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The Effect of an Educational Video on the Acceptance of Nanotechnology

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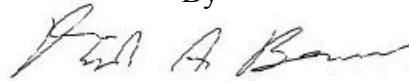
The Effect of an Educational Video on the Acceptance of Nanotechnology

AN INTERACTIVE QUALIFYING PROJECT

Submitted to the Faculty of the
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
By

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Abstract

The effect of an educational video on the acceptance of nanotechnology was studied using an internet based system to collect data. Analysis includes comparison between majors, gender, college, and overall trends with the general acceptance and the acceptance of specific types of nanotechnology. As the knowledge of nanotechnology increased the general acceptance decreased even though acceptance within specific areas of nanotechnology increased.

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1. Context and Goals

1.1. Introduction

A brief observation of history shows that new ideas are not always met with the esteem and enthusiasm expected. Society, as a collective, is apprehensive towards the emergence of certain new technologies and, more specifically, their potential. Sometimes propaganda is used by opposing groups to reduce society's general acceptance to prevent the emergence of these up-and-coming technologies. To counteract this propaganda or to simply change negative opinions, media can be used to spread knowledge to positively affect society's acceptance. Media is a broad category of communications, including written, auditory, and visual forms. In today's world, one cannot escape the appearance of media of some sort. It is the interpretation of the containing message(s) and the presentation of the message which has made media a powerful tool throughout our existence.

1.2. Nanotechnology: The Future

Many people attribute the beginning of the age of nanotechnology to the American physicist Richard Feynman. In December 1959, he gave a speech entitled "There's Plenty of Room at the Bottom" at an American Physical Society meeting at the California Institute of Technology [16, p. 18]. He stated, "What I want to talk about is the problem of manipulating and controlling things on a small scale... What I have demonstrated is that there is room --- that you can decrease the size of things in a practical way...We are not doing it simply because we have not gotten around to it [16, p. 18]."

Since Feynman's presentation, nanotechnology has spread into almost every aspect of science and engineering. The US federal government alone spent approximately $1,081 million on nanotechnology research in 2005, and requested $1 billion again in 2006 [13]. These statistics do not include the enormous spending of private universities from around the globe from Northeastern University to National Nanoscience Center in Bejing [15, p. 2]. The National Science Foundation even predicts the nano-related market to approach $1 trillion by 2015 [15, p. 3].

There has been some obscurity in the usage of the term nanotechnology. To define

nanotechnology, nanostructures need to first be defined. A formal definition of a nanostructure includes:

> "(a) Has at least one physical dimension of approximately 1-100 nanometers; and

> (b) Possesses a special property, provides a special function, or produces a special

> effect that is uniquely attributable to the structures nanoscale physical size [20]."

Products of nanotechnology include nanostructures which may be of nano-scale or macro-scale, depending on their applications. The three main divisions of nanotechnology are: medicine, manufacturing and materials.

1.2.1. Medicine

Medicine may prove to be the most influential division of nanotechnology because of the staggering number of applications it offers. Drug development is beginning to use nano-scale methods to aid in designing drugs, leading to faster drug implementation [15, p. 109]. Once these drugs are administered, nanotechnology promises better bioavailability and targeted delivery of the drugs to boost their performance in the body [15, p. 110]. Photodynamic therapy, an alternative

Figure 1.1: Nanobot in bloodstream [10]

to chemotherapy, is made possible by photo reactive nanodots which are distributed through the body and attach to targeted sites such as tumor sites [15, p. 113]. Once these dots absorb light from an external source, they heat up, destroying organic tissue surrounding the dot. As a last example, nanotechnology allows the development of neuro-electric interfaces, allowing interactions between electronics and the body [15, p. 115].

1.2.2. Manufacturing

Manufacturing with nanostructures is called nanofabrication. Presently there are two categories of nanofabrication: top-down and bottom-up [16, p. 37]. The top-down approach
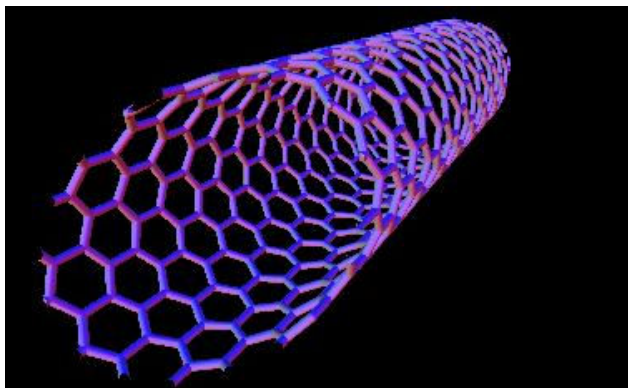
Figure 1.2: Carbon nanotube (11)

includes methods such as lithography and manipulation by scanning probes. Both of these start out with larger scale productions which are shrunk down to nanoscale [16, p. 49]. These methods are extremely accurate at creating nanoscale replicas, but are too expensive and slow for mass production. Bottom-up approaches use controlled chemical reactions to cost effectively assemble nanostructures atom by atom or molecule by molecule [16, p. 49]. This method is efficient in the case of creating nanotubes and nanowires; however it is impractical to make electronics of any sort. This method lacks the ability to create designs and patterns needed for circuit production [16, p. 49].

1.2.3. Materials

Materials designed with nanotechnology are often described as smart materials, although not all smart materials include nanotechnology. These materials incorporate the capability to perform specific tasks at the molecular level. Biological structures, such as human skin, provide nanotechnology with a direction for the design of synthetic structures [15, p. 84]. Some abilities which define a smart material are self-healing, recognition, and separation. Self-healing occurs in most biological membranes, and reacts to breaks in continuity of a surface [15, p. 85]. This process can be applied, for example, to create a non-scratching paint for automobiles. Recognition refers to the ability to distinguish between stimuli and react only to specific stimuli. The growth of nanotubes and nanowires from a single crystal is an example of

Figure 1.3:
Nano tennis racket (13)

recognition [15, p. 87]. Separation refers to the ability to separate molecules or materials from a mixture. This process has been used for years by numerous industries including waste treatment [15, p. 88]. Nanotechnology applications of separation include cellophane and dialysis [15, p. 88].

1.3. Previous Research

There are many other studies that have been conducted on the acceptance of nanotechnology. For the sake of brevity, we will discuss two.

One study involved an Internet survey of the US public on the acceptance of nanotechnology [7]. The people conducting the study had two major conclusions. The first conclusion was that the public's opinion is based on their emotions more than their conception of risks versus benefits. The second conclusion was that people are subject to "polarization." They did this by comparing a group of people who were informed of the risks and benefits to those who were not. This means that people that who do not consider industry dangerous do not see the risks and focus on the benefits. In contrast, people who are more environmentally aware tend to focus on the risks. The study showed a polarization effect between liberals and conservatives as well as whites and African Americans. This survey also indicated that more than 80 percent of the survey takers had heard little or nothing about nanotechnology [7].

The second survey focused on nanotechnology in foods. Their results showed that 69 percent of survey takers disapproved of nano-additives in spices to prevent caking. Also, 84 percent disapproved of making foods look appetizing longer with nanoparticles. Even though the majority of people were against nanotechnology in food, 66 percent recognized the benefits and approve of further development. The overall significance of this study showed that people approved of nanotechnology when they had minimal contact with the nanoparticles. They compared their 52 percent awareness of nanotechnology to the 15 percent in 2005 [5].

This project is a continuation of three previous Interactive Qualifying Projects. Each of these projects had a similar goal: to analyze the acceptance of an emerging technology.

The first project had the title, "Will Prey Consume Nanotechnology?" This project

used Michael Crichton's book <u>Prey</u> as inspiration to investigate society's acceptance of nanotechnology. The project team designed a survey containing questions about the three branches of nanotechnology, general knowledge of nanotechnology, and risks and benefits of nanotechnology. The results showed that, in general, people don't know much about nanotechnology. Despite this, they support the idea of nanotechnology in the medical, manufacturing, and materials fields. One area the survey takers, mostly WPI students, were uncomfortable was with the concept of self-replicating nanobots [2].

