A FUTURE SCIENTISTS AND ENGINEERS CLUB FOR WORCESTER TECHNICAL HS

An Interactive Qualifying Project Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

George Chyoghly

Keegan Richey

Date: October 26, 2007

Professor John Wilkes, Advisor

Transcript Abstract (79 words)

A "Future Scientist and Technologists Club" was created to help students in their junior year at Worcester Vocational High School learn more about the fields of science, technology, and engineering. Unlike other clubs of this type in Worcester High Schools, this Club was held during school hours in an honors physics class. The Clubs in the other Worcester Public Schools are quite different as they serve different types of students, but both projects were successful and should be continued.

Report Abstract

A future scientist and technologist school club was designed to assist the students of Worcester Technical High School learn more about the fields of science, technology, and engineering. This project was based off a pilot program conducted last year at Doherty High School where student involvement and interest was very high. Attention was paid to the sex of the participants in the club because of the history of the fields of science, technology, and engineering attracting mostly males. The ability for this club to provide a plethora of information to aspiring scientists and engineers that is not offered to them in their normal school curriculum is an extremely valuable tool to increase and enforce interest in technical careers. Therefore this club concept must be continued and expanded upon.

Acknowledgements

We would like to thank the following individuals for their advice and support throughout our project.

We would first like to thank Professor John M. Wilkes, our project advisor as well as our co-advisor Elizabeth Tomaszewski for their support thought our entire process from planning to implementation. Without their help this club would not have been possible and also for their elevated level of involvement with the field trip to WPI. Their instigation helped our teams to get the first of many field trips to WPI for the future scientist and technologist clubs, although at the time it seemed like too much to organize given the commitment and time constraints.

We would also like to thank our sponsor, the members of the City Manager's Advisory Committee on the Status of Women.

Last but not least our outstanding advisors at Worcester Technical High School Azad Chaparian, and Tom Gusek. It was with their help that we were able to keep the club students excited, interested, and involved.

1. Introduction

1.1 Project Sponsor

The project's sponsor for this year as well as last was the Advisory Committee for the Status of Woman (ACSW). They are involved in the project due to concerns about continuing gender inequality within engineering. This is one problem that is being addressed through the implementation of the science and technology club, which can help to stimulate the interest of women in engineering by providing information regarding careers that cater to their interests. A study performed by Nora Rizkalla and Zachary Gautreau, presents the results of a subject interest survey given to 8th graders that is similar to a career aspirations survey administered to the 11th graders by Marsland et al. The goal of this pair of studies was to compare the information received and attempt to draw conclusions based on the data similarities and differences.

Of concern were the two subjects most important in preparing for a career in engineering and technology, science and math. The data taken from 8th graders suggests that while a gender bias does exist with regard to interest in mathematics, science is reported by 20% of both males and females to be their favorite subject. The 11th grade data suggests that the number of students who indicate science as a potential career choice is a mere 5%. However, 20% of the males express interest in engineering compared to 5% of females. It is interesting to note that approximately three times as many females as males express interest in a medical profession by the 11th grade. Rizkullo and Gautreau hypothesize that the interest in science

for the 8th graders translates into biology for the females and physical sciences for the males for reasons related to gender stereotyping. However, at that grade level Worcester is offering an integrated science course that involves exposure to physical sciences other than just biology. In any case, 8th grade is a time of high interest and Gender Equality in science.

Judging from the results it would appear as if the critical time in which their interest in science related subjects, as reflected by the data, is between the 8th grade and 11th grade. Early high school, 9th and 10th grade, must be when the major decline occurs, especially among females. Not only does this overall decline in interest in science occur, but also it affects the majority of females while the males are sorting themselves out between the pure and applied fields of science and engineering. No definite reason has been determined for the decline of interest in applied science among the females being so much greater than among the males, but it is thought that this decline in science as the "favorite" subject is due to the introduction of chemistry and physics as the main science courses taken in high school.

Science throughout middle school is a combination of disciplines that emphasizes biology, chemistry and Earth science. In high school, specifically 11th grade, the majority of students are enrolled in either chemistry or a physics class that is vastly different from the descriptive biology the 8th graders experienced. Our theory is that science has taken on a different meaning, partially resulting in the decline found in the data. In addition, the interest in medicine, a service profession, by twice as many females as males, tells one about the image of engineering as well. Clearly it is not viewed as an outlet to humanity, yet public health and safety depend more on the Engineer than the Medical Doctor.

The small school system in place in the Worcester Public Schools is at odds with policies that place 8th grade students into the respective high schools based on their residence within the district rather than their interests. In the system there is currently only one small school within a larger public school High School that caters to those interested in engineering. This small school, the Engineering Technology Academy (ETA) is located at Doherty High School. In principle, those interested in engineering are encouraged to enroll in this academy, which will govern their high school class schedule, but in practice few 8th graders (20%) are aware of the small schools and even fewer are prepared to leave their districts and friends to specialize at so young an age.

If the technically interested students in the district had clustered around ETA, one would think that there would be little interest in a science and technology club in the other schools. The Marsland et al. survey indicated that levels of interest in Engineering were similar in the other public High Schools. Knowing this, one would expect about 75% of the students interested in the technical fields to be in the other high schools. So, more than a few students at each high school are interested in a technical profession, enough to support a club at each High School. The students with technical interests have not concentrated at ETA, so someone has to reach out to them and provide information and support. In a way we are the ETA outreach program. It was at the WPI field trip that the Doherty students in ETA met the students interested in engineering from the other high schools for the first time, and they really did not get to interact much.

In the case of the North High Club, not all of the Club members aspire to be engineers. They are browsing and some are equally interested in medicine which is the specialty of the Small School Academy at that High School. Keeping one's options open at that age is

something we tried to encourage. The club advisors at North stated that they believed a good number of students who they felt would ordinarily attend were involved with other after school activities. If so, just a portion of the pool of students interested in technology at this high school was enough to support a club. One aspect of this project that was controversial was how an effort at support by an all male (but non-stereotypical) group of engineering students would be received by the High School females? Would they need same sex role models to be encouraged?

Since one of the goals was to attract females who were interested in exploring the possibilities in technical fields, it was thought that a team of Club leaders including one male and one female would be more successful than an all male team. It was for this reason that the great success of our group with females as well as males came as a pleasant surprise to all those involved. Disproportionate interest and attendance by females was reported by about half of the clubs.

While it is important to involve WPI females and future clubs would benefit from female role models, the results achieved this year without them are encouraging. This good start should not be undermined by taking a year off next year if no WPI female club leaders are available. The project is still in the building phases and the positive image of a technical career portrayed this year was an important one. It should be built on immediately. The goal of fostering gender equality is not dependent on having females from WPI set up clubs. Judging by the success of this year still, it would be beneficial overall to seek gender balanced teams in the future. Typically, engineers have gotten the image of being nerdy and unable to effectively communicate with others. This is an image that is usually untrue, one that we wished to dispel and we think we dealt with that issue quite successfully.

