Seeking Academic and Career Advancement Through Robotics:
A Study of Unlocking Students Potential in S.T.E.M. Fields

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BACKGROUND OF THE PROBLEM:

Lack of student motivation is a very significant challenge faced by teachers at all grade levels. When first brought into a formal learning environment- most commonly at the preschool or kindergarten level- children often experience varying degrees of difficulty adjusting to the new social and academic structures and restrictions placed upon them. However, as students mature and progress further into their academic careers, the challenge of maintaining academic motivation does not seem to fade away. Though students entering high school will have already completed an average of ten years of schooling, the common changes in social climate provide a myriad of possible distractions for students trying to focus on their education.

A student's transition into high school often overlaps with the transition into young adulthood. This transition can manifest itself in increased responsibility and/or increased social freedom- both changes that have the potential to negatively impact a student's focus on schoolwork. When students reach legal working age, many are either forced, or make the decision, to take on part-time jobs to support their family or earn their own spending money. While this added responsibility can build a stronger work ethic, it inevitably leaves less time and energy to invest in academic endeavors; unless a student is able to develop and apply strong time management skills, balancing school and work will present a difficult challenge. Similarly, the balance of school campuses as both an educational and social environment can bring difficulty in balancing the two, as students are faced with the prospects of dating, more complex friendship dynamics, and the peer pressure to submit to gang affiliation and drug use.

Perhaps a less expected obstacle in the quest for maintaining student motivation is the curriculum itself. Classes at the high school-level are becoming increasingly departmentalized- a shift that is making it more and more challenging for students to draw connections between the different academic disciplines, as well as comprehend how knowledge in these various fields can be applied to their own lives. These various disconnections can be discouraging for a struggling student, and further support the common misconception that school is merely a formality or obligation. Unfortunately, when students fail to see the importance of a strong education, there is more perceived justification in succumbing to outside distractions, such as taking on more hours at work, or placing a higher priority on social events and personal relationships.

SETTING:

Oak Grove High School serves 2,442 students whose varying ethnic backgrounds reflect the diversity of most schools in the Silicon Valley. Of the 2,442 students, 47% are Hispanic, 22% are Asian, 22% are White, 17% are African American, 4% are Filipino, and 1% are Pacific Islander and American Indian. Though the surrounding area was once predominated with single families, it is currently primarily composed of multiple-dwelling families in the low to middle income bracket. Within the school's population, 12.4% are classified as LEP students, 21.2% are classified as RFEP, and 38% of the students participate in the Free and Reduced Lunch Program. (2008 statistics)

Statistics from standardized test results show Oak Grove students performing below average in the categories of math and science. In the subject of math, only 34% of the Asian student population scored proficient or advanced, 16% for Filipino students, 8% for Hispanic students, 19% for White students, and 7% for African American students. Notably, only 14% of students from economically disadvantaged backgrounds and 8% of English learners scored proficiently/advanced in Math. In the subject of science, 51% of Asian students scored proficiently,

50% of Filipino students, 15% of Hispanic students, 20% of African American students, 21% of economically disadvantaged students and 7% of English learners.

STATEMENT OF THE PROBLEM:

Students at the high school level can lose their focus and interest in academic classes. They often fail to understand the connection between academic disciplines because subject areas at the high school level are departmentalized. There seems to be few, if any, transitions relating one topic to another as they appear in real world situations. In addition, students are adjusting to a freer social setting, and unless they have the self-discipline, drive, and work ethics to stay focused on academics, they can very quickly fall behind in their studies. While some students have more free time, many students are also balancing a part-time job with academic demands. Data has indicated that lack of motivation to excel in the fields of Science, Technology, Engineering, and Math (STEM), while a global issue, is at a more alarming rate in the United States, and evident at Oak Grove High School in San Jose, CA.

STATEMENT OF THE PURPOSE:

Robotics allows students to connect and apply the subjects they learn in school in a meaningful way. By designing, building, programming and documenting their research and activities, students connect the disciplines of science, engineering, technology, math, computers, writing skills, history and art in a hands-on, project-based learning environment that reinforces their learning. Students meet state and national standards in these disciplines, and are able to apply other life-long learning experiences by giving presentations to service clubs, churches, and to the board of directors at local businesses. They also gain additional teaching and public speaking skills by presenting to peers, younger students and at school board meetings.

RESEARCH QUESTIONS:

Will an afterschool program in robotics help students to succeed and thrive in an increasingly challenging academic environment and changing social climate, as well as encourage them to consider future careers in Science, Technology, Engineering, and Math (STEM).

Oak Grove High School is located in the heart of Silicon Valley, San Jose, CA. It is a comprehensive 9th-12th grade public high school, and has approximately 2,214 students. Data collected by the East Side Union High School District indicates that student population diversity is as follows: African American 9%, Asian 23%, Filipino 4%, Hispanic 41%, Pacific Islander and American Indian 1%. Oak Grove High School attendance area shows a socio-economical composition of primarily multiple-dwelling families who are of middle to low income. Approximately 12 % of the student population is Limited English Proficient (LEP), 21% of students have been reclassified as having higher English language proficiency, and 16% are classified as Fully English Proficient (FEP).