The second project was titled, "Social Acceptance of Technologies." This group did research on revolutionary technologies in history. These included nuclear energy, genetically modified food, and vaccines. They looked at some challenges the technologies had to overcome and their acceptances as they emerged. These problems were then compared to nanotechnology. Their conclusion was that the acceptance depends on the risk versus benefit ratio of the specific technology being discussed. For nanotechnology, manufacturing and materials have a low risk versus benefit ratio, while the ratio for medicine is much higher. One suggestion the group gave was to have the government work with the media to publicize the safety of nanotechnology [17].

The third project was called, "Social Acceptance of Nanomedicine." This group decided to investigate nanomedicine since the previous groups found that this was the aspect of nanotechnology most prone to disapproval. They used cognitive types and risk behavior to categorize the type of people that are more or less likely to approve nanomedicine. The cognitive types were cognitive miser (who take the advice of friends and family) and scientific literate (who gather factual information before making a decision). The risk behavior types were risk prone and risk adverse. This project involved a survey with questions that categorized the survey taker according to cognitive type and risk behavior. These groups were compared to their acceptance levels of nanomedicine. The conclusion was that there is no correlation between cognitive type or risk behavior and acceptance of nanomedicine [3].

1.4. Scope of Project

The first project team suggested that a subsequent project might consider examining the effect of education about nanotechnology on acceptance. This project aimed towards addressing this issue. This involved students accessing a website that used a video and two surveys (one before and one after the video). The purpose of this was to show if an educated person would be more likely to accept a new technology compared to a person uneducated on that same subject.

2. Hypothesis and Methodology

2.1. Hypothesis

When new technologies emerge in society, they are not always accepted as a favorable development. All technologies have their pros and cons. If the community becomes educated it might be more willing to accept that the pros can be used while minimizing the impact of the cons. Nanotechnology is one of these newly emerging technologies and it comes with many advantages as well as disadvantages. If the population where the technology is developing is properly informed, the fears of the drawbacks and the unknown may decrease. Our hypothesis states that showing an educational video on nanotechnology will improve its acceptance.

2.2. Methodology

2.2.1. Survey

To determine the participants' level of acceptance of nanotechnology, two surveys were used. One was presented before and the other after an informative video. Each survey consisted of ten questions, kept short to maintain interest. Both surveys asked essentially the same question, but in the second survey the questions were reworded and reordered in an attempt to minimize the participants' awareness that they were being asked about the same information. The questions were designed to focus on specific aspects of nanotechnology. These aspects included: overall knowledge, overall acceptance, medical, military, materials, and science fiction. The questions were designed in a ranking fashion. The participants were asked to rank a statement from strongly disagree to strongly disagree with five levels of acceptance. If the participants were unsure of their answers or felt they did not know enough to answer the questions, they were asked to select "neutral". The format of these questions helped make the surveys easy to take as well as analyze.

2.2.2. Video

The idea of developing a video surfaced while determining what media to use alongside the surveys. A video was decided as the best means of communication because of the advantages it holds over other media. Visual presentation of information was viewed as

quicker and more stimulating compared to text or audio. After brief consideration, using video media was thought to be most effective and was integrated into the project title.

Given our time constraint, a mere two weeks, it was unanimously decided that creating a video from scratch was an inefficient use of time. No one in the project group had experience with video production or owned production equipment. Instead, existing online media were collected and used to compile the video using video-editing software. This compilation incorporated seven videos and reached a length of five minutes thirty-five seconds.

The structure of the video was created in a manner that attempts to present the information in a non-biased format. The introduction is brief and quickly followed by a few applications of nanotechnology, after which concerns are addressed. Both the positive and negative sides were introduced to provide a balanced view of nanotechnology.

2.2.3. Website

Building upon technology has always been a big concern in today's world. Since most people in the United States now have easy access to a computer with the internet [4], the most effective way to reach our target population was through that gateway. The easiest way to deploy the survey and video was to put it all in website format. This was not only an efficient way to collect data and analyze the data set, but also provided cross-platform functionality, allowing it to work on any computing platform.

The website began with an introduction page briefly explaining who was involved in the project and what requirements were needed to complete the survey. Java [19] and Flash [18] were required to take the survey, so test links for these were provided on the start page in case the user was unsure if they were available. This helped minimize any confusion and invalid results.

Knowing that anonymity was important, the survey was created to keep the participants anonymous while still collecting background information for analysis. This information included college, gender, class, and major of the participant. There are a plethora of majors available to people [10] and listing them all would be impractical from a data analysis standpoint. Therefore in the 'Major' pull-down menu in the survey, only prevalent majors were listed in an effort to group responses together. Since the website was accessible from anywhere in the world, an 'other' option existed for college, class, and

major. In principle, this helped to minimize untruthful results. If the class selection was selected as 'other', the users were required to input their ages, which were later used in analyzing the data.

After the users hit the submit button, they were redirected to the pre-video survey. Upon submitting the first survey, the participants were taken to a webpage designed to display nothing but the video and were asked to watch it in its entirety before continuing. After the continue button was pressed on the video webpage, the participants were then directed to the last survey. Since this survey was similar to the first one, its completion should have been straightforward. Instructions at the top of each survey page were repeated in case the participants had any doubts as to the format of the second survey.

After spending a few minutes to complete the survey, the participants were told a little more about the project and presented with two links. The e-mail addresses of each of the group members were given in case of any comments or questions the participants would like to communicate. The last two links could be visited without going through the survey process again. The first link was dedicated to crediting the proper people for their contributions in the video and the second link was created to display the results from our project. The results shown on this page were the tables and the raw data collected from the surveys.

The first challenge in developing a multipage survey was keeping the results grouped together, yet anonymous. This was where JavaScript and Perl became important in user interaction. Immediately upon pushing the start button, users were directed to a CGI script [6.5.Appendix E] held on the server. These CGI scripts were written in computing language Perl. The first script accessed by the user merely generated a random number and appended it to the URL of the background page. This random number was used to group the data together. Once the user was directed to a URL, CGI no longer had control over that random number. The only way to pass it on to the next CGI program was to use JavaScript. JavaScript did the same thing as the previous CGI script, but merely directing the page to the next CGI script. These redirects continued in subsequent pages to keep the results grouped.

Each CGI script was written to decrypt the data that were input into the background, pre-video, and post-video survey fields and dumped it into a text file named by the random

number. This made it easy to import into Excel spreadsheets or other data analysis tools. Neither CGI nor JavaScript were used in displaying the video. To do this Flash was used.

Flash was chosen to display the educational video mainly because it is the most common platform for browser video displaying. If you have seen a video online, played a web-based game, or even used a web based application, it most likely used Flash. The Flash video format is highly compressed and therefore optimized for internet distribution [8].

The Flash video was not played natively in the browser, but a Flash video player application [1] was loaded into the browser. This video player was then directed to where the video was located and it was then downloaded to the users' computers and played directly from their internet files. Real-time streaming requires a constant bandwidth to operate. Since Flash video players can download the video in chunks, burst speeds are utilized and therefore more likely to meet the bandwidth requirements of the entire video playback sequence. This increased the chance that the video will playback continuously and not need to pause every so often to re-buffer.

2.2.4 . Target Population

The chosen target population was the students of the Colleges of Worcester Consortium. These thirteen different colleges span numerable majors from engineering to liberal arts to veterinary medicine. There were two distinct reasons for choosing the consortium. The college population will be the next generation to decide the future, therefore educating this population would prove beneficial. Secondly, because this population is educated in such diverse studies, the received responses would to some extent represent the population of the world.

2.2.5. Difficulties / Resolutions

There were many difficulties which stalled the progression this project. To obtain participants, we originally planned to go to the different schools in the Worcester consortium. After visiting a few schools, we realized that this was very inefficient and unfruitful. Many of the schools refused to post our flyers and would not allow us to pass out brochures on campus, while others limited the amount of advertisement allowed at their school. To try to get to all of the students at each school, the project team emailed the webmasters at each school and asked them to forward our flyer to the students. At WPI, the

Student Government Association has access to the undergraduate mailing list, which we were able to use successfully.