1.2 Evolution of Goals

This project was built around the concept of last years "Future Scientist and Engineers Club" created by Matthew Duncan and Brian Dorchik. Their club's focus was to teach students at Doherty High School in Worcester about career options in the many fields of Science and Engineering. This year the club evolved into the city wide Future Scientist and Technologist Club initiative and clubs were started at all five of the Worcester High Schools. The general motivation of the group was to continue that work that was done last year and expand it to the other schools while also building a stronger base at Doherty High School. Rather than viewing the club as redundant and competitive with Doherty's Engineering and Technology Academy (ETA), the ETA faculty members wanted to make the club permanent with the help of WPI students. Our other goal was to set the initial ground work at the other four Worcester Public Schools so that they would be able to have continuing clubs in the future.

Our initial goals were to re-establish contact with already existing contacts in the Worcester Public School science program and also to establish many new contacts at the Worcester Public School's that were not yet involved in the program. With these contacts we would be able to set up the clubs at the school and also be able to establish a lasting bond between the Worcester public schools and WPI. Also the high school faculty contacts at the schools would be great assets in recruitment of students for the clubs to make them a success.

Another goal of last year's project that was not achieved was to have a field trip to WPI. Last year because of lack of time and resources the proposed and partly planned field trip was not possible. This year's larger team and earlier start in the schools led us to believe that we could make this field trip work and also be an annual event between WPS and WPI. Our initial intentions were to have the students for a tour that incluced demonstrations in lab facilities as

proposed by last year's team. But given Professor Wilkes' involvement with many space oriented IQP groups at WPI, and also the WPI Chapter of Student Pugwash's plan to hold a space oriented conference on the WPI campus, we changed our plans and came to campus on the day of Pugwash Space Conference. Part of the appeal of this plan was that we were not getting much encouragement and support from the WPI staff that ran interesting tour stops like the Fire lab and Robotics lab for our trip. This was disappointing since when Laura Handler organized the FACES field trip to WPI (for just the females interested in Science and Engineering identified by the first city wide aspirations survey), these facilities were opened to the 50 or so students and their guidance officers. We had about 75 people from the same schools on campus and got assistance only from the admissions department. So, the space conference was our fall back position.

The kind of tour Duncan and Dorchick envisioned would probably be better, but the lack of administrative support prevented us from doing that that. Laura had contacts in the women's program office, we did not have that kind of organizational access and would have needed much more time than we gave ourselves to make appointments with department chairs and solicit their assistance one by one. Future teams should be aware that it takes a month to set up a trip like this, and once the Worcester Public Schools review the plan it can take weeks to execute the plan. They need to set up the logistics of buses, substitute teachers, and field trip permission slips.

Along with the trip to WPI we saw as a group that the students would like to see experienced WPI professors come to their school to speak with them about their engineering fields. The professionalism of a WPI professor speaking about their specialization in engineering would have enhanced our club program. We could not successfully recruit speakers.

If we had been able to do so, it would have excited the student's interest very much and also allowed for a more in depth explanation of interesting topics to the students. In the future, it would be best to have each of the clubs advised by actual science and engineering faculty members who could actually "do the rounds" to the various high schools over a period of two months.

The Main goal of this project was always to excite the student's interest in engineering and science related fields. This was definitely the main focus of the club from the beginning of its creation and our group spent the most time designing activities around that goal, and we did have considerable success, even without direct WPI technical faculty participation.

1.3 Goals

To sum up the goals of the Future Scientist and Engineering Club initiative as it applied to our team in the Worcester Technical High School we were trying to create a science and technology club, in a vocational technical setting using last year's Doherty High club which served mostly ETA students as a model. Additionally we wanted to get WPI professors involved with the students in our clubs to share their first hand experience in engineering as a career. We saw ourselves as planning and coordinating the program, not personally delivering all of it. We wanted to see if the Doherty High School model of an after school club was appropriate to a trade school where the students spend half of their time off campus working in their trade. We also wanted to see how this very different student body which was less likely to be college bound, reacted to us. We were curious as to what percentage of the students we would be interacting with were thinking about college and taking the kind of courses necessary to apply to an engineering school. We wanted to establish a relationship with one or more science faculty members at the technical high school that would be able to identify the students who should be thinking of a future in science and engineering. As for getting these students to WPI for a tour, we thought would be beneficial to see how they reacted to the atmosphere and the possibility of going to college at such a place. Specific questions about how to get admitted, as we had been, could be asked in more detail after the trip than before they got oriented by WPI admissions.

1.4 Overview

The Project proposed to us was based on a plan to do a cmparative study with us as the stimulus, and then we would watch the response at five Worcester Public Schools with different small schools focusing on different interests. We did know from the aspiration survey results that the percentages of students interested in science and engineering was pretty even across the board at the five high schools, and was not heavily concentrated that Doherty High where the Engineering and Technology Academy (ETA) is located. Another statistic revealed by the survey was that many more females were interested in science and technology as 8^{th} graders than anticipated when the survey was administered. The size of the group still interested in 11^{th} grade was worth supporting, but it seemed possible to slow the erosion if the larger pool of 9^{th} graders with this interest received attention and support.

Therefore we felt that our services were needed to provide an outlet for the students interested in science and technology to explore those interests in an after school club. This was especially the case when the school itself did not cater to student with interests in this area. Our intentions were also to focus on the women at the school to see if the proportion of women found to be interested in engineering through the survey was at least the same that appeared in our club meetings.

Another area of interest aside from the students that was being examined was how best to get the number of approvals needed to get an after school club accepted by the overall Worcester Public School system including teachers, principals, and superintendent. The prior group lost about three months and had little time to actually deliver the programs. We wanted to do better than that.

1.5 Issues

The largest early stumbling block which we had to deal with was not being able to receive official approval to enter the school. This caused us to get late start for the club. We were unable to get in as many meetings as we wished as a result. So, the first year Doherty experience was repeated at Tech, in that regard. Also, this made it almost impossible to set up meetings with WPI faculty. Had we known what was going to happen we may have been able to prevent it by keeping interested faculty informed. However, since it was the first time this has been tried, our lack of experience resulted in a trial and error approach. The information below may give the following years groups a head start, so they can do better than we did. At least the second Doherty team got off to a timely start, providing followup teams a successful model to emulate for next year.

The number one requirement to enter the school is the submission and approval of the CORI background check. This check took, at least two weeks to go through. This ended up preventing the majority of groups from entering their schools on the starting dates they had planned on. In preparation for next year's clubs the students should get their CORI forms filled out before the end of the prior school year if they want to start in September.

Due to this time delay, scheduling meetings which included demonstrations from the WPI faculty was greatly hindered. Another problem was the WPI faculty (understandably) not wanting to do five of the same demonstrations at each of the schools. This problem could be solved by planning ahead. Finding a larger pool of faculty members willing to do the demonstrations would be the first thing to do. Figuring out a rotation where faculty members show their demonstration once or twice a semester would also be ideal. They don't have to go to

every school though a club project IQP advisor might want to “do the rounds” to get oriented to the Worcester Public Schools.

One of the big issues which our group faced was how unavailable the students at the Worcester Technical High School were after school. Our club advisors warned us that because this was a technical high school many of the students worked in their trade after school. Also, if they weren’t working after school they were likely to be playing a sport. All in all our advisors made it clear that an afterschool program just would not work. In light of this we decided to come in during school hours. Our club was simply a junior year honors physics class. The advisors believed that this would be the best direction to go in and we were hardly in a position to disagree. This issue was dealt with and our meeting day of Friday and time of 8:08 was set. We would “enrich” the class by adding club activities to it.

