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AN EVALUATION OF FEED THE WORLD

An Interactive Qualifying Project Report

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by

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Abstract

The goal of this project was to evaluate and make recommendations for the improvement of the experimental, first-year, project-based course entitled *Feed the World* which was offered for the first time in the 2007-2008 academic year. The seminar was intended to focus on problems rather than disciplines. It was designed to: engage students with current events, societal problems, and human needs; require critical thinking, information literacy, and evidence-based writing; and help the students develop effective teamwork, time management, organization, and personal responsibility. In order to evaluate the course, we interviewed students, interviewed the professors, studied the official course evaluations, and reviewed the students' work. Based on our observations we conclude that the seminar was successful and could be further improved if the professors put more emphasis on critical thinking, adopt limited content oriented goals for the seminar and subsequently teach more content especially economics.

Executive Summary

The goal of this project was to evaluate and make recommendations for the improvement of the experimental first-year project-based course entitled *Feed the World*. The course was a semester long (comprising A and B terms) and was offered for the first time in the 2007-2008 academic year. In order to evaluate the course, we interviewed students, interviewed the professors, studied the official course evaluations, and reviewed the students' work. Based on our observations we made recommendations that can improve the quality of the course in future years.

The seminar was intended to focus on problems rather than disciplines. The faculty who developed the seminars focused on three key principles. They determined that the seminars should: 1. engage first-year students with current events, societal problems, and human needs; 2. require critical thinking, information literacy, and evidence-based writing; and 3. help the students develop effective teamwork, time management, organization, and personal responsibility. We conclude that the seminar accomplished the first and third goals well, and the second goal imperfectly.

We began by interviewing twelve students during the middle of A-term in order to gain their opinions on the course. We asked them questions about their academic background and their opinions on homework assignments, projects, and the course in general. We conducted follow up interviews near the end of B-term which was the end of the course. We sought to track the changes in the students' views between these times. The students were much more positive about the course in B-term than in A-term. We also interviewed the Professors toward the end of B-term to gain their views of the course.

They were very positive about the course and said that the students had made considerable progress in the course.

Using the official course evaluation data from the seminar we compared it to other predominantly first year courses. In the main the course was ranked slightly below the average; which, for the first offering of a course, is entirely satisfactory.

With the knowledge gained from this and the interviews we revised some of the seminar's assignments in an attempt to improve them.

We reviewed the written reports, oral presentations, and posters of the students' final projects. The writing style, posters, and oral presentations were clear and overall very well done. The intellectual content of the projects was inadequate. The content of the projects evinced little systematic or logical thought and occasionally lacked discussion on vital aspects of their topics.

Based on our analysis of all the information we acquired from theses various sources we then made recommendations for the improvement of the seminar. We recommend that the professors put more emphasis on critical thinking, adopt limited content oriented goals for the seminar and subsequently teach more content especially economics.

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Introduction

The goal of this IQP was to evaluate and make recommendations for the improvement of the experimental first-year project-based course entitled *Feed the World*. The course was a semester long (comprising A and B terms) and was offered for the first time in the 2007-2008 academic year. In order to evaluate the course, we interviewed students, interviewed the professors, studied the official course evaluations, and reviewed the students' work. Based on our observations we make recommendations that can improve the quality of the course in future years.

Feed the World is one of the new *Great Problems Seminars* at WPI. The Great Problems Seminars are first-year courses defined by problems not disciplines. They do not start with a list of topics to cover. They focus on problems and guide students to develop and complete projects related to larger problems.

Two seminars were offered for the first time in AB2007: *Feed the World* and *Power the World*. Feed the World examined the global challenge of feeding the world with a combination of nutrition (specifically protein and micronutrient sources in a diet and consequences of both an overabundance and deficiency), macro/microeconomics of food, and explored how the arts (painting, literature, film and sculpture) depict food issues in ways that are different from the sciences and social sciences. Power the World focused on projects related to energy, from the thermodynamics of power generation to the impact of new technologies on societies.

The faculty who developed the seminars focused on three key principles. They determined that the seminars should: 1. engage first-year students with current events, societal problems, and human needs; 2. require critical thinking, information literacy, and

evidence-based writing; and 3. help the students develop effective teamwork, time management, organization, and personal responsibility.

The first point, the focus on engagement as the primary goal for the Great Problems Seminars, is the key. The plan was to have students involved in project work during their first semester, by allowing them to choose a project that they really cared about. In the process, the instructors facilitated the students' development of greater proficiency in writing, thinking, and presenting.

While engagement is the primary goal, the faculty who developed the Great Problems Seminars believed that WPI students needed a better early introduction to the skills they will need in project work in their Junior and Senior years at WPI, the MQP and IQP. By giving students real experience with group projects early in their academic career, it was hoped that the students would be better prepared and have a better learning experience in their later projects.

The Great Problems Seminars may have another positive impact, in that, students will see why the concepts they learn in disciplinary courses (basic science and humanities in particular) are needed in order to solve real problems. This may help motivate students who do not realize that regular course work, especially in their first year, provides the tools needed to solve real problems in their majors and careers.

Before we go on we will clarify the nomenclature of this report. The term "project" is used loosely in this report. We generally use it to denote any assignment that is more than three or four days in duration, does not have a definite/correct answer, and requires background research. We are able to use the term "project" in this manner because we do not intend to prove anything about project based learning in general, but

rather use it when referring to it to the type of assignment described above. The true definition of a project used in project-based learning is discussed further in our background research section.

Project based learning is typically justified as a method that teaches disciplinary content more effectively than traditional methods. It is a method of teaching but the discipline that is the subject matter is unchanged. Project based learning is simply an alternative means of learning; content delivery remains the primary goal. Feed the World does not utilize project based learning in this sense, it utilizes projects not because project based learning is necessarily the superior method of conveying knowledge, but principally to give the students experience in working on open-ended group projects.

The rest of this report is organized into the following sections: background research, student interview summaries, professor interview summary, analysis of the official course evaluation data, evaluation of the students final projects, assignment and project revision, conclusions and recommendations, and areas in which we could have improved our methodology.

Relevance to WPI Academic Career

The relevance of the Feed the World Seminar at WPI is clear. WPI utilizes projects as a means of preparing students for their careers. The projects, namely the Major Qualifying Project and Interactive Qualifying Project, are worth one quarter of an academic year of credit (the equivalent of three courses). In addition to these projects nearly all engineering majors require at least one capstone design course, which generally consists entirely of one or two projects. Many regular (non-capstone design) courses also

incorporate minor projects into the course work. In short, students at WPI are exposed to many types of projects often group projects: therefore it is advantageous for the students to be well prepared for those projects by attending the FTW seminar.

The majority of FTW students we interviewed had little to no experience doing projects, particularly group projects, in high school. Furthermore, what little experience high schools students do have with group projects is more likely to have been for a social science or humanities course rather than for a math or science course (which was confirmed by the FTW student interviews); whereas most WPI group projects are technical in nature. The seminar teaches the basics of project work, such as proper background research, report format, and how to make a poster/PowerPoint presentation. It also exposes the students to tools, such as Microsoft Excel, before most of their classmates. Such things are quite important and are typically considered to be assumed knowledge in later courses.

Based on our own experience and observing classmates, even up to our third year, we still see plenty of evidence that some of our classmates' project skills are inadequate. We believe the students that attended FTW are better prepared for future courses and projects at WPI and this will give them a definite advantage over their classmates. We believe the FTW students gained valuable experience completing semi-technical group projects, which will allow them to attain greater academic success and this, in turn, will translate into greater professional success that they would otherwise achieve.

Background Research

The WPI motto was suggested by head of the physics department, Alonzo S. Kimball and adopted in 1888. The motto, Lehr und Kunst, originally meant Learning and Skilled Art, but has come to mean, to Learn and to Practice. This motto is exemplified by WPI's project-based approach to learning. Within WPI's approach it seems as though something has been lacking; first year students' experience in a project-based environment upon entering the degree-required projects. Many students go into these major projects having little background and experience working on projects and in groups. In this paper we will look at a new approach the school is testing in order to provide students earlier emersion and exposure to projects. This new approach has come in the form of courses entitled The Great Problem Seminars. Before exploring the advantages and outcomes of these new seminars, it is important to explain the prior groundwork for which the seminars and other courses are based: Project-based learning.

Project-based learning, or PBL, varies from the traditional teaching methods. What we consider traditional teaching is when a professor teaches by predetermined material. If a question is asked there is usually a correct and unique answer that the students find using a set method or formula or specified readings. Teaching using a PBL system the teacher poses a question to students that cannot be answered in simple, one-word statements. This way puts forth a question, which they then decide how to approach and then determine possible solutions in order to find the best answer. This method of teaching/learning allows the students to figure out how well certain group dynamics work in order to accomplish goals and to determine how much time is needed to accomplish the task. There are arguments that project based learning does not work and students do

not learn enough. One thought behind these arguments is that instructors are afraid to assign problems that are too complicated for students to solve, which results in problems that do not interest and/or challenge them. If the students are not interested they will not put any effort forth and with thus not derive any benefit from the experience.[1]

What defines a project? There is great diversity in this definition. Some define a project as students being given certain materials and told to work within specified boundaries.[2] Others feel that a project is an open-ended question or problem in which the students use any resources available to them in order to develop answers.[3]

There are five basic tenets to PBL.[4] These do not define PBL, but help us determine if something could be considered PBL. The first of these is that the project is the primary learning mechanism to where the students' energy is focused, rather than the projects being a tool in which to deliver classroom instruction. Projects done on topics that are not entirely relevant to the class are not considered project-based learning, as they are no longer closely aligned to the subject in the classroom. The project topic must be central to the core or primary focus of the class, not a tangential subject that the students are just covering.

Second, the projects are primarily focused on problems that challenge the students to deal with concepts and rules of a certain topic. Often these problems have no clear

[1] Blumenfeld, P., Soloway, E., Marx, R., Krajcik, J., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, 26 (3&4), 369-398.

[2] Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences*, 2, 141-178.

[3] Gallagher, S. A., Stepien, W. J., & Rosenthal, H. (1992). The effects of problem-based learning on problem solving. *Gifted Child Quarterly*, 36, 195-200.

[4] Thomas, John; A Review of Research on Project-Based Learning, March, 2000

answer or direction for the students to take. This encourages them to look at it from many different angles.

Third, simply assigning a student a project cannot be considered project-based learning. The students must be challenged and struggle to develop an answer. If they meet no difficulty in the process, then it can only be considered an exercise or practice. It is important that the students take away newly acquired skills and knowledge. When a student has to struggle to develop an answer, it implies that they did not previously know it and had to acquire knowledge in order to create an answer.

The forth criteria is that the problems must be led and directed by students; driven forward by their approach, rather than by an instructor. Clearly laid out guidelines to the project, or problems are neatly solved are not considered to be PBL. Although it may still have a topic central to the class, if the students are not determining the majority of the direction with minor guidance from the instructor, than it cannot be considered PBL.

Finally the fifth criteria states that the projects must pertain to the real world and not be a purely academic exercise.

Project-based learning attempts to modify the classroom dynamics. It is intended to eliminate competition among the students while encouraging teamwork. When individual incentives for students are removed from the class and the ability to work together is encouraged, students gain an attitude that is more about accomplishing the task at hand rather than furthering themselves. If students are motivated to work with others and not simply to further themselves it is more likely that the students will gain more from the coursework.[5] We however believe that this logic is flawed: it may work

[5] Thomas, John; A Review of Research on Project-Based Learning, March, 2000

for short projects in small groups but for larger projects and/or larger groups it will not. Like communism the lack of individual incentives will not motivate the students.

Students are also taught how to seek out answers to particular questions instead of relying on one source that will hand them an answer. They learn how to become self sufficient in these tasks. This is not to say instructors are to simply be relegated to sitting aside and letting the students run the entirety of the class, especially in situations where students have not had a significant amount of exposure to this type of learning. While the instructor provides a firm foundation, the students are free to go wherever they want on the topic, while the instructor keeps them moving forward.

There are a few different styles of project-based learning that are well established. The first, Expeditionary Learning (EL), has roots in a wilderness exploration program called Outward Bound. The basis for this project style involves a combination of tough real life problems, community or classroom development, as well as the development of the students themselves. Classes that utilize this method of learning differ slightly from other PBL classes. Because of the origins and nature of this teaching style, the course tends to involve large amounts of fieldwork and teamwork all completed outside of class. The students keep all of their work so as to have a record of changes made and improvement in their academic performance. Expeditionary Learning tends to have very flexible scheduling. Research conducted on this type of learning environment has been very positive. In Dubuque, Iowa three schools that had changed to the Expeditionary Learning style were reviewed. After two years, two of the schools showed improvements in standardized test scores on the Iowa Test of Basic Skills from a rating of "Well below average" to "average" for the district. The third school went from "Well below average"

to "well above [the district] average". In Portland, Maine a middle school utilizing the Expeditionary Learning method had improvements in all subject areas tested by the Maine Educational Assessment. These scores, on average were 59 points higher than the average of the rest of the state, about a 15-point increase for the school (the increases were not given in percent form from this source because it was a biased source). Changes in these environments were not only limited to intellectual changes. It was found that attendance rates were high with all schools that used this program and the rates of disciplinary problems were "unusually low."[6]

Another study done by researchers at the University of Memphis, on a slightly different type of PBL, showed that in the period of two years, students at the test school gained 26% over students from a control school at the elementary school level.[7] Similar results were also reported in schools located in Cincinnati.[8] As mentioned above the two preceding sources were taken from highly partial sources: Expeditionary Learning Outward Bound (ELOB) and Connect publications (http://www.elschools.org/publications/ and http://www.connectpublications.co.uk/) both proponents of PBL.

Researchers conducted a follow up study by studying two PBL courses. One was a senior level course in a biological sciences and another was a sophomore level American History course. Both of these courses dealt with not only topics in their own fields but the ethical issues involved with them as well. To measure the progress made by

[6] Expeditionary Learning Outward Bound (1999a). A design for comprehensive school reform. Cambridge, MA: Expeditionary Learning Outward Bound.

[7] Ross, S. M. et al. (1999). Two- and three-year achievement results on the Tennessee value added assessment system for restructuring schools in Memphis. Memphis: Center for Research in Educational Policy, University of Memphis.

[8] Cincinnati Public Schools. (1999). New American Schools designs: An analysis of program results in district schools. Cincinnati Public Schools.

students during the course, there was a pre-test and a post-test given. The results from the sophomore class showed that students demonstrated equal or better knowledge of factual learning when compared to a control class which studied the same material with traditional methods. The seniors were tested on their ethical aspects. In comparison with the control group, the PBL group did better not only on the ethics, but also on the supporting arguments they used to bolster their answers.[9]

Project based learning has also been shown to have a positive effect on critical thinking in young students. A study was conducted with students in the sixth grade working on a nine week project related to the apparent shortage of housing in six different countries. Critical thinking in this source is defied as the process by which a person takes information given to them on a particular problem and then analyzes and provides a solution. Utilizing the Cornell Critical Thinking Test, the researcher found that, compared to a control group, there was a gain of skill as well as confidence (after completion of the project report).[10]

A landmark study on PBL in mathematics was conducted in Great Britain in two secondary schools on students ranging in age from 11-18 by award winning researcher Jo Boaler.[11] The study was conducted for three years using closely matched schools. The students at each school were from similar economic backgrounds and had been taught with the same approach in mathematics up until this study was given. The traditional school was taught with a traditional lecture approach, which used textbooks and frequent

[9] Stepien, W. & Gallagher, S. (1993). Problem-based learning: As authentic as it gets. *Educational Leadership,* 51, 25-28.

[10] Shepherd, H. G. (1998). The probe method: A problem-based learning model's effect on critical thinking skills of fourth- and fifth-grade social studies students. *Dissertation* Abstracts International, Section A: Humanities and Social Sciences, September 1988, 59 (3-A), p. 779.

[11] Boaler, J. (1997). Experiencing school mathematics; Teaching styles, sex, and settings. Buckingham, UK: Open University Press.

tests. For the PBL approach teachers used projects with very infrequent use of tests or textbooks. The students were allowed to work on their own and in groups and choose the speed at which they progressed. There were open-ended projects and problem until January of the third year when the school switched to more traditional classroom teaching in order to prepare the students for the national standardized test.

The results from a standardized test given before the start of this study showed no significant differences between the schools. Most students in both schools were below the national average for the test. The results after the three years showed a much greater improvement in the school utilizing PBL. On items that were taught by large amounts of repetition, such as the knowledge of formulas or methods, the students in the PBL setting performed just as well as the school using the traditional style.