The difficulties encountered while developing the movie were numerous, but fairly minor. Windows Movie Maker was originally chosen for compiling the video, but was soon discovered to be an insufficient tool to produce a video of acceptable quality. Instead, Adobe Premier was chosen for its intuitive and powerful editing abilities. Even though it was intuitive, there was a steep learning curve to use this suite efficiently. After compiling the video, the differences in attributes between the various clips were highly noticeable. These included: sound level, video brightness, and video quality. Finding out how to manipulate the video, as a whole, ended up being the biggest difficulty. Finally, tests were conducted to find the most appropriate file size and quality to post it online. It was important to keep the file size of the video low so that participants could quickly load the video on their own computers, however the lower the quality the more difficult it was to see and hear the information being conveyed. A compromise was found that provided the best load times with the highest possible quality.

The most difficult aspect of the website design, surprisingly, was not the pages that the user saw in their web browser, but was the interactions that went on behind the pages. These were the CGI scripts in Perl language and the JavaScript embedded within. One very hard aspect was getting Perl to write variables to the file which was named based on the randomly generated number within the URL. This was due to security restrictions imbedded within the program itself. Each variable which could be changed based on user input was considered 'Tainted' and could not be used for any interaction within the physical filing system. In order to 'unTaint' the variable, a complex and obscure line of code was used which ran a series of checks to make sure it was not malicious code. Once the variable was redefined as safe, it could be used to name the file and have the data dumped into it.

3. Results and Data Analysis

3.1. Participation

With the data gathered, there were several choices as how to run the analysis. First and foremost was to see how the results were split up amongst school, gender, and major. Primarily Worcester Polytechnic Institute was responsive to our advertisements to take our survey. This was mostly due to the aforementioned problems with inter-consortium relations.
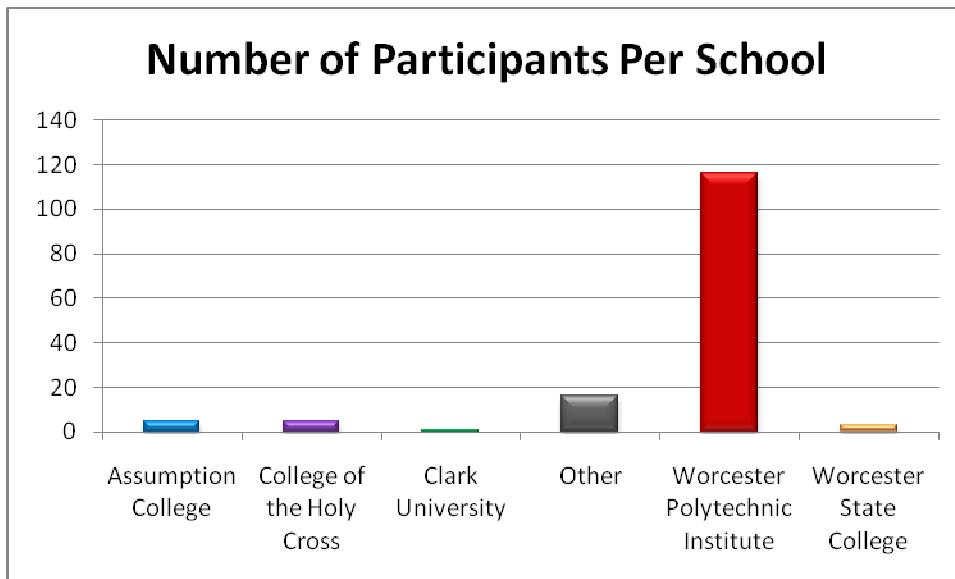
Figure 3.1

As you can see here, WPI had the most survey takers.

The imbalance between male and female is just as significant.

Figure 3.2

Easily seen here, almost twice as many males took the survey than females. This may be due to population of WPI or other non-related plausible explanations.
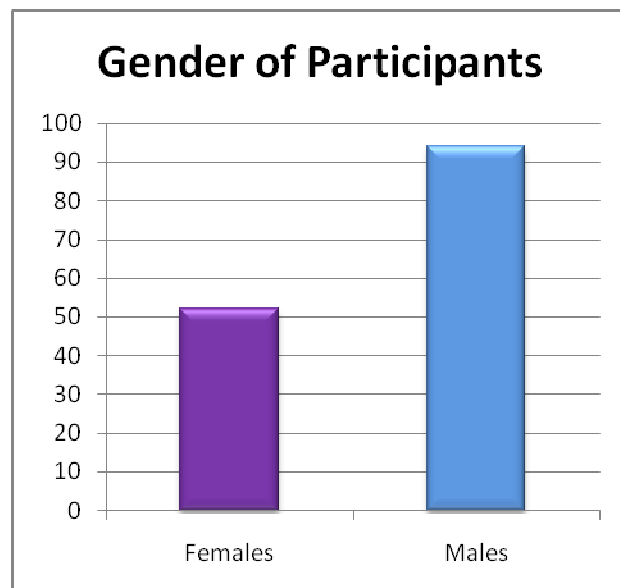
While nanotechnology has many applications amongst many major areas of study, most associate the field with science and technology. As seen by **Figure 3.3,** many people who took the survey were engineering or computer science majors.
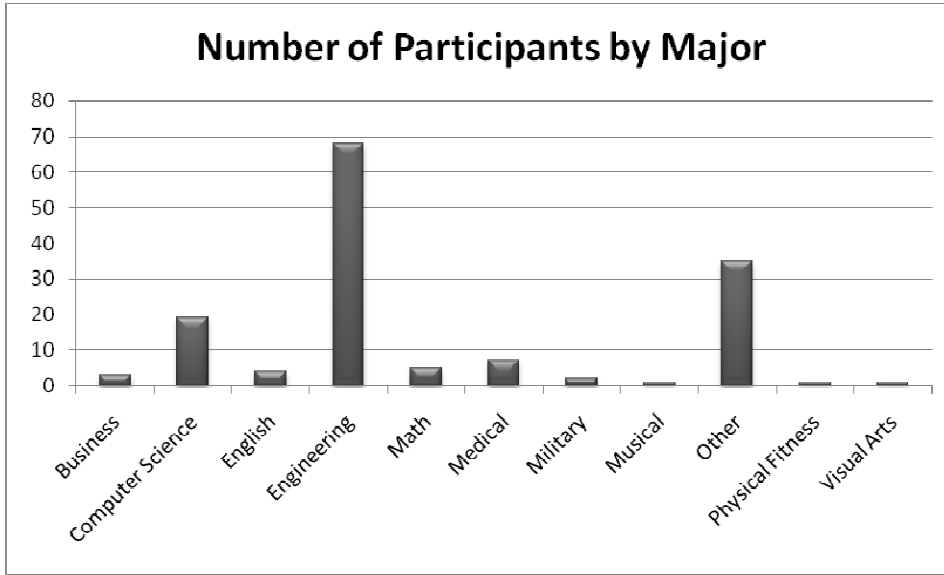
Figure 3.3:

The distribution of major areas of study is weighted with the majority of participants: Engineering or Computer Science majors

3.2. Overall Analysis

The analysis was done using Excel spreadsheets. For computational purposes, the pre-video survey was assumed as QA and the post-video survey QB. A simple yet effective method to determine a base-level of acceptance is to average the answers from each participant on the pre-video survey. Mathematically this correlates to the mean per question or:

Eq. 3.1:

$$\text{Baseline Acceptance }_i = \frac{\sum_1^n QA_i}{n} - 3$$

Where n represents the number of participants and i represents the question from one to ten.

The values of QA range from one to five, from strongly disagree to strongly agree, and in order to scale the values to something more understandable, or a neutral answer is zero, three must be subtracted. Since the questions have been rearranged to deter similarities between pre and post surveys, the questions had to be re-tabulated so that each question properly lines up with the matching question on each survey.

