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A FUTURE SCIENTISTS AND ENGINEERS CLUB FOR DOHERTY HS: A PILOT PROJECT

An Interactive Qualifying Project Report

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by

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Abstract

A future scientist and engineers after school club program was designed to assist students of Doherty High School achieve their aspirations. This short pilot project version of the project established the feasibility of creating such a program and the level of interest at the school. Several means of having a meaningful influence on the students were tested. Attention is also paid to the question of gaining access and the form this project might take in the future. The striking success of the program in attracting females who wanted to explore the possibilities in a technical career without making the commitment necessary to be part of the Engineering and Technology Academy at Doherty is noted. We conclude that lack of knowledge is a barrier to the technical professions, that this project was successful in lowering that barrier, and should be expanded.

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1. Introduction

1.1 Evolution of Goals

This project has evolved quite a bit from what was originally proposed. At the outset we thought we would be working closely with the guidance departments of the Worcester Public Schools (WPS). The plan was to field an aspirations survey for them to the sophomore and junior classes. Then the data collected from the junior class was to be handed over to another team of Worcester Polytechnic Institute students doing a "replication" study of data collected last year. We would the use the sophomore data set to identify a pool of twelve to eighteen students aspiring to technical careers who were interested in "coaching". Coaching would be centered on how to use the student's junior and senior years in high school, both academic and extra curricular, so as to enhance their chances of college admissions to a technical school.

We would also interview a comparable group of seniors identified by the data set acquired by last year's team, who created this survey. This would provide a baseline of data for how well students progressed towards their aspirations without the influence of coaching. It would also be an opportunity to identify any "oversights" so that we could be aware and avoid these discrepancies.

After the outcome of this project, when the class of 2006 graduates and the final goals of the individuals come to pass, another team would analyze and quantify the effect this project would have on the students, and potentially justify recruiting more WPI students to put together teams and continue the coaching

project. Concurrently, as the coaching took place, the team with the junior dataset will determine if there is a significant difference between juniors and sophomores in their aspirations, and discern if the lack of another year of wisdom and experience invalidates the aspiration data that one collects from sophomores early in the 10th grade year. Do students that young possess a career aspiration, or are they just randomly filling out a questionnaire? The comparison of sophomore and junior data would tell us whether it was too early to ask about aspirations in 10th grade.

However, this “nice and neat” integrated development which started from studying the problem, led to an idealistic project outline, did not get reviewed and amended by the school system and then executed as amended. It died as a filibustered proposal. The project faced opposition in the forms of controversy surrounding the survey, delays by individuals and groups, and finally abandonment of the survey guided coaching concept by the guidance departments. Hence, the form of “interaction” evolved into, instead of coaching, a faculty advised, after school “Future Scientists and Engineers Club”.

Finally after all the delays, the survey was actually approved and data gathered. The next step was to use the results of the survey to invite students and call upon the existing Engineering Technology Academy (ETA) to participate in our club events. The following task was to create meaningful and interesting meetings in the little time that we had. This was much different than the originally proposed coaching project which seemed to meet a dead end at every turn. So it seems, with the demise of our original plans and the omens of project failure

looming overhead, we finally got our break and were able to complete a project with a much different format but the same overall objective.

Hence there is an interesting story to tell about the overwhelming success of the club which emerged at the very last minute in terms of the WPI academic year. Furthermore, the club was able to interest an unexpectedly large percentage of female students which is a significant finding for the project sponsors, the Worcester City Manager's Committee on the Status of Women (ACSW).

1.2 Goals

Past studies of student aspirations were justifiably criticized, by the WPS guidance office, as being too late to be of use to juniors who were going to be applying to college early in the following year. Hence, one can't set forth a program to assist these students in achieving their personal career goals, unless you can start at least a year earlier. Also, Dr. Mostue of the WPS expressed doubt that students still in their first half of their second year of high school, possessed post collegiate "aspirations", that were measurable via a survey. One of the main goals of this project is to determine if there is a significant difference between high school sophomores and juniors regarding their future aspirations. Our other main goal relates to getting students excited about their future careers, and helping them achieve their dreams.

The ACSW is interested in the results of this project, and in the continuation of related projects for many reasons. The first project of this type was the "Gender-Based Comparative Survey of Public HS Students" and was

done by Pat Hogan, and Laura Handler. Their HS respondents were the class of 2006, when they were juniors in 2004-2005. The ACSW had an interest in these types of projects in order to make recommendations to the City Manager regarding the strength and impact of gender-based career stereotypes within the WPS. Another benefit is to be able to single out students with counter stereotypical aspirations and give encouragement to these students, in the form of mentors, and specialized information groups. The ACSW also gives an award to a leader at the high school level with political aspirations this award is called the Annual Young Women of Consequence Award. The ACSW members are particularly interested in this project as a method to raise awareness, and encourage gender equity, particularly create a better balance between males and females interested in different careers. Fields where women are under-represented, such as engineering, are of particular concern.

Concurrently there are multiple related research projects occurring, one of which is similar to Laura's project and is distributing a revised survey to all Worcester Public School students in the eleventh grade. The purpose is to replicate previous findings and to establish the survey as a something worth repeating every year or two. Then the advisory committee can see if any trends are occurring that could change the gender balance in critical areas of interest. It was also hoped that the survey would be accepted and used by the schools as a tool for the guidance department to assist the students in determining a proper curriculum or establish a career path.

