Woodlawn High School's Robotics Academy

Cover Page

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Introduction

Woodlawn High School's Robotics Academy is a project that will create two classes at Woodlawn High School where students will learn how to design, engineer, and program robots to accomplish a number of complex tasks. The classes are being developed to integrate robotics technology and project based learning into classroom education as a means of increasing student achievement. This project is based on the need to change the traditional method of classroom instruction (lecture, paper/pencil) used by a majority of teachers and to improve the quality of STEM instruction within Woodlawn High School. According to district data taken from over 1,400 classroom observations conducted in fall 2011, 84% of classes are usually taught by teacher-directed whole group instruction (students sitting in desks listening to the teacher lecture about class material). Only 18% of the students were involved in hands-on experiential learning, while over 40% of the students were observed completing worksheets.

Woodlawn High School's Robotics Academy will offer classes that focus on hands-on experiential learning. By using small, kit-based robots, the academy will provide students at Woodlawn the opportunity to implement mathematics and science skills in a hands-on environment. The data gleaned from the Robotics Academy can then be used within the district to improve hands-on instruction in high-schools within the district overall.

The Need for Woodlawn High School's Robotics Academy:

Woodlawn High School is, in many ways, a microcosm of the East Baton Rouge Parish school system. Its population makeup and standardized test score percentages mirror those of the district. For example; where 89% of East Baton Rouge Parish School system students fall within a historical minority, Woodlawn High School is comprised of 70.5% minority students. According to Tsui (2007), students who are part of a historical minority are less likely to pursue careers in STEM fields and according to the National Action Council for Minorities in Engineering (NACME) while minorities comprise over 30% of students who receive undergraduate degrees, only 12 percent receive degrees in engineering (Frehill, Defabio, and Hill, 2008).

Percentage of Students Scoring Below Basic (2011 GEE Test)		
	Science	**Math**
	WHS	WHS
GEE (Grades 10 & 11)	28.7	31.2

Each year, students in grades 10-11 are administered state wide assessments based on grade level expectations that reflect the knowledge and skills students should have acquired at the time of testing. Students scoring below the "Basic" achievement level have not demonstrated

the fundamental knowledge and skills needed for the next level of schooling. Data from the spring 2011 state assessment program show that over 25% of students at Woodlawn High School do not score a basic level in either Math or Science.

Beyond improving test scores, there exists a need in the East Baton Rouge Parish community for programs that inspire the imagination of students and prepare them for the varying careers that they will encounter as adults. According to Platt (2012), careers in robotics are some of the fastest growing in engineering. Students who involve themselves in robotics can become involved in many different fields ranging from computer design to industrial robot creation or even autonomous car design. The possibilities are endless.

The Plan of Woodlawn High School's Robotics Academy:

During the one-year grant period, approximately 36 students will participate in *Woodlawn High School's Robotics Academy*. Students are being chosen to participate in the program based on applications turned in to the lead teacher - a certified gifted teacher and coach of the currently existing after school robotics club. The classes will take place over one school year and will include six major strategies for engaging the students, school, and surrounding community: 1) professional learning and job embedded technical assistance, 2) project-based learning, 3) keystone projects, 4) in-class robotics competitions, 5) community partnerships, and 6) after-school programs.

The professional learning and technical assistance component establishes the foundation for the integration of robotic technology and project-based learning. According to Hirsh (2004), it is important for teachers to receive the highest quality of professional development when engaging a new classroom project. She notes that "High-quality professional development is essential for school systems to achieve their goals for student and staff performance" (Hirsh, 2004). To this end, experts in the field of Robotics such as Carnegie Mellon University's National Robotics Engineering Institute will provide training and technical assistance to the lead teacher during their five day Robotics Academy.

Woodlawn High School's Robotics Academy emphasizes project-based learning where students work in small collaborative groups on progressively challenging robot building and programming projects. These projects will allow students to creatively explore project management, computer programming, mechanical design, physics, mathematics, motion, environmental factors, problem-solving, and group collaboration. According to Barker and Ansorge (2007), in a study of technological education of 9^{th} – 12^{th} graders, the use of robotics to increase achievement scores provides a statistical advantage to high school students. The researchers found "youth in the robotics intervention had a significant increase in mean scores

on the posttest and that the control group had no change in scores from the pretest to the posttest" (Barker and Ansorge, 2007).