Question	1	2	3	4	5	6	7	8	9	10
QB	1	2	3	4	5	6	7	8	9	10
QA	3	4	1	2	8	9	10	7	6	5

Table 3.1

Shown is how the post and pre surveys match up per question

Using this translation table, the base-level of acceptance was graphed per question.
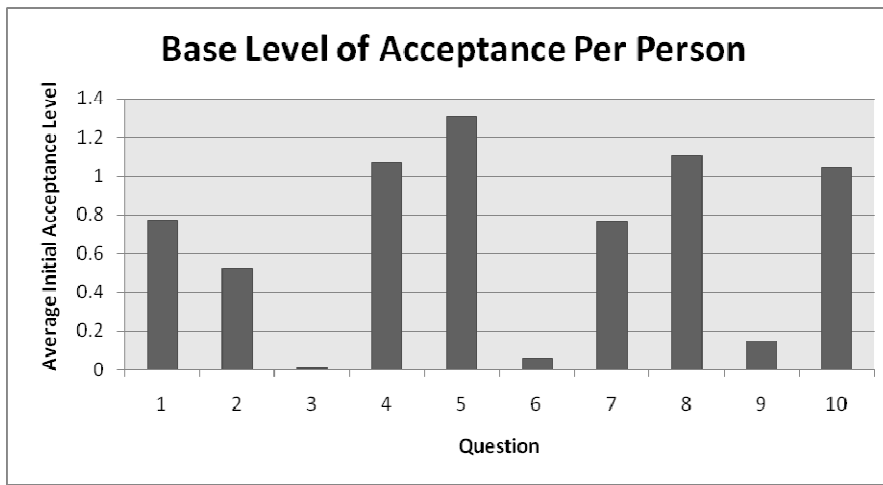
Figure 3.4:

Shown is the base level of acceptance where negative numbers reflect negative acceptance and positive numbers reflect positive acceptance

Questions three, six, and nine were neutral in response and questions one, two, four, five, seven, eight, and ten have a significant acceptance level value around one which translates to an agreeing statement (two would be a strongly agreeing statement).

Calculating a base level of acceptance is only half the analysis. The interesting aspect is what the change in acceptance level was. This was done by subtracting the answers from the pre-survey questions from the corresponding post-video survey. This number needs to be normalized by a simple average over the number of participants. In equation form:

Eq. 3.2:

$$\text{Average Change in Acceptance per Person} = \frac{\sum_{1}^{n} QB_i - QA_{i'}}{n}$$

Where n represents the number of participants, i represents the post-video question number and i' represents its corresponding question on the pre-video survey.

Figure 3.5 shows this change in acceptance level per question.
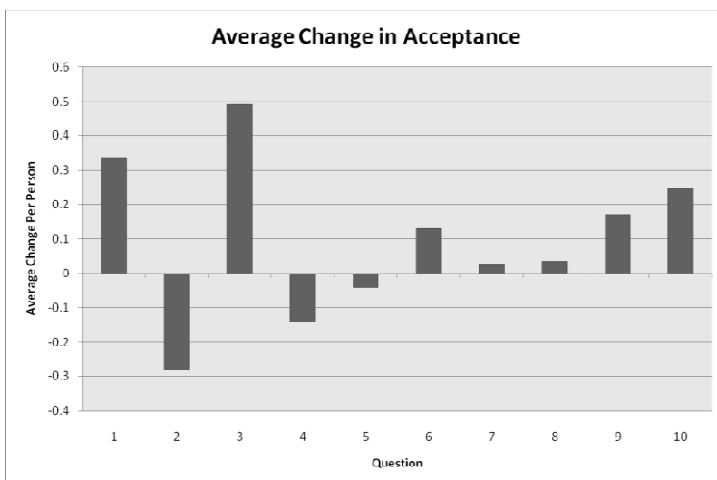
Figure 3.5

The average change in acceptance per question. Positive values reflect an increase and negative values represent a decrease in acceptance.

3.3. Validation of Results

In order to determine if the changes between the post and pre-video surveys are statistically significant, a t-test was performed on the entirety of the data. The t-test that was suitable for the data set was a matched paired t-test because we tested the same individuals before and after the video. An online software program was used to perform the test [9]. This test yielded P-values which represent the probability that the result was due to chance. If this value was less than five percent (0.05), the change in acceptance of that particular question was considered significant. Table 2 displays the correlation between each question and its related P-value.

Question #	Question	P-value	Change after video (significance)
1	I am aware of the already expanding presence of nanotechnology.	0.0001	increase
2	I support the use of topical substances which use nanoparticles.	0.0002	decrease
3	I am knowledgeable about nanotechnology and its applications.	< 0.0001	increase
4	I support nanotechnology: its research, prospects and uses	0.0230	decrease
5	I approve of electronics which use nanotechnology (nano-electronics).	0.4072	no change
6	I support the use of self-replicating nanobots.	0.0463	increase
7	I am concerned about the possible abuse of nanotechnology.	0.7141	no change
8	I approve of materials which use nanotechnology (nano-materials).	0.5169	no change
9	I approve of possible military use of nanotechnology.	0.0055	increase
10	I support medical practices which include nanotechnology.	0.0001	increase

Table 3.2: The P-values for the t-test and the relation to each question

4. Trends and Conclusions

Using the previously mentioned analysis techniques, the following sections include interpretations of trends found within various categories of the data. These interpretations are purely speculation because further investigation outside the scope of this project would be needed to validate these claims.

4.1. Trends Between WPI and Non-WPI

WPI's positive baseline acceptance when compared to Non-WPI participants could be attributed to the technical nature of the school. There were similar trends between these two categories of participants. One such trend was the increased general knowledge (Q3) of nanotechnology coupled with the decreased acceptance of topical uses (Q2). Both groups of participants realized the expanding presence of nanotechnology (Q1) and accepted medical (Q10) and possible military (Q9) applications.
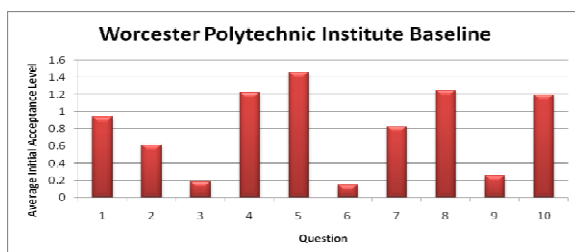
Figure 4.1
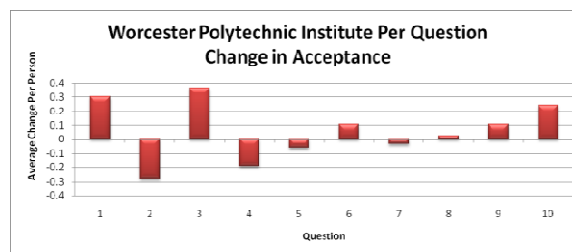
Figure 4.2
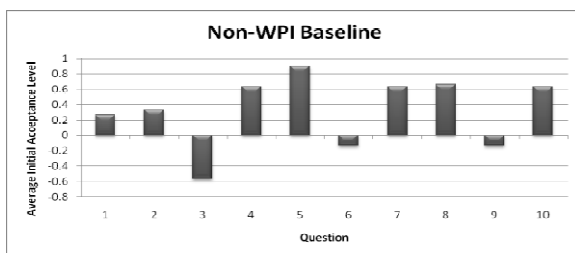
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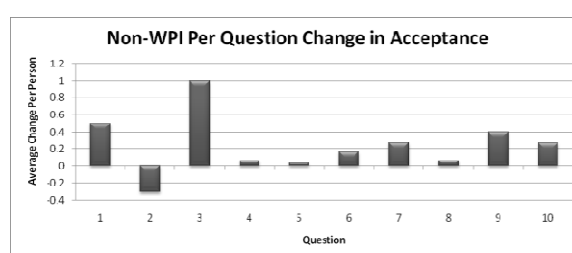
Figure 4.4

