of the teams compete in a double-elimination tournament. It is a fun and exciting event to close out the activities at the KTC.

During the Robotics rotation, teams are challenged to complete activities quickly through the use of teamwork. The emphasis of everyone working together to solve the problem quickly and accurately is repeated throughout the roughly three hours and fifteen minutes of instructional time. By division of labor and communication within the group (team), the students see firsthand how working well together allows them to accomplish more. While it is true that some teams are more successful at this than others; the sheer experience of witnessing or experiencing the failure of the ineffective teams is also a learning experience. This point is emphasized in the instructions given to the student mentors.

Each team of 3 to 5 scholars is assigned one or more Pittsburg State University student to serve in the role as mentor. These mentors are student chosen from all different majors at the university through an application process coordinated by our Office of Student Diversity. A

schedule is prepared detailing the activities for the staff assisting with the instruction but is not shared with the scholars participating in the activities. This is done intentionally so that scholars will not be diverting their focus from the current activity by wondering what is next. Instructors keep the teams constantly informed of the time remaining in order to create a sense of urgency for the participants. It is desirable for the teams to be giving as close to 100% during the entire three hour and fifteen minute time period as possible. The sense of urgency also assists with the team building that is being attempted. A student who normally would want to complete all aspects of a project themselves may be more willing to allow other to assist if they think it will help them win. The following is a portion of the instructions given to the individual group mentors: “We want EVERY participant to have a positive experience. This does not mean that they get to do everything they want, fail to follow instructions or disrupt the group. Make sure that each child is actively participating and attempt to involve those that are not. Our goal is that each and every child takes home something of value from this week. Even if that is as simple as the concept of working together to solve a problem, or that other people may have important ideas that are worth listening to. Please remember why we are here, to reach out to this next generation and give them something of value.”

The concept of no winners and no losers is emphasized during the final competition. The students are assured that they are all winners for having participated in the experience and having grown in knowledge as a result of their participation. Even though that is said – the students still want to win and the competition between the teams is often passionate.

The Plastics rotation allows the students to become familiar with design and manufacturing methods used in the plastics industry. Students are encouraged to display their creativity by using Solid Works to create 3D models of medallions. The models are then sent to a 3D printer where plastic rapid prototypes of their medallions are produced. This activity not only brings out the creativity of the student, but also allows them to create a souvenir they can be proud of. Plastic processing methods are introduced by allowing students to run equipment located in the processing lab. Frisbees are made with the injection molding press, plastic bottles are made using the blow molding machine and flower pots are made using the thermoforming machine. Students are allowed to take home many of the products that are made during this activity. While in this rotation, students also learn the importance of recycling. Through a demonstration students can see how bottles and other plastic materials that are gathered for recycling are sent through a grinding machine and then re-introduced into a plastic process. Seeing this process first-hand helps the students realize that their recycling efforts are worthwhile and very important to sustaining our environment.

The Construction rotation¹ includes several activities which span the gamut of the construction industry. Students are introduced to design, analysis, and field work by completing several different modules. The structural systems module explains the importance of basic building components such as columns and beams. Terms such as forces/loads, pressure, levers and moments are introduced and explained through a lecture and demonstration. Many students at

that age are unable to equate the terms discussed to a practical application. This exercise helps bridge that gap. The REVIT module allows students to learn about 3D modeling of structures. The students are introduced to the basics of the REVIT software through a demonstration, and then students will work with the faculty to develop a model building resulting in a printed copy for each student. The project includes the layout of a building perimeter, adding interior walls, windows, doors and a roof. They are also shown how to add trees, cars and people to enhance their design. The Mini Excavator rotation allows each student the opportunity to operate a piece of construction equipment. After a brief safety and operation orientation, students compete against one another in a timed skills event. Each student will be given a maximum of 2 minutes to knock balls off of cones (5 points for each ball, 5 point penalty if cone is knocked over). There is also a 10 point bonus for each ball that is dropped into a bucket by the excavator arm. In the GPS module students compete in a scavenger hunt. Each group of students is given a set of coordinates to their next coordinate instructions. This event is tailored after “The Amazing Race” TV show. Students move from one set of coordinates to the next where you will receive additional coordinates and instructions. Your final coordinates reveal a treasure. The first group back to the starting point with their treasure wins.

Other Activities on Campus

In the evenings the Scholars are treated to other aspects of college living. There are pizza parties, ice cream parties, dance parties, a movie at the student center and bowling. The students are housed in the dormitories on campus during their two night stay, which includes breakfast and dinner in the dining hall. But more importantly the students are able to learn about college life first-hand from their group leaders who are current students at PSU. Providing a positive environment for these urban youth will make them feel better about themselves, which will strengthen their desire to do well in school and eventually go to college.

Awards Banquet

The conclusion of this great event is the awards banquet. The Kauffman scholars and their coaches along with the faculty and staff from PSU get together and celebrate the accomplishments of the students over the past three days. Winning teams receive certificates, all members are recognized and a few fun and emotional stories are shared. At the end of the 3 day event at PSU, each student has been involved in several hands-on, applied science and math projects that have reinforced their understanding of S.T.E.M topics.

Bibliography

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