In interviews conducted by the researcher, the students at the traditional school said that they found the work "boring and tedious". They said that their success in math depended upon the ability to remember and apply rules. The PBL school described math as a "dynamic, flexible subject that involved exploration and thought."[12] Moreover students in the traditional setting claimed that the knowledge they acquired would be of little use in the real world, whereas the PBL students felt that their knowledge could be used in a variety of different ways and settings.

A group of researchers from Vanderbilt University in the Cognition and Technology Group, developed projects and evaluated student performance over the period of several years. One project given to fifth graders was to design a playground. The students were evaluated on three different factors: how well the students could adapt

[12] Boaler, J. (1997). Experiencing school mathematics; Teaching styles, sex, and settings. Buckingham, UK: Open University Press.

to new design problems, how well they understood basic concepts of geometry, and how well they worked together to coordinate designs. The students all showed significant improvements in the ability to understand and utilize the concepts learned as well as the ability to answer traditional test questions dealing with mathematics, in particular geometry. Of all the designs, 84% were determined to be accurate enough to build from the plans.[13] An interesting side note is that the teachers (during follow up interviews) said that students used available resources to look over and edit their work. This was something that was described as "uncharacteristic" of these students prior to this project.[14]

In a different study, also conducted by the Cognition and Technology Group at Vanderbilt, three projects were completed over a three-week period by another group of students. Two of the projects were on trip planning and the last one involved the statistics used to create a business. After they had completed the three projects, the students' performance on these tasks was assessed in five areas: basic math concepts, mathematical word problems, planning capabilities, attitudes, and based on instructor feedback.[15] The areas where the largest improvement was made were planning capabilities, word problems, and attitudes towards math. These results are similar to those of the study conducted in England by the Vanderbilt researchers who felt their findings showed that a shift toward a more positive attitude could contribute to success and skills learned, such as strategy and problem solving. The improvement in attitude towards math encompassed

[13] Barron, B. J. S., Schwartz, D. L., Vye, N. J., Moore, A., Petrosino, A., Zech, L., Bransford, J.D., & The Cognition and Technology Group at Vanderbilt. (1998). Doing with understanding: Lessons from research on problem- and project-based learning. *The Journal of the Learning Sciences*, 7, 271-311.

[14] Thomas, John; A Review of Research on Project-Based Learning, March, 2000

[15] Cognitive and Technology Group at Vanderbilt University. (1992). The Jasper series as an example of anchored instruction: Theory, program description, and assessment data. *Educational Psychologist*, 27, 291-315.

the following: students felt less anxious about math, they noticed more real-world uses for math in day to day life, and they began to regard mathematic challenges more positively.[16] In short these projects made math more enjoyable.

A study reported in 2000 used real-world student directed projects. They were given many different multimedia projects to work on over the course of the study. To assess this, a control group and the PBL groups were both given a project to develop a brochure to give to school officials and have it inform people about issues faced by homeless students. The results showed that students that had a background with the multimedia projects preformed better than the control on all three criteria: content master, sensitivity to the audience as well as coherent design. The study also showed that this knowledge did not come at the expense of learning in other areas. The students in this class demonstrated the same progress as students not in this class on standardized tests in basic skills.[17]

In regards to students, a quote taken from Tretten and Zacharious (1995) about PBL used in four elementary schools, judging from teacher interviews as well as surveying of parents said the following.

> "Students, working both individually and cooperatively, feel empowered when they use effective work habits and apply critical thinking to solve problems by finding or creating solutions in relevant projects. In this productive work, students learn and/or strengthen their work habits, their critical thinking skills and their productivity.

[16] Cognitive and Technology Group at Vanderbilt University. (1992). The Jasper series as an example of anchored instruction: Theory, program description, and assessment data. *Educational Psychologist,* 27, 291-315.

[17] Penuel, W. R., & Means, B. (2000). Designing a performance assessment to measure Students' communication skills in multi-media-supported, project-based learning.

> Throughout this process students are learning new knowledge, skills and positive attitudes."[18]

There were a few studies conducted showing that many students who instructors expected to do poorly, in fact exceeded expectations on standardized testing.[19] This could be because PBL matches more closely to some individuals learning styles than traditional learning methods do. Another test done with higher ability students compared with lower ability students showed that there was a higher gain of knowledge from PBL in critical thinking and social interaction in lower ability students than in higher ability students, nearly six times more improvement.[20]

While the results for PBL seem to be promising, there are challenges. Problem-based learning is not easy to enact. Some of the problems facing instructors include the following. Give time to students to follow their own investigations or ideas or to follow predetermined curriculum given by the school or the state, design problems so that students have to find their own answer or control the situation so all students get the correct results, should students guide themselves in what they learn or does the instructor direct the activities and decide what information is given out in a class. More difficulties taken from *Marx et al. (1997)* are:

> **Time:** Projects often take longer than anticipated. In addition, difficulties that teachers experience in incorporating Project-Based Science into district guidelines are exacerbated by the time necessary to implement in-depth approaches such as Project-Based Learning.

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[18] Tretten, R. & Zachariou, P. (1995). Learning about project-based learning: Self-assessment preliminary report of results. San Rafael, CA: The Autodesk Foundation, 8.

[19] Rosenfeld, M. & Rosenfeld, S. (1998). Understanding the "surprises" in PBL: An exploration into the learning styles of teachers and their students.

[20] Horan, C., Lavaroni, C.. & Beldon, P. (1996). Observation of the Tinker Tech Program students for critical thinking and social participation behaviors. Novato, CA: Buck Institute for Education.

Classroom management: In order for students to work productively, teachers must balance the need to allow students to work on their own with the need to maintain order.

Control: Teachers often feel the need to control the flow of information while at the same time believing that student's understanding requires that they build their own understanding.

Support of student learning: Teachers have difficulty scaffolding students' activities, sometimes giving them too much independence or too little modeling and feedback.

Technology use: Teachers have difficulty incorporating technology into the classroom, especially as a cognitive tool.

Assessment: Teachers have difficulty designing assessments that require students to demonstrate their understanding.[21]

These researchers also found that teachers have difficulty adjusting to the style needed to teach PBL. Teachers would rather attempt to adapt slowly, trying to fit the style of teaching they are used to. These particular researchers believe that a supportive school environment can overcome these difficulties.[22]

Overall PBL shows definite potential, but implementing PBL is difficult.

Limitations of Background Research

From our background research we found that project based learning methods can be effective. We did not however find many studies involving college-aged students. Not only are college students psychologically more developed and altogether different from high school and especially middle schools students, but the mere fact that they are

[21] Marx, R. W., Blumenfeld, P. C., Krajcik, J.S., & Soloway, E. (1997). Enacting project-based science: Challenges for practice and policy. *Elementary School Journal*, 97, 341-358.

[22] Marx, R. W., Blumenfeld, P. C., Krajcik, J.S., & Soloway, E. (1997). Enacting project-based science: Challenges for practice and policy. *Elementary School Journal*, 97, 341-358.

attending college indicates that they are reasonably adept at traditional learning and enjoy it enough to continue their education. In short, college students want to be in college and most want to learn. Many high school students do not want to be in schools and are uninterested in learning. In our research a trend emerged: often the individuals who benefit most from PBL especially Expeditionary Learning, are those who struggle with traditional learning. These individuals are not typical WPI student. Thus we are not suggesting that our research necessarily indicates that typical WPI first years will learn a subject better from the project based FTW.

What our research does unequivocally prove, unsurprisingly, is that students in studies who were in the experimental group, that is the students who were taught by PBL, were able to complete projects far better than students in the control, traditional learning group after the study. This is true even in studies where the control group was taught (using traditional methods) about how to complete a project but not given experience doing projects. Thus being given experience completing group projects clearly prepares the students for projects better than alternative methods.

FTW does not employ project based learning because the students will learn the subject matter more thoroughly than by traditional methods. The primary goal of the seminars is not content delivery. It is intended to teach/give experience to the students how to complete group projects. The course is also intended to give first year students a taste of the subjects of the seminar. This taste of engineering, as with the Power the World seminar, is intended to stimulate the student's interest in engineering.

Student Interviews

We interviewed students in FTW in order to hear their opinions on the course. During one of their lectures midway through A-term, we asked for volunteers. We interviewed 12 students during A-term. At the end of B term, we interviewed the same students during their poster presentation day.

Student A-Term Interview

We interviewed twelve students midway through A-term. At the time we interviewed, the students had completed the following assignments favorite meal, food log, nutrition assignment, ethnic market, and economic assignment (price elasticity of demand). The interviews were conducted individually so that students would not be influenced by their peer's opinions. The questions we asked the students are shown below. Three questions intended to obtain an impression of their intellectual and academic background. We wished to determine this in order to use as a correction factor for analyzing their responses to the other questions. For example we would give more credence if an intelligent/academically capable (based on past performance) student indicated that the course was quite intellectually challenging than we would if a student with a less academically challenging background made the same statements. We then asked general questions about their views on the course and how much work they were putting into the course. We then asked questions about the homework and projects, which they had completed and were completing.

Student Interview A-term Questions:

Academic Background

- GPA (optional)?
- AP classes and AP test scores?
- What have you done in the past for group projects?
    - What size groups are you used to or do you prefer working with?

Opinions' of the class

- Do you find this class intellectually challenging?
- How time consuming is this class compared to the rest of your schedule? (In numbers?)
- With what you know now about this class, would you still choose to take it given the choice over?
- Why or why not?
- How much do you feel you are learning in this course compared to other courses you are currently taking?
- Do you feel that this course is valuable to your future education?
- The credit for the course is equal parts chemistry and humanities. What do you think the proportion of lecture time, material learned etc. of chemistry to humanities is for this course?
- Is the focus of the course to broad or too narrow?
    - How would you change this?
- Why did you choose to take this seminar?
- Do you prefer a class taught by 3 different professors, or would you rather 1 instructor?
    - Why?

Projects

- What would you like to see for projects, (topics, and ideas)?
- Would you rather a series of small projects or 2 or 3 large projects?

Homework

- Do you find the homework relevant to what you are learning in class?
- Do you find this homework to be busy work or are you actually learning material?
- Do you do your homework for this class individually or in groups?

Most of the students interviewed were average to slightly above average for WPI first year students: Only three students had below a 3.7 GPA in high school, which is was

the average for incoming freshmen in their class.[23] Nearly all of the students (11 out of the 12 interviewed) had taken and done reasonably well on at least a two or three AP tests. Only a couple of the interviewed students had extensive experience with group projects. Most, (10 out of 12) had only done one or two group projects, and most of the projects they had done were not math or science related.

Most, nine out of twelve, of the students did not find the course intellectually challenging. About half of the interviewed students said that they were not learning very much material from the course, but many of these students did concede that at least the project experience would be valuable in the future. Nearly all the students felt that the projects and homework (the nutrition assignment in particular) were, at best, far too repetitive. Many described the homework and mini-projects as busy work. Most felt that the homework was relevant and "worth it" but needed to be more concise and especially less repetitive. Our experience has shown us that in high school most courses have a much higher degree of repetition, in a math course when learning how to differentiate polynomial for example students will be assigned probably three or four times more problems of that type than they would be assigned in a college course. Some did not appreciate the course; one said that the only thing he was learning was "how to make tables look nice" and that the papers are graded on "syntax" rather than "scientific merit". The complaint of tables and harsh grading on presentation was common but may have been exaggerated because of the recentness of the papers return to them.

Nine out of the twelve students said they spent much more time on the Feed the World seminar coursework than their other courses (primarily math and science courses). The average time spent on the course outside of class was 1-2 hours per day.

[23] http://admissions.wpi.edu/Parents/2007_Class_Profile.pdf

The students' expectations for the course differed widely. Some expected to actually "feed the world," that is do community service. Some expected a focus on genetically engineered foods. Most students indicated that the broadness of the course attracted them to it when they were choosing courses. Having experienced the course for more than half of A term, about four weeks, many students thought the topics studied in the course had about the ideal degree of broadness: neither too broad nor too narrow. However, nine of the twelve students expressed the hope that the topics discussed would be studied in more detail in the future.

At the time we interviewed, the students had been involved in a few group assignments, so we felt it important to ask what size groups the students were more comfortable in. The students' responses hinted at a preference for more but smaller projects or 2-3 large projects, the typical response was a mix of small and large. Few students we interviewed had specific ideas for projects.

Virtually all the students felt that having two professors made the course better. The phrase "two for [the price of] one" was used frequently. Most commented that Wobbe and Traver worked well together, that their knowledge and teaching styles complementing each other's and made the course much better than it would otherwise have been.

When asked if, knowing what they did at the time of the interview, they would still choose to take the course, most were ambivalent but eventually gave an answer; while few gave a definite answer immediately. Almost half of the students (5 out of 12 with one undecided) said that they would not take the course again. Many of the students said that they would take the course over again, based on the assumption that B term was

going to be better and more in depth with less superficial overviews that typified A-term for many students.

Student B-Term Interview

We conducted another student interview at the end of B-term in order to help us determine if there were any changes in the students' satisfaction with the course in general and/or with specific features of the seminar. Unlike the interviews during A-term, which were conducted on an individual basis, we held the interviews during the students' final project presentation would be. We assumed that there would be some potential for hurried, ill considered, or even untruthful answers involved with conducting the interviews during this time due to distractions and the presence of their peers. Nonetheless we felt that these factors would not completely nullify the students answers and any conclusions, furthermore every student was required to attend the presentations thus we would be assured an adequate sample size.

When developing the B term interview questions, we started with the core questions from the A term interview. Because the judges would have the students' full attention during the presentation day, we decided that only asking three key questions would reduce the probability of hurried or unmeasured answers. We did however prepare more questions for the students to answer if time permitted.

We focused on question topics about opinions of the seminar and transition from high school to college. Two questions on the opinions of the seminar topic asked the students to compare the Feed the World seminar to their other WPI courses and asked the students to identify changes that they would make to the seminar. The students made

these comparisons based on assignments and exams, how the professors taught and how the lecture was conducted. The remaining question asked students about the transition from high school to WPI. Because there were no questions during the first interview that compared the academic and social aspect of high school and WPI, we felt that posing this question to the students would help us understand their background and how well they adjusted to WPI as freshmen.

Student Interview B Term questions:

Shift from High School to College

- Would you consider the social life and academic aspect of High School a big shift to WPI?

Opinions of the seminars

- Is Feed the World different from the rest of WPI?
- What would you change about the seminar?

During the presentations we interviewed 8 students (out of the initial 12 interviewed in A-term). Since the final project presentations were held during regular class times, some students, as well as the remaining four, were absent during portions of the presentations. Our strategy was to wait until the students had a free moment, when there were no judges or other observers present. We recorded the students' responses in audio format, after asking permission, instead of in writing.

The responses were fairly consistent with one another. For Question #1, 5 out 8 students believed that there was a definite shift of the social scenes between high school and WPI, whereas 2 out of 8 said that there was not. (One student did not answer this question). One of the students who believed there was a shift stated, "I knew a big bunch

of people [in high school], but when I came to WPI I had to meet a whole new group of people and basically start over." Most students agreed that there was a better social life at WPI than at high school because of the greater freedom at college and the opportunity to meet many other students from places all over the world. Most students, 5 out of 8, agreed that there was a definite academic shift from high school to WPI. They explained that this shift was due to the intensity of the coursework and the faster pace of the courses. Others felt that it was the project and group work aspects of WPI that was different from their high school. One of the students who said that there was not a shift stated: "I don't really think it's that huge of an academic shift from high school to WPI. I go to class, read, and then study: just like I did in high school." Although a lot of the students we interviewed scored well on a variety of AP tests in high school, we can still assume that most of these students are still involved in the preparatory classes that closely relate to their high school courses, such as Calculus, Physics and Chemistry.

The second question asked if Feed the World was different from other courses at WPI. Most of the students, 6 out of 8, said that FTW does differ from their other first-year courses, while 2 out of 8 said that it did not. Those that felt there was a difference said that FTW focused mostly on project and group learning, where most of their other classes did not. Since these students are freshmen, most of them are taking entry level courses, such as Calculus I, Chemistry I and Physics I. These courses are generally taught the same way every year and virtually never utilize projects or group learning. The students who felt FTW was similar to other courses at WPI and the students who felt it differed focused on FTW's project and group learning. The students that felt FTW was different were comparing project and group learning to their current courses, while those

students who believed FTW was similar compared it to the overall academic experience of WPI, knowing about the three major projects.

The last question asked what the students would change about the seminar. The responses to this question varied, but there were some similarities/trends. Two students felt that the seminar could benefit from better organization. The students did not go into much detail about this change, but simply explained that the seminar's layout and organization of material could be improved. Some of the students, 3 out of 8, felt that there should be changes in the homework assignments. They all felt that the assignments were usually too repetitive and boring. Another student wanted the seminar to have had more chemistry infused within it. This student liked everything else about the course, but felt that it would be a good change to concentrate more on chemistry than humanities. The last two students decided that they liked the seminar as it was and did not want to make any changes to it. Explaining their positions, they said that the seminar was conducted in a fair manner and had a reasonable amount of work.