The aspirations survey instrument starts with a section for the student to fill in their personal information, lists career fields, and allows the student to show their interest level in each field, and has a section for parent's occupation. Yet another portion is for plans after high school, and another asks for reasons one might not pursue a college education. The final portion asks what the student is involved in at the school. In order to achieve our goals and answer the question about whether such data could be collected earlier, we determined that the sophomore class would also need to fill out this survey this year-but only at the schools where we were going to try to set up clubs.

This project is designed as a pilot so that, in the following years, more Worcester Polytechnic Institute students can help high school students achieve their dreams. This project report will be presented to the ACSW, and will be available to the Worcester Public School System for review. It is hoped that when re-assessed both organizations determine this project to be valuable enough to continue and expand.

1.3 Overview

The way that this project was proposed to us, it was a continuation of a previous project, which created an aspirations survey. This survey was only given to eleventh grade students, those who attended the Worcester public schools and some private schools in the city. The purpose of this previous project was to see whether or not if the career aspirations of the WPS students followed the stereotypical gender and ethnic based aspiration patterns. It seems that the project succeeded in proving that a well developed survey could be used

to discover such trends, and this information could be useful to many people. However, the survey was not accepted by the school system, as a tool to identify or help students who demonstrate a strong interest in a post high school career. It is strongly believed that this survey should be viewed as a pre-coaching tool to help locate those students with a strong interest in a particular career. Once an aspiration is defined, it clearly would be beneficial for the student to meet a mentor who has a wealth of knowledge about that field of study. The most important task in this project is to find out the proper manner in which to interact with and be helpful to the students interested in technical careers as a demonstration of what can be done in a range of career areas. Also, a second concern for this team is to determine if the WPS students and faculty are interested in the continuation of this program in the future. We believe that we can interact with students based on a revised survey, and help all students with science or engineering aspirations, who give us their time, to achieve that which they aspire to do.

1.4 Issues

On the outset of this project it was apparent that many delicate issues involving the survey and the sponsor that needed to be addressed. Among these issues were gender and ethnicity. All parties involved were very aware that this could create much controversy about this project and could cause it to fail. The ACSW believes in affirmative action, but did not insist that this team pursue that goal.. The members of this project strongly believe that no one should receive preferential treatment in any way, only that everyone should be treated as an equal.

We were warned that equally interested males and females might express interest in technical careers in different ways. Due to this, team members were ready to accommodate each individual's needs. The team members' goal was to limit the potential for controversy and increase the chances of the project succeeding. The project had to be accepted and embraced by the local government, Worcester Polytechnic Institute (WPI), the Worcester Public School system, and the particular schools and club advisors involved, so it could not be ideologically motivated. It is understandable that every different individual has a different policy or belief, about gender equity. The team wanted to avoid dealing with this as much as possible so that it could concentrate on helping any and all students with an interest in a technical career join the program and explore that possibility. If, as a consequence of these beliefs, the project encouraged women, along with men, to become more interested in technical careers, who could object?

Another issue, which is probably the most limiting and unavoidable, is the limitations of how helpful the team members can be to the students. This program is being created and carried out by two WPI students who possess a wealth of knowledge about getting into a college and pursuing a career which is based in science and engineering. It is fair to say that WPI students are good at helping other people who are interested in similar things, and it is also fair to say that they are probably not the best people to assist someone who is interested in a career normally grounded in liberal arts, for example, politics or poetry. People who only looked at careers in engineering do not possess the ability to even name a college which has a reputation for producing politicians and poets, much less help a student find a good personal fit. This means that the scope of our interaction program must be limited to students who are interested in engineering and physical science who would want to know how engineering programs differ from Dartmouth to Cornell, or RPI from WPI. Because of this, we chose to develop this program at Doherty High School because it is Worcester's "magnet" school for engineering and technical science.

Out of the group of students who may demonstrate interest in these fields in the survey, many will not be serious about our program and still others will not even bother to show up and accept our offer of information and assistance. An additional problem that will need to be overcome is that if the survey is the only tool available that can identify students to invite we will miss at least a third of the potential candidates. Problems with the survey start with absentees on the day it was issued and range to missing or false ID numbers and students who outright

refuse to complete it or take it seriously. We estimate that our response rate was 64% overall but that we have accurate ID numbers on usable surveys only for about half the students in the class at best.

1.5 The Study Context: Doherty High School

After creating the idea of our interaction program many questions were posed to the team and others were raised by the team. The crux of these questions centered our curiosity about what we would find at Doherty High School which is the high school with the Engineering and Technical Academy (ETA) and the school which had the worst sex ratio eight males to one female, of any high school in the city among those interested in science and engineering. This was according to Hogan and Handler's (2005) aspirations survey. At most Worcester high schools the engineering/science sex ratio had been four to one. Given this situation, gender equity questions arose. Some questions posed to us were, would we seek out the "missing females" or accept more females than males? What if ethnic equality issues arose, does the team plan to seek out under represented ethnic groups, in engineering, if the females are not interested? Should any group get preferential treatment now to compensate for oppression in the past?