The robotics course will make use of Carnegie Mellon's curriculum (VEX 2.0 Cortex Curriculum), which provides teachers with a large variety of projects, activities, and teacher resources for instructing students in how to create engineering products from start to finish. Mike Dischner, a veteran teacher using Carnegie Mellon's curriculum notes that the curriculum provides students multiple opportunities to engage a variety of engineering practices at their own pace: "The VEX hardware gets the students interested; once they see the robot rolling around they want to build one. . . The ROBOTC training materials have simplified my job and all of the challenges involved in teaching a diverse classroom how to program" (Atwood, 2008).

Woodlawn High School's Robotics Academy Summary	
	High Schools
Course	Engineering Design (2 semesters)
Curriculum	VEX PIC and CORTEX by Carnegie Melon University
Programming	Robot-C
Hardware (KITS)	VEX Robotics Kits
Competition (KITS)	VEX Robotics Competition Fields
Training/ Technical Assistance	-Carnegie Mellon (5 days) -Volunteer Engineering Mentors

Beyond increasing student achievement in science and mathematics, it is the goal of Woodlawn High School's Robotics Academy to prepare students for the rigors of their other high school courses. For example, every student at Woodlawn High School is required to complete a Senior Project in order to graduate. This project incorporates a research paper, product, and presentation on a topic of the student's selection. One of the goals of the Robotics Academy is to provide students early opportunities to practice developing cumulative projects in order to prepare for this requirement. To accomplish this, each student will be asked to complete a keystone project which will involve selecting a focus area related to a STEM field, researching that area, interacting with a mentor in that area, and completing a project in that area. For example, a student may choose to engage the area of Computer Aided Design (CAD). This student would interact with someone in this field, complete a research paper about the field, and create a CAD of their own.

To further increase student achievement in STEM fields, the robotics academy includes regularly scheduled in-class competitions. According to Nichols and Sullivan (), there are

marked effects of using team competition to increase interest and learning, "Team-based competitive approaches (e.g., class-wide games) may be especially effective at making instructional material more enjoyable and engaging," (as). In the Robotics Academy, teams of students will compete by building robots to complete prescribed challenges and will then pit their robots against one another. While designed to increase student performance, these activities will also provide a venue for students to showcase their accomplishments. To help increase interest in the program competitions may even be held at such times that other students at Woodlawn High School can watch such as during lunch, and before or after school.

During the year, students will be able to interact with real-world professional mentors who use STEM based knowledge in their fields. Friedman, P. (2003) states that mentoring programs can provide students with emotional support, encourage them to become more involved in their school, and help with their transition from school to work. Because of the importance of mentoring, Woodlawn High School Robotics Academy has partnered with Volunteers in Public Schools (VIPS), the Louisiana Engineering Society (LES), and the Louisiana State University Department of Engineering . These organizations will assist the teacher in recruiting volunteer professional engineers to serve as mentors for the students. These mentors will provide technical assistance and guidance during classes, competitions, keystone projects, and eventually as the students begin to explore a career.

While classroom based learning and competition is important, equally important is what students do after school. To provide students with the ability to engage technical knowledge outside of the classroom, Woodlawn High School offers an after-school robotics club that competes in FIRST® Robotics Competitions each year. The mission of FIRST® robotics is to "is to inspire young people to be science and technology leaders, by engaging them in exciting mentor-based programs that build science, engineering and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership." FIRST accomplishes this through using yearly robotics competitions at both regional and international levels. According to a study done by Brandeis University, students who participate in after-school robotics clubs experience a wide variety of benefits that are not limited to high-school alone:

Brandeis University Results of FIRST® Robotics Participants	
Likelihood of college-attendance by participants:	35% greater than non-participants.
Likelihood of majoring in science or engineering:	50% more likely than non-participants.
Likelihood of pursuing an engineering career:	20% more likely than non-participants.

Panthrobotics, Woodlawn High School's FIRST® robotics club has been in existence since 2010.