We noticed that 6 out of the 8 students had a project partner who was also interviewed. We believe that they may have fed off of each other or limited the other's answers. One student may have simply concurred with the others in their answer because he or she did not wish to contradict his/her partner. For example, the two students who felt the seminar did not need improvement were in a group together and we believe that the answers they provided were influenced by each other. The other observation we made was that the students were really only focusing on their presentations and the judges. Although they did there best to answer our questions, we noticed that their minds were elsewhere.

Though the interview circumstances were not the most favorable, we believe that based on the A-term interview responses and now the B-term responses, we were able to use the comparisons in order to construct a reasonably accurate, though not detailed portrayal of the students' opinions of the seminar.

Professor Interviews

We conducted separate interviews with Professors Wobbe and Traver during the middle of B-term. We chose this time because we wanted the professors to be able to express their concerns regarding completed projects, homework assignments and group dynamics. If we were to conduct the interviews during A-term, we would have missed their thoughts on particular changes in the students' work and projects the students completed later in the term. Just as with the, we chose to conduct the interviews separately because we felt that each professor brought something unique to the seminar and we wanted to capture that in the interviews.

The questions designed for these interviews were primarily derived from the A-term student interview questions, which we modified to be suitable for the professors. We made the questions such that they coincided with the student interview, thus allowing us to compare the professors' answers to the students' answers.

We began the interviews by asking the professor why and how they came to be co-teaching the Feed the World seminar. Dr. Robert Traver is currently the principal at the Massachusetts Academy of Mathematics and Science in Worcester Massachusetts and while he fulfills his principal duties there, he is also involved in teaching at WPI. Because the students at Mass Academy are involved in yearlong projects and take courses at WPI during their senior year, he felt somewhat underutilized and decided to scout out something to do at WPI. He has taught a teaching methods course in the Social Sciences Department called *Philosophical Theories of Knowledge and Reality*. The course introduced students to methods of philosophical analysis relating to the classification and conceptualization of entities and the nature of knowledge. So after talking to Dean John

Orr, who suggested a new seminar course in which Traver could participate. Traver accepted the offer to teach this course, not knowing that he would be co-teaching with another professor.

The other professor, Kristin Wobbe, is an associate professor at WPI as well as interim department head of Chemistry and Biochemistry. She has taught several chemistry courses at WPI, including Chemistry II (Forces and Bonding), and Biochemistry I and II. The primary reason she chose to teach this project-based course is that her experience as a professor and MQP advisor showed her that WPI students do not know how to do research projects at a professional level and "you begin to see deficiencies the students have". Therefore she wanted to be a part of the seminar knowing that what they were doing would benefit the students in the long run.

Like many professors Traver was used to teaching alone, but when he must co-teach, he likes working with a "Wobbe type". He believes that he and Wobbe work well together and he could not ask for a better teaching partner. They are able to combine thoughts and ideas for the lectures/projects and pick up where the other one may need it. When asked about teaching with another professor, Wobbe replied: "I enjoy teaching with Professor Traver, it is not necessarily any easier, but it makes for a much better class. The decisions on everything throughout the course tends to be a bit harder because we need to check in with each other and make sure we are on a common ground." Much like Traver, she feels that the two of them have different approaches when dealing with students, but she believes that this benefits the course.

Regarding who addresses the class and lectures, Wobbe takes the majority of it, while Traver pulls people in to start discussion. Traver stated that the fraction of the

course he lectures is less than one third. Wobbe believes that at least one third of Wednesday's class is directed more for her lecturing on the designated material, while Monday's class time is directed more towards discussion. Although one professor lectures more than the other, they plan each lecture and do outside research together. Traver estimated that he and Wobbe together spend around 3-5 hours a week planning each lecture and around 4-8 hours per week grading projects and assignments. Wobbe believes that she spends about half of her time working on this course, which averages out to be about 30 hours a week. Traver, however, did not give a definite estimate of how many hours a week he used in researching materials for the course and planned and graded by himself. They both feel that the students are unaware and thus unappreciative of how much time and effort they both put into the course, whether together or separately, and this frustrates them.

Wobbe has not taught or attended any classes that involve project-based learning. She relies mostly on her experience from Biochemistry I, which is generally taken by juniors who have completed organic chemistry. The main project in Biochemistry I involved researching a particular protein chosen at random, for a term long assignment. She feels that these classroom projects have prepared her for teaching this seminar. When we asked Traver about his experience with project-based courses, he responded by giving his definition of a project and examples of instances in which he had taught project-based courses. He believes that a project starts open ended, is long term (no two day assignments), has several components and has results that are applicable to the real world. To him, this is what separates an in-class assignment from a project. When we asked

Wobbe she said that she felt there was no single definition, but among other things a project must be an open-ended exercise that is more than one day in duration.

Traver has taught a few science courses, mostly in biology, where his main method of teaching was projects. These science courses were environmental biology and botany at the college level. When Traver taught botany at Purdue, his course consisted of small projects, which required that students come to real-world conclusions. The students were given an open-ended problem/question, such as examining the growth and metabolic pattern of a particular plant, given several components on which to experiment, and received results that related to the real world. A point that Traver wanted to make was that although these projects were smaller, he believed that it was not the size or quantity of the project that made it important, but rather the conclusions or lack thereof, that the students produce.

Traver has also taught student teachers how to become teachers. He feels that although this is not any specific course, teaching someone how to develop lesson plans and basically preparing them for a world of teaching is a major undertaking. He believes that this compares with his definition of a project, where each student teacher starts with the general open-ended problem of ‘teaching students’ and then researches and then creates various activities and lessons to properly convey the material to the students. He has also been an educational consultant for various schools. He has gone to other high schools and colleges and has taught teachers how to incorporate new technology into their teaching, which was new field for most of the teachers. He feels that showing these teachers how to use new technology and how to use it with their students is similar to teaching student teachers, because that was new territory for them.

His background, knowledge, and experience in teaching project-based learning courses prepared him well for the Feed the World seminar. The seminar differs from other courses he has taught in that it consists entirely of freshmen. Although he works with high school students everyday at the Mass Academy, who are heavily involved with research projects, most of the students in FTW have had no real experience in projects or research. This course may be a bit harder not only because of their lack of experience, but also because of their "high school mentality" which can be expected of freshmen during the first couple of terms.

What we consider high school mentality is when a student still thinks and acts like they did in high school. When a student is right out of high school and is new to college, many of them are still holding tightly onto their past, whether it be family, friends or old teachers. This can be expected because they are in a new environment and need to make new friends. The social aspect of being new can disturb some students. In high school, they had a group of friends that they have known for a long time. When they come to WPI most students do not know anyone, so a big part of college is meeting new people, joining teams and going to parties. This is very exciting and new for most students, so it is common that the social scene of any college might affect their academics and effort put into a course.

The high school mentality of students also consists of the belief that they can succeed and get good grades without needing to work hard. Every high school has a distribution of students' intelligence and willingness to understand and succeed; this dictates how fast paced and intellectually challenging classes are. For many WPI students, this meant not having to study very hard. This often influences their expectations for the

difficulty of courses here at WPI. Many, if not most, of the incoming freshmen were used to getting easy A's or B's in high school, so they assume that they will be able to do the same here. They complain about the course taking up too much of their time outside of class and not being straightforward. This can be attributed to a high school mentality. They expected to come into the seminar and master it during the first week, much like their other basic classes. However this is not the case. Traver, being aware of this mentality, explained to the FTW students that this course was like none that they have taken before and that it would really test them.

To get the students comfortable, Traver and Wobbe had them work in teams first. This allowed the students to build knowledge, communicate ideas, and prepared them for the rest of the seminar. One of his main goals for the students by the end of the semester long seminar was to get these students out of 'high school mode' and for them to know that the real world is not clean and nice like it was in high school. He believes that this transition causes anxiety.

Having worked with students most of his career, Traver has gained the knowledge of student dynamics and the experience students have in various group sizes. Since a lot of the students are not used to extensive group and research work, Traver and Wobbe believe that groups of three (depending on specific assignment) work the best. He believes that groups of three allow and require all of the students to participate equally and allows them to become comfortable with one another. He believes that groups of four do not function well and does not particularly like them. He feels that three of the members usually do most of the work, while the fourth person just 'hangs out'. Groups of four may also pose the threat of being too social. Usually with this many students

working together on one assignment, there is bound to be some extensive socializing, possibly too much. According to him since most of the students are new to group projects, they do not necessarily have the skills to bring the fourth person in and get them to work, so by keeping it to groups of three such problems can be avoided. He explained that groups of two can also be very useful, especially the quiet students. He has noticed that, like any classroom, there are students who sit in the back, which he feels is their way of keeping their distance from the 'authority', there are students in groups near the middle of the classroom, which can be considered cliques and there are lone students who are dispersed throughout the classroom, who seem to listen more than participate. In order to get everyone involved and working with each other, groups of two allow a few options for discussion. Traver gave this example: if student 1 and student 2 are in a group together and student 1 is a quiet individual, instead of having them discuss with each other and then recite their own thoughts back to the class, he would have student 1 repeat back what student 2 said and visa versa. This approach seems to make student 1 feel more comfortable because they are reciting back someone else's ideas and thus keeping them out of the spotlight.

Wobbe agreed with Traver on groups of two and also said that one thing she would change about the group dynamics is not let the students form and reuse the same groups over and over again. She found that by allowing this, students became too comfortable with each other and did not connect to the rest of the class in discussion. They wanted the students to work in groups with various students in order to understand the importance of group dynamics.

For this seminar students received one regular course worth of credit for elective 1000 level chemistry and one for elective humanities. Wobbe fears, however, that the credit assigned for the course is somewhat arbitrary. She thinks the course has a very "social science" feel to it. Both Traver and Wobbe decided that it was more efficient for the students to start off with humanities in the beginning rather than a crash course in chemistry. They started them off with some group work and a few writing assignments. Some of these writing assignments were meant to get a feel for their writing skills, but also to introduce them to nutrition such as the nutrition and favorite meal assignment.

Traver and Wobbe feel that they integrated the chemistry and the humanities in a way that made the students feel more comfortable with the humanities and then better able to focus on the chemistry. Traver stated that the students have had more humanities in their schooling than chemistry, but believes that the seminar has an equal amount of chemistry and humanities. The seminar had many components that needed to be built up on, not to be tackled first. For instance, before having the students dive into a large open-ended project, they feel that taking it slow in the beginning and having the students become comfortable with the material and even each other is an important first step. To have each students prepare for project work, they have designated individual assignments that will help them with research and writing. It is very important to have each student comfortable and understand what they need to bring to each group.

The fact that the seminar encompassed some intellectual disciplines and is offered to students who may or may not have had any knowledge of these disciplines in high school insinuates that this seminar may be very challenging. Traver feels that there are two ways to measure a challenge: practically and intellectually. He believes that the

material being taught in the seminar is not necessarily hard conceptually, but more practically challenging. Wobbe finds the seminar challenging because familiarizing herself with the material to the point where she feels comfortable lecturing is difficult. Unlike a calculus or physics class where the formulas and material are concrete, they feel that because the issues being presented in the seminar are raw and not cleaned up like their other classes, it may pose more of a practical challenge for the students.

In basic courses, such as calculus and chemistry that have been taught many times before the concepts that are presented to students are clear-cut formulas that must be mastered before being able to move on. These concepts and ideas cannot really be altered, but only understood. What makes these classes 'cleaned up' is that the professors weed out unnecessary areas of the material and approach certain concepts differently to help students understand. The seminar is not like this. Traver and Wobbe cannot simply sift through different world problems, such as world hunger and economic struggles, and make these concepts easier for students to understand by explaining them in a simple manner. Because of this, Traver and Wobbe believe that the students are learning the same, if not more, in the Feed the World seminar than they are in other classes. Aside from the obvious research, project knowledge and experience the students will gain from the seminar, they feel that it is the content issues that are not resolved (i.e. world hunger and poverty) and not immediately recognized. Wobbe believes that these content issues are "a much less concrete kind of knowledge" and she hopes this gives the students a broader perspective of the world and people in it. Traver predicted that students who want to understand how to 'fix' these problems would probably not like the seminar. This

seminar does not show students what steps to take, but rather prepares them on how to go about taking the steps.

However, he hopes that each student will be able to take something specific away, even if it is not the material being taught. He hopes that they will always have this project knowledge further down the road at WPI and wherever they end up after college. Although most students might not notice the life lessons they are learning now, he and Wobbe hope that when a problem arises or a research opportunity opens for them, they will always have the research and group work from the seminar to refer back too. All, without exception, has learned something, whether they see it yet or not.

As far as this seminar being challenging for Traver, he feels that it is more practically challenging than intellectually challenging. He already knows most of the material being covered. He is more interested in helping the student's develop cognitive reasoning. Teaching them how to think for themselves rather than telling them what they should believe. He believes that this seminar and the project knowledge will help the students in their future academic and professional careers. As a teacher it seems that his main goal was to prepare the students for their future, more specifically their future work on group projects.

The purpose of the projects in the seminar was not only to help prepare the students for future group and project work, but also to have them explore outside the material presented in the class. They have devised the course in such a way that the students are to understand the material on their own accord and then apply it to the projects. The ethnic market project and the Heifer project are prime examples of having the students thinking outside just the material. For the ethnic market project, the students

were asked to go to an ethnic market with a fixed budget and select foods to feed a family. This helped the students relate food choices and options to income. Some students focused on large quantity low cost items, such as bags of rice, while others focused on the nutritional aspect of the food. The students were not told to look for certain foods, so this gave the students the opportunity to assess each other's motivations for choosing what they did.

The Heifer project was a field trip to a farm that raises livestock and provides them to other countries around the world. Their method is focused on helping people obtain a sustainable source of food and income. The main goal of this project was to have the students' critique how effective Heifer's method is. After some background research within and outside of the class and the field trip to see exactly what Heifer did, the students were able to come to their own conclusions and recommendations. This project again allows the students to think outside of the typical resolutions of solving world hunger and come up with their own solutions and suggestions.

Because the semester course was almost complete at the time of this interview, we wanted to know how Traver thought the students felt about the projects. He thought that some of the students probably came into this course wanting to know how to actually feed the world or at least people in Worcester, so these students' expectations of the projects differed widely from a student who had less of a community service based interpretation of the course. When he and Wobbe asked the students on one of the first days of the seminar what types of projects they would like to see, the students suggested 25 similar projects out of the 30 already considered. It was quite amazing that the

students had so many ideas for projects they would like to see, judging by that Traver felt that students would enjoy the assigned projects.

For the students who want content and an actual solution to world hunger, he had to remind them that the course focuses on a broader and maybe not so direct approach to solving world hunger. Whether the students see it or not, Traver feels that the course is providing the steps and knowledge that the students need to begin to understand this world problem. One cannot expect to take a semester course and know how to solve the great problems of the world. However, with the knowledge presented in the lectures and projects, each student will be prepared with ideas for future interest in the subject. This seminar will allow each student to really think about these key issues and then see where they stand. For instance, one group felt that the work that Heifer was doing for other countries was really important, so they decided to take it upon themselves and raise money for a Heifer center in Namibia Africa. This is a prime example of the effect the seminar should have on some of the students. A main point is that some students may go above and beyond with the issues in the course, while others may just take it in and do nothing outside of class or after the seminar ends, but everyone who takes the seminar will gain awareness and knowledge of the present situation at hand.

Before the students begin work on the projects, Traver and Wobbe feel that small assignments/ projects should be done first, which prepares the students for the larger projects. They believe that even if a project is large and open-ended, there still needs to be smaller sections in place to keep the students on the path to a solution. This is especially true since most students are new to large projects; having these sections set up will only help them to reach a conclusion.

In this seminar Wobbe and Traver refer to these smaller assignments/projects as homework assignments. Unlike the projects, which allow the students to think outside the material covered in lecture, the homework assignments are designed to keep the students in the textbook and material. Wobbe likes to assign work that covers material outside of what was lectured on. Traver and Wobbe form expectations for the answers, and occasionally they will get something completely different. Yet again illustrating the diverse minds in the class. Traver considers the homework to be the gist of the class. The homework assignments received mixed reviews by the students. Some students feel that the homework is too repetitive and busy, while some students feel that it is necessary to get the main points of the material. When asked, Traver explained that the assignments do have a busy work quality to them, however he does not feel that it is wasted time. He does agree that some of the assignments were a bit too drawn out and 'messy', and if they have the chance to repeat the seminar he will fix those aspects. For example, one of the student's homework assignments involved highlighting fifty countries on the world map that had some type of economic problems or food issues. Traver feels that fifty countries is a bit too excessive for a one to two day homework assignment, so he would change the quantity to 10-25 countries. As far as changing any aspects of the projects, he believes that it is too soon to tell.