In addition approximately 48% of students qualify for the free or reduced lunch program. The high school exhibits a rich cultural diversity representing many different cultures. Oak Grove High School presents as a family/community enterprise, and is a product of a spirited, communal collaboration.

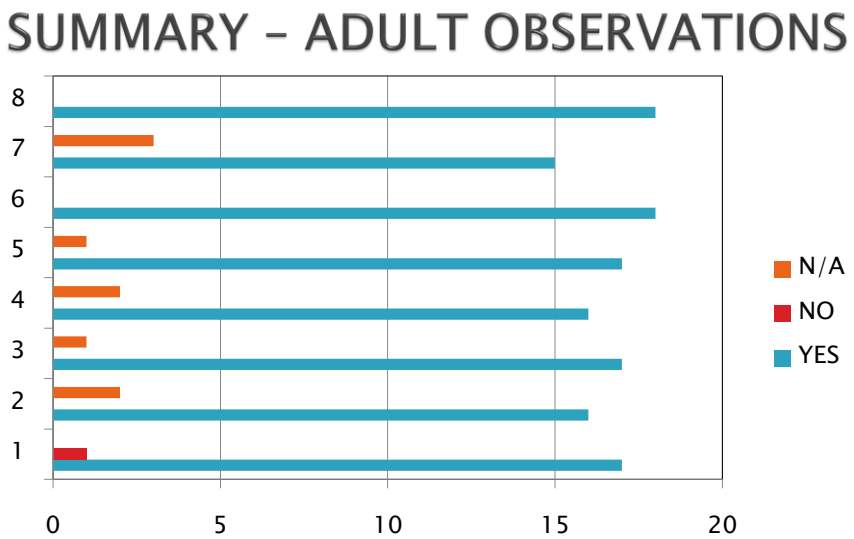
SUMMARY: Survey results demonstrate an overwhelming majority of adult observers and students responding to each question in a positive way.

Many of the students in the Eaglebots Club already had good attendance. Some did improve, however, during high competition demands, students used class time (with teacher permission) to work on the robots. Adults noticed increased school pride, good citizenship behaviors, increased teamwork, increased respect for teachers and administrators. Students are considered very well rounded.

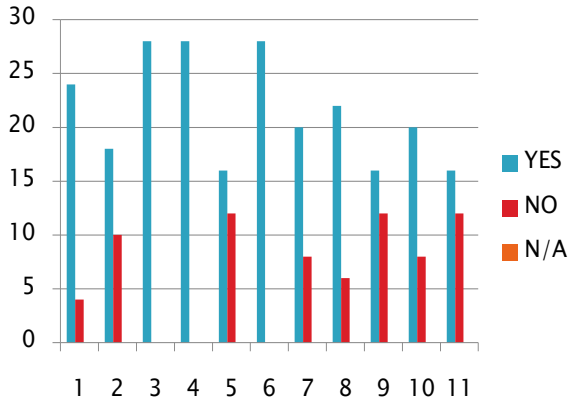
Club members have a high esteem for whatever they are doing as OGHS academic achievers. They have become role models to most of the student body.

Eaglebots Club has brought international recognition to Oak Grove and the robotics program. Our students have traveled together and are globally educated as a result of this wonderful program. Another teacher said, “most students seemed to better appreciate the need for planning and teamwork.

Most of the students earn their own money to pay for the trip to Global competition. They practice life skills everyday due to the robotics program.



SUMMARY – STUDENT OBSERVATIONS



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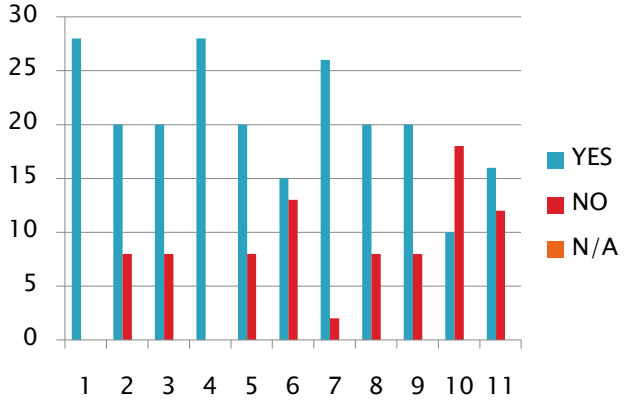

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APPENDIX - A

PARTICIPANT SKILL RESPONSE SURVEY

Please keep in mind interviews are anonymous; any information provided to the researcher will be kept confidential and private, for the protection of your identity as a participant.