4.2. Trends Within Major

To keep analysis valid, only the majors with substantial responses were compared. Looking at the baseline figures, similarities are evident. Both Computer Science and Engineering Majors had about the same level of acceptance with a noticeable difference between question nine. This question involved use of nanotechnology within the military. There was no significance found between majors with regards to this military question and therefore the question remains ambiguous amongst majors. Most noticeably, there was a general acceptance of nanotechnology and its applications.
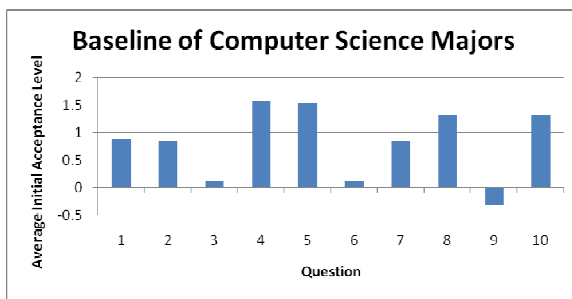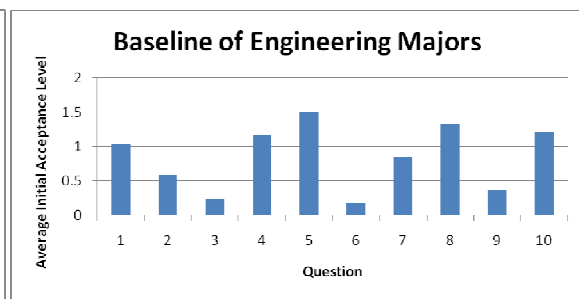
Figure 4.5   **Figure 4.6**

The change in acceptance appeared to be much greater among computer science majors when compared to engineering majors. This can be attributed to the reduced interactions that computer science majors would have with nanotechnology and therefore are not as affected. Engineering majors have a lower acceptance because they would be more involved in the development and research of nanotechnologies and therefore have a more critical view.
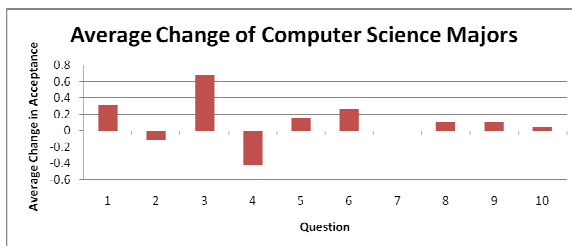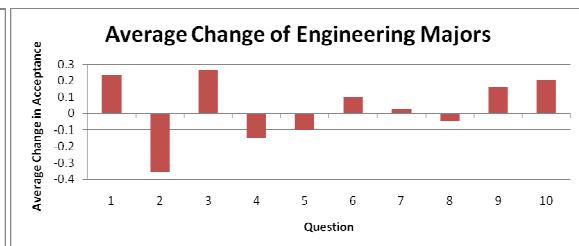
Figure 4.7   **Figure 4.8**

The greatest positive and negative changes occur on questions regarding overall knowledge (Q3) and acceptance (Q4), respectively, within the computer science major. This suggests that as the knowledge of nanotechnology increases, the acceptance decreases. This trend is also seen within engineering majors but not to the same degree of change.

4.3. Trends Within Gender

Males showed greater baseline knowledge (Q3) of nanotechnology when compared to females. Males also exhibited greater overall acceptance in all aspects of nanotechnology although both genders had similar trends between questions.
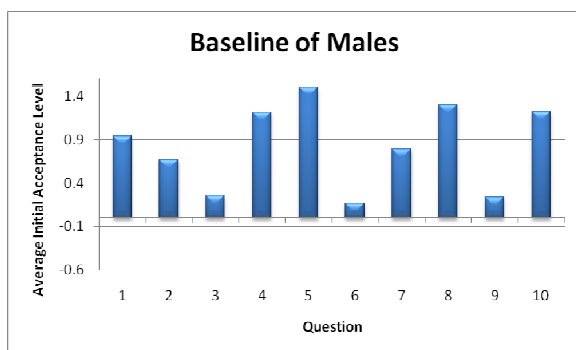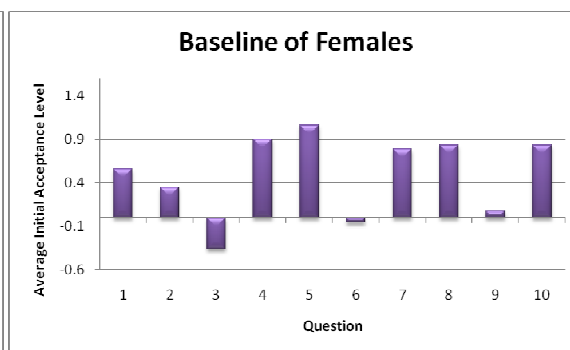
Figure 4.9   **Figure 4.10**

The average change in general knowledge (Q3) was greater for women because their baseline value was lower, whereas this trend was less dramatic for men. By merely adding the change of acceptance to the baseline, it is possible to obtain a post level of acceptance. After the video, males and females had about the same level of knowledge of nanotechnology. After learning about topical uses (Q2) of nanotechnology, both males and females had a lower acceptance of this application. As with the division of majors, as the knowledge of nanotechnology increased, its acceptance decreased.
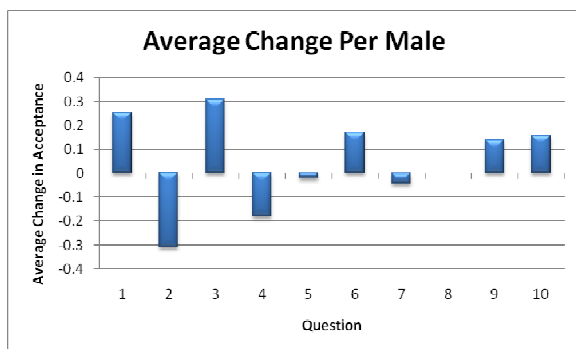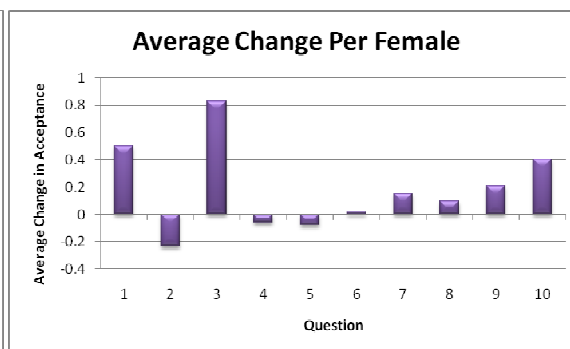
Figure 4.11   **Figure 4.12**

4.4. Overall Trends

The base level of acceptance pattern was consistent with all previously discussed

Figure 4.13

divisions. Here it is seen that the knowledge of nanotechnology was initially neutral and the acceptance of nano-electronics (Q5) was exceptionally high. The use of self-replicating nanobots (Q6) and military uses (Q9) were relatively neutral. This can be attributed to a lack
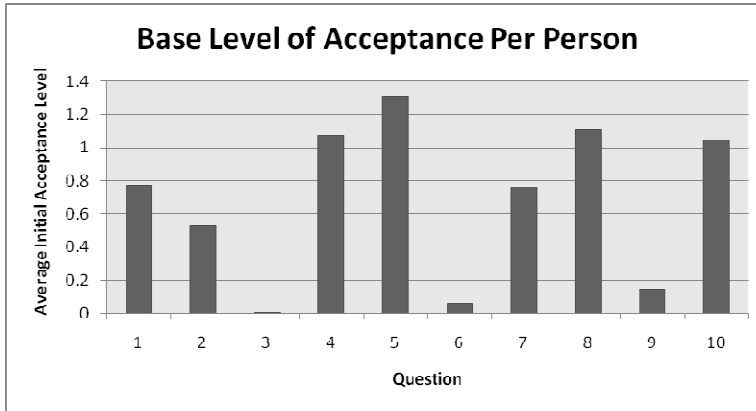
of knowledge and/or neutrality. It seemed that as long as the topic did not include military or personal use it was generally accepted.

Correlating with the t-test, the questions regarding nano-electronics (Q5), the potential abuse of nanotechnology (Q7), and nano-materials (Q8) are statistically insignificant in change and therefore do not merit further analysis. Again, the greatest

positive change involved overall knowledge of nanotechnology. Also consistent with previous divisions, the overall acceptance decreased after viewing the video.

Figure 4.14

4.5. Drawing Conclusions

The hypothesis stated that showing an educational video on nanotechnology will improve its acceptance. The data that have been presented do not support the hypothesis. As general knowledge of nanotechnology increased, the general acceptance decreased. The t-test showed that the respondents to the survey significantly felt more knowledgeable and also significantly less accepting of nanotechnology after viewing the informative video.