In 2011, the club won the Bayou Regional Competition in Louisiana and competed in the World Championship in St. Louis, Missouri. In 2012 the group participated both in the Bayou Regional and in Houston, Texas at the Lone Star Regional. While still in its infancy, Panthrobotics has seen two of its members graduate to pursue careers in Mechanical Engineering at Louisiana State University. Other students who have not yet graduated have expressed their desire to pursue a number of STEM based programs ranging from Mechanical to Aerospace engineering.

The breadth of Woodlawn High School's robotics program is what demonstrates its innovation. By integrating robot design, career research, after-school engineering programs, and competitive spirit, the program will provide students with the ability to develop a future career as an engineer, a scientist, computer designer, or enter into a myriad of other fields.

The Evaluation of Woodlawn High School's Robotics Academy

Woodlawn High School's Robotics Academy is designed to enhance STEM teaching and learning through the integration of robotic technology and to demonstrate that involvement in STEM related subjects can be fun and interesting for students as well as future career choices. While the major focus is on the participating teachers and students, the project is also intended to have a positive impact on the school as a whole by: 1) promoting school spirit, and 2) improving the community's perception of the school and 3) the development of positive relationships between the mentors and students.

Formative and summative evaluation methods will be employed to show specific impact. Baseline, interim and outcome data will be collected, analyzed and reported by teacher.

Baseline data to be collected prior to the project commencement:

- Student rosters with identification numbers.
- LEAP (8^{th} Grade), iLEAP (7^{th} Grade) and GEE (10^{th} – 11^{th} Grade) Science and math scores for participating students.
- Test of Science Related Attitudes Survey pretest scores of participating students.

Goals and Performance Indicators

Goal 1: To improve academic achievement in science and math

Performance Indicator	Evidence
Teacher trained in project based learning and Robotic technology	Professional leave forms, attendance sheets
Teacher effectively integrating robotic technology and project based learning into classroom instruction	Lesson plans
Number and percent of participating students to successfully complete the Robotics program	Class rosters, end of year grades
Number of days of each student's participation in their Robotics classes	Attendance data

Improved student achievement in science and math	GEE scores

Goal 2: To increase student awareness and interest in the fields of STEM

Performance Indicator	Evidence
Increase in the percentage of students enrolling in the after-school robotics program	Registration Forms
Number of volunteer professional engineer volunteer hours	Logs
Number and percent of students indicating an interest in STEM careers	TOSRA Pre & Post test scores

The Funding of Woodlawn High School's Robotics Academy

Woodlawn High School, through the East Baton Rouge Parish School System is requesting a total of $56,700 from the American Honda Foundation to provide for the implementation ***Woodlawn High School's Robotics Academy***. This funding provides for the purchase of the Carnegie Mellon VEX Curriculum, training for the teacher, robotics components for the curriculum, competition supplies, and prizes for the winners of each competition to foster student excitement as they participate.

In-kind donations are being made through both the East Baton Rouge Parish School System, whose is providing the teacher's salary and benefits ($52,000) from their general fund. Woodlawn High School is providing the classroom in which to hold the class as well as materials required for the teacher (teacher's desk, desktop computer, filing cabinets).

The per-participant cost being provided by the American Honda Foundation is $1,575. This amount is cost effective as the project is being used on non-consumable funds that will last for many years after the project ends. The project will also have a much wider impact in the school. As student interest continues to increase, other classes will be developed to allow students to continue engaging STEM fields. It is the long-term goal of the Robotics Academy to add further courses each year beyond the scope of this funding. Further, as the first high school robotics academy in East Baton Rouge Parish, Woodlawn High School's Robotics Academy will act as a model for other schools to follow in the future.

The Future of Woodlawn High School's Robotics Academy

Because of the expandable nature of robotics courses, it is the intention to continue to expand this project each year through future funding and by using the robotics material provided through the America Honda Foundation grant. This expansion will take the form of two directions. First, as students complete the introductory course it is expected that Woodlawn

High School will offer more advanced robotics courses. Secondly, as popularity in the program grows, other introductory robotics classes will be offered.

By providing classes that effectively engage students in STEM disciplines through hands-on learning, Woodlawn High School's Robotics Academy will provide students the opportunity to increase their standardized test scores, increase their interest in STEM career fields, and will help lead them to fulfilling lives.

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