A way to help Wobbe and Traver assess the student's abilities and whether the assignments are effective is seeing if there is a shift in the quality of student's work. We can assume that most students do better the second half of a semester course because of the experience they have gained. Traver and Wobbe both believe that there was a large shift in the quality of the student's work a couple weeks before the fall break and after the

break. They noticed that presentations after the break were more organized and each student was taking turns speaking, whereas before, some presentations were messy/unorganized and some of the group members would have nothing to say during the entire presentation. The students may not think a well organized excel table is crucial, but to Traver an organized presentation shows that someone thoroughly understands the subject and is worthy of listening to. In a professional setting the students would not present a messy presentation to their boss, so why continue the habit in college? He views the students on more of a professional level than just student versus professor, so his eagerness about properly organized tables and figures will help them later on. This seminar will promote not only the ability to work in groups to solve real life open-ended problems, but also prepare them for a career. Wobbe was not sure if this shift was due to the amount the students had learned from A-term or if it was based on the popularity of the new assignments (the Heifer International and Morgan Hall food waste project for example).

We asked them if they had any last remarks they wanted to add about the students or the seminar and Traver responded by saying that his peers and whoever is looking on the outside at this seminar to cut Wobbe and him some slack. He hopes that others will see and understand what he and Wobbe are trying to teach to the students. He said that he knows that, because this is a new experimental class and there are two professors teaching, the WPI community will have high expectations. He wants them to know that there will be imperfections and problems which need correcting and that he does not want to be judged. He simply wishes that his peers and students could see how hard they are working to make this seminar a success with the students and the WPI community as a

whole. Wobbe responded by saying that this seminar was "enormously fun for me". She believes that the course has value in a college setting because the students are looking at big complicated problems in addition to the fundamentals of the discipline. Overall she feels that the course will only get better.

Summary

After interviewing both professors we feel that we have gained their perspective of the course and the students as a whole. Although Traver and Wobbe come from different academic and teaching backgrounds, we found that they agreed on the majority of interview questions. They define projects as being more than a few days in durations and being open ended, and preferably having real world applications. They feel that the ideal group size is three for larger projects. Overall they were able to work well together. They feel that the course was very successful and that the students benefited greatly from the course. Wobbe and Traver argued that FTW was not about what the students learned (what Wobbe called “stuff”) but about how they learned it.

Official Course Evaluations

We studied data from the official WPI course evaluations for Feed the World in both A and B terms. The surveys include questions that ask students to assess the quality of the course as well as the quality of the instructor. The students are also asked to assess their own effort and interest in the course.

Data for FTW was compared to traditional courses that enroll primarily first-year students, including introductory courses in Physics, Chemistry, Mathematics, and Humanities. In particular, Chemistry and Humanities courses were chosen to match the credit provided by FTW. The summary statistics used here were obtained from WPI's website.[24] Fourteen courses were selected to be used for comparison:

1. WR 2211—Elements of Writing
2. SP 2521—Intermediate Spanish I
3. PY 1731—Intro to Philosophy And Religion
4. HU 1401—Intro to Humanities And Arts I
5. HI 1311—Intro to American Urban History
6. EN 1222—Shakespeare in The Age Of Eliz
7. AR 1111—Intro to Art History
8. MA1021—Calculus 1 (2 courses different instructors)
9. MA1022—Calculus 2
10. PH1110—General Physics: Mechanics
11. CH1010—Molecularity
12. CH1020—Forces and Bonding (2 courses different instructors)

In all cases, the traditional courses were taught by professors who have taught the same course many times, so we are comparing a completely new course (ID 120X—FTW) with courses that have been restructured and refined over several years of experience. While this is perhaps unfair to the experimental course, this cannot be avoided. There are no other "completely new" first year courses to use for comparison.

[24] https://banner-as1.admin.wpi.edu/pls/prod/hwwkscevrp.P_Select_CrseInst

The course evaluation form assumes that there is one instructor responsible for the course and all questions on the form refer to that single instructor. Because Feed the World was *team taught* by two instructors, student comments could refer to either instructor or to both. In order to avoid double counting questions about the course and to avoid confusion regarding questions about the instructors, Wobbe and Traver asked the FTW students to answer all questions pertaining to *the course* on only the set of forms assigned to Professor Wobbe. Questions that refer to specific instructors were answered on forms assigned to that instructor. (For Wobbe's sections, students answered all of the questions. For Traver, students answered only the instructor-specific questions.) A few students did not follow specific directions, but the small number did not have a significant impact on the averages for the evaluations.

There are clearly many factors which influence the results of these evaluations and we do not focus on the absolute numbers in our analysis. We look instead at changes or differences in the student responses, both between A and B terms for FTW and between FTW and traditional courses. A large percent difference provides a high degree of confidence that the difference is real and a small percent difference indicates that there is probably no real difference in the students' assessment of the course or instructor.

We will analyze the course evaluations for ID120X using the twelve questions listed below. All questions use a 5-point Likert scale but the answers associated with the numbers vary.

The first cluster of questions pertains to the quality of the course and the instruction. For these questions, the answers were on a scale from 1=Very Poor to 5=Excellent.

Q1: My overall rating of the quality of this course is
Q2: My overall rating of the instructor's teaching is
Q4: The educational value of the assigned work was
Q7: The instructor's skill in providing understandable explanations was

The next block of questions pertains to student learning, interest, and effort. Answers range from 1= Much Less to 5 = Much More and all ask for comparison with other classes at WPI.

Q9: The amount I learned from the course was
Q10: The intellectual challenge presented by the course was
Q12: The instructor stimulated my interest in the subject matter
Q14: The amount of reading, homework, and other assigned work was
Q15: My attendance and participation for this course was
Q16: The amount of effort I put into this course was

The next question also asked about the course, focusing on the ways that student performance was evaluated. This did not ask for a comparison with other courses but an assessment of frequency; 1=Never to 5=Always.

Q22. The exams and/or evaluations were good measures of the material covered

One final question asked the students to estimate the amount of time that they spent working on the course. The answers in this case referred to hours spent per week, with 1= "8 or fewer" and 5 = "21 or more."

Q26: On average, what were the total hours you spent per week on all activities related to this course?

We chose these questions because we felt that they would provide us with the best data on which to compare each course to. Each of these questions holds a specific importance either about the course, the instructor or the students' presumptions.

Evaluations from A and B terms for Feed the World

We begin by comparing the course evaluations for Feed the World in A term with the evaluations for Feed the World in B term. The students' answers were consistent for four questions but there were notable changes for others. The data are summarized in Table 1 below.

Table 1: Course Evaluation Data for Feed the World

	FTW A term	*FTW B term*	*Change*	*% Change*
Q1: Quality of Course	3.20	3.58	0.38	12%
Q2: Quality of Instructor	3.83	3.79	-0.04	-1%
Q4: Value of Work	3.11	3.61	0.50	16%
Q7: Instructor Skill	3.89	3.89	0.00	0%
Q9: Amount Learned	3.25	3.58	0.33	10%
Q10: Intellectual Challenge	3.39	3.45	0.06	2%
Q12: Stimulated Interest	3.58	3.64	0.06	2%
Q14: Amount of Work	4.44	4.10	-0.34	-8%
Q15: My Attendance	4.29	4.09	-0.20	-5%
Q16: My Effort	4.27	4.09	-0.18	-4%
Q22: Evaluations Used	3.66	3.97	0.31	8%

Question 14, which asked students to assess the amount of work dedicated to FTW, had the highest average in each term. In both terms, the students reported that the amount of work for FTW was "More to Much More" than their other courses. There was a slight decrease from A-term to B-term, so perhaps the workload lessened in B-term, but the students still reported that FTW was more work than traditional courses.

The students' assessment of the quality of the course, the value of the work assigned, the amount learned, and the quality of the evaluation used all increased between

A and B terms (Q1, Q4, Q9, and Q22 respectively). The largest increase was for the "Value of the Work Assigned" with a 16% increase.

There was little change, or a very slight increase, in student assessment of the Instructor Skill, Intellectual Challenge, or how the work stimulated their interest (Q2, Q7, Q10, and Q12 respectively).

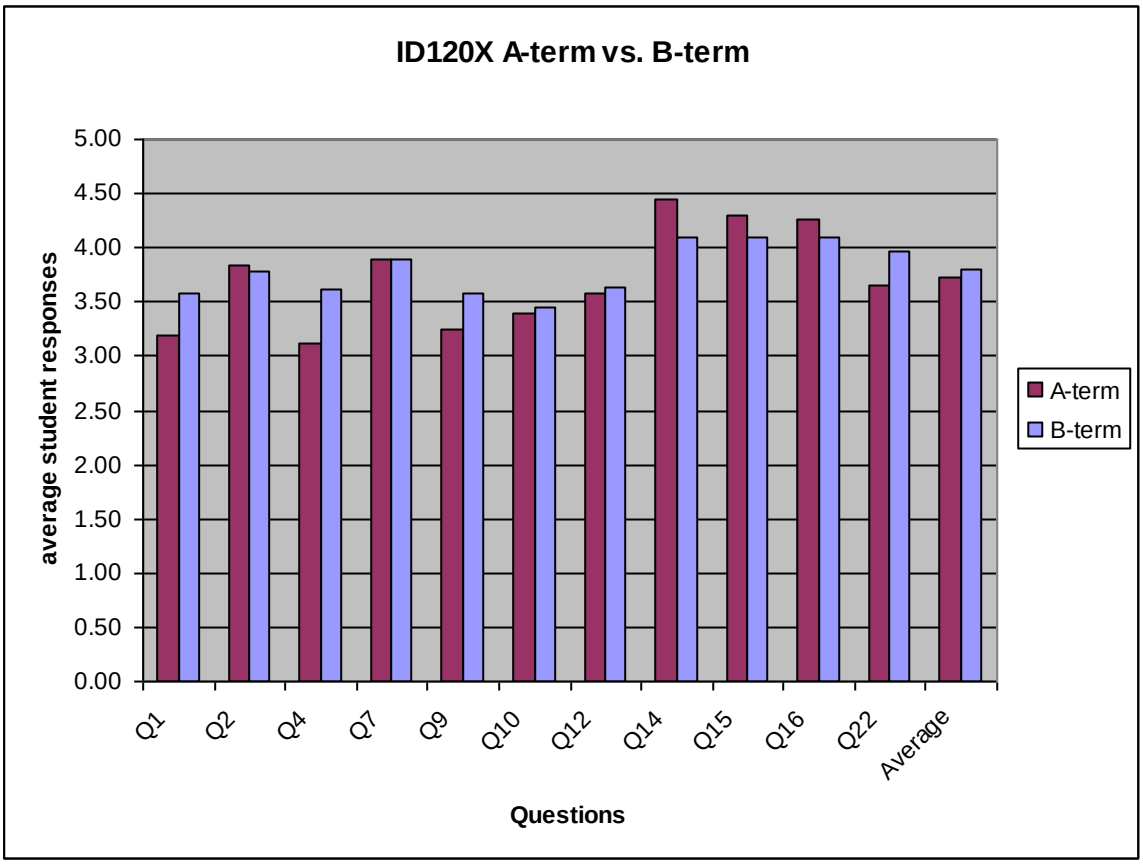

Figure 1: FTW Course Evaluation Ratings A-term vs. B-term

The data are summarized in Figure 1, which shows two particularly interesting facts:

- The questions with the 7 lowest evaluations in A-term all increased (slightly) in B term. These questions all referred to the quality of the course or the instructors.
- The questions with the 3 highest evaluations in A-term all decreased (slightly) in B-term. These questions all referred to amount of work or effort committed to the course.

We can clearly see that the course improved in B-term relative to A-term. The "overall quality of the course" (Question 1) increased by twelve percent; the "amount learned" (Question 9) increased by ten percent. The "educational value of the assigned work" (Question 4) increased by sixteen percent. The question relating to amount of work, attendance, and effort level (Questions 14, 15, and 16 respectively) all decreased slightly but they were all higher than the comparable courses, thus this cannot be seen as a negative outcome. The "evaluations … [being] good measures of the material covered" (Question 22) increased by eight percent. Thus clearly the professors listened to the students and modified their course for B-term. This data mirrors sentiments expressed in interviews conducted at the end of B-term: when asked if they would take the course again most students were hesitant or noncommittal; when asked if they would take the course again but without A-term all students queried responded with a definite "yes".

Comparison of FTW with Other Courses

We found the weighted average for each question for all of the courses in each subject area (humanities, science, and math) and for FTW with A and B term scores

combined. We also took an unweighted average of the averaged subject scores so we had a single number for comparing FTW to. It did not seem worthwhile to compare every freshmen level course individually with ID120X because the outcomes would most likely not be much different. Averaging also allows for a more appropriate means of comparison. Because we sought to compare FTW to traditionally structured courses and not all first year courses we did not include FTW in the overall averages.

Table 2: Course Evaluation Data

	Science	Math	Humanities	FTW
Q1: Quality of Course	3.88	4.48	4.19	3.38
Q2: Quality of Instructor	3.83	4.57	4.29	3.81
Q4: Value of Work	3.88	4.24	4.14	3.35
Q7: Instructor Skill	3.87	4.50	4.30	3.88
Q9: Amount Learned	3.53	4.25	3.78	3.41
Q10: Intellectual Challenge	3.77	4.19	3.79	3.42
Q12: Stimulated Interest	3.44	4.07	3.95	3.61
Q14: Amount of Work	3.50	3.97	3.71	4.28
Q15: My Attendance	3.76	4.14	4.02	4.19
Q16: My Effort	3.72	4.14	3.83	4.18
Q22: Evaluations Used	3.98	4.57	4.44	3.81
Average	***3.74***	***4.28***	***4.04***	***3.74***

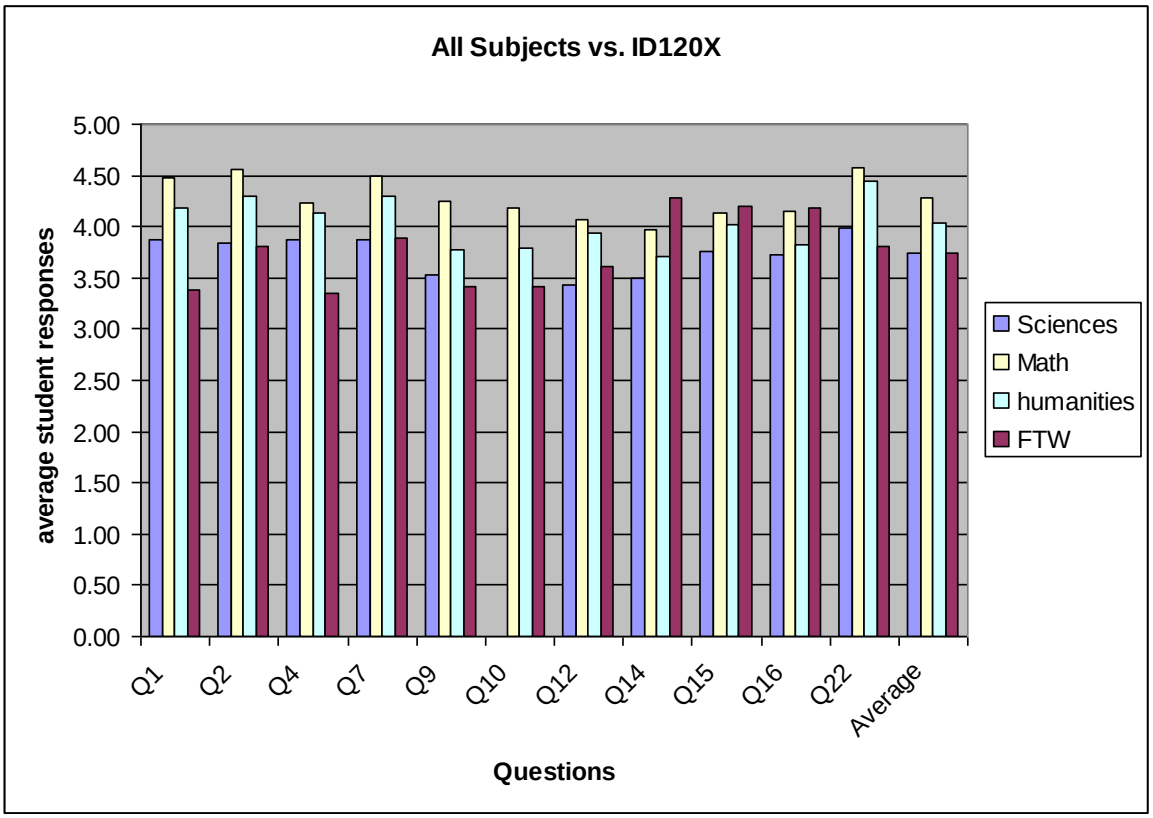

Figure 2: Course Evaluation Data FTW vs. Subjects

Overall FTW received slightly lower marks on the evaluations than the average. The average of all the questions was six percent lower than the averaged first year courses. Six percent is too small to conclude that FTW is significantly worse than the average. This average does not tell all however. Generally FTW did significantly worse than the average on key questions as shown in Figure 2, Table 2, and Table 5. For the questions relating to the students assessment of the course itself: "My overall rating of the course", "The educational value of the assigned work", "The amount I learned from the course", and "The intellectual challenge presented by the course" (Questions 1, 4, 9, and 10 respectively) FTW received marks 19%, 18%, 12%, and 13% lower than the overall averages respectively. The amount learned being 12% lower than the average may be due

to the student's failure to account for the less tangible benefits of the course. The students were most likely to perceive the course as not having taught them very much because they only accounted for the definite knowledge learned in the course and not the less quantifiable aspects, engagement and experience doing projects for example. Many students complained in the interview especially the A-term ones that they were not learning anything, only how to make "tables look nice". According to one source the students knew that the course was primarily intended to teach the students how to do projects rather than about food related problems specifically. Still based on the interviews some students companied about it, they were unaccustomed to projects or and a course which is less about the subject matter than the learning format. This is one reason why the students ranked the amount learned in FTW as lower than average.