1. Has being involved in the Eaglebots Club introduced you to careers in science, technology, engineering, or math (STEM)? Yes No

2. Will you consider seeking a career in an area not previously considered? Yes No

3. Is learning in the Eaglebots Club connected to state and national standards in your math, science, art, English, computers or other classes? Yes No

4. Has the Eaglebots Club given you problems to solve in a scientific and mathematical way? Yes No

5. Have you had an introduction to programming in "C" language since joining the club? Yes No

6. Have you had an opportunity to build your very own robot? Yes No

7. Have you been part of the grant, scholarship, or fund raising process? Yes No

8. Have you had the opportunity to learn how to create a website? Yes No

9. Have you had the opportunity to learn how to give a slide-show presentation? Yes No

10. Have you had the chance to visit a business or service club to share information about the Eaglebots? Yes No

11. Have you had, or will you have, the opportunity to research and write a paper related to STEM and present it at the Global Conference? Yes No

APPENDIX B

PARTICIPANT SOCIAL RESPONSE SURVEY

Please keep in mind interviews are anonymous; any information provided to the researcher will be kept confidential and private, for the protection of your identity as a participant.

1. Has involvement in robotics improved your critical thinking skills?	Yes	No
2. Has being involved in the Eaglebots Club helped you make better behavior choices?	Yes	No
3. Has being in the Eaglebots Club enabled you to be a better team player?	Yes	No
4. Has being in the Eaglebots Club given you the opportunity to learn leadership skills?	Yes	No
5. Has your involvement in robotics given you confidence to tackle more advanced academic classes?	Yes	No
6. Have your grades in the subjects of math and science improved since joining the Eaglebots Club?	Yes	No
7. Has involvement in robotics boosted your interest in using technology for recreational and personal purposes?	Yes	No
8. Has involvement in robotics improved your time-management and organizational skills?	Yes	No
9. Have you become more social and gained friendships through your involvement in the Eaglebots Club?	Yes	No
10. Has involvement in the Eaglebots Club improved your attendance?	Yes	No
11. Has involvement in robotics influenced your parents to give you more privileges?	Yes	No

APPENDIX C

OBSERVATION SURVEY
By Researcher

Please keep inform participants that interviews are anonymous; any information provided to the researcher will be kept confidential and private, for the protection of the participant's privacy.

1. Does the Eaglebots Club provide opportunities for all learners? Please check off all that apply:

a. English Language Learners____ b. Special Education____

c. General Education____ d. Honors students____

e. Gifted and Talented____ f. Advanced Placement____

2. How many cultures are represented in the Eaglebots Club? Please list.

3. How many different languages are spoken by club members? Please list.

4. Does the Eaglebots Club provide opportunities for students to meet state and national standards in science, technology, engineering and math? Please list standards that are met during club time.

5. Are club members exposed to scientists, engineers, and other science, technological, engineering, and math professionals?

6. Does the classroom provide a safe environment for students to explore new ideas and take risks?

7. Are students representing ESUHSD as ambassadors of good will by setting high standards in work ethics?

8. Are students given the skill set to potentially teach a peer, younger student or adult/teacher how to build and program an autonomous robot?

9. Are students learning skill acquisition for STEM in the Eaglebots club?

10. Have each student identify possible "change-of-career" considerations they will be making in light of new knowledge and interests developed in the program.

APPENDIX D

ADULT/TEACHER RESPONSE SURVEY

Please keep in mind interviews are anonymous; any information provided to the researcher will be kept confidential and private, for the protection of your identity as a participant.

1. Have you observed involvement in the Eaglebots Club resulting in a increased interest in careers in Science, Technology, Engineering, and Math (STEM) among study participants?	Yes	No
2. Have you observed involvement in the Eaglebots Club resulting in a positive change in academic performance among study participants?	Yes	No
3. Have you observed involvement in the Eaglebots Club resulting in a positive change in behavioral tendencies among study participants?	Yes	No
4. Have you observed an increase in confidence and aptitude among study participants in the area of public speaking and presentation, as demonstrated through fundraising efforts performed for the club?	Yes	No
5. Have you observed involvement in the Eaglebots Club resulting in stronger leadership skills among study participants?	Yes	No
6. Have you observed involvement in the Eaglebots Club resulting in a marked improvement in collaborative and teamwork skills among study participants?	Yes	No
7. Have you observed involvement in the Eaglebots Club resulting in an improvement in attendance and participation among study participants?	Yes	No
8. Have you observed the learning done in the Eaglebots Club as connecting to state and/or national standards for study participants' classes in the fields of math, science, art, English, computers, etc?	Yes	No

9. Please list any additional observations made on student participants in the Eaglebots Club:

APPENDIX E

ACTIVITIES CHECK LIST

Please keep in mind interviews are anonymous; any information provided to the researcher will be kept confidential and private, for the protection of your identity as a participant.

_____Using lego materials in the classroom, students will build a free-form robot.

_____Using a NXT robotic kit, students will create a robot.

_____Using an icreate, lego parts, and controller, students will build and program a robot by writing a "C" language computer program. The robot will move forward, backward, turn at a 90 degree angle and turn in a 380 degree circle. Complete workshop presented by KISS Institute and is NASA sponsored.

_____Students will research autonomous vehicles and post their research information on a website they have designed.

_____Students will prepare for Botball Regional competition.

_____Students will create and present a slideshow presentation about robotics, including marketing. They will also fill out college admissions and scholarship applications.

_____Students will reflect on their learning and experiences during the past seven weeks. To demonstrate knowledge students will write a paper for extra credit and submit it to the teacher of their choice. (A copy of the reflection paper will also be given to the researcher)