The next issue faced was the uniqueness of the school which we were setting up our club at. The uniqueness comes from the fact that the school is a technical high school where students learn academics, but also learn a specific trade. The way the school scheduled this in was by switching academics and trades every other week. This meant that we would be meeting with two sets of students. These two sets would rotate every week. Now we were faced with the decision of whether or not we wanted to give the same presentation to both groups. We weighed the options and decided that presenting the same topics would at least give both groups the same amount of information. If we did different presentations one group may have received a less interesting presentation than the other group or vice versa. Knowing this ahead of time would create a lot of waiting time up.

The overall result of the WPI field trip we ended up with compared, to the one we'd wanted to do was rather poor in our opinions. The trip could have been better scheduled along with more interesting topics for the high school students. The Space Technology and Policy conference dealt a lot with living and working on the Moon and Mars. Most of the speakers came from students working on IQP's within this area. This simply was not something that the high school students could relate to.

The individuals responsible for planning on campus activities for WPI students were the WPI Chapter of Student Pugwash Organizing Committee. These students are also space buffs. Many of the topics were both much too general and basic, or too specific and technically complicated. The lead presentation was poorly delivered five students from two teams who had clearly not practiced together or decided on a clear message. It dealt with Fusion reactors and space drives, even we had trouble following their argument. This was definitely not a talk designed for the high school students. Luckily the second team was prepared and practiced, but they were talking about how to grow potatoes on the moon, hardly an area that could get a job in tomorrow. Next up the topic is how to gather oxygen in low earth orbit. This was not space material designed for a high school audience.

The scenario laid out for the students was also extremely unappealing. It was set in a large lecture hall with a video camera taping the conference. There was no interaction between the high school students and WPI students. They basically were being allowed to sit in on presentations, so they felt lectured at for a good portion of the day. The presentations really just did not get the job done of awakening high school students to the potential of a technical career. We are told the later presentations, after we left included "Dospace" which was about careers in space and one about a knowledge and opinion study about space topics in which science classes

of Worcester Public Schools were the subjects. Why they did not schedule those talks into the two hours our club students were there is not clear. The organizers said it was hard to work around the WPI class schedules of the presenters. Again, if the initial stages of planning had been started earlier maybe this could have been avoided.

We believed that the students got much more out of the tour and admission video tape they watched before the space conference. These were designed for a high school audience and while not perfect they worked. Also, the best speaker of the day, who was brought in from Florida, to talk about living on Mars was not even heard by the high school students because the buses picked them up before he could give much of his presentation. The planning was done badly and messed up the feature presentation. What we learned from that conference was what not to do in the future.

For future groups we suggest that the students do not have to go to any presentations designed by college students on WPI projectsfor more than one hour. A conference should also be more basic and interactive and designed for the high school students if they are to enjoy it. These presentations should come from the key note speaker instead of WPI students overviewing their final report. It would also be wise to include lab demonstrations at some point during the field trip. The WPI labs are probably its most enticing feature of a potential tour and they should be exploited.

The funding of the project was another issue that we had to deal with. We had not realized this in the beginning of the project. The original deal was that each student would provide 75 dollars, equivalent to a price of books for two classes, per three term project. This would equal 150 dollars per club group which would be matched by the WPI IGSD. This would

create a budget of 300 dollars per group to cover the various expenses. Extreme delays in getting the budget request together with a proposal made this resource hard to get a hold of. Our first budget was disapproved, as it included an honorarium for the high school advisors, and this was not allowed. In the end we only got help paying for the buses. Student Pugwash used its budget to cover lunch for all the high school studentsand got some help from WPI admissions. In the future a well written proposal done in September which explained the group's goals and justified a budget would greatly increase the probability of running a well funded project that could afford its own field trip. However, one subject that will not be resolved is that WPI will not pay the high school faculty members to advise the clubs. This will have to be dealt with by the Worcester Public Schools, and they say they have no money. Due to our failure in getting the full funding only about 40 percent of the request was approved, and that means our club advisors were volunteering their time and were technically in violation of their union contract. It is hard to say if our club would breach that contract, as it was run during school hours, but the others were clearly after school hours. Our project evolved into a class enhancement effort in which we designed hands on activities for the students in the class.

The final issue dealt with the timing of when the project would take place. The project was scheduled for B, C, and D terms. This worked out well in one sense because A term is the only term when the WPI and Worcester Public Schools schedules don't fit together. Still, the high school club meeting would have been more successful had they started earlier and run for a longer portion of the year. If there were meetings every week for C term and D term then we believe the project would have been a huge success. However, an A term start could also have its benefits. This would get the planning and organizing out of the way so the club could start in B term. This would also free up time to write the final report towards the end of the year. It

would also put the club in better position to recruit in the face of competition from other after school activities. At our high school operating in a classroom, it matters less when the project starts. Ideally, we would have like to prepare meetings and activities well in advance with our high school advisor before entering the class.

1.6 What We Hoped To Achieve

The purpose of the Club project was to encourage the members of our club to become interested in science and technology and consider these fields as potential career paths after high school. While the encouragement was offered to all students in general, moving toward gender equality in these fields was the hope of the sponsors, club organizers, WPI, and participants. With the majority of our club members being juniors, the thought of college selection and admissions looms over them. Having been in that position only a few years ago, we are aware that it is very intimidating to know that a choice will have to be made shortly that can potentially dictate one's path in life. One thing that is often overlooked is the importance of opinions and information conveyed by individuals who are only a few years their senior. These are individuals who know how they are feeling and can help the club members face their fears, focus and make better informed choices if they are considering a technical career. It does not have to be a final choice, but one should keep options open. It is okay to have doubts, not be sure and just try something. The club needs to be a safe place to try this idea on for size and talk to people starting out towards such a career themselves.

One of the club advisors from Doherty High said that any chance her students have to be able to get away from the high school for a day and visit a college she feels is an extremely valuable experience. In her opinion, not enough of them entertain thoughts of going to college, and if they do they are ill informed as to the whole process. With some of the local Worcester colleges often taking a chance on some of the graduating high school students who otherwise would not be able to financially afford college, it is important that the students realize the nature of the opportunity being offered to them.

One of the goals of the Doherty team last year was to address the gender imbalance between males and females in the science and technology disciplines. With last year's North high team not being able to gather a consistent group of students across several meetings, the North team went into this year's project with little idea as to what to expect gender wise but ended up pretty balanced. Our club took place during a scheduled honors physics class which took away the problem of attracting a gender balanced club meetings. The male to female ratio that we got was predetermined. At each meeting we had six to eight females and eight to ten males. However, this was an effective course for those interested in the science and technology disciplines. Regardless we hoped to create an atmosphere that is as friendly and attractive to females as for males.

We also hoped to shed some light on the best way to go about communicating information regarding the future and technical careers to the students. Whereas many do not think about college and approach the process with little idea of what they want to do, others do not even entertain thoughts of college because of concerns that it is too hard to do and costs too much. By providing information early in high school or even providing help with college application process for those members who are juniors and seniors, we hoped to prepare the students to make better decisions when the time comes. The sort of information which the aspirations survey gathered on what the student concerns are, is not only useful for our purposes, but to the guidance counselors at the respective high schools as well. The WPI admissions office would also benefit from knowing if finances, grades or standardized test scores are the greatest looming obstacle to aspiring to college.