For questions relating to the professors: "overall rating of the instructor's teaching", "the instructors skill in providing understandable explanations", and how much the instructor "stimulated… interest in the subject matter" (Questions 2, 7, and 12 respectively), FTW received 10%, 8% and 5% lower marks that the average respectively. The lower ranking on providing understandable explanations is likely lower for FTW because the subject matter is much less definite than most courses. With a math or science course there are generally definite answers to certain questions, however with FTW their subject matter is much less definite and involves many open ended problems without any correct answer, and much more complex situations than other courses.

Table 3: Weighted Averages vs. FTW A-term and Percent Difference

A term	*Weighted Averages*					*% Deviation From Subject Ratings*			
	Science	**Math**	**HU&A**	**AVG**	**FTW A Term**	**Science**	**Math**	**HU&A**	**AVG**
Q1	3.88	4.48	4.19	4.18	3.20	-17%	-29%	-24%	-23%
Q2	3.83	4.57	4.29	4.23	3.83	0%	-16%	-11%	-9%
Q4	3.88	4.24	4.14	4.09	3.11	-20%	-27%	-25%	-24%
Q7	3.87	4.50	4.30	4.22	3.89	0%	-14%	-10%	-8%
Q9	3.53	4.25	3.78	3.85	3.25	-8%	-24%	-14%	-16%
Q10	3.77	4.19	3.79	3.92	3.39	-10%	-19%	-11%	-13%
Q12	3.44	4.07	3.95	3.82	3.58	4%	-12%	-9%	-6%
Q14	3.50	3.97	3.71	3.73	4.44	27%	12%	20%	19%
Q15	3.76	4.14	4.02	3.97	4.29	14%	4%	7%	8%
Q16	3.72	4.14	3.83	3.90	4.27	15%	3%	12%	10%
Q22	3.98	4.57	4.44	4.33	3.66	-8%	-20%	-18%	-16%
Average	3.74	4.28	4.04	4.02	3.72	-1%	-13%	-8%	-8%

Table 4: Weighted Averages vs. FTW B-term and Percent Difference

B term	*Weighted Averages*					*% Deviation From Subject Ratings*			
	Science	**Math**	**HU&A**	**AVG**	**FTW B Term**	**Science**	**Math**	**HU&A**	**AVG**
Q1	3.88	4.48	4.19	4.18	3.58	-8%	-20%	-15%	-14%
Q2	3.83	4.57	4.29	4.23	3.79	-1%	-17%	-12%	-10%
Q4	3.88	4.24	4.14	4.09	3.61	-7%	-15%	-13%	-12%
Q7	3.87	4.50	4.30	4.22	3.89	1%	-14%	-10%	-8%
Q9	3.53	4.25	3.78	3.85	3.58	1%	-16%	-5%	-7%
Q10	3.77	4.19	3.79	3.92	3.45	-8%	-18%	-9%	-12%
Q12	3.44	4.07	3.95	3.82	3.64	6%	-11%	-8%	-5%
Q14	3.50	3.97	3.71	3.73	4.10	17%	3%	10%	10%
Q15	3.76	4.14	4.02	3.97	4.09	9%	-1%	2%	3%
Q16	3.72	4.14	3.83	3.90	4.09	10%	-1%	7%	5%
Q22	3.98	4.57	4.44	4.33	3.97	0%	-13%	-11%	-8%
AVG	3.74	4.28	4.04	4.02	3.80	2%	-11%	-6%	-6%

Table 5: FTW Weighted Averages vs. FTW and Percent Difference

	Weighted Averages					*% Deviation From Subject Ratings*			
	Science	**Math**	**HU&A**	**AVG**	**FTW**	**Science**	**Math**	**HU&A**	**AVG**
Q1	3.88	4.48	4.19	4.18	3.38	-13%	-24%	-19%	-19%
Q2	3.83	4.57	4.29	4.23	3.81	-1%	-17%	-11%	-10%
Q4	3.88	4.24	4.14	4.09	3.35	-14%	-21%	-19%	-18%
Q7	3.87	4.50	4.30	4.22	3.88	0%	-14%	-10%	-8%
Q9	3.53	4.25	3.78	3.85	3.41	-4%	-20%	-10%	-12%
Q10	3.77	4.19	3.79	3.92	3.42	-9%	-18%	-10%	-13%
Q12	3.44	4.07	3.95	3.82	3.61	5%	-11%	-9%	-5%
Q14	3.50	3.97	3.71	3.73	4.28	22%	8%	15%	15%
Q15	3.76	4.14	4.02	3.97	4.19	12%	1%	4%	6%
Q16	3.72	4.14	3.83	3.90	4.18	12%	1%	9%	7%
Q22	3.98	4.57	4.44	4.33	3.81	-4%	-17%	-14%	-12%
AVG	3.74	4.28	4.04	4.02	3.74	0%	-13%	-7%	-7%

Time Spent on the Seminar

The one area in which FTW was ranked much higher was in "the amount of reading, homework, and other assigned work" (Question 14). FTW received a fifteen percent higher rating than the average. The amount of effort put into the course (Questions 16) was ranked seven percent higher than the average. Participation and attendance was six percent higher.

Question 26 asks students to estimate the total amount of time they spent on the courses each week. This question provides a measure of the level of difficulty of a course. (Faculty at WPI generally recommends at least 2 hours study outside class for each hour in lecture, so a student should report 12 hours per week for a course that meets 4 hours each week.) Since students indicated in the interviews that FTW is more difficult and time consuming than their other courses.

The distribution of time spent on the course was shifted toward more time for FTW students than all of the three comparison subjects as shown by Figures 3-5. This confirmed what the students had said in their interview. They had said that it was more time consuming and more work than their other courses.

The fact that the amount of homework and time spent on the course of FTW was relatively high compared to the amount of effort and also the low intellectual challenge of the course indicates that though there was a lot of work it was not difficult. This is consistent the low rating of the "educational value of the assigned work" (Question 4). This was also a major complaint in the interviews especially in A-term. Initially we thought that this perception was because their other courses were math and science courses rather than humanities. Commonly humanities take more effort for WPI students because they are much more skilled in math and science. We were wrong in this however; the amount of work in FTW was ranked 15% higher than the average of the humanities courses.

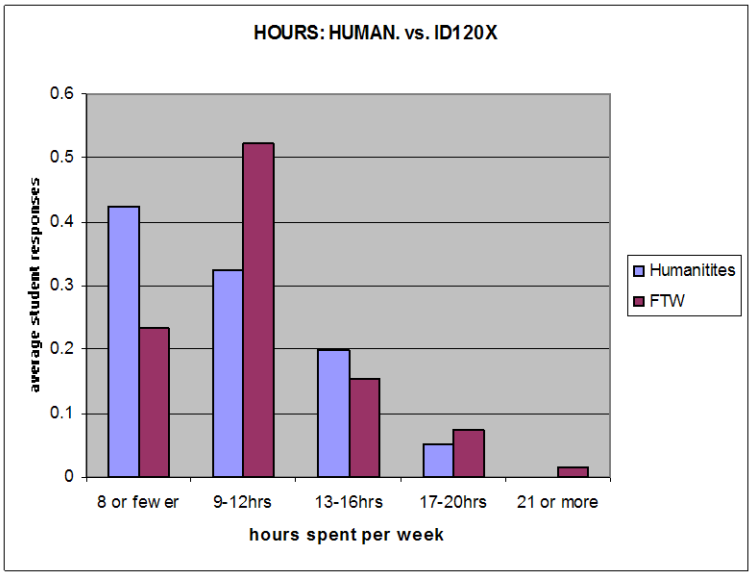

Figure 3: Hours Spent on Course: Humanities vs. FTW

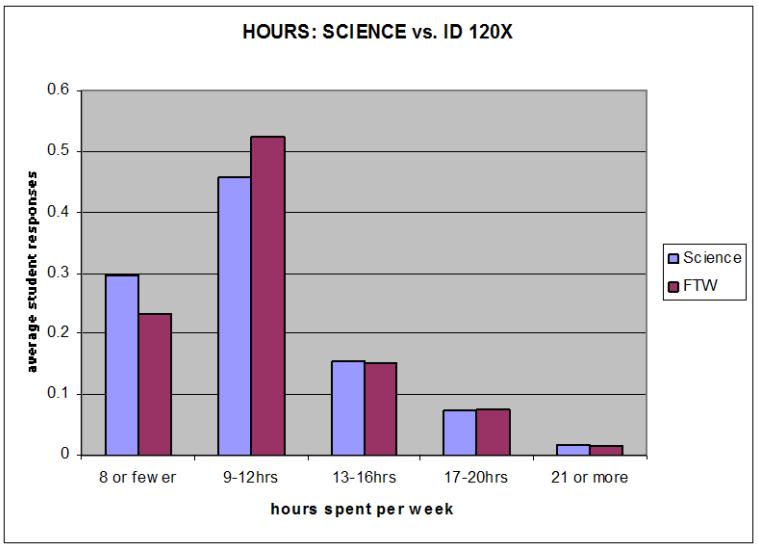

Figure 4: Hours Spent on Course: Science vs. FTW

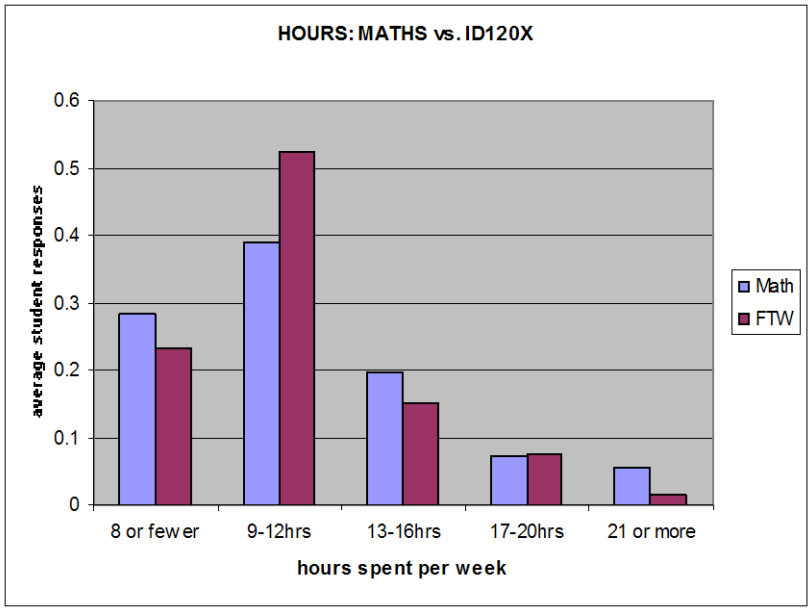

Figure 5: Hours Spent on Course: Math vs. FTW

The average ranking for questions 22 (the exams and/or evaluations were good measures of the material covered) was twelve percent lower in FTW than the overall average. This is expected from a course that has not been taught before; the professors can never judge exactly what is to be expected of the students.

Thus overall FTW was ranked as more work and less valuable that the average first year courses. The amount of work may not be decreased in future years but the course and professor ratings can be expected to improve. The official WPI course evaluation data confirms that the first run of FTW was certainly successful.

Evaluation of Final Projects

We studied the final project posters and reports because they were the culmination of the course. We did not study the promotional material. The course was intended to prepare the students for their MQP/IQP and we can evaluate how well the course succeeded in this goal by evaluating the final projects. Furthermore students were expected to use most of the knowledge they acquired throughout the seminar in these projects. Thus deficiencies in the reports and posters are possibly indicative of deficiencies in the course. Deficiencies may be due simply to the students but given that there was a graded interim report and the large amount of feedback the students were given from the professors and peers, the reports should be rough indicator of deficiencies in the course. Single instances of sub-standard work are obviously no basis for analysis but when multiple reports demonstrate similar inadequacies, trends emerge which are indicative of needed improvements for the course. Because the students are freshmen the projects will certainly be imperfect. We do not categorize understandable imperfections as deficiencies. Deficiencies and inadequacies as we refer to them are defined relative to reasonable expectations for first-year students.

One of the purposes of the seminar was to teach the students how to do group projects. Thus their last and largest project can be used to evaluate how effective the seminar was at this goal. We judged the projects' content and the presentation of the content.

The final project consisted of a 7-10 page report, a poster, and promotional material (pamphlets, videos, etc.) completed in eleven groups of four students each. The students presented their posters (on December 10, 2007) to members of the WPI

community including eighteen judges who helped evaluate the projects and Eric Hahn, (a WPI alum who helped fund the Great Problems Seminars).

Final Project Abstracts

Preventing Fertilizer Runoff

Excess fertilizer and herbicide runoff kills aquatic life in oceans and rivers. The project develops a method to reduce runoff without reducing crop yield. The proposed method to reduce runoff is called "runoff farming". Runoff farming lowers the quantity of fertilizer used and lowers the externally added water to a given field. Essentially runoff farming consists of capturing the runoff in a pond or tank and adding it back into the irrigation system to be reused. The motivation for farmers to adopt this system includes a cap vs. trade system, a financial chapter to make grants to farmers to offset the cost, tax incentives, and low interest loans.

Aspartame: Not a Healthy Alternative to Sugar

Studies have shown that aspartame can be unhealthy and should be avoided. Aspartame has shown a strong correlation with acute facial pain, chronic headaches, cancer, seizures, and hyperactivity in children. The project proposes a plan to warn the public of the potentially harmful side-effects of aspartame through television and radio advertisements. Monitoring the sales of products containing aspartame will be used to evaluate the effectiveness of the advertisements.

Method for Preserving Fishery Yield in Chesapeake Bay

Livestock, primarily chicken, waste runoff is contributing to nitrogen rich "dead zones" in the fisheries of the Delmarva region, the tri-state peninsula surrounding the Chesapeake Bay, which is reducing the fishery yield in the region. The nitrogen in the waste creates algae blooms which lower oxygen levels thus killing native marine life. The proposed solution is to enforce limits on the quantity of animal waste that is allowed to runoff into the water ways from farms. An

informational video and report was produced to inform and motivate the policy change.

Hyperactivity and Tasty Snacks

There is a strong correlation between the amount of food colorings and preservatives consumed by children and their lack of attentiveness and level of hyperactivity. The recent spike in the number of children diagnosed with ADHD in the US is possibly linked to the increased consumption of these food additives. Proposed solutions are to create a website detailing the foods to avoid and informing the general public about this issue.

Keeping Kids Healthy: The Harmful Effects of Food Additives

Food additives such as tartrazine, benzoates, and aspartame are unhealthy and may be responsible for health problems especially in children. More research is needed to fully understand these chemicals' interaction with the human body, to which end grants etc. should be awarded. The FDA should create stricter controls of these chemicals and the public should be informed of their danger through billboards, websites and magazine articles targeting children and teens specifically.

Food Security in the Inner City

Low income residents of American inner city areas have difficulty obtaining healthy, affordable food. The increased costs associated with the inner city food sales make food, especially fresh whole foods, more expensive. For the poor the desperation leads to the abandonment of both nutrition in favor of a full stomach. Where food aid continues to pour resources into temporary relief, a more permanent solution is to move food retail outlets into the city while expanding the use of urban agriculture promotes food self-sufficiency and availability. The success of this solution depends on its regular monitoring and promotion.