The team, in response to all these questions had some straightforward answers designed to be both pragmatic and evenhanded. Delay was the major threat, if any delay issues were to occur the team would do the best they could to overcome such obstacles by amending the project to make it more attractive to

those who were causing the delay. The team was not in a position to be doctrinaire or ideological. We wanted little or no controversy. The important fact to remember in this situation is that the team members were committed to the project and would like to accomplish their goals regardless of obstacles. That meant that the priority had to be getting into the school. As far as what would most benefit the students, the group outlined different possible topics and methods of delivery but in the end it was really up to what the students wanted. So, we were prepared to be flexible and spend one of the early meetings letting the students tell us what they would like help with, or what they wanted to see the club become. We would try ideas out on them of course, but first the advisor and later the club members would get a chance to shape the agenda.

As far as male to female ratio, the team is looking to help all students who are interested. If there were more students interested than we could accommodate, the solution would be a combination of first come first served policy, and trying to equally represent both genders. However we were not committed to finding a fifty percent female club population. We would work with those who took the initiative to come to our meetings. As far as ethnic representation, the team decided to make it known that no one would receive preferential treatment for any reason. All were welcome, and it was hoped that would be enough to draw a minority population proportionate to that in the school. These are only a few examples of questions posed to the group but they are representative of the concerns, raised by our sponsor, the ACSW. It was agreed that our primary mission was to show how the aspirations survey data could be

put to use to help students achieve their dreams. Then the public schools would keep gathering such data and want to develop the club idea concurrently.

1.6 What we hope to achieve

With these issues identified and addressed we can now define what it is we hoped to achieve in this project. The project team hopes to learn about the worries and reservations of high school students, especially those which lead them to doubt that pursuing their dreams is worthwhile. Technology careers are just the first test case of a concept involving college student coaches and clubs. It is hoped that by informing the students about others in their situation, who overcame their anxieties, tried and succeeded that they too will plan better, be more confident, try harder and increase their chances of success.

These anxieties are usually centered on high school transcripts and grades, standardized test grades, and financial limitations. Depending on the family resources, experience and attitude toward higher education, the details will vary. This is where the phrase “if there is a will, there is a way” comes to play. If a student wants to be an engineer or scientist there are always strategies that make sense for a strong student with little money, or a student whose grades are average but tests well. However, a traditional guidance knows all this, and more, and certainly can explain “need blind” college admissions. What did we have to offer that was different?

The main point of this project was to spend time with sophomores that the guidance counselors wish they could, but can’t due to the demands of juniors and particularly seniors who are involved with the college admission process directly. By talking to sophomores we hoped to do three things, number 1) Convince them it was possible, that financial issues are not insurmountable.

Hence, they should assume those problems will work out and focus on having the paper record to support college admission. Number 2) Keep your options open. Deciding not to take “hard” math and science courses closes doors. Keep them open, try things that can open doors. Number 3) Dream a little. If you think it would be fun to work at “Disney World” designing new rides or play computer games for a living, look into what background you need to achieve such careers.

There is a major in interactive game design at WPI but that is unusual. A computer science degree, a concentration on graphics, and a minor in creative and technical writing could also get you to a game designing type career. As for amusement park creators, yes, they hire engineers and are very interested in robotics at theme parks, for example at “Disney World” they call what they do “Imagineering”, especially in the “World of Tomorrow Pavilion”. Theme parks contract with engineering firms for designing and building everything from rollercoasters to waterslides to creating better queue lines. So, believe, open doors, dream, and plan a strategy. Courses are part of that plan but it could include extra curricular activities and volunteer work and summer programs- any of which could set your college application apart. It is too late to talk about these sorts of issues to a current junior and would need to be set in place at latest by the start of junior year.

Due to the target audience of the team, the hope is to increase the enthusiasm of those who demonstrate an interest in engineering and science by having them decide what they want to be part of in general terms be it the auto industry, space program, or designing the audiophile’s dream sound system. We

hoped to help the students to understand what engineers and scientists do so that they know the sky is the limit, but can also make an informed decision about what they want to do for the rest of their lives. It would be pleasing if the students got as excited about science and engineer as the team members are, and spread enthusiasm among their peers who are curious about the subject matter. It would also be beneficial for the future of the world if more students and even some brilliant students, who can do anything they want, decide to become engineers and scientists rather than doctors or lawyers. These are the people who can make the most noticeable changes in the daily life of an average person, though they usually don't make as much money as doctors and lawyers they can do as well financially and can contribute as much or more to society.

2. Planning and Implementation

2.1 Plan One

The group of people involved in this project proposed a method which would achieve all of the goals and desired outcomes that have been previously discussed. This was a high school student coaching, or interaction program. It would include ensuring that students with any interest in technology were on the right path to take at least pre-calculus, chemistry, biology, and physics to keep that option open. This program involve meeting individually or in small groups with each student identified and would not only focus top high school curriculum but also introduce the student to the types of engineering there are, and inform the student of opportunities that might be available to them, as we dream a little and try to locate the students interest and ignite it into a passion, and hopefully a motivating dream.

As a method of identifying students the team would distribute, to the tenth grade students, the same survey that was being given to the eleventh grade students. The reason for selecting the sophomore class was due to the high school experience of the team members and consultants on the matter. It is too late to help a junior adjust their curriculum. A junior should already be on the proper career path and are usually locked into a series of classes, and in some cases it would be beneficial to be looking at possible colleges. It is thought by many of the 11 WPI students involved in aspirations projects this year that the degree to which career aspirations are developed does not differ greatly between sophomores and juniors. Hopefully this claim will be proven correct when the

sophomore and junior data set are compared. For first year high school students, we would not make such claim as they have been able to demonstrate their strength and weaknesses for subject matters in previous years of study but are rarely sure of what that means in terms of a career worth aspiring to.