We also hope that the clubs will provide a source of guidance for the members of our club with regards to what high school classes they should take to better prepare themselves for

college. Dorchik and Duncan started with this goal and were told to start a club instead. Now the club members are making it clear that they want that, and the original project concept was on the right track. It is unrealistic to believe that the high school guidance counselors can identify and help the technically oriented students that are freshman and sophomores, who haven't even thought about college yet let alone started preparing for it. The counselors have neither the time nor the experience to do this. Having not yet considered how taking advanced classes and developing a solid work ethic may impact their chance at a successful college career, they are not ready for the standard college admissions pitch either. It is our hope that we can instill a good attitude toward academics and provide good advice to those who are willing to listen. This could range from convincing them not to back down from the challenging class, (because they heard rumors that it was hard) to sharing tips about how crucial it is to develop a good relationship with your instructors.

We think we can make a difference in this area of how to navigate H.S. and get into college. As role models and sources of information we are just making ourselves available to the students, so those considering a technical major in college have us as a guide. We did it, or are doing it, so engineering college can't be too intimidating.

2. Planning and Implementation

2.1 Initial Planning

At the beginning of our project we were concentrated on coming up with ideas for activities to do as demonstrations at the schools, as well as finding WPI professors that would be willing to come to the schools and do demonstrations we could not. Many of our weekly group meetings were brainstorming sessions coming up with different possible club meeting sessions that could be performed at each high school. We would get useful feedback from the other IQP teams on how to improve a unit, or adapt it for use in another site, or throw it out completely.

We experienced much difficulty in the beginning stages with getting WPI technical faculty involved with the project. Due to the overall lack of enthusiasm we received from the WPI Science and Engineering faculty our group did not maintain contact with the few professors that said they may be willing to do at least one meeting when our schedule slipped due to delays. We were easily discouraged by a few early negative replies from professors on coming to the high schools for a presentation. The search for finding suitable faculty members ended prematurely, as we decided to what we ourselves could present to the clubs. This was initially a fall back plan and just a way to buy time to finalize appointments with WPI faculty. However, in the process of designing our own session we gave up trying to recruit science and engineering faculty members. Our group should have e-mailed whole departments or gone to meet with department heads in person for advice as to how to approach our situation. Having club meetings run by WPI professors would have been much more beneficial for the club than we

oringinally thought. Re-contacting professors that expressed interest as the schedule and situation changed could have insured that a professor from WPI would hold at least one meeting with each club. With WPI's professors assistance the clubs program could have been more substantial, credible, and exciting than it was. More professional help from the WPI faculty would have better supported the club and should be the goal of the project next year. However, in our case, working in a class as support personnel, what we did together worked out fairly well. We were able to run hands on class activities that were fun and related to the material being presented by the class instructor.

2.2 Plan One

Our first idea for the clubs was to have each five groups of two, come up with a plan for one meeting that could be presented to each of the schools. With the exception of Worcester Technical High School most of the groups met at the same time, this meant while traveling to another school most club organizers would not be able to attend our own club's meeting. If all ten of us were switching schools every week to give presentations at other schools I do not think that bond our team made with the students would have been anywhere near as strong. We believe if this had happened the ten of us would not have been as effective at being role models.

With all the teams meeting at the same time theoretically we could have rotated from school to school week by week, but for the clubs that had a late start, the process of getting to get to know their group and a bond would have been cut short. If only one person on the team goes the people who designed the activity together aren't acting as a team. Clearly a better model is to have outsiders not "running" a club circulate, and let a team provide continuity at the site and run half of the sessions. We proved this year that they can put on demonstrations and run activities designed by another team and practice it with them back at WPI before running the activity for their club.

2.3 Plan Two

We decided to come up with a large group of ideas that each group of two could present to their respective advisors at the high schools to approve or disapprove. Ideas such as the egg drop, LEGO project management, and chocolate asphalt were used by about three of the clubs. This was effective because directions for each activity could be written up in one or two pages and simplified enough so that anyone from any technical discipline could present the activity to a group. This allowed each group to have a large number of activities to plan from without having to worry about to much other than presenting the information effectively to the club.

Overall this approach worked very well and in the future with a bigger pool of ideas that groups would be able to organize many more meetings quickly by feeding off of each other. If anyone "circulates" it should be WPI engineering professor advisors for each IQP group. If there were five faculty advisors for each five teams "each at one school" they could "do the rounds" and repeat a favorite activity of their own that worked for their own team at the other schools as well as get to know the H.S. clubs faculty advisor.

3. Implementation

3.1 Meeting A (3/07/2007)

Our team set up a meeting after a long process of trying to schedule a meeting with Azad Chaparian and Tom Gusek, which was due to a break on the Worcester Public School side. This was the first time we ever met with the advisors from Worcester Technical High School. This meeting gave us the opportunity to share our ideas for possible activities with the advisors at the specific school. We first talked the schedule of the students at a technical high school. Mr. Chaparian and Mr. Gusek explained to us how at a technical high school the students have one week of academics and then the following week they study their specific trade. This meant we would be meeting with two different groups each successive week. So, instead of doing a different presentation each week, our group had the same presentation for two weeks in order to teach the same material to both groups taking the same class.

The next topic of conversation was when we would meet with the students. They explained to us how most of the students at the school had very limited time after school time. A large majority of the students at the school had jobs in their specific trade after school. Also, if the students weren't working after school they most likely were in an after school sports program or other extracurricular activity. Knowing this, the advisors suggested that we come in during school time. We decided that we would come in to Tom Guseks eleventh grade honors physics class. It was decided that this cluster of students could benefit the most from our project.

Now knowing the type of students we would be teaching we moved on to talking about the ideas for possible activities for the meetings. We told the advisors the original ideas we had for the meetings (these can be seen in the Appendix). Mr. Chaparian and Mr. Gusek were pleased with our original ideas and truly liked a couple of them. One of the big points the advisors made was that they wanted a lot of "hands on" activities. They didn't want any power points, or anything that would remind the students of a lecture. They believed this would turn the students off from the "club" right away.

We got a tour of the school and Tom Gusek brought us down to the classroom we would be teaching in. The school had recently been rebuilt and plenty of new lab equipment was available. Tom let us know that we were free to use any of the equipment we wanted. He even lent us a lab notebook that had different labs in it, as well as how to use computer programs and tools with these labs. Everything went well and we were finally ready to get into the classroom. We decided on a first meeting date of (3/23/2007). Due to the fact that we got a late start we decided that our first meeting would get right into some material.

3.2 Meeting 1 (3/23/2007):

Objective:

This was our first meeting with the students we would be teaching. Tom Gusek gave us a nice introduction to start out the class and we then introduced ourselves. We explained what we were doing and why we were at their school. In this meeting we decided to broaden the planned activity to something that all types of engineers have to be familiar with. We decided to focus on the project management portion of engineering. Many of the student probably believed that engineers just sit at a desk all day and run calculations through a computer. We wanted to show the students that you cannot just jump into a problem and start solving it. You have to first organize everything that the project will cover and also do it as efficiently as possible. This activity was mainly a civil engineering topic, but all fields of engineering have to go through a similar process prior to solving a technical problem.