Fish Stock Depletion: Mainland Tanzania

The current rate of fish depletion in Tanzania will lead to malnutrition of the poor who depend on fishing as their only source of protein. Solutions to this problem are aquaculture, increased production of land crops, water flow monitoring. These will be accomplished by means of stocking fish and regulating the methods of harvesting of fish in order to create sustainable economic growth.

Heifer International in Namibia

In Namibia hunger is a major problem. It is due to poverty, HIV/AIDS, and irresponsible agricultural practices. The proposed solution is to raise $10,000 for Heifer International (a non-profit organization which gives animals to rural communities and teaches them responsible agriculture) to launch a new project site in Namibia, with the potential of WPI's Namibia project site to collaborate with Heifer.

Saving Thanksgiving: Analyzing Current Trends in Turkey Biodiversity Loss

In North America there are a number of species of turkeys which are near extinction, there are few of them being raised in captivity for food production. Ninety percent of the turkeys produced in the US are of one variety. This lack of biodiversity makes the species vulnerable to diseases. The problem needs to be remedied by shifting consumer tastes to more naturally raised heritage turkeys.

Preventing Elderly Malnutrition in Worcester: Expanding the Meals on Wheels Program

Elderly Malnutrition increases the cost of Social Security, reduces the physical and cognitive functionality/utility of the elderly, increases the need for health care, increases mortality, and leads to premature institutionalization. Proposed solution of elderly malnutrition is to expand the Meals on Wheels program to assist individuals in the 50 to 60 years of age range. This expansion will be accomplished by a proposed new non-governmental and non-profit division of Meals on Wheels, which will be funded completely by donations.

Obesity: A GROWING Concern

Obesity in the US is a problem and is inadequately addressed. In order to address this problem the public needs to be better informed about the food they are consuming. Recommendations include nutrition labels with the calories and serving size put in bold. Additionally foods deemed unhealthy should have labels warning consumers that the food can cause health problems if consumed in excess. Television advertisements, pamphlets, a website, and health awareness events can be used to inform/educate the public about healthy eating. Surveys can be used to evaluate the effectiveness of the methods.

Posters

Most of the final project posters for the presentation were excellent. The posters were intended to draw in the observers, which would allow the group members to explain the details of their project and answer any questions brought up specifically by the poster. The posters were not intended to stand alone as a complete synopsis of the groups' projects, but rather as a starting point for discussion. Though intended to raise questions and interest onlookers, some did not succeed at this. For example the poster on inner city food security contained a large quantity of small text, plain and unadorned flow charts, and only one small pie chart with virtually no other images. This poster is very informative, but seeing it at a distance does not raise any interest or desire for closer inspection by the observer, unless of course the observer is a mathematician. This poster was an exception to the norm. It was clearly the result of a misunderstanding of the instructions by the students and is obviously not an indication of any inadequacies of the course. This was by no means the worst poster, the obesity project was very poor and yet it too is an exception. Overall most of the posters are quite well done.

Oral Presentations

The quality of the oral presentations was difficult to judge because we had little for comparison. The students are in their first year so they have not had any real experience presenting at a college level, therefore all we have to compare their performance against is our junior and senior skill level. Evaluating the presentations

based simply on our impressions is still a valid means. Our overall assessment of the oral presentations was that the Feed the World students performed quite well.

The students were nervous and excited; each group was friendly and eager to welcome us. We noticed that although the students were nominally there to enlighten any observer who approached their group, they were primarily concerned about the judges (who would be determining a portion of their grade for the oral presentation). We observed the students' interaction with the judges and individuals at the event without interfering as well as played the role of observer and asked the groups about their project. After we had exhausted the groups project subject we interviewed some students about the seminar. We noticed that generally the students' behavior when addressing one of the judges or a non-student was more revealing as compared to how they tended to treat us, which was with more familiarity. We are their peers and they were much more concerned with what the judges and other professors thought of them than what we did. Thus we are less concerned about how they performed for us because it would be unfair to the students. Hence for the purposes of evaluating the quality of the oral presentations we rely on our observations of the students' interaction with judges and other professors.

As just stated we are peers of the students, so they were less formal and much more familiar with us. We encouraged this familiarity because we sought to receive candid opinions when we interviewed them. We did notice however that when speaking with the students, they seemed to be distracted. In one instance we were interviewing a student and he did not make eye contact with us at all, instead his eyes wandered around the room. This may have been because of nerves or simply curiosity of what was happening elsewhere.

As stated before the posters were intended to draw in observers and raise questions, which the students would then answer. Some groups were over reliant on their poster. We agree that students should point out graphs or charts on their poster which illustrate what they are saying, but some students would turn to the poster and point out text or bulleted items rather than verbalizing them. Using the poster as a security in this manner clearly indicated that some of the students were not as confident as others. However, most of the presenters spoke with a confidence and professional demeanor.

Most of the group members spoke clear and understandably. The groups seemed to be well organized, each member knew who would speak about what, and this allowed everyone to participate. Like most situations some students seemed to dominate a particular subject or question, but most allowed everyone one in the group to have a turn speaking and only added to what the other said.

As far as whether or not the students' explanations on their results and conclusions were thorough and clear, we first had to look at their position on the project topic. It seemed that some of the groups had more reasonable expectations and results, whereas the other groups seemed to just glaze over it. This may have been a result of the topics they chose. So because of this, some of the groups' explanations only went as deep as the posters. This was not always the case however, when asked further questions about the project most students were able to respond intelligently or at least steer the question in such a way that allowed the observer to make their own conclusions. If the observer asked a question, which the students clearly had not anticipated, the students' answers though unrehearsed were still reasonably respectable for the most part.

Overall, the oral presentations of the students' final project were well done especially for freshmen. Nearly all of the students were confident, spoke clearly and audibly, knew their topic well, were well organized, and improvised well when necessary. In short they were professional. The experience will almost certainly be very helpful in their future project presentations at WPI.

Final Project Written Report

The content of the final reports and the thought processes evinced in them were unimpressive at times. All of the projects have flaws. Nearly all of the proposed solutions to the students' nutrition related problems were idealistic, impractically expensive, and probably ineffective. The fact that this work was done by freshman, inexperienced in open-ended problem solving, makes this lack of impressiveness understandable and, in many cases, excusable.

Many of the students in their final projects inadequately consider and discuss basic economic aspects of their problem. For example in the Turkey biodiversity report, the group neglects to consider the most basic economic elements of the problem. They did not provide the cost or size of Heritage turkeys as compared to White American turkeys and discuss whether or not it would be an obstacle in increasing the free range turkeys' share of the market.

The students who wrote the report on dead zones in the Delmarva region stated that chicken waste (the separated "solid waste") could be used to produce fertilizer for farms in the west. They state, "it would make it so that the chicken farmers would not have to pay much extra for disposal." The students do not provide any more details,

sources, or calculations to support this statement and they do not state how the byproducts of the separation process are to be disposed of. If the students were unable to find information about the cost of disposal, they should have at least done a rough estimation on how much it would cost to transport it to "the West." They also mention that a company has found a way to use chicken waste to make electricity, though at the moment it is four times more expensive than conventionally produced electricity. Thus the students dismiss it as a solution for now.

In the report on establishing Heifer International in Namibia the students mention that there is a large quantity of beef produced in Namibia, but it is primarily exported. They state that most jobs are in the agricultural sector, but it is defined by low wages. Instead of solving the problem by giving livestock (primarily cows) to poor Namibians, perhaps the workers should receive higher wages; a possibility the students did not discuss. In short, in order for the students to fully appreciate their problems and proposed solutions there needs to more time and emphasis put on economics in the Feed the World seminar.

In the reports and posters on the topic of food additives is the fallacy that correlation is causation. Causation always means that there is correlation but correlation does not always indicate causation. Based on survey studies a correlation of two factors can be established, for example ADHD and food additives (coloring and preservatives). The more a child consumes these additives the more likely the child is to be ADHD. This does not establish causation. The onset of ADHD cannot be said to be definitively caused by the consumption of food additives. Another example of this correlation and causation confusion is the group who did their report on runoff farming. They have sources that say

the average corn yield from 1994 to 2001 in Iowa and Illinois was 1.7 and 1.5 billion bushels using 740 and 847 thousand tons of nitrogen respectively. This is their justification for stating that "Ironically, these same factors [large amounts of fertilizers, pesticides, and nitrates] are what are reducing the quantity of produce." The students clearly did not think this statement through. Correlation can establish something as a possibility and even probability, as perhaps with the food additives, but determination of causation can only be done with controlled experiments. Correlation studies are still very useful, obviously but the fact that the students used them as if they unequivocally established causation is a major flaw in their thinking if only a relatively minor flaw in failing to mention the inherent uncertainty in their reports.

Overall, we were not impressed with the students reasoning ability. The students should be thinking about and analyzing these problems scientifically (not just in their proposed solution to a given problem but in problem identification and definition also), and this is not overwhelmingly evident in their writing as evidenced by some of the above examples. Although they are first year students at WPI, they should be expected to at least approximate scientific and systematic thought. Scientific, logical, and systematic thought processes should be emphasized in the analysis a problem in the Feed the World seminar.

A minor shortcoming of the assignment was the fact that the students were not required to write abstracts. By writing an abstract of no more than a half page the students would be able to clarify the essence of their project and would probably be better able to present their ideas. Another minor correction that should be made to the

assignment is the reports length. The 7-10 pages do not provide enough length for the full explanation of the project. Fifteen pages would be adequate for four person groups.

Our impression of the quality of the research was that the students found plenty of sources, but lack the scientific cynicism to evaluate the validity of the claims and the sources. A perusal of the bibliographies reveals that some of the students did reasonably well, though most did poorly. We are unaware of the extent to which good research practices were emphasized, but the students need to be aware that primarily scholarly journals should be used. Google is acceptable for finding data, statistics, definitions, etc. but generally not acceptable for finding principal sources. The Gordon library has staff who teach an hour long seminar on how to research WPI's extensive on and offline collection, which was used by the seminar. Above all, the students need to use scholarly journals and books, and this should to be emphasized more.

Final Project Conclusions and Recommendations

The professors put a great deal of emphasis on the poster and oral presentation of the students' final project (more emphasis than was put on the report) because they argued that in implementing a solution to a real problem, persuading others that the solution will work is equally as important as finding a good solution. This philosophy manifested itself in the excellence of the posters and presentation while, or perhaps, at the expense of the reports. That is to say that the students persuaded others of the efficacy of their solutions well, but their solutions seemed superficial and would probably be ineffective. Though the professors say that persuading others that ones' approach is valid is *just* as important as finding a good solution, the impression we receive from the final

projects themselves is that the students received a different message. The presentation of the projects is excellent while the proposed solutions are not. Hopefully the students do not assume that the key to a great project is presentation and the content is less important.

The relative excellence of the posters in comparison to the mediocrity of the reports makes us believe that there should be more time devoted to the report. The posters and oral presentations were emphasized more than the report. This was presumably done to try to enable the students make a good impression on members of the WPI community and Eric Hahn at the poster session in order to ensure the continued existence of the seminar. This was fine for the first year the seminar was in existence, but it should be modified. Oral presentations for the MQP and IQP are much less important than the written report, thus the final project of FTW should mimic this.

There should be more emphasis on making the students think scientifically. Perhaps this can be accomplished by having the interim report drafts' intellectual content, the analysis and conclusions critiqued and challenged when their logic is faulty or incomplete. Much greater emphasis on the importance of economic factors is needed for this project specifically and the course in general. Proper research practice, in particular the near exclusive use of scholarly (that is to say, peer reviewed) sources, is crucial; and the students need to know this.

Revised Assignments

We chose to revise assignments to improve the students' experience in the seminar. Some of the early assignments were problematic, and there were many complaints about them in the student interviews. Many were described as "busy work" and repetitious. We determined to modify the existing assignments in order to make them less exasperating for the students without diminishing and/or compromising the educational value of the assignments. The changes we made are not necessarily improvements to the assignment in so much as the amount learned is concerned. Many of the changes may slightly reduce what the student gains from the assignment but it makes them more feasible and realistic for the students to accomplish them. Most of the changes are simply meant to reduce busy work and unnecessary repetition.

We selected assignments to revise based on the student and professor interviews. The professors conducted a survey of the students at the end of A-term in which the students ranked each assignment and project on a 0-10 scale in two categories: first, how worthwhile the assignment/project was and second how interesting the assignment/project was. The data from this survey was also useful in the selection of assignment for revision and how each one should be modified.

Nutrition Assignment

We chose the Nutrition Assignment as one for modification because it could be improved significantly with a minimal reduction in the lessons learned from the assignment. In the interviews with the students they complained about the repetitiousness

of the assignment. Most said that it was useful, interesting, and they did learn from it but it was unnecessarily repetitious and tedious. The students complained specifically about the number of times they had to do the same type of calculation. The full text of the original assignment is shown below:

ID120x Feed the World
Nutrition Assignments:

PART 1. Nutritional analysis.
50 points. Due 8/29

You are going to analyze the nutritional value of your favorite meal, as described in your paper. For that meal, list its components and determine amounts of each food that you ate. Using either Appendix A from back of your textbook or the USDA web site (http://www.mypyramid.gov/), calculate the following:

Total Calories	Vitamine A
Carbohydrate (g)	Vitamin B6
Fat (g)	Vitamin B12
Protein (g)	Vitamin C
	Vitamin E
	Folate
	Niacin
	Riboflavin
	Thiamin
	Iron

Now go to the library and select a recipe from the *Hungry Planet* book on reserve. Do the same analysis for this dish. Since these recipes are for the family, you will need to divide the total amount of food by the number of members in the family.
THINK about it: What assumption are we making here? Why make that assumption? Is it realistic?

1. List the components of your favorite meal and separately list the components of the recipe from *Hungry Planet* (HP).

2. Prepare a data table that compares the level of the various nutrient totals in the list above for your favorite meal and for the recipe from the book. (5 pts)

3. Prepare another table that uses the same data, but lists the totals for consuming nothing but that meal (both yours and separately, the meal from the book) for an entire day. Assume 3 meals/day, all equivalently sized.
THINK about it: Is this a reasonable assumption? Why or why not?

To help determine if this is a healthy diet, we need to know the recommended daily amounts of these items. Calorie requirements vary by age and activity level. To find yours go to http://www.mypyramid.gov/mypyramid/index.aspx and use that as a recommended amount. The RDI for the items in the second column above vary far less and can be found on the inside cover or in the table on pg 63 of *Discovering Nutrition*. Include this information as a separate column in

your table. Finally calculate the % RDA/AI for these items for each diet. Bold those items in which the calculated value exceeds the RDA/AI by 50%, and italicize those that are less than 50% of the RDA/AI.
This table then should have 6 columns: the nutrients list; the RDA/AI; the totals from your favorite meal x3; the %RDA/AI for that diet; the totals for the HP recipe x3; the % RDA/AI for that diet. Items from either diet that vary significantly from RDA/AI should be bolded (exceeded) or italicized (not met) in the appropriate column.
THINK about it: Can you determine from this information the likelihood of weight gain or loss? Why or why not?

Be prepared to answer the *THINK about it* questions in class.

Rubric:
1. Lists of major meal components (5 pts): We should know the major items involved. For instance: *Spaghetti, red sauce, meatballs, green beans, garlic bread, milk*. Or *noodle casserole with chicken pieces*.

2. Table 1 (15 pts): Meal data.
   Layout (5 pts): 3 columns, appearance, labels
   Content (10 pts): required nutrients listed, all data present.

3. Table 2 (30 pts): Whole day data.
   Layout (5 pts): 6 columns, appearance, labels
   Content (25 pts): required nutrients listed, all data present, RDA/AI values included, % RDA/AI present and calculated appropriately, bold and italics as appropriate.

NUTRITION ASSIGNMENT PART 2. Benefits of Variety.
75 points. Due 9/4 and 9/5

Using your log of the week's worth of food, calculate your weekly total and average/day for each of the nutrients listed above. (See Food Log Assignment)

Go back to the *Hungry Planet* (HP). Using the same family as you did for part I, look at the week's worth of food, and calculate the nutritional intake (following the same list of nutrients) for one member of the family for that week, both a weekly total and a daily average. Also calculate the % RDA for the daily average. (**Send the daily average and the % RDA for the HP diet- to Prof. Wobbe by noon 9/4**. She will compile these and present a table with them all for discussion.)

THINK about it: How will you do the calculation for the individual? In order to get the most accurate numbers, what, if any, foods from the list might you eliminate or not divide equally among all family members? Why?

Prepare a table that includes the average daily values for you for your week of food, the average daily values for the *Hungry Planet* individual, and the daily values from the last assignment. Again include the RDA/AI values and % RDA/AI values. (See below for one possible table layout.) Bold and italicize as before. Be sure to indicate which diet you are using from the *Hungry Planet*.