After the student aspirations were identified it was hoped that the team members could work hand-in-hand with guidance department and be able to assist a guidance counselor in supplying information to the student about how to prepare for their career interests. At least we were willing to meet with some of the students who aspire to technical careers discuss our experiences with them and offer planning advice.

2.2 Plan Two

After creating a proposal for “Plan A” described above, in WPI’s A term or mid October, and sending the proposal into the school system soon thereafter, we heard very little positive feedback. So when our project was still not approved by the WPS guidance or higher administration by the middle of C term, the start of February, we became very discouraged and decided it was time to seek alternate methods of “coaching” or our report would simply end with a proposal. We made some progress when WPS higher administration recommended we look into creating an after school “Future Scientists and Engineers Club”.

This new idea gave new hope to us, and It soon became evident that the major agenda of our project could still be achieved in this format and our original proposal was easily modified to fit this mold. The following pages outline our interaction program as it happened.

2.3 Implementation

Meeting A (03/30/06):

This was a preliminary meeting where we met Miss. Kambosos (Kathy) for the first time. We met Kathy through Elizabeth Tomaszewski who has children in the WPS system. Kathy is the events coordinator at Doherty, and the faculty advisor of the Engineering Technical Academy. ETA is designed to help students with an interest in engineering or technology prepare to follow such a career path when the graduate from high school. Until this first meeting, we were anxious as to the outcome of our project because Brian had only spoken to Kathy briefly a few times over the phone and exchanged a few e-mails. This meeting allowed us to put a face to a voice, and see how exactly how interested in the project she was. One of the previous e-mails sent to Kathy included the student ID numbers, of those students we had identified, using the aspirations survey, who showed a strong interest in engineering. When Kathy looked up which students these were, she discovered that many of the students expressing interest in such careers were not part of the ETA.

Prior to being allowed into the school, for this first meeting, both team members needed to have completed a Criminal Offender Record or "CORI" check to formally allow us to gain access to the Worcester Public Schools. When we arrived at Doherty we went to the school's main office and asked for Kathy. She met us at the office and explained to us that whenever we entered the school that we needed to sign in and obtain a visitor's pass. Once we were signed in we sat down in a conference room and began the formal meeting. We

were both surprised to hear that she had been meeting similar resistance from the administration that we were encountering. She explained to us that they have wanted to start a program like ours at Doherty for some time, but met a lot of resistance from the upper administration every time they tried.

Once we finished discussing the hassles we had gone through we moved on to discussing the structure of the “Future Scientists and Engineers” club meeting. Ideally we had wanted eight meetings over the course of four weeks meeting twice a week, but we had left one very vital detail out. During the third week of April the Worcester Public School system has a week long “spring break” and this news cut our meeting allowance to a maximum of three weeks before the WPI term ended and the group members summer jobs started. This unforeseen obstacle cut our projected meetings list to six, and with the sixth meeting being a tentative field trip to WPI, and the first one being introductory, we really one had four to five meetings to plan. Once we laid out our game plan (Meeting 1. Introduction, 2. Robotics, 3.Cad/CAM 4.Space, 5.Computergames, 6. Fieldtrip to WPI), we set our first Club meeting for the following Thursday (04/06/2006).

At the end of the meeting Kathy explained that we should create a flyer to raise awareness and advertise for our club. She also said that she was going to go around to the classrooms and ask the people to join whose ID numbers we had given her, especially to ask them if they had even considered being part of the ETA? This turned out to be very effective, and we were very fortunate to be able to have met a person in her position that has the same mindset that we do.

Meeting 1 (04/06/06):

Objective:

This was our first official meeting of the club. We both figured that if we got between seven to ten students that we would consider the club a success. We went into the meeting trying to make it as laid back and casual as possible, so we decided not to have a formal agenda. Our plan was just to introduce ourselves, give some background about us and the club and then go around and have each student introduce themselves and explain why he/she decided to come to the club, and arrange to meet those expectations in the next few meetings.

Turnout:

We were pleasantly surprised when we had a turn out of fifteen students, and there was an even ratio of males and female. The spread for grade levels was very good as well; there were eight sophomores, six freshmen and one junior.

Results:

Some of the types of engineering the students showed strong interest in were:

- Mechanical
- Civil/Architecture
- Electrical/Computer
- Computer Science
- Biomedical

After we finished the introductions we planned to answer any questions and then end the meeting early. We were very surprised when almost every student had at least one question to ask.

Some of the questions topics were:

- What exactly does an engineer do?
- What is the difference between becoming an architect as opposed to a Civil Engineer?
- Why did you (Matt and Brian) decide to become engineers and why did you pick your respective types of engineering?
- If I want to do (insert job here), what type of engineering should I choose?
- If I am undecided about what I want to take as a major in college what should I do?
- What types of engineering presentations will this club have?
- Are we going to visit WPI and if we visit what will we see?