The experiment focused on how the students would go about solving a problem with specific requirements that needed to be taken into account. We first separated the students into groups of three or four and explained to them that being in groups would build their team working experience which is extremely important in engineering. Each of the groups received a bag of Legos which were separated evenly before we went to the school. Each of the different sized and colored Legos had a specific point value which represented the price that using the Lego would cost. The general rule was the bigger the Lego the more it would cost to use it in the

building. The students had to use these Legos to build a tower of what-ever size and shape they wanted and had to complete this task in twenty minutes. After the towers were constructed we put them through certain tests to find the best buildings and a potential winning group. The towers were tested on their height, the amount of money spent and lastly be put through a series of wind tests. The group who could create the strongest, tallest, and least expensive tower would be the winners.

Turnout:

The class had fourteen students, eight of which were boys and six were girls. We never had to worry about the turnout for each meeting because we knew the approximate size of the group would be constant because a club held during the school days. The students seemed excited to do this activity which was pleasing to us. If this meeting went well, which it did, it would keep the students interested for the duration of the project.

Results:

After the students had finished their towers in the allotted time we put the designs to the testing phase. Two of the groups used good management skills in the building of the towers, while the other two did not. This was good because two of the groups showed basically good management skills but there were additional “tricks” to teach them more and the other two could truly be taught from scratch how to correctly manage a project such as this. One of the points we noted was how the groups emphasized strength rather worrying about the cost of the building. One of the groups ended up creating a tower that earned a negative point total because they used too many expensive parts. Another group focused too much on using cheap the materials and ended up building an extremely weak tower.

After the towers were put to the wind tests three out of the four group's towers were still standing. The tower that was purely built on strength (and ended up gaining negative cost point) did withstand the wind test. The second group built a relatively small tower which withstood the wind test because it was so low to the ground. The third group built the best tower which was tall, kept within a good price range and withstood the wind test and turned out to be the winner of the contest. The fourth group's tower was simply blown over because it wasn't built strong enough. This "contest" had really worked out well for us with 3 of 4 groups tripping up over different criteria, and one successfully optimizing the tradeoff. Due to scheduling and conflict of Worcester Public School breaks with WPI breaks we were unable to do this project with the other group of students.

Conclusions:

This meeting turned out to be a solid learning experience for the students. It taught the students lessons about organization and how to complete a task with set guidelines. This teaching could not only be helpful with in the class room but also in other aspects of their lives. The activity taught the students how to work as a team, develop multiple strategies to achieve a goal, and how to manage their time efficiently. One of the comments made by Tom after the activity was that he loved the activity but he would like the next activity to be more physics based because of the type of class he was teaching. However, he liked the experience and everyone looked forward to the next "club" meeting.

3.3 Meeting 2 (4/13/2007):

Objectives:

With this meeting we wanted to take Tom's advice and do a more physics based lab. Tom had told us that his students were just getting into potential and kinetic energy. Knowing this we decided to select an activity that would tie into this concept. We wanted to design an experiment which could demonstrate these physics laws well, while still getting the students to participate in a team working and hands on experience. This activity was to be exceptionally "physics based" and could teach the students a lot about applying this idea.

The experiment focused on two basic physics laws. These are laws of potential energy and kinetic energy. We wanted to show how these laws are related and how using these equations you can figure out how to solve many problems with very little information. The activity started with an explanation of how these laws worked together. We then split the groups into groups of three or four and explained how the lab would run. A ramp, a golf ball, a cup, and measuring tape were assembled before the meeting. We brought these materials in with us and set them up appropriately. The students were given two equations, one being a potential energy

equation, and the other being a kinetic energy equation. They would have to use this equation, the materials we brought along with the apparatus and measurements taking from this apparatus to figure out where the ball would land after going off the ramp and heading across the floor. The students would either be right or wrong in the lab. Either the ball would land in the cup where they positioned it or it wouldn't. If the students used the equations correctly and measured correctly then the ball would land in the cup.

Turnout:

Due to the success of the last meeting the students were excited to see us again. There was seven girls and seven boys in this meeting, but as mentioned before this could not be controlled because the meeting was held during the school day. After explaining the topic the students were ready to get started. They seemed like they were motivated to do this activity, at least curious enough to be interested

Results:

After the students had finished their measurements and calculations it was time for the second phase of the experiment which was to see if the work done was correct. Two out of the four groups ended up placing their cups in the correct spots to catch it. These two groups showed good teamwork in measuring and calculating the correct answer. They made precise measurements and made use of the equations to come up with the correct answer. One of the other groups ended up making careless measurements, but used the equations correctly. However, because of the poor measurements their ball landed outside of the cup. The other group made the correct measurements, but did not use the equations correctly and also missed the cup. The group that we did this activity with was the group that was unable to do the Lego

activity prior. Like the prior activity due to scheduling conflicts with Worcester Public School breaks with WPI breaks we were unable to do this activity with the other group.

Conclusions:

This meeting ended up being a great learning experience for the students. It turned out to be more beneficial to the class than the last meeting because it tied in directly with what the students were learning in physics. Also, the meeting was much improved because we already had one under our belt. We were more confident in teaching and any uneasy tension about student cooperation and participation was gone because it was our second meeting. It was good to see that half the students generated the correct answer and half the students did not. This is because it showed that we taught the students well enough for two groups to work out the correct answer and they could see what happened when execution or calculation was sloppy. The other half probably ended up learning more because of their mistakes. They could correct these and apply the lesson to a similar problem in the future. All in all this meeting was another success, one point for engineering and one for science in two attempts.

3.4 Meeting 3(4/04/2007):

Objective:

This meeting consisted of an idea that last year's Doherty group had trouble completing. The idea proposed last year was to have the students take a field trip to WPI in order to visit and see the WPI campus as well as get an idea of what campus life is like. A field trip for high school students takes a lot of work and preparation. Plenty of planning and communication with the schools has to be done. This idea failed last year because due to timing issues because they could not organize it before the end of the year. However, knowing these downfalls the group knew it could be done for this year.

Giving these students a good trip would mean a lot in the long run. They could get an idea of what WPI is like, but more importantly what college life is like. Many of our students were learning trades and may not have had an interest in college at all. However, coming to a college campus and seeing the type of lifestyle lived could sway this decision. On this field trip we planned to show other IQP projects and show them laboratories and other parts of the campus. In preparation for this trip we came across another IQP group who was setting up a space conference. We wanted to line up our trip with this space conference so our students would be able to attend it. This space conference consisted of numerous IQP groups who presented projects on space related topics. With these presentations we hoped for our students to gain insight into different space topics and what future opportunities there may be for them. With a well done tour of the campus and this space conference we hoped to have a successful field trip.

Turnout:

We needed a lot of help from our advisors in order to complete all the behind the scene tasks that are necessary for a high school field trip. Our inexperience almost led to a second aborted trip. The agenda for the field trip was difficult in itself, because of the multiple schedules we had to work around. The club from South High didn't make it, but the rest did, so the IQP group as a whole did pull off an event in the end. Approximately 20 students from Worcester Technical High School attended the field trip. Although we didn't have a meeting at the High School after the field trip, the feedback we received from the students and their chaperones before they went back to school was positive. We were more critical than they were. It was a success by the time the tour and admissions talk was over in terms of the teachers goals.

We expected more. Still, the field trip should be continued and improved. We think in the future a short questionnaire that could be filled out before the students return to their respective high schools would be beneficial. The trip should be more like what Duncan and Dorchik envisioned.