		My week		Weitaiwu China week		My favorite meal (day)		Weitaiwu Meal (day)	
Nutrients	RDA/AI	Daily avg.	% RDA/AI	Daily avg.	% RDA/AI	Amt.	% RDA/AI	Amt.	% RDA/AI
Calories									
etc									

Write a short (1 pg or less) evaluation of these data. Make sure it answers the following questions, but do it in a narrative format (not a series of questions and answers). Which column corresponds to the most well balanced diet with respect to the micronutrients? Is it healthy to eat the same items in every meal of every day? Why or why not? Are there deficiencies in any of the diets above? Who has the better diet, you or your international counterpart?

Rubric:

1. The daily average for your HP family diet should be emailed (in an excel spreadsheet) to Prof. Wobbe by noon on Tuesday, Sept. 4. (5 pts). On time, and complete.

2. Food log (10 pts): 7 days worth, approx. amounts of all items
3. Table (45 pts):
   - Layout (5 pts): 6 columns, appearance, labels
   - Content (40 pts): required nutrients listed, RDA/AI values included, all data present, % RDA/AI present and calculated appropriately, bold and italics as appropriate.
4. 1 pg evaluation of the data (15 pts).
   - Mechanics (3 pts): Grammer, spelling, subject/verb agreement, etc
   - Content (8 pts): Are questions above answered?
   - Clarity (4 pts): Can we follow your narrative? Does it flow logically?

Part 3. Micronutrient health.
Due 9/10. 50 points

Imagine that each of the 4 different nutritional intakes from the last table you created (the table from #3 in the last assignment) were extended for a longer period of time (months). For most of you, there will be some micronutrients that are significantly over or under represented in one or more of the diets. Use the information in Chapters 9 and 10 of *Discovering Nutrition* to determine what, if any, symptoms might be experienced due to the excess or deficiency of these micronutrient levels in the diet.

For each of the 10 micronutrients in the list, note the amount of it in each of the 4 daily averages you calculated in the last assignment, and then note what, if any, symptoms that might be seen due to hyper or hypo accumulation of that particular nutrient. For an example, see below.

Vitamin C – RDA/AI: 75 mg.
My daily average: 100 mg. Favorite meal (day): 19 mg.
HP daily average: 300 mg. HP recipe (day): 0 mg.
While both averages from the week's worth of food are in excess of the RDA, the amounts are not sufficient to lead to vitamin C toxicity, and thus these levels are harmless. More problematic are the vitamin C amounts calculated from eating the single meals for a full day. These are both significantly below the RDA for vitamin C and over time will lead to ….

Rubric:
Each nutrient: 5 pts. One point for considering the effect of each diet on this particular nutrient. The remaining point is for clarity and mechanics.

The assignment is divided into three parts. The first part asks the students to analyze the nutritional value of their favorite meal (from a prior writing assignment) and a meal from the *Hungry Planet* (HP) and compare their nutritional values. The second part of the assignment has the students perform the same calculations for one week's worth of food, both daily and total for themselves and for a *Hungry Planet* family. The individual dietary intake data for the students was taken from their "food log," a prior assignment. Part three of the assignment has the students list the possible symptoms for an excess or deficiency of each of the micronutrients listed in the first part.

The first and second parts of the assignment have identical calculations which are performed twice in part one and twice in part two: once for their own diet and once for the HP diet for average daily then in the second part once for the weekly total of the two diets. For each of these calculations the student has to determine the intake of fourteen nutrients and the percentage of the recommended daily intake to the actual intake. Based on the complaints we heard in the interviews the students resented this repetition. The results of the comparisons were intended to teach the students a lesson about healthy eating but performing the calculations more than twice is overkill: they are unlikely to acquire significant additional knowledge, understanding, or benefit of any kind from repeating the calculations more than twice. They will learn a small amount, but it is not worth the effort involved.

In order to reduce the duration of the assignment without compromising the effectiveness of the intended lesson we devised the following modifications. For the first and second parts of the assignment we eliminated the calculations for a meal from

Hungry Planet. The whole point of this part of the assignment was to compare the nutritional values of each meal, the student's favorite meal versus the HP meal. This will give the students perspective on the culture and eating habits of other nations. Thus we could not just eliminate the HP meal all together from the assignment; we simply eliminated the need to perform the calculations. In our suggested revision of this assignment data on the various HP meals will be provided for the students in an electronic copy, specifically in MS Excel spreadsheet format, available for download from the seminar's MyWPI site. The files could be adapted from the work of the students from the 2007-2008 academic year. In this way the number of calculations for the assignment is halved.

Furthermore because the students will have an existing table with the required format there will be less confusion about the proper table format. Teaching the students to use MS Excel is also an important aspect of this assignment. It is surprising how many upperclassmen do not know how to use Excel; it is an essential skill for anyone in science or engineering. Therefore we are pleased that the professors integrated the need for the students to familiarize themselves with the program in this and other assignments.

Alternate methods of reducing the workload for this assignment would be to have the students work in pairs. One student would perform the calculations for their own diet while the other would perform the calculations for a HP diet of their choice. Then together they could compare and contrast the two diets. This alternative is not adopted by us in our recommendations because of the likely hood that only one student would do the actual comparisons. In addition the students who performed the HP calculations would not be given the insight into how healthy or unhealthy their own personal diet really is.

This is an interesting and important aspect of the assignment and should not be eliminated for half of the students.

We do not recommend modification of the third part of the assignment. It appears somewhat tedious, but the workload could not be reduced without removing some of the micronutrients and thus reducing the amount the students will learn. However if the alternative method of the assignment is used then the students could also work in pairs for this part and would only have to do five micronutrients each. However this would reduce the effectiveness of the lesson and for this reason we again do not recommend this alternative method of revising the assignment for the third part of the assignment.

The revised text of the nutrition assignment is shown below.

ID120x Feed the World
[Revised] Nutrition Assignments:

PART 1. Nutritional analysis.
50 points. Due 8/29

You are going to analyze the nutritional value of your favorite meal, as described in your paper. For that meal, list its components and determine amounts of each food that you ate. Using either Appendix A from back of your textbook or the USDA web site (http://www.mypyramid.gov/), calculate the following:

Total Calories	Vitamine A
Carbohydrate (g)	Vitamin B6
Fat (g)	Vitamin B12
Protein (g)	Vitamin C
	Vitamin E
	Folate
	Niacin
	Riboflavin
	Thiamin
	Iron

Now go to the library and, from the *Hungry Planet* book on reserve select a recipe from the available list for which data has already been compiled. The list of components and amounts of each will be provided.
THINK about it: What assumption are we making here? Why make that assumption? Is it realistic?

1. List the components of your favorite meal and separately include the provided list the components of the recipe from *Hungry Planet* (HP).

2. Prepare a data table that compares the level of the various nutrient totals in the list above for your favorite meal and the *Hungry Planet meal.* A table of the various nutrient totals for the *Hungry Planet* will be provided. (5 pts)

3. Prepare another table that uses the same data, but lists the totals for consuming nothing but that meal (both yours and separately, the meal from the book) for an entire day. Assume 3 meals/day, all equivalently sized.
THINK about it: Is this a reasonable assumption? Why or why not?

To help determine if this is a healthy diet, we need to know the recommended daily amounts of these items. Calorie requirements vary by age and activity level. To find yours go to http://www.mypyramid.gov/mypyramid/index.aspx and use that as a recommended amount. The RDI for the items in the second column above vary far less and can be found on the inside cover or in the table on pg 63 of *Discovering Nutrition*. Include this information as a separate column in your table. Finally calculate the % RDA/AI for these items your diet, the HP diet data is provided. Bold those items in which the calculated value exceeds the RDA/AI by 50%, and italicize those that are less than 50% of the RDA/AI.
This table then should have 6 columns: the nutrients list; the RDA/AI; the totals from your favorite meal x3; the %RDA/AI for that diet; the totals for the HP recipe x3; the % RDA/AI for that diet. Items from either diet that vary significantly from RDA/AI should be bolded (exceeded) or italicized (not met) in the appropriate column.
THINK about it: Can you determine from this information the likelihood of weight gain or loss? Why or why not?

Be prepared to answer the *THINK about it* questions in class.

Rubric:
1. Lists of major meal components (5 pts): We should know the major items involved. For instance: *Spaghetti, red sauce, meatballs, green beans, garlic bread, milk*. Or *noodle casserole with chicken pieces*.

2. Table 1 (15 pts): Meal data.
   Layout (5 pts): 3 columns, appearance, labels
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3. Table 2 (30 pts): Whole day data.
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   Content (25 pts): required nutrients listed, all data present, RDA/AI values included, % RDA/AI present and calculated appropriately, bold and italics as appropriate.

NUTRITION ASSIGNMENT PART 2. Benefits of Variety.
75 points. Due 9/4 and 9/5

Using your log of the week's worth of food, calculate your weekly total and average/day for each of the nutrients listed above. (See Food Log Assignment)

A table of the family which you selected in part 1 will also be provided by the Professor.

THINK about it: How will you do the calculation for the individual? In order to get the most accurate numbers, what, if any, foods from the list might you eliminate or not divide equally among all family members? Why?

Prepare a table that includes the average daily values for you for your week of food, the average daily values for the *Hungry Planet* individual, and the daily values from the last assignment. Again include the RDA/AI values and % RDA/AI values. (See below for one possible table layout.) Bold and italicize as before. Be sure to indicate which diet you are using from the *Hungry Planet*.

		My week		Weitaiwu China week		My favorite meal (day)		Weitaiwu Meal (day)	
Nutrients	RDA/AI	Daily avg.	% RDA/AI	Daily avg.	% RDA/AI	Amt.	% RDA/AI	Amt.	% RDA/AI
Calories									
etc									

Write a short (1 pg or less) evaluation of these data. Make sure it answers the following questions, but do it in a narrative format (not a series of questions and answers). Which column corresponds to the most well balanced diet with respect to the micronutrients? Is it healthy to eat the same items in every meal of every day? Why or why not? Are there deficiencies in any of the diets above? Who has the better diet, you or your international counterpart?

Rubric:

1. The daily average for your HP family diet should be emailed (in an excel spreadsheet) to Prof. Wobbe by noon on Tuesday, Sept. 4. (5 pts). On time, and complete.
2. Food log (10 pts): 7 days worth, approx. amounts of all items
3. Table (45 pts):
   - Layout (5 pts): 6 columns, appearance, labels
   - Content (40 pts): required nutrients listed, RDA/AI values included, all data present, % RDA/AI present and calculated appropriately, bold and italics as appropriate.
4. 1 pg evaluation of the data (15 pts).
   - Mechanics (3 pts): Grammer, spelling, subject/verb agreement, etc
   - Content (8 pts): Are questions above answered?
   - Clarity (4 pts): Can we follow your narrative? Does it flow logically?

Part 3. Micronutrient health.
Due 9/10. 50 points

Imagine that each of the 4 different nutritional intakes from the last table you created (the table from #3 in the last assignment) were extended for a longer period of time (months). For most of you, there will be some micronutrients that are significantly over or under represented in one or more of the diets. Use the information in Chapters 9 and 10 of *Discovering Nutrition* to determine what, if any, symptoms might be experienced due to the excess or deficiency of these micronutrient levels in the diet.

For each of the 10 micronutrients in the list, note the amount of it in each of the 4 daily averages you calculated in the last assignment, and then note what, if any, symptoms that might be seen due to hyper or hypo accumulation of that particular nutrient. For an example, see below.

Vitamin C – RDA/AI: 75 mg.
My daily average: 100 mg. Favorite meal (day): 19 mg.
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While both averages from the week's worth of food are in excess of the RDA, the amounts are not sufficient to lead to vitamin C toxicity, and thus these levels are harmless. More problematic are the vitamin C amounts calculated from eating the single meals for a full day. These are both significantly below the RDA for vitamin C and over time will lead to ….

Rubric:
Each nutrient: 5 pts. One point for considering the effect of each diet on this particular nutrient. The remaining point is for clarity and mechanics.

Economy and World Food Issues Assignment

The next project we updated and improved was the economy and elasticity assignment. This homework assignment was distributed to the students early in A-term. By this time they had completed the materials on nutrition and moved towards economics, more specifically supply/demand and price elasticity of demand.

The assignment was developed to show students how the economic concepts they learned in class apply to various nations. They asked students to select 50 countries from the USDA list (with a random number generator) and label them on a world map. Once this was completed the students were to select 20 countries (with a number generator) and rank them in terms of their overall elasticity of demand for food and then explain their observations. The students were then asked to show the food group preferences in terms of relative necessity and relative luxury. The next step in this assignment was to determine how the phrase "They eat high on the hog" is related to elasticity and the economic concepts they had learned. Lastly the students were asked to choose 6 countries from the USDA list, 2 high developed, 2 low developed and 2 developing in terms of total expenditures of food and put them in a chart showing percent expenditure spend on

food vs. price elasticity. Below is the original homework assignment as well as the grading rubric.

Original Economy and Elasticity Assignment

In this assignment we ask you to look closely at some economic concepts that help us understand world food issues. In addition, there is a little geography. The key resource is the United States Department of Agriculture (USDA) web-site:
http://www.ers.usda.gov/Data/InternationalFoodDemand/

Use a random number generator to select 50 countries from the USDA list and locate and label these countries on a world map.
a) Use a random number generator to select 20 countries from the USDA list. Order them in terms of their overall food elasticity. What do you notice? b) Use elasticities to show food group preferences in terms of relative necessity and relative luxury. What does all this have to do with the phrase, "They eat high on the hog"? c) Non-randomly select 6 countries from the USDA chart--2 high-developed, 2 low-developed, and 2 developing-- in terms of their total expenditures on food. (e.g., US, France, Poland, Turkey, Chad and Ecuador). Create a chart that shows the income and price elasticities of the 6 countries. Remember that a chart is labeled. What do you notice?

Rubric for Economics and World Food Issues. 50 points.
5 pts
a) 15 pts, b)15 pts, c)15 pts

1		**50 Countries correct locations & labels**	**< 50 Countries or < 3 incorrect locations & labels**	**< 50 Countries or < 10 incorrect locations & labels**	**< 50 Countries or <15 incorrect locations & labels**
2	a	**20 Countries ordered by food elasticity 2 significant comments**	**> 18 Countries or 1 or 2 errors of order 2 significant comments**	**> 10 Countries or with 3-5 errors of order 1 significant comment**	**< 10 Countires or > 5 errors weak comment**
	b	**r necessity/luxury chart clearly/economically labeled high-on-hog insightful**	**chart clear but extraneous high - on - hog ok**	**chart inaccurate, not carefully planned high - on - hog poor**	**chart inaccurate, not carefully planned high - on -hog misses point**
	c	**6 countries high, mid, low income/price elasticities 2 significant comments**	**6 countries high, mid, low table some mislabels 1-2 significant comments**	**6 countries high, mid, low chart poorly labeled 1 comment**	**< 6 countries high, mid, low, not clear mislabeled trivial comment**

With the matrix, the students scored the economy assignment a 213 out of 360 for interesting and a 214 out of 360 for how worthwhile the assignment was. The first score, 213, is fairly low compared to the average total interesting score of 235. The total average worthwhile score is 210, so the 214 that the economy assignment received is a little above average. This basically means that the students found this assignment more valuable than appealing and exciting. Based on these scores and comparisons we knew that something should be modified. In order to determine what should be modified we turned to the student and professor interviews. Much like the first assignments, the students expressed that the economy assignment seemed repetitive and boring. Traver agreed in his interview that this particular assignment might have been a bit too long and repetitive, especially when it asked the students to locate and label 50 countries. He felt that the students would understand the direction of the assignment after labeling 25 countries. Based on this information, we only had to make a few changes to the assignment. Whether or not the students will find the assignment more interesting is up to them.

We first modified the layout and organization of the assignment in order to clarify the directions. The original assignment had too many questions bunched together in one line. Without clear objectives, the students may have glanced over the important questions that needed consideration. We decided to eliminate the need for the students to randomly generate, locate and then label 50 countries on a world map. We felt that this task alone did not really add any benefit to the project. We decided to modify the second part by asking the students to randomly generate 25 countries, instead of the 20, and label them on a world map as well as comparing the foods' price elasticity of demand asked in

part B. We agreed with Traver and believe that labeling and studying 25 countries is adequate for the purposes of this assignment. Lastly, we organized and made the appropriate changes to the rubric and grading chart. We changed the number of countries and tried to make the layout of the chart easier to understand. Below is the revised version of the project.