We were both very surprised with the large amount of very in-depth questions and wound up running out of time, but before we had to end the meeting we decided to take the last 5 minutes or so to poll the students about their impression of the meeting and how we handled things in general. We asked the students to be as honest as possible, and to express everything they liked or disliked about the meeting, and things they would like to see.

Meeting 1 Conclusion:

The meeting was very relaxed and casual, and that made it seem more like a real club and not just another class or information session. This allowed the students to stay focused and not become bored**.** The students thought we were both very well spoken and had good public speaking skills, and appreciated the fact that we were able to provide answers to all of their questions. However there were things that we could have improved upon.

One student said she would prefer if the meetings were more “hands on.” (We explained to her that this was just an intro meeting and future meetings would

have more interactive demonstrations). A few students said it seemed like we were slightly unprepared for the second half of the meeting. This was true because we weren't expecting the students to be so inquisitive so we were caught off guard. We went into the meeting planning to be very relaxed so we decided not to have a set agenda because that would make it seems more like a class. After this meeting we decided that we should develop a rough agenda to keep us on track, but nothing too regimented.

Things the students said they would like to see in future meetings:

- A robotics demonstration
- A CNC machine demonstration
- A field trip to WPI
- A demonstration on ECE (Electrical Computer)
- A presentation explaining the different types of engineering and the jobs that each major offers.

Meeting 2 (04-11-2006):

Objective:

For this meeting we decided to give the students what they asked for in the last meeting. We were able to set up a robotics demonstration from Ken Stafford (a professor at WPI). Our plan for the meeting was to take the first five to ten minutes of the meeting to ask the students if they have any questions from the previous meeting. Once we answer any questions the students may have we plan to introduce Ken and let him take over. Since this is a club with students who are already interested in engineering Ken decided to modify his presentation a bit. He moved away from trying to get the students interested, and more in the direction of getting them to understand why and how things worked.

Turnout:

We didn't have as good of a turn out as the previous meeting, but Kathy explained that it was because Tuesday was very busy day as far as after school activities go at Doherty. Still we had nine students show up, and again to our surprise we had more females than males.

Results:

Overall we found the presentation to be interesting, but it was anything but smooth. The first major issue was that Ken brought two Mass Academy students, and threw a few plugs for Mass Academy into the demonstration. We weren't overly happy with the Mass Academy plugs and the students weren't impressed either, and Ken apologized after he got a poor response from the students.

The two students he brought with him as assistants were not very good at all. They did not have very good presenting skills, and were very clumsy, slightly immature, and not very good at explaining how to operate the robot to the students in the club. At one point Ken actually had to stop and yell at them because they were cracking jokes with each other while he was talking. Ken, on the other hand, was an excellent presenter. He was very energetic and well spoken, and really sent off the vibe that he truly enjoys building robots and presenting to students.

The presentation consisted of Ken talking about each of the two robots that he brought with him, and giving short demonstrations of each of the unique features they possessed. Then he asked for student volunteers to try to operate the robot manually. Surprisingly not too many of the students were eager to

volunteer, we are not sure if they were being shy or generally not interested. The presentation lasted the entire hour period and Ken took the last five minutes to ask the students a few questions and see if they had any questions.

Meeting 2 Conclusion:

We feel that this presentation was good overall, but if a robotics demonstration is to be part of the program in the future a few modifications should be made. First, we feel that scheduling it on a busy day and not having a full turnout hindered the effectiveness of the demonstration. Secondly, we feel Ken should have brought WPI college students, rather than Mass Academy students. They would be more familiar with the robots and able to handle themselves better in front of a group, and could talk about their career plans. We feel if these changes are made this will be a good presentation to have in any future clubs. It helps if the students don't look like a negative stereotypical engineer, and the Mass Academy students were, unfortunately, just that.

Meeting 3 (04/13/2006):

Objectives:

At the end of the first meeting we asked the students what they would like to see for future meetings and one of the suggestions was a meeting devoted to explaining in-depth the different types of engineering. For this meeting we decided to create a power point presentation on the main types of engineering and the different concentrations they offer. We also briefly touched on the different job opportunities each of the major's offer and the average starting salaries. Our main objective is to offer the students some clarity about each major and fix any misconceptions they may have.

Turnout:

We had a turnout of thirteen students, which consisted of six females and seven males. We were also happy to see that there were three first time students to the club. We consider this turnout of thirteen students to be extremely good because this meeting took place on the final day before the students went on spring break. We did not expect nearly as many students to show up because we expected them to just want to get out of school and start their break.

Results:

We split the presentation into two parts with Brian starting off with the first part and Matt finishing up with the second part. We each chose four engineering majors and their respective concentrations. The majors and concentrations were as follows:

Brian:

- Mechanical Engineering
    - Manufacturing
    - Design
    - Aerospace
    - Material Science

- Computer Science
    - We realize Computer science isn't actually engineering, but almost every major engineering school offers computer science as a major
    - Programming
    - Artificial Intelligence
    - Game Developer/Tester

- Civil Engineering
    - Transportation
    - Structural
    - Geotechnical
    - Environmental
    - Project Management/Construction Planning

- Biomedical Engineering
    - Biomaterials
    - Biomechanics
    - Bioinstrumentation

- Biotechnical Engineering
    - Biology
    - Cells and Genetics
    - Environmental Biology
    - Computational Biology