Results:

Since the field trip was planned to be an all day event we had to come up with an itinerary that gave the students plenty to do. From eleven to one was the space conference, and we had to find two and a half hours to find something for them to do prior to that. Our IQP group of ten decided on a tour of WPI, that each group of two could lead for the members of their club in attendance. This ended up not working out because most of us had a class in this time block, so WPI admissions tour guides took our places in running standard tours. This was fine for our high school students who were juniors, but a bit odd for the clubs dominated by the 9^{th} and 10^{th} graders.

Student Pugwash and we came to an agreement with admissions to help us financially with the student's lunches. Pugwash had some money for lunches, but not enough. So admissions contributed, and in return we allowed them to give a short presentation to the students on how to get into WPI before the tour. They also showed a videotape. The lunch was the biggest challenge on the actual day of the field trip; we originally wanted something easy like bagged lunches. Admissions wanted something more like pizza. Pugwash made the decision in favor of a buffet style lunch. This was a mistake. It takes too long for 80 people to assemble sandwiches and there was a concurrent lunch speaker. His talk on Mars was disrupted and the High School students had to go to the buses before he was through. Again we deferred and

delegated too much to Pugwash, and their organizers did not understand the audience, time constraints or priorities of the high school club advisors from the high schools. The field trip went pretty smoothly with a few glitches in the conference, but was still a success.

4. Conclusions

4.1 Recommendations

We learned as much about what not to do as what to do, because this was the first time there was a club at Worcester Technical High School, and the situation is radically different than from Doherty High School the pilot site. The most important thing is to start as soon as possible, recruit an plan in A term, operate in B and C term, and write in C and D term. The more planning and organization that goes into this kind of logistics heavy project the easier it will be. We believe the most important meeting was the field trip and that will take a month to plan. The sooner that gets planned and budgeted, the less chance something will go wrong the day of the trip. The field trip planner must find a way to get into the laboratories for some kind of demonstration. We found out this cannot be accomplished without planning and working with WPI administrators well in advance. As a group we would suggest on trying to get technology and science professor's involved with your clubs as co-advisors as well. Even though we were unsuccessful, we strongly believe that it will add a lot to the event when you do the field trip and be beneficial for the high school students. The chance of getting an advisor to talk at two different schools is reasonably good, and they will understand the club goals.

The most important thing to think of when going through different ideas for meetings is what will be the most interesting to the students. This may be an obvious factor but a lot of people do not take this into account. By coming to the realization that these are students still in high school (and some are 9^{th} graders in other clubs) your growing understanding of where they

are at and how they think will give you a serious advantage in reaching them through your prearranged activities. Everyone has been through high school and we all know what holds our interest and what puts us to sleep. The meetings must keep the students on their toes and still maintain their educational value. The large majority meetings should be hands on and all should involve all the students. It cannot be a classroom atmosphere, even if you are working in a class like we were. It should remain a "club" type situation with some entertainment value as well as educational value. The students have been sitting in the classroom all day and the last thing they want is to be lectured at some more. They are young and full of energy and you must use this to your advantage. The meetings must intertwine something that you would not associate with the classroom, something fun, with a certain level of gained knowledge for the students. This gives the Club planning team some tough decisions to make but these are the most important decisions because the more interesting the meetings the more students will be encouraged the following week. If the "club" is after school, attendance will depend on being interesting as well as informative. If the students were at a meeting and were extremely bored they will not want to return the following week. In a class they still have to come, but you don't want to turn them off to a career you are presenting as an appealing alternative. Keep their interest and you will maintain a club with many students that are eager to find out what is next. Then in our case you are giving working class a reason to go to college and a chance to advance in life. You are also helping the US maintain its pipeline of technical talent. Currently only about seven percent become engineers, and in Worcester only five percent of the 11^{th} grade girls and twenty percent of the boys seriously consider the possibility. That is eleven to twelve percent overall. Estimates of the population of high school student interested in engineering in China and India run as high as one in three.

4.2 Overall Conclusion

This project took a lot of work from multiple sources. The final outcome was a success, but we only did a small proportion of what we wanted to do at our High School. Even though we started late we learned enough from last year's group at Doherty High School to want to do more. This year's groups that started before us did better, but still did not fully achieve the promise in the club concept. It is very important for the high school students interested in science and technology to be exposed to this type of group activity atmosphere. They can learn a lot of new things that they will not learn in the typical classroom, things that may benefit them in later group work and the next step of their search for a career. Our students seemed to take a lot away from every meeting and were hungry for more. This is what gives the program its importance and potential.

The goal of the program is to help the students learn what their interests are by exposing them to technical ideas and activities in different fields. If they happen to be in science and engineering then we are the ones that coach and role model for them. So a reason to meet and do things together is needed. We are where they want to be and for us to teach them what we know and show them what it takes to get to attend a technical college program will be the most effective way to encourage and support their dreams. We want to help them explore options, or at least to know what their options in life are, and they extend beyond a trade if they want to be a professional. They do not get the information that they need to pursue the type of career we are seeking, and that is too bad. If it was up to us we would have other Worcester colleges that specialize in different types of career paths come in and start their own clubs, for future politician, lawyer, and businessman "clubs". We just think the importance of this club extends

beyond just one or two years. It is something that must be continued and we wish we could continue it ourselves. We have a genuine hope that the future of this club program reaches its true potential by spawning other clubs supported by other colleges. The club idea means a new college-city relationship that could be very beneficial.

References

Custudio, Evan, Brian Marsland and James Scully "Worcester High Schools Career Aspiration Replication Study" IQP, Worcester Polytechnic Institute, December 8, 2006

Duncan, Matthew, and Brian Dorchik. A Future Scientists and Engineers Club for Doherty High School: a Pilot Project. Worcester Polytechnic Institute. Worcester, 2006.

Handler, Laura and Patrick Hogan "Gender-Based Comparative Study of Public High School Students" IQP, Worcester Polytechnic Institute, March 7, 2005

Hwang, Jason, and Tri Lai. North High Coaching: Coaching Students and Analyzing Urban Education. Worcester Polytechnic Institute. Worcester, 2006.

Ngo, Alan and Souza Timothy. North High School: Science and Engineering Club. *Sections: (What We Hope To Achieve, Issues, and Sponsor).* Worcester Polytechnic Institute. Worcester, 2007.

Rizkalla, Nora, and Zachary Gautreau. Middle School Aspirations Study. Worcester Polytechnic Institute. Worcester, 2007.

APPENDIX A:

November 5, 2006

Kathy Kambosos

Doherty H.S.

299 Highland Street

Worcester, MA 01602

Dear Mrs. Kambosos,

I am writing this letter to introduce a team of ten students that have registered for the project offered by John Wilkes and Liz Tomaszewski to expand and improve on last year's high school clubs project. This project would work off of the project that Brian Dorchik and Mathew Duncan set up last year, but we will now have a larger team setting up five teams of two students to send to each major Worcester High School. We would also like to start earlier to make more meeting times possible.

Our group consists of juniors in both mechanical and civil engineering. Most of us are also football players at WPI and involved in the fraternity system. We are looking forward to working with kids in the same place we were three of four years ago thinking about what we are going to do with our lives and considering engineering as a possible career. We would all like to share what we have learned at WPI to help these students potentially interested in engineering to pursue their goals and give them a better engineering knowledge base as they move towards college. We can share about the college culture and community life as well as the academics, but will not be trying to "sell" WPI per se. Still we want to make WPI resources available to the clubs.