The hypothesis focused on the change in the acceptance levels. Only two questions demonstrated a significant negative change, whereas five questions showed a significant positive change in acceptance and three were not significant. This would lean towards supporting the hypothesis, however, it is important to note that one of the two negatively changed questions included general acceptance. The change in this question contradicts the five positively changed questions. This contradiction could be caused by biased events in the video. Even though the video was designed to be as neutral as possible, certain elements of bias may be reflected in the results.

Although the hypothesis was not proven, there was still a positive general acceptance of nanotechnologies in specific areas after the video. Using this information, it can be inferred that while showing a video might not increase the general acceptance, it certainly would not decrease the acceptance in specific areas of nanotechnology and would leave the population more informed (Q1, Q3).

4.6. Future Recommendations

In the last few years there has been an overwhelming increase in the amount of information available on nanotechnology. This definitely hints at the strength that this technology has and its vast potential for the future. A future IQP group continuing this project might consider looking at the acceptance of nanotechnology when it first appeared and compare it to the current acceptance. This might show a trend in acceptance. This could be accomplished by looking at various polls and surveys that organizations publish.

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6. Appendices

6.1. Appendix A: Proposal

The Effect of an Educational Video
on the Acceptance of Nanotechnology

PROPOSAL FOR AN INTERACTIVE QUALIFYING PROJECT

Submitted to the Faculty of the
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
By

_____
David Beavers

_____
Calvin Goodrich

_____
Brad Kaufman

Date: October 11, 2007

_____
Dr. Nancy A. Burnham, Major Advisor

Introduction

  Nanotechnology is technology used to make artificial materials that are one to a hundred nanometers in at least one dimension. Nanotechnology is a hidden gem in today's society. Many products made with nanotechnology are of better quality compared to the same item made without it. However, if asked, most people will not know what nanotechnology is[1].

Many corporations have started nanotechnology research. Some even have products on the market that contain nanotechnology. These range from stain resistant materials to more efficient oil refinement. There are also some disadvantages to nanotechnology such as the manufacturing of deadlier weapons and the thought that self-replicating nanoparticles could possibly take over the world.

  Some beliefs for and against nanotechnology are exaggerated. Science-fiction books depict nanotechnology as being able to shrink people to miniature versions of themselves[2]. Movies, books, and other sources of media give ambiguous or even incorrect interpretations of what nanotechnology is capable of achieving[3].

  The objectives of this project are to provide facts to college students and test their acceptance of nanotechnology before and after learning about nanotechnology. Their views will be analyzed to look for patterns of better acceptance of a new technology after being given information of the advantages of and dangers in the nanotechnology field.

Previous Research

  Similar projects to this one have already been done by previous groups at WPI. The first group, *Will 'Prey' Consume Nanotechnology,* did an overall study of the current acceptance of nanotechnology comparing scientific and nonscientific minds[4]. The next group, *Social Acceptance of Nanotechnologies,* studied how different consumer items involving vaccines, nuclear power, and genetically modified foods were accepted in society over time with a small comparison between countries[5]. The third group, *Social Acceptance of Nanomedicine,* did an in-depth study on risk adverse and risk prone people on the acceptance of new medicines containing nanoparticles[6].

Among the previous groups, varying degrees of testing was done on various populations. In the first project, a very limited survey was carried out on the three major categories of nanotechnology (materials, manufacturing, and medicine) which tested the acceptance between different mind sets. Testing occurred at technological colleges as well as liberal arts colleges. This allowed comparison of which group is more accepting of nanotechnology in which categories. The third group took one category of nanotechnology and concentrated on finding out whether nanomedicines would be accepted by different kinds of mind sets. The second group took the technology itself and analyzed how it was dealt with in different populations. This proposal is concerned with how an educational video about nanotechnology would influence the perception of it.

Information is already readily accessible about nanotechnology. There are videos on sites such as YouTube which go into detail about nanotechnology (See Appendix B). Most of these videos are biased since they are released by manufacturing companies trying to acquire funding to continue research and development. One video developed in the Global Media course at Brown University in June of 2007 [B.1] has captured a nanotechnology informative session which presents a balanced view. This was accomplished by including both the good and bad faces of nanotechnology.

Goals

The general population does not always sanction new technologies invented by the geniuses of society. Every new technology has it implications and if the public is educated and shown what the technology encompasses, there will be a more general acceptance of it. The focus now is nanotechnology; what it is, where it comes from, and how it impacts the lives of the people using it. When new advancements arise, people will be more accepting of this new development if they have been informed of the device's technicalities. If the population is informed properly, many fears of rising technology trends will be minimized, promoting further research funding and interest. Our thesis states that showing an informational video on nanotechnology will improve its acceptance.

By measuring the acceptance of nanotechnology before and after a short informational video the information can be compared, and we can indeed determine if the thesis has been proved or disproved. An analysis of the results will be broken down into many different subgroups to decide what type of population would be swayed the most after being informed of the nanotechnologies' benefits and costs. The video will be as close to non-biased as possible.

Target Population

The target population is the students at the colleges of Worcester Consortium (Appendix C). These thirteen schools will provide an ample population for proper analysis. These colleges include technical, liberal arts, private, medical, and community colleges. The college population is one of the most important for the future of nanotechnology because this group will influence its success in society.

Process

In order to determine if education increases a participant's acceptance of nanotechnology, surveying must take place before and after educating each person. An effective way to educate the participants would be through a short informational video. The survey will be conducted via a website accessible only to the target population. The entire surveying process is aimed to take place within approximately thirty minutes.

The creation of a website has a few benefits. The first is that sampled data will already be in electronic form. Another advantage is the ease of making the surveys and video available to the target population. In order for the participants to take the survey, they must register. Here each person will provide information such as college, major, year of graduation, and gender. After completing this brief registration, the participants will immediately be directed to the first survey. Upon its completion the participants will be exposed to the informational video, and then the final survey. Completing the entire survey will then store the information provided in a database for the research group to analyze later. The website will be up for an extended period of time to try and increase the number of responses to a maximum.

Organizing and shooting a video would be too time consuming and not feasible. Instead a video will be constructed out of existing informational videos online. The goal is to make a video which is non-biased. To achieve this there must be representation of both the positive and negative views of nanotechnology. The movie will be approximately ten minutes long and will cover a range of information, for example: nanomedicine, computer

technologies, tennis racquets, stainless materials, Israel's nano-robot, nano-manufacturing, carbon nanotubes, lab-on-a-chip, and video games. There are also hopes to include clips from some science fiction programs such as Star Trek, Jake 2.0, and others.

As stated previously, there will be two surveys. One will be presented before and the other will be presented after the video. Each will consist of between ten and fifteen questions. The questions will be developed to rate the participant's level of acceptance of nanotechnology. There will be minor differences between the first and second surveys. Technically they will be inquiring about the same information. However, the questions will be reworded and jumbled in an attempt to minimize the participant's awareness that they are being asked about the same information.

In order to attain an appropriate number of responses, three techniques will be used to encourage college students to take the survey. First, by contacting the webmaster and dean of each school, permission will be obtained to e-mail the student body and possibly integrate the survey's link into the school's website. Next, flyers will be handed out and posted on campuses. Finally, access to the survey will be convenient and available at all times to the participants.

After all data are collected, analysis will be performed. The data will be broken apart by each of the categories specified under registration: college, gender, graduation year, and major. Differences in each of these categories will be studied. Then all of the information will be pooled together. This will be used to determine if the thesis is upheld.