- Chemical Engineering
    - Materials
    - Bio Chemicals

- Electrical/Computer Engineering
    - Computers
    - Bioelectrical
    - Communications and Signals
    - Power Electronics

- Fire Protection
    - No real concentrations

Meeting 3 Conclusion:

Overall the meeting went very well. The students seemed to be very interested and we were stopped frequently with an array of different questions from many different students. The topic the students seemed to be most interested in was Biomedical engineering. However, we also came away struck by the level of female interest in Civil and environmental engineering. The fact that the ETA emphasizes mechanical engineering activities and the interests of the female population in our club lays elsewhere, explains some of the difficulty that the ETA has had recruiting females, despite having a female head of the program. Also, to keep the atmosphere of the meeting as laid back as possible we decided to include humorous pictures into the presentation, included a photo of a squirt gun enthusiast. This proved to be a good idea.

Meeting 4 (04/25/2006):

Objective:

Our plan for this meeting is to show the students different types of projects that different engineers are working on now and will be working on in the near future. We decided on three short presentations, a presentation on a possible space elevator in the future, a presentation on a project Matt completed for a class involving adding a pressure sensor to a water gun and finally a project to create a human powered vehicle.

Turnout:

We had a turnout of nine students, consisting of four males and five females. We have noticed that we have much better turnouts for our Thursday meetings. Kathy explained that Tuesday is a very busy after school day and that was probably what was causing our poor turnouts on Tuesdays. In future after school clubs, meeting once a week on a day that is not as busy would be advisable.

Results:

Brian started off the meeting by doing the space elevator presentation. We had originally planned on having the IQP team, who did the project on the space elevator, come into the school and present. Unfortunately, they were unable to come. After Brian finished the space elevator presentation Matt followed with his presentation on how he modified a water gun by adding a pressure sensor. We had originally planned on having the actual water gun to show the student, but unfortunately Matt's partner for the project took the gun after they were done and

lost it. Finally Matt gave a presentation on human powered vehicles. The project was originally done by Matt's friend Al Adams from Catholic University of Washington DC, who was gracious enough to send Matt a copy of his power point presentation.

Meeting 4 Conclusion:

This particular meeting didn't flow as well as the others. We believe it was a combination of the lower than normal turnout and the obstacles we ran into presenting projects using notes that were prepared by other people. Projects carried out by other student teams should have been presented by the students who did them. They would have had a better understanding of the details and be more enthusiastic about the subject. It is recommended for the future to stick to only one or two topics per meeting so that enough time can be dedicated to each presentation so that the club members would be interested, instead of rushing through presentations to follow a schedule and losing the attention of the students. This way the students can get the most out of each meeting.

Meeting 5 (04/27/2006):

Objectives:

This will be the final meeting of the club for this year. In typical high school fashion we plan to have a party for the students. Along with the part we plan to have the students fill out a brief feedback survey.

Turnout:

We had a turnout of thirteen students, breaking down to four males and nine females.

Results:

The meeting went great. Before we gave out the food we had the students fill out a feedback survey. Some key points from the survey are:

- All thirteen students liked the club and would participate next year
- The most popular meetings were meeting 2 (six votes) and meeting 4 (five votes)
- One student wrote in on her survey that she liked the robotics demonstration but didn't like the people who did it. (This goes along with our write up from that meeting, in which we said the presenters were not very good)

Some presentations the students said they would like for next year were:

- Robotics
- Science
- Computers
- Biomedical Engineering
- Anything "hands on"
- Architecture
- Video Games

Meeting 5 Conclusion:

Along with the survey we handed out a sheet with our contact information and some helpful college research website. We were both very sad to have to end the club so soon as we both had a great time and will miss the students. All the students were very unhappy to find out that we won't be running the club next year, but we hope to be involved in planning it, and to make a few appearances.

Meeting 6:

Objectives:

This was supposed to be the final meeting for the club, but because the club only ran for a few weeks we were unable to make the proper arrangements. The plan was to organize a field trip to WPI to give the students a "real world" presentation of the different types of engineering. It also allowed us to give us a chance to present certain things that we couldn't bring into the high school.

We planned for the field trip to include:

- A CNC demonstration in Washburn Shops
- A demonstration from Jeff Faria of his MQP. He and his group members modified and re-wrote the code for the popular video game Quake 3. We had planned to reserve a computer lab and we would have been able to let all the students actually plan the game at the same time.
- A tour of the dormitories
- A tour of the different science laboratories
- A Civil Engineering demonstration
- A Fire Protection Engineering demonstration
- A tour of the campus center

Basically we wanted to give the students an idea of what college life is like, and to show them what the different engineering disciplines do for research and studying.

3. Conclusion:

3.1 Summary of Results

After all of the set backs and delays we finally were able to secure a contact person at the Doherty. Kathy Kambosos is the director of the ETA (Engineering Technology Academy) at Doherty. Once we made contact Kathy things finally started to come together and we were able to start the actual planning for the club, instead of sitting around and planning theoretical scenarios.

We initially met with Kathy on March thirtieth and she greeted us with much enthusiasm and excitement about the club. Apparently she had been asking the upper administration of the WPS (Worcester Public Schools) for a club like ours for quite a while. We learned from Kathy that the delays and resistance that we met from the upper administration were not uncommon in the WPS system and she had also suffered similar delays and resistance on several occasions.