As we develop our proposal we will want your perspective on how things went last year at Doherty. We have read Dorchik and Duncan's report and it made us optimistic about what can be done this year.

We also want to know what you think about the idea of approaching the other schools about similar clubs. Would you be able to provide names of people at other Worcester high schools who can advise clubs and do you think the ETA should "sponsor" the clubs at other

schools as an “outreach” program? We also want to talk to you about whether running the sophomore survey was valuable enough to do again maybe in a required science class.

I hope we can meet soon to discuss the club and how it will be moving forward this year. We are really excited to get the club going and start teaching kids some basic engineering.

Sincerely,

Chris Norton, Orry Cummings, Charles Fradella, George Chyoghly, Keegan Richey, Matt Frasier, Nick Ambrosino, Alan Ngo, and Timothy Souza

ctnorton@wpi.edu

APPENDIX B:

Initial Group Proposal

Our intentions of this project this group is partaking in is to set up and run successfully various science and engineering programs in the several high schools in the Worcester and immediate surrounding area. Our preliminary idea was that these programs could be run as an after school extracurricular activity, where this group's members gave demonstrations as well as interactive lessons on concepts related to space, engineering, and any future concepts relating these two ideas. The initial schools that we wished to pursue these programs in but not limited to Doherty High School, North High, South High, and Burncoat. The group's decision was that with our desires being to contact several of the appropriate faculty members in as many possible establishments, a terrific beginning would be to be able to collaborate in some way with a person who both cares about the meaning behind these projects and also has the ability to contact possible faculty members in other schools. Our optimum goal in the end would be to have some sort of variance of the currently existing group called ETA, which would be in essence spread out amongst these other schools in order to either aid in already interested children, or to spark some sort of interest in these fields of engineering. We currently have data, albeit it somewhat outdated, on several other schools which confirms suspicions that there is an increased interest in high school students in this area in the fields of engineering and other related sciences. Our group's desire is to cultivate these interests in order to give these students a taste of what pursuing these concepts in a career would be like. An additional goal spoken of is to be able to create a significant increase in the percentage of young women participating in these hypothetical science programs; however this of course is a supplementary goal that will be spoken of once these programs begin to actually materialize. We have decided that the first step

in this project should not be contact Bert, but to rather attempt to contact faculty members in these other schools who may eventually be able to run these programs. Our reasoning behind this decision is that if these faculty members bring this idea to their supervisors in an organized manner as well as in a manner specific to their situation, our chances of these ideas taking form in one way or another increase dramatically.

Our group realizes how valuable you would be to the continuance of this project. You have a unique perspective in this project, in part due to your close interaction with the group as it acted last year. Your advice on what concepts you thought to be successful or worth pursuing further may be what separates this project from being a successful one or a failure. If we are eventually able to move these programs into other surrounding high schools, any possible contacts as to people who may be interested in heading these groups around Worcester. We would also love to hear your concerns and conclusions about the validity of the survey conducted last year, as well as if another should be given. Our group realizes you are going well out of your way in being a part of this project or providing any types of appropriate contacts, and we appreciate any sort of assistance you would like to provide in creating these projects. Thank you in advance for reading and considering our proposal.

APPENDIX C:

High Prospective Projects

- Chocolate Asphalt
- Lego Project Management
- Gears, Cams, and Linkages
- Teraforming Mars
- Computer Science with Professor Gennert
- Rehabilitation Engineering with Professor Ault
- Robotics Demonstration with Ken Stafford
- Space presentation field Trip
- Introduction to Engineering (Job's, salaries, and general information session) with WPI Admissions department
- Another Field Trip to WPI for more demonstrations
- Space Survey results presentation

WPI Breaks: March 2nd to 12th

May 2nd done

WPS Breaks:

School gets out:

What do the kids want to see:

Anything you want us to present on:

APPENDIX D:

Future Scientists and Engineers Club

Perspective Meetings

1. Chocolate Asphalt
    - Civil Engineering - A basic over view of road construction and different materials used in the process followed by making of asphalt from melted chocolate and other chocolate candy.
2. Lego Project Management
    - Civil Engineering and Project Management- An overview of what a project management and then a construction project with legos. Project goals would include building a tower with legos, surviving a wind test with that tower, and also keeping cost low with the amount of legos.
3. Gears, Cams, and Linkages
    - Mechanical Engineering- A look at many simple devices that are used in all types of machines.
4. Teraforming Mars
    - Biotechnology- Presentation on how different plants could be used to create oxygen on Mars.
5. Computer Science with Professor Gennert
    - Computer Science- A look into computer science from the head of the WPI department. Actual presentation focus undetermined.
6. Rehabilitation Engineering with Professor Ault
    - Rehabilitation Engineering- Look at the design process and helping people with disabilities have as much of a normal life as possible with the help of engineering. More details to be determined.
7. Robotics Demonstration with Ken Stafford
    - Robotics Engineering- A presentation using robots to show in a fun way the ability of robots.
8. Space presentation field trip at Ecoterium
    - A WPI sponsored field trip where WPI IQP presentations will be given at the Ecoterium in Worcester accompanied by a presentation by a member of the NASA Institute for Advanced Concepts.
9. Introduction to Engineering given by the WPI Admissions dept.
    - Overview of all the different typed of engineering accompanied with information about starting salary and the growing market for engineers.
10. Another Field trip to WPI
    - Field trip sponsored by WPI to give a tour of labs on campus and to give demonstrations on computer software unavailable at the Worcester Public High schools.
11. Space Survey results presentation
    - An overview of data gathered from a survey in Pennsylvania and in Worcester High Schools to show what high school students think about space.

APPENDIX E:

Worcester Technical High School 2007 Future Scientist and Technologist Club

Advisor:

WPI Team: George Chyoghly and Keegan Richey

Meeting 1: Project Management

In this lab the students were given the task of building a structure out of Legos. They were told to make it tall and able to withstand a wind test while also staying under budget. All the Legos were given price values. Once the students had constructed their towers they were tested with a fan to make sure they were stable and a point system was used to find a winner. Then we talked with the students about the things they should have done differently and what they did not expect going in to the lab.

Meeting 2: Projectile Motion

In this lab student were given basic projectile motion Physics equations, and challenged to determine where on the floor a golf ball would land when rolled down a ramp lying on the table. The students were broken into groups, and when they had determined the distance the ball would travel a bowl was placed there. All the groups were successful and left the meeting with an understanding of the material we presented to them that day.

Meeting 3: Field Trip to WPI

For our field trip we organized for the students to come to WPI for the Pugwash space conference. The students first got a talk from admissions about WPI and the project system offered here. They were then given a tour of WPI. Then the space conference began and they saw WPI IQP group's projects on the future of space. They saw presentations on growing potatoes on the moon, what a future moon settlement would look like, future space propulsion systems, and how gasses could be harvested from the atmosphere to support these settlements. The students were also given lunch at WPI and then sent back to their schools by the end of the day.