Timeline
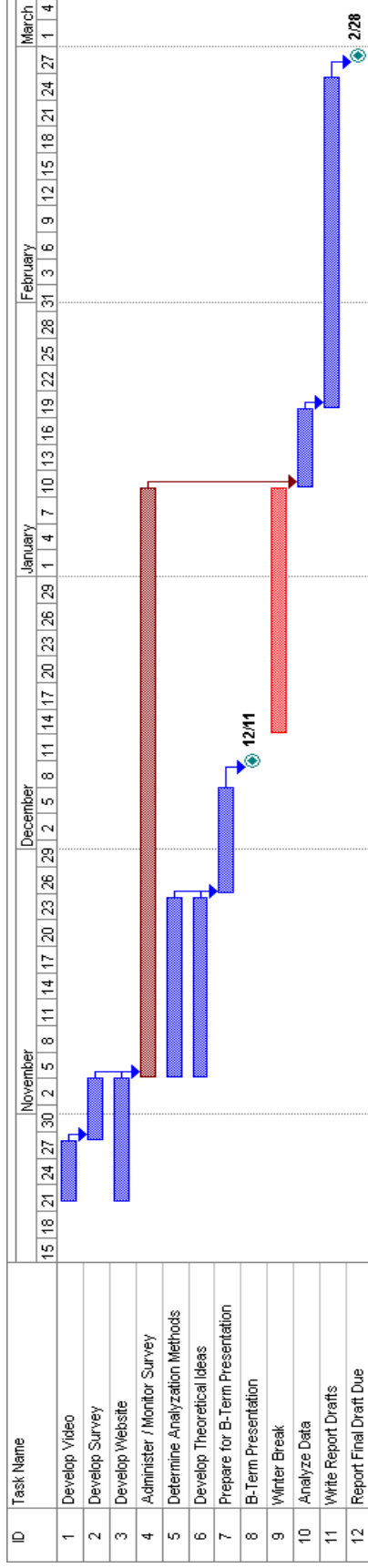
The Gantt chart above shows an approximate timeline for the remainder of the project. Observing this chart shows that the survey will be available until the beginning of C-Term, to allow a maximum number of responses. However, it is necessary to observe the results of the survey before its conclusion to include information in the B-Term Presentation. While the survey is being administered, ideas of how to present and interpret the data will be developed. This will help minimize the analysis in C-Term to allow maximum time to write the final report.

Summary

Nanotechnology has many promising applications for the future; some are even a reality today. Humans are not even aware that the acceptance of this revolutionary technology is essential for the development of the future. It would seem that education has a profound impact on how a group of people accepts an idea. The college students of today will significantly contribute to the success of nanotechnology. Educating this group on nanotechnology using a simple video may potentially increase its acceptance.

Appendix A

  The top-down approach to manufacturing is what is most commonly used today in which the manufacturer creates a product by manipulation on the macro scale of an object. Even microchips are still manufactured using this method.

  The bottom-up approach is still quite conceptual and involves creating the object on a molecular scale. This process includes nanobots or other manufacturing methods to place individual molecules to create the final product, whether it is macro, micro, or nano. Theoretically it is much easier to produce something nano-scale using a bottom-up approach as to a top-down approach. Not only do you have more precision in the makeup of the final product, but extremely small objects, merely molecules or atoms large, can be made.

  Moore's Law says that the number of transistors on a microchip will double about every eighteen months. So far this has held true but with current transistors composed of only a few molecules, the "semiconductor roadblock" is drawing closer.

Appendix B

You Tube Nanotechnology Videos
1. youtube.com/watch?v=xZs3FolkI-8
2. youtube.com/watch?v=S4CjZ-OkGDs
3. youtube.com/watch?v=97X1MeJVjR0
4. youtube.com/watch?v=5jqQxuVncmc
5. youtube.com/watch?v=BxilVKlFlo8&mode=related&search=

Appendix C

The Colleges of Worcester Consortium includes Anna Maria College, Assumption College, Atlantic Union College, Becker College, Clark University, College of the Holy Cross, Massachusetts College of Pharmacy & Health Sciences, Nichols College, Quinsigamond Community College, Tufts Cummings School of Veterinary Medicine, UMass Medical School, Worcester State College, and Worcester Polytechnic Institute.

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6.2. Appendix B1: Survey Questions Before Video

(Only one set of answer buttons are shown for sake of brevity)

Questions

Please answer these questions by rating them from strongly disagree to strongly agree.

Try not to think too much about the response after reading the statement.

Quite often the first response is the most accurate.

If you feel that you do not have enough knowledge to answer the question or it does not apply to you then please answer neutral.

3) I am knowledgeable about nanotechnology and its applications.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

4) I support nanotechnology: its research, prospects and uses.

1) I am aware of the already expanding presence of nanotechnology.

2) I support the use of topical substances which use nanoparticles.

10) I support medical practices which include nanotechnology.

9) I approve of possible military use of nanotechnology.

8) I approve of materials which use nanotechnology (nano-materials).

5) I approve of electronics which use nanotechnology (nano-electronics).

6) I support the use of self-replicating nanobots.

7) I am concerned about the possible abuse of nanotechnology.

6.2. Appendix B2 Survey Questions Before Video
(Only one set of answer buttons are shown for sake of brevity)

Questions

Please answer these questions by rating them from strongly disagree to strongly agree.

Try not to think too much about the response after reading the statement.

Quite often the first response is the most accurate.

If you feel that you do not have enough knowledge to answer the question or it does not apply to you then please answer neutral.

1) **I am conscious that nanotechnology has already emerged in products.**

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
☐	☐	☐	☐	☐

2) **I support the use of nanoparticles in skin products.**

3) **I am educated about topics concerning nanotechnology and its applications.**

4) **I approve of nanotechnology and its integration into society.**

5) **I approve of the use of nano-electronics.**

6) **I support the use of self-replicating nanobots.**

7) **I am bothered by the possible exploitation of nanotechnology.**

8) **I support the use of nano-materials.**

9) **I approve of the use of nanotechnology by military.**

10) **I support nanotechnology in treating medical problems.**

6.3. Appendix C1: Flyer For Encouraging Participation

How Much Do You Know About Nanotechnology?

What does nanotechnology mean and why is it in these products?

Many products today are marketed with nanotechnology on their label.

Are these products good or do they have consequences from their use?

The answers to these questions and more are answered in the video at:

www.wpi.edu/~dbeavers

An Interactive Qualifying Project by WPI students:
Dave Beavers, Calvin Goodrich, Brad Kaufman

6.3. Appendix C2: Brochure
For Encouraging Participation

How Much Do You Know About Nanotechnology?

Take a brief survey and watch a video about nanotechnology.

Visit

www.wpi.edu/~dbeavers

Picture on front page from

http://www.etcgroup.org/gallery2/d/
3091-2/nanobot0224_20061109_
214342.jpg
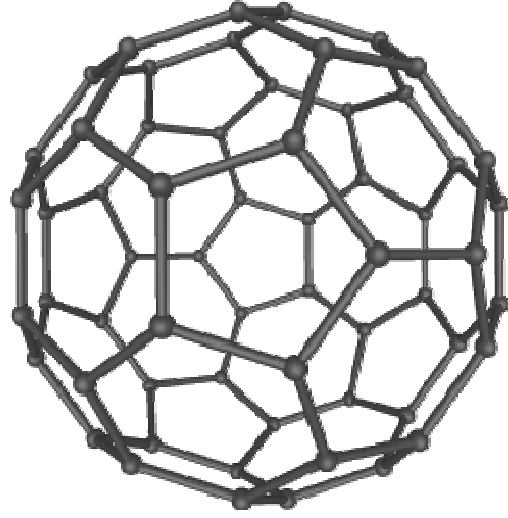
buckyball:
http://upload.wikimedia.org/wikipedia/co
mmons/4/41/C60a.png

An Interactive Qualifying Project
by WPI students:
Dave Beavers, Calvin Goodrich,
Brad Kaufman

Many products today are marketed with nanotechnology on their label.

What does nanotechnology mean and why is it in these products?

Are these products good or do they have consequences from their use?

What is some nanotechnology currently being developed?