Our “Plan B” for the club was already a revision of our coaching “Plan A”. it was to have two meetings a week for four weeks totaling eight meetings, and that would bring us right up to the end of the WPI term. One thing that we should have taken into account was that during the third week of our time frame the WPS had a week off for spring break. This unforeseen setback left us with only six possible meeting days for “Plan C” and no leeway for accommodating the schedule of the people we wanted to present. Our final meeting was supposed to be a field trip to WPI to show the students around a real college campus, but

unfortunately due to time constraints we were not able to properly arrange for it so we only ended up having a total of five meetings.

Do not underestimate the lead-time necessary when transportation costs, timing before dismissal and permission slips are involved in carrying out a field trip. We are told a full month of warning and lead activity is typically called for to take a group of students out of the building. Anything that disrupts transportation home is especially problematic.

Our original focus for the project was to interact with just the sophomores at Doherty, especially those identified by the aspirations study as interested in a technical career. However, Kathy proposed opening the club up to freshmen and juniors as well and we actually had access to junior aspirations survey data but did not think to use it. We had no objection to opening the club up to the freshmen and juniors, we figured it would help our chances at getting an acceptable turnout, and the freshmen will be sophomores next year when we really expect the project to “take off” after our pilot program.

Before we held our first meeting we had decided that if we could have a turnout of ten students we would consider the club a success. Our turnout for the first meeting consisted of eight females and seven males for a total of fifteen students. The grade breakdown was seven freshmen, seven sophomores and one junior. We were able to have a total of five meetings of the six we had in “Plan C”. We logged each meeting and they can be found in the “meeting logs” section of this report. We decided to write an outline for the sixth meeting, even though we were unable to have it.

We realized very early into the club activity report that by opening the club up to all of the grade levels we had inadvertently raised an issue that we had not addressed in the beginning of the project. If a student joins the club in his or her freshman year, then he or she will presumably be involved in the club for the next three years of his or her pre-college career. So the question is, “How do we hold the club yearly, hit all the important topics we want to hit, and not have the club become redundant and boring for the returning members?”

We feel the best approach to solving this problem would be to hold two meetings a week. The first meeting of the week would be a full club meeting for everyone in the club, and would probably follow the same formula for the coming years of the club in terms of gathering ideas for later meetings, trips, games, incoming speakers and party events. The second meeting, however, would focus on a different grade level each week of the month and be more of a demonstration or career line discussion, which would be very different for a sophomore or a senior. This would allow the people running the club to have time for more focused one on one interaction with the students who need “coaching” as we meant it in Plan A. The meetings should focus on addressing issues the students are dealing with at their current time in school.

The second weekly meetings should focus less on demonstrations of engineering and the applied physical sciences, and focus more on the kind of course curriculum to follow in HS (sophomores), the kind of extracurricular activities that enhance a college application and how one finances college (juniors) and the proper way to choose and apply to different colleges (seniors).

By customizing the meetings for the different grade levels the Club offers the returning students something new every year. Meanwhile the main meeting for the week will still be a fun, and hands on, experience for everyone with the club organizers as cheerleaders and boosters. One should never forget they are dealing with the question of motivations, dreams and why one wants to go to college and how one wants to spend their lives in the first place. Along the way, if one can encourage a female to do something interesting to them and counter-stereotypical, so much the better. Equal opportunity is a worthy goal.

4. Recommendations

Finally, we will close with some recommendations for the future of this project. We understand that about 8 students, 4 groups of 2, will be continuing the project next year. It is assumed that the project will be one of creating 4 clubs at four high schools. At two of them there will have been no pilot club and they are starting fresh. At two high schools there will have been a pilot club project, but very different ones. The North High project focused on space activity and had about half the turnout we had, due to publicity later in the year and flyers that were even less developed than ours. There is also not an ETA program at any of these other schools. Hence, much of what we did would be new there, for one year. It is only the group that comes in after us at Doherty that faces a problem or potential repetition that all of the Clubs will face the next year. We first must raise the point that if the program the second year is redundant to the participants, they will not return the following year and we believe this would

cause the project to fail rapidly. So, it is important to not have the exact same meetings as we did at Doherty. A meeting should be redone only by request of the veterans from this year's club who think the newcomers need to see it.

Also there is the question about the specific needs of students based on class year. Freshmen would need more of an introduction to get them excited about engineering whereas seniors would need help on deciding which school's invitation to accept, and answers to financial aid package questions. With this in mind is it reasonable for each of the four groups to focus on one of the four high school class years rather than to organize by school? If this is the case will each of the four groups do the presentation four times at each school, or is it possible for all sophomores to go to one school for a presentation on the same day?

This alternate scenario raises the important issue of transportation and funding. We applied for funds at the end of C term hoping to be able to offer some money to our faculty advisor. We did not officially get denied but we never heard back from the WPI IGSD office, and we were only lucky to have met Kathy who cared about this project as much as we did who was willing to do it on her own time. Will groups at all schools be this lucky? The teacher's union (EAW) will never allow such a major give away of faculty time. The clubs will have to get into the school system budget overall or the individual high school budgets. If they do not, each team will have to raise money from WPI for their faculty advisor, which the North High team managed to do this year, raising $300 for this purpose. This was essentially a matching funds grant from WPI in which the partners put up $75 each a total of $150 and the WPI IGSD office matched their

contribution to total $300, which at $30/ hour covered 10 hours of their advisor's time.