APPENDIX F:

Proposal Draft #1

The Worcester Future Scientist and Engineer Clubs:

A Proposal to be reviewed by …

Last year Duncan and Dorchik (June, 2006) ran a pilot project at Doherty High School on the possibility of establishing Future Scientist and Technologist clubs in the Worcester Public Schools. This year that pilot program has been expanded into five teams of two students that will be setting up clubs at five different high schools, Doherty, Burncoat, North, South, and Worcester Technical High School. Advisors have been designated at all the schools and they will start in WPI's D Term, at the latest. This would make time for a two month long program with one meeting a week with a field trip to WPI included as one of those meetings.

Some of the meeting topics last year such as a general overview of the different areas of engineering and a robotics demonstration would be included again in our meetings. Also our group has been working with our advisor John Wilkes on many new ideas for meetings such as presentations on assistive technology, materials, space exploration, asphalt properties and mixing, and a design challenge. These proposed meetings show many different aspects of engineering and the high school club advisors have responded well to most of them. Some of the advisors like Joseph Marzilli and Brian Morse of North High are both WPI alumni and have agreed to advise the club there at North, with or without "overtime" pay. However, most of the principals are saying that no pay is available, and not all advisors can donate their time.

To fund this club each group member is going to contribute seventy five dollars over the course of our three term IQP. We would like to ask WPI to provide one hundred dollars for each

group member to supplement the donation of seventy five dollars of our own. Thus each two person team will have a "WPI" budget of three hundred and fifty dollars per term. Along with the money WPI and our group is supplying we will also ask the Worcester Public School system to match WPI's investment to the club of two hundred dollars per club. This would give us a budget of two thousand seven hundred and fifty dollars for the five clubs. This allows for over twelve hours of time with the high school advisors to the club. We would like to spend eight of those hours in the club and four for outside meetings with the advisors to organize for meetings, and go on a field trip.

The main resource requirement for the club project involves union rules for WPS teachers. They must be paid thirty dollars an hour for "overtime" – after hours teaching and advising. Last year the WPS first promised the money for two clubs and then rescinded the offer. To protect the project we plan to fund the club for a minimum "honorarium" from WPI of two hundred dollars, per advisor and still have seven hundred and fifty for busses to have a field trip to WPI. This will cover an hour a week for seven actual club meetings, and five meetings to plan, debrief, and do other things such as recruit and assess. A request will also be submitted to WPS for two hundred dollars per club, but that will be to cover transportation for a second field trip, special events, and other expenses including a party for the last club meeting. These are things we can do without if we have to do so, though they would greatly enhance the program. Thus, if WPS again runs out of funds and cuts all the "frills", the project can go forward on a "staff" and WPI trip only budget. If they come through each club will have a five hundred and fifty dollar budget. We expect to cost share the project with WPI, as noted above.

We believe that this project could be very important for the city of Worcester, and help WPI enhance the engineering profession. Many people would garner the benefits of these clubs.

All ten of us are eager to get started. If we want these club programs to be as extensive as we explained we must know we have advisor pay and can get to WPI at least once at the time of a student Pugwash conference on space technology and the return to the moon tentatively scheduled for early April. We know we can get these clubs off the ground, if we can get the WPS faculty advisors to commit enough time without your assistance we will not be able to assure them that they will get al least token payment for their time, and get to use WPI resources at least once.

Field Trip to WPI

If possible, our team feels it would be of great benefit to the clubs to visit the WPI campus and take a guided tour which could include presentations from faculty and students. One area of interest which we feel would be both entertaining and informative would be a demonstration of WPI's CNC machine capabilities. Though an agreement with Haas, WPI receives a certain number of CNC machines during an allotted period in time provide that specified amounts are also purchased. This appears to be a point of attraction for the school as it is mentions during campus tours, which most potential students choose to go on.

It is because of this popularity that we feel a CNC machine demonstration would be a positive experience for the students involved. The discussed idea we have involves the repeating party of the lab portion of the class which most WPI student take, ME1800. The majority of this lab is spend learning computer programs associated with CNC machinery as well as how to operate the machines. The goal of this is for the students to machine a Sterling engine. Similarly, this would be a demonstration provide for the students participating in the Science and Technology club. While it is unrealistic to expect them to learn these computer programs, it would be a simple exercise to run a pre-constructed program to demonstrate how the CNC machine cuts the metal into the shape specified by the user. Upon completion, the club would be able to bring their fully functional Sterling engine back to their high school as a souvenir.

In order to ensure that such a demonstration is possible, we must arrange for an individual with knowledge of both CNC machine operation as well as the Sterling engine project to be available. While we have not receive positive confirmation from any individuals, it is possible that the demonstration could be given by a ME1800 lab teacher, a student involved in

the MQP project attempting to fabricate all elements of the engine on campus, or even one of our group members, a work study in the Washburn machine shops. There are a number of individuals qualified to perform such a demonstration. Ms. Kambosos hopes that the proper arrangements can be made, since she found the idea attractive.

In order to put on this demonstration, our group will need funds to arrange for transportation as well as material fees associated with the demonstration. We plan to make this presentation dependant on WPS coming though with their portion of the funding for the project. However, some of the club advisors are interested in considering other possible field trips, such as the New England Ecotarium.

Budget

Requirement for one H.S. club run by two students

- $30/hour x 12 hours = $360
- Student contribution of $150
- Requested WPI contribution $200

Total WPI Contribution of $1000

Total club budget of $2750

Cost Sharing with WPS

- Request of $1000 from WPS

Combine budget with WPS contribution $3750

Budget covers

- Advisors Salary $360 x 5 = 1800
- Field Trip to WPI $150 x 5 = 750
- Second Field Trip $150 x 5 = 750
- Honarin and Supplies = 450

$3750

APPENDIX G:

Proposal Draft #2

The Worcester Future Scientist and Technologist Clubs:

A Proposal to be reviewed by Richard F. Vaz

Last year Duncan and Dorchik (June, 2006) ran a pilot project at Doherty High School on the possibility of establishing Future Scientist and Technologist clubs in the Worcester Public Schools. This year that pilot program has been expanded into five teams of two students that will be setting up clubs at five different high schools, Doherty, Burncoat, North, South, and Worcester Technical High School. Last year a field trip was talked about but was never actually done this year a field trip to WPI was made possible by our IQP team. Our field trip included an admissions talk about WPI and the projects program, an admissions guided tour of campus, and the Pugwash space conference. The Pugwash space conference showcased many WPI IQP groups which did projects on the future of space. The presentations showed new technologies being developed now and what a future space station on the moon would look like and how it would function. The trip was set up to excite the students interest in engineering which is the clubs main goal and also to get the students interested in a career in new space opportunities as an option for their future. This field trip brought about eighty students form the Worcester high schools to WPI and further stimulated their interest in engineering. Our team thinks that this was a very valuable experience for the students and wants this type of trip to be done annually.

We are requesting that WPI reimburse our group for the busses for the trip which totaled three hundred dollars. All other expenses of the group have been covered by our group members themselves and have definitely amounted to the two hundred and twenty five dollars that each

member is supposed to spend for the three term IQP. We would greatly appreciate the help of WPI in funding for the busses to lessen the strain on us for money. Without this help it would be very hard to get the clubs next year to organize and follow through with a similar trip to WPI. With the momentum we currently have with these high school clubs it would be a shame is the IQP group next year working with these clubs was not able to achieve this field trip again after the success we had this year.