Revised Economy Assignment

Economics and World Food Issues

In this assignment we ask you to look closely at some economic concepts that help us understand world food issues. In addition, there is a little geography. The key resource is the United States Department of Agriculture (USDA) web-site:
http://www.ers.usda.gov/Data/InternationalFoodDemand/

1a. Use a random number generator to select 25 countries from the USDA list, then locate and label them on a world map. (If there are any questions concerning the number generator, please ask)
b. Order them in terms of their overall food elasticity. What do you notice? Use elasticities to show food group preferences in terms of relative necessity and relative luxury.
c. What does all of this have to do with the phrase, "They eat high on the hog?"

2. Non-randomly select 6 countries from the USDA chart--2 high developed, 2 low developed, 2 developing-- in terms of their total expenditures on food. (e.g., US, France, Poland, Turkey, Chad and Ecuador). Create a chart that shows the income and price elasticity of the 6 countries. Remember that a chart is labeled. What do you notice?

Rubric for Economics and World Food Issues. (50 points)

1. a) 15 pts
   b) 15 pts
   c) 5 pts

2. 15 pts

1a	**25 countries correct locations and labels**	**< 25 countries or < 3 incorrect locations and labels**	**<25 countries or <10 incorrect locations and labels**	**<25 countries or <15 incorrect locations and labels**
b	**25 countries ordered by food elasticity with 2 significant comments. r. necessity/luxury clear**	**> 23 countries or 1 or 2 errors of order with 2 significant comments. r. necessity/luxury somewhat clear**	**> 13 countries or with 3-5 errors of order with 1 significant comments. r. necessity/luxury not really clear**	**< 13 countries or > 5 errors with weak comment. r. necessity/luxury misses point**
c	**High-on-hog insightful**	**High-on-hog OK**	**High-on-hog poor**	**High-on-hog misses point**
2	**6 countries high, mid, low income/price elasticities 2 significant comments**	**6 countries high, mid, low table some mislabels 1-2 significant comments**	**6 countries high, mid, low chart poorly labeled 1 comment**	**< 6 countries high, mid, low, not clear mislabeled trivial comment**

Overall the economy assignment correlates to what they were learning in class and provides a means to understand the relative prosperity vs. the price elasticity of demand by studying other countries around the world. We felt that only making minor changes to the assignment will benefit both student and teacher. The students should find the revised assignment less repetitive and less busy work although it may not be any more interesting.

Food Waste at WPI

In this assignment students recorded the amount of food wasted at WPI's dining hall by working in shifts. They were to recommend methods of reducing this waste and prepare a letter communicating their findings and recommendations to a public audience or official (e.g. The Towers, Chartwells Management, WPI Admin, or Student Government). The changes we chose to make to the assignment were minor and essentially cosmetic. The original assignment is shown below.

Food Waste at WPI

The purpose of this assignment is for you to study food waste in the Morgan dining area of WPI and to suggest ways that it may be reduced. You are also required to communicate your findings and suggestions to a public audience or official (e.g. The Towers, Chartwells Management, WPI Admin, Student Government).

1. The study requires that you determine
    a) the amount of food that goes uneaten in the Morgan dining are of WPI
    b) some of its characteristics and conditions (e.g. solid and liquid; morning, noon, or night).

You will work in teams of two. Sign up for a 1 hour time slot between 7 am and 8 pm Thursday or Friday (Oct 25 or 26). Show up in grubby clothes. You will be shown how to dispose of the food in appropriate containers. Be on time and courteous.

To be turned in: A record of the total mass of solid waste and the total mass of liquid waste, a bulleted list of 3-10 observations of what you noticed.(Due 10/31. 25 pts.)

2. Once the class data are aggregated, you need to recommend ways that the food waste might be reduced. Suggestions can focus on the supply side of food service (primarily Chartwells) or the demand side (student choices), or a combination of these. Prepare a letter that communicates your findings and recommendations in written form to any of the following: The towers, Chartwells management, WPI Administration, Student Government, or other print media. Which of these recipients you choose will determine the form of the communiqué. All letters must be submitted first to Professors Wobbe and Traver for review by Nov.5. Following our okay, the letter must be submitted to the respective audience and the team must obtain written acknowledgement. 2 pts

The students commented that the assignment was too vague and inaccurate. They said specifically that it was often difficult to differentiate between solid and liquid waste. Thus we modified the assignment such that the students collectively determine a comprehensive classification system by which the types of waste can be categorized. In this way the data will be more accurate. We also devised a system by which all time slots will be filled for the days of data compilation and thus the data will be more complete and accurate. Below is the revised assignment.

Food Waste at WPI

The purpose of this assignment is for you to study food waste in the Morgan dining area of WPI and to suggest ways that it may be reduced. You are also required to communicate your findings and suggestions to a public audience or official (e.g. The Towers, Chartwells Management, WPI Admin, Student Government).

1. The study requires that you determine
    a) the amount of food that goes uneaten in the Morgan dining area of WPI
    b) some of its characteristics and conditions (ex. Type of food, time of day, other comparisons).

The class as a whole will decide what is considered liquid and solid waste. This will ensure separation accuracy across every group. We will also discuss the difference between food waste and 'trash'. For instance, the difference between a half eaten cookie versus a watermelon rind. Again deciding on these things before collecting data will provide more accurate results.

You will work in teams of two. Sign up for a 1 hour time slot between 7 am and 7pm. Every time slot should be filled (in order to provide more accurate results). If they all cannot be filled, then collectively we will decide which times are most important for data purposes. Thursday or Friday (Oct 25 or 26). Show up in grubby clothes. You will be shown how to dispose of the food in appropriate containers. Be on time and courteous.

2. Once the class data are collected and analyzed, you need to recommend ways that the food waste might be reduced. Suggestions can focus on the supply side of food service (primarily Chartwells) or the demand side (student choices), or a combination of these.

Prepare a letter that communicates your findings and recommendations in written form to any of the following: The Towers, Chartwells management, WPI Administration, Student Government, or other print media. The audience you choose will determine the form of the communiqué. All letters must be submitted first to Professors Wobbe and Traver for review by Nov.5. Following our approval, the letter must be submitted to the respective audience. 25 pts

3. To promote "clean plates", each team must create a poster to be hung within Morgan dining hall. This poster will be used to educate the students and faculty dining at DAKA. It must contain waste data collected during the assignment and tips that students/faculty may follow in order to reduce food waste. The poster must be neat and eye catching to get the point across.

To Be Turned In:

1. A record of the total weight of solid waste and the total weight of liquid waste on your shift.
2. A bulleted list of 3-10 observations (Both Due 10/31) 25pts
3. A letter of findings and recommendation to a specific recipient (described above) (Due 11/5 to be reviewed before sending to specific audience) 50pts
4. A poster explaining your findings and tips that the students/faculty can follow to prevent unnecessary food waste. (Due 11/19) 25
    a. It must be neat and eye-catching

An alternative option for this assignment instead of finding ways to reduce food waste would be to devise a system by which the food that is thrown out could be used in a productive manner (pig farming for example). Overall the assignment was clarified and modified in order to make the data collected more accurate.

Conclusions and Recommendations

As stated in the introduction of this report, the Great Problems Seminar were designed to

1. engage first-year students with current events, societal problems, and human needs;
2. require critical thinking, information literacy, and evidence-based writing; and
3. help the students develop effective teamwork, time management, organization, and personal responsibility.

We will summarize the results of our analysis in terms of these three areas. We draw our conclusions from the interviews with a sample of FTW students, interviews with the faculty who developed the seminar, the standard course evaluations, and the work produced by students for their final projects.

Student Engagement

Perhaps the most important goal of the seminars was to engage first-year students with current events, societal problems, and human needs. Interviews with students and evaluation of the final projects, both the reports and presentations, indicate that Feed the World was successful in promoting student engagement.

The food waste assignment provided a good level of student interest and engagement before the final projects. Students who eat in the cafeteria know that a great deal of food is wasted. While the data is impressive (more than 1/3 pound of food per person is wasted), the experience of collecting and weighing the food was more valuable,

and had more impact, than the data alone could. The students seemed to enjoy the assignment, including both the writing assignment after collecting the waste and doing the collection itself. They were proud to think that their work could possibly lead to a real change and make the world, at least their local world, a better place. Even though the phrase is appallingly cliché, it is applicable.

The final projects had the most impact on student pride and engagement. It was important that students were able to choose a project that interested them. For example, the group that studied the problem of elderly malnutrition in Worcester, described the importance of the simple discovery that elderly malnutrition is more serious than some more publicized problems (including obesity, which currently spends a great deal of time in the headlines). According to one student, the WPI public relations office took their poster and planned on trying to get media attention for the problem. With help from the public relations office, they are in the process of trying to bring their proposed solution to Worcester City Council. The group has discussed doing an IQP together on this problem.

It is possible that the students who chose to enroll in the Great Problems Seminars may not be typical first year students. The students who opt to take an experimental course probably are not representative of the whole first-year population. They are likely to be more engaged than the average first-year students. Yet even if certain individuals would be relatively engaged without taking the seminar, having taken it they are more engaged than they would have been without attending the seminar. Thus the seminar was successful at the goal of engaging students in societal problems.

The extent to which this engagement continues and influences the students' experience at WPI is an important area for future research.

Academic Development

On the second goal, to require critical thinking, information literacy, and evidence-based writing, the seminar has room for improvement. The students' development of writing and presentation skills as well as academic confidence was impressive and can be described as a very successful part of FTW. There remains, however, room for significant development in the students' critical thinking skills. We will focus on ways that we believe would improve the seminar in this area.

World food problems involve many different disciplines: nutrition and the basics of disciplines relevant to the world food problem (economics, sociology, etc.). The nature of the course was so broad and multifaceted that it cannot be reasonably expected that the students would become experts in all of the disciplines necessary to understand, let alone solve, world problems. Indeed, many students said that they were attracted by the breadth of the course. We agree that the course's breadth is attractive, but the course could be restructured to focus more clearly on aspects that are most important to understanding and solving the problems.

Critical Thinking

Some of the arguments presented in the final project reports were weak and some conclusions were poorly supported. The students should be challenged to think more methodically and scientifically (not just in their proposed solution to a given problem but also in problem identification and definition). Although they are first-year students, as

students at WPI they should be held to a higher standard of scientific and systematic thought.

Some of the students expressed the belief that the key to a successful project is the presentation. They said that, as long as a report is well written, organized, and presented then the content, the intellectual content is less important. In any report or project there is a minimum threshold for the quality of the content *and* the presentation. It is irrelevant how excellent one is if the other is inadequate. One student stated it succinctly when he said that they were graded on "syntax rather than science."

The students' information literacy and the ability to evaluate evidence needs to be improved. The writing was quite polished; the evidence (and especially the conclusions derived from the evidence) was not always so polished. In the final project report, the students rarely evaluate the validity or possible bias of their sources.

In the seminar, the students are challenged to find and solve problems which are sometimes beyond their abilities. We are not suggesting eliminating these open-ended projects or simplifying to make them easier, the projects complexity is needed for the project experience. We do believe that it is important to bring more critical analysis to these difficult problems. We are not arguing that there should be more emphasis on finding the right answer, but rather, that a focus on argument and justification becomes more important.

We are not suggesting that the professors stop emphasizing the importance of the ability to clearly present arguments both in writing and in speaking and stop grading this in reports: the professors taught this very well and should continue to do so. The students writing improved dramatically. What we are suggesting is that (with assignments which

are not exclusively meant to be writing exercises) they should also emphasize and grade on the content of the students work. In short, we believe that the professors need to grade on syntax and science.

To reiterate, the intellectual content of the final projects could be improved. We suggest that the professors explicitly emphasize the intellectual content of assignments and projects without decreasing their current emphasis on high quality writing.

Content Oriented Goals

The course could be improved if there were more content oriented goals introduced. This could both ease the transition from high school to college (by providing a more familiar course environment) and build a stronger first-year experience. Gaining engagement and project experience of the seminar in the students' first year is certainly beneficial for the students but seems difficult to justify on this basis alone. This would do much to remedy the perceived lackluster intellectual content of the project reports and other assignments. If the students were taught more content related to food problems (especially economics and public policy) they would be capable of a better understanding of the open-ended problems which they grapple with in this seminar.

By employing project-based learning in its classical form (that is, as a means of content delivery) the students could still be given valuable experience with projects and group projects *while* they are being taught factual knowledge. This would improve the course immensely: though the experience with group projects gained would likely to be diluted somewhat.

For the first offering of FTW, many of the students described early assignments as essentially busywork. This implies that there is "space" in the schedule for an increase in

content. Some of the topics may be taught more efficiently with traditional techniques. The Economics and World Food Issues assignment (price elasticity of demand for various nations) was the example most cited by students.

Even without resorting to traditional learning methods the amount of factual knowledge the students garner from the course could be increased. We are simply saying that it would be more expedient to occasionally employ traditional methods for certain topics.

In summary the FTW seminar should adopt some content oriented goals in addition to its existing goals. The amount of concrete knowledge taught in the seminar could be increased with an improvement in student satisfaction. One possible method of how to increase the amount of definite knowledge gained in the course is to employ traditional teaching methods for the teaching of certain topics (select economic principles for example) in which it would be more efficient and thus advantageous.

Personal Development

The third goal of the course is to help the students develop effective teamwork, time management, organization, and personal responsibility. This goal is less open to direct or quantitative evaluation at this time. Regarding the goal of time management, organization, and personal responsibility the seminar does not impress us as significantly different from many first year courses, though it may have been emphasized more in FTW than in others. We do believe that FTW fostered greater development in effective teamwork because it incorporated more project work than other first year courses. By giving students experience with group projects the seminar will obviously help them

develop more effective teamwork. Furthermore the completion of a major final project requires much better organization and time management as well as more responsibility than completing a conventional homework assignment. Thus we believe that GPS in general and FTW in particular was more effective than traditional first year courses in helping the students develop effective teamwork, time management, organization, and personal responsibility. This is perhaps the most important area for continued assessment of the Great Problems Seminars. Do the students who completed FTW bring valuable new skills to their IQP and MQP.

Summary

FTW accomplished it two of its goals very well. The students demonstrated a high degree of engagement and gained valuable experience doing group projects. They showed major improvement in their writing and oral presentation ability and confidence. Their intellectual development was less satisfactory but can be improved. We believe that limited content-oriented goals should be adopted in addition to the goals already in place. The official WPI course evaluations displayed marked improvement from A-term the B-term. The data from the course evaluations shows that FTW is only slightly below the average (of other first year courses), in some areas, which is excellent for an experimental course. Students were generally positive about the course, and the aspects they disliked have already been remedied in the main. The professors view the course as successful and are confident they will improve it further. Overall the first offering of FTW was successful, but there are certainly opportunities for improvement.

Future Work

During the beginning of our project we, as an IQP group, had a lot of discussions of how we could create a project out of the FTW seminar. We juggled many ideas around, such as focusing mainly on developing new projects for the course, analyzing the students' work, specifically writing assignments, from A to B term or focusing on the project-based learning aspect of the seminar. We did however, have a clear understanding that we wanted to compare FTW to other courses at WPI as well as analyzing the seminar as a whole. Eventually we decided to focus on assessing the students and professors perceptions of the course and how well the course accomplished its intended goals. Although our objectives were clear we feel that some things could have been done differently.

We would first make the B-term student interview identical with the A-term interview. We would also add new questions to both interviews. We feel that it is important for the students to explain how they feel the course succeeded in three of its goals: engaging first year students with current events, societal problems and human needs; requiring critical thinking, information literacy and evidence-based writing; and lastly helping the students develop effective teamwork, time management and personal responsibility.

We would conduct the B-term interviews at a different time and place. Since we held the interviews during the students' final project presentations, the students were distracted and susceptible to their peers' opinions. Since the task of isolating each individual for an interview session during B-term may be impractical, finding a common

place and time that the *student* would want to meet is very important. It may actually be better to hold the second interviews early in C-term to avoid end-of-term time pressures.

Although the professor interview questions themselves do not need to be modified, the way the interviews were conducted could be improved. The interviews were held individually but not all of the questions were answered in full. Although the interviews should be casual, it is important that all questions are answered so that the professors' answers can be compared.

Keeping in close contact with the professors, students and the course would have benefited our IQP. Although it is not practical to attend every FTW lecture, getting more involved with the course and professors would have helped us analyze the seminar more comprehensively. This would make it possible to collect the students work immediately after it is graded. Scanning the students graded work for future analysis would have provided valuable information about growth in student writing and presentation skills.

Next, it will be valuable to conduct interviews next year with students who completed FTW in AB2007. The questions used could be comparable to the questions asked of the new FTW class in AB2008, but there should be new questions that focus on the long-term impact of the seminars. Following the FTW students into their project work in the Junior and Senior year is an important area for future research.

Finally, meeting with the professors after the course has ended would also be valuable. The professors are beginning to make plans for next year and it would be valuable to learn how they decide to change the seminar after their first year's experience.