Another Issue is the continuation of the "Aspirations Survey" from which this project developed. If this club is open to all students, is the survey necessary? It is not essential, and due to the fact that 50 percent of the students we identified to be prime candidates for the program had written down invalid ID numbers it was not a way to find all the potential club members. While these losses were discouraging, the good ID numbers did allow us to issue some targeted personal invitations. That really was a good way to start. The other 50 percent would have been less likely to come if they had not received an invitation to the first club meeting. Kathy knew about half of these students, some she had met through ETA, but the other half of them were new to her. She took it upon herself to go meet these students aspiring to be scientists and engineers who were not part of her ETA program and whom she obviously thought should have been in it.

Thus, she met some students interested in technology who had other interests too and wanted to explore them without making commitments yet. The Club is a perfect vehicle for that, and the heavy participation of females that resulted is notable. ETA is about 4:1 male. The majority of our club members were female. These two programs were clearly serving different student populations and Kathy was quick to pick up on that, and we noted her extension of the club to the freshmen, people she might later recruit into ETA as Sophomores. Given this experience it is hard for us to say that the survey had

no value and should be dropped. On the other hand, the freshmen who appeared were not coming in due to the sophomore survey. They were recruited word of mouth. Some of them may have heard of the club from sophomores who got personal invitations. However, the Club was not a static group of people. It kept changing and kept getting more female dominated. We had tapped into some kind of student network among the freshmen and sophomores and have no idea whether one or more of the people identified by the survey was the key to that, but this was not just the ETA crowd coming due to their connection to Kathy. She was doing outreach in her own school via the Club. We think the aspirations survey was helpful in getting that going.

Also, the survey could be used as a tool to observe the progress of our club reach and influence over time. Will engineering and science become more popular over time, especially to women and minority students? If the survey is administered to sophomores it could be used by the guidance counselors to help students be certain that their HS course schedules fit their college admission plans. That would not require coaches from the area colleges, but they might be available if requested. A guidance counselor may be primarily focused on getting students into college and much less concerned about their major or plans after college, but there are a few institutions of higher education that are atypical and not for everyone. Music conservatory (Boston) , Art School (RISD, Mass ART) Technical Institutes (WPI, VPI) and Business colleges (Bentley, Babson) are all places where one is making an early career commitment and even if it just

helped locate the 15% of the HS students who should be thinking about going to highly specialized colleges or universities.

An expanded version of our project has the potential to attract students at other high schools, who are interested in engineering, to transfer to the engineering magnet school. This implies that Doherty may become too popular and have to turn some away, however what if club projects were started for those students who have other career aspirations? Then the schools could “swap” students as openings appear in their small school programs. A comprehensive aspirations survey distribution (with good ID information) could also open the door to a controlled student transfer program. These are all ideas that have come up as we planned an executed this project. How much potential they have can only be assessed overtime as other projects are run to explore the possibilities.

3.2 Overall Conclusion:

In conclusion, our project was successful in determining many things, and raising many questions, and hopefully in launching a line of projects to follow in the future. Firstly, with the help of our data set and another team of WPI students, we found that there is not a major difference between sophomore and junior career aspirations. Oddly enough, there seems to be greater interest in engineering among sophomores than juniors at Doherty HS but most of the other careers produced roughly comparable percentages. Thus, it does make sense to gather data a year earlier and that gives us an extra year to start helping those students who have an interest in technical fields before it is too late to get math

and science into their junior and senior class schedules. An extra year of lead time also opens up doors for informational sessions that will get students interested and excited about what they might be able to accomplish in their lifetime. Based on feedback from Kathy Kambosos, and from the students who participated in the club, it turns out that our project was not just stimulating and interesting, it was also pre-coaching. By that we mean that it gave us a way to raise and answer questions about engineering that would not have even thought of, much less asked before a group, without the presence of our club. Both the club students, and Kathy are excited about seeing what the students of next year's project have to offer to continue this line of activity. Since we have already been allowed into the school, the future project can start much earlier and will probably flourish where we struggled to get in the door.

Due to the delays we encountered, we had to change the scope of our project many times, until it was almost downsized out of existence. Due to the short amount of time we had to plan meetings for our only shot at an interaction program, we did not have the optimal content or presenter for each meeting. If we had the time to plan more, we would have hosted a field trip to WPI which we feel would have been extremely valuable to the students. If exciting demonstrations from different departments were set up as part of such a tour or preceded the tour, it would greatly increase the participants' interest in pursuing a science or engineering career.

We would have also liked to have more student oriented, hands on activities, and access to cool things for the students to play with, because

creating neat and useful things to happen is at the heart of engineering. This would be a great asset to the program, and it is unfortunate that we lacked the time to plan for a series of such activities tying into different technical fields.

Although we did not get to do things in the optimal way, we did offer lots of information to participants in a way that was interesting and not overwhelming. We were able, somehow, to interest students, with an anti-stereotypical message about engineering that resonated with women and attracted more and more females to our club. That these were women that were not interested in joining the ETA, but were still just exploring and hit us with lots of questions about civil and environmental engineering is interesting. We hope that in the future this project will allow for all students who have an interest in a career to follow their dreams without the influence of cultural stereotypes getting in the way.