The answers to these questions and more are answered in the video at:

www.wpi.edu/~dbeavers
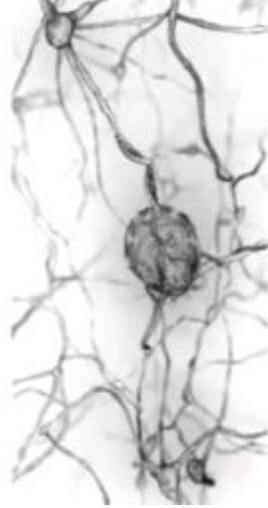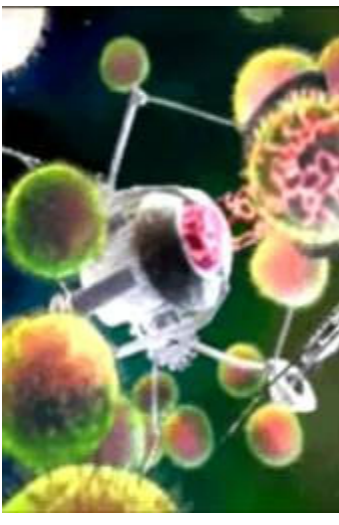
6.4. Appendix D: Raw Survey Data

School	AC	AC	AC	AC	AC	AC	CHC	CHC	CHC	CHC	CHC	CU	other	other
Gender	female	female	female	female	female	male	female	female	female	male	male	male	female	female
Class	4	4	4	4	4	3	3	4	4	500	3	2	1	47
Major	en	bus	bus	bus	en	en	med	oth	oth	oth	oth	med	oth	oth
QA1	2	2	1	1	2	2	2	1	2	3	4	3	2	3
QA2	3	3	4	3	3	3	4	3	4	3	4	4	3	3
QA3	3	3	1	2	3	2	4	2	3	3	4	4	3	3
QA4	3	3	3	4	3	2	3	3	3	3	4	4	3	3
QA5	3	3	4	3	2	2	4	4	4	3	4	5	3	3
QA6	3	3	4	3	3	2	3	4	4	3	3	3	3	3
QA7	3	3	4	3	4	4	3	4	4	3	4	4	3	3
QA8	3	3	5	3	4	4	3	4	4	3	4	4	3	3
QA9	2	2	2	2	3	2	3	2	4	3	3	3	3	3
QA10	4	4	4	4	3	4	4	4	4	3	4	4	3	3
QB1	4	4	5	4	4	4	3	4	3	3	4	3	4	4
QB2	2	2	4	3	3	3	2	3	2	3	4	3	4	3
QB3	2	2	4	4	4	3	2	3	3	3	4	3	4	4
QB4	3	3	5	4	3	4	3	4	4	3	4	3	4	4
QB5	3	3	5	4	3	4	4	3	4	3	4	3	4	4
QB6	2	2	5	2	3	3	3	2	4	3	3	3	4	4
QB7	4	4	4	5	4	4	3	2	4	3	4	3	4	3
QB8	3	3	5	4	3	4	3	4	4	3	4	3	4	4
QB9	4	4	5	4	3	2	3	4	4	3	3	1	4	3
QB10	4	4	5	5	4	3	4	5	4	3	4	3	4	4

Gender	Field	n																			
other female	oth	2	1	3	1	3	3	3	3	3	3	4	4	2	4	3	4	2	5	4	4	5
other female	va	3	2	4	4	3	4	4	4	4	3	3	2	3	2	3	3	3	4	3	3	4
other female	mu	3	1	4	4	3	3	3	4	4	3	3	1	3	3	3	4	3	5	3	3	3
other female	oth	3	3	5	5	3	3	3	3	3	3	3	5	4	3	4	4	3	4	4	4	4
other female	oth	1	4	4	4	3	4	2	4	4	2	4	4	3	4	4	4	2	3	4	4	4
other female	bus	18	2	2	2	3	3	3	3	3	3	4	4	2	4	3	4	2	4	3	3	3
other male	eng	45	3	4	4	4	4	3	4	5	4	4	5	4	4	4	5	5	4	4	3	4
other male	oth	3	4	3	4	3	3	4	4	5	3	2	4	3	4	4	5	3	2	4	5	3
other male	oth	15	4	5	4	5	5	2	4	5	4	4	4	3	4	4	4	4	5	4	1	3
other male	cs	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
other male	cs	2	3	5	5	4	4	1	3	5	1	5	3	3	4	3	5	1	5	3	1	3
other male	cs	23	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	3
other male	eng	3	2	3	4	3	4	2	4	4	3	5	4	3	2	4	4	4	3	5	4	4
other male	med	4	4	4	4	5	5	1	4	4	3	4	4	4	4	4	4	4	3	4	4	5

WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female	WPI female
4	3	3	2	1	3	2	2	2	3	1	1	47	1	4
eng	med	mil	eng	eng	cs	oth	oth	oth	med	cs	oth	oth	ma	oth
1	2	2	1	4	3	4	4	3	4	4	3	2	3	4
3	3	5	3	3	5	4	4	3	4	5	4	4	5	4
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4	2	4	3	4	5	4	4	4	4	5	3	4	5	4
3	2	5	2	1	1	3	3	3	2	3	3	4	3	3
1	4	5	5	5	5	4	3	4	4	4	4	5	5	4

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
WPI female 4 oth	2	4	4	3	4	3	4	4	3	4	4	3	2	4	4	3	4	4	4	5
WPI female 1 oth	2	4	4	3	4	3	4	4	3	4	5	3	3	4	4	4	4	4	4	3
WPI female 3 eng	4	5	5	4	4	4	4	5	2	3	4	4	4	4	4	2	3	4	4	4
WPI female 4 eng	3	4	4	3	4	2	4	4	4	2	5	5	3	4	4	2	5	4	4	4
WPI female 2 oth	2	4	4	3	3	3	3	3	3	3	4	4	3	2	4	4	3	2	4	4
WPI female 2 eng	3	4	4	3	4	3	4	4	3	4	4	4	4	4	4	3	4	4	4	4
WPI female 2 ma	4	5	4	4	4	2	4	5	4	2	4	4	2	3	4	4	4	2	3	4
WPI female 3 oth	4	5	3	3	4	2	3	4	3	4	4	4	4	4	4	4	3	5	4	4
WPI female 3 eng	2	4	4	4	4	2	3	5	5	3	4	4	4	3	2	4	4	3	4	5
WPI female 4 oth	4	4	4	4	4	3	4	4	3	4	4	3	3	4	4	4	3	3	4	4
WPI female 4 eng	4	4	4	3	4	4	4	5	4	5	5	4	4	5	4	4	3	4	4	4
WPI female 1 eng	3	5	4	4	5	5	5	5	4	2	5	5	5	5	5	5	5	5	5	5
WPI female 2 eng	2	3	5	3	4	4	4	4	4	3	4	4	2	4	4	4	2	4	4	4
WPI female 2 oth	3	4	3	3	4	2	3	5	2	5	4	4	4	4	5	2	5	5	1	5

WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI
female	female	female	female	female	male	male	male	male	male	male	male	male	male	male	male
eng	eng	eng	eng	oth	eng	eng	eng	eng	eng	eng	eng	eng	eng	eng	eng
4	2	1	1	3		3	3	3	3	3	3	3	3	3	2
4	4	4	3	1		4	4	4	4	4	4	3	3	4	2
4	4	5	5	4		4	4	4	4	4	4	4	4	4	5
4	4	5	5	2		5	4	4	4	4	3	3	3	4	3
4	4	4	4	3		3	4	4	4	3	3	3	3	4	3
4	4	5	5	3		5	5	5	5	4	4	4	4	4	4
3	3	3	3	3		5	5	2	5	2	4	4	4	3	3
4	3	5	5	3		5	5	4	5	4	5	5	5	3	4
4	4	5	5	4		5	5	5	5	5	5	4	4	4	4
3	3	3	3	3		4	4	3	3	3	3	3	3	3	4
4	4	4	4	3		4	4	5	4	5	4	4	4	4	2
4	4	5	5	4		5	5	4	5	4	5	4	4	4	4
3	3	3	3	3		3	3	3	3	3	4	3	3	2	3
4	3	4	4	2		2	5	3	5	5	4	2	2	4	3
4	4	4	4	4		4	5	4	5	5	4	4	4	4	4
3	3	5	5	4		4	5	5	5	5	5	4	4	5	5
3	3	4	4	3		5	4	4	4	3	4	5	4	4	3
4	4	5	5	4		4	5	5	5	4	5	4	4	5	5
4	4	5	4	4		5	5	5	4	5	5	4	4	5	4
3	3	4	3	3		4	5	4	5	3	4	4	4	2	3
4	4	5	5	4		5	5	5	5	5	5	4	4	5	5

Group	Gender	Num	Lang	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
WPI	male	1	eng	1	3	3	3	3	4	4	4	3	4	5	3	4	4	4	3	5	4	4	4	5
WPI	male	4	eng	4	5	5	5	5	4	5	5	2	3	5	2	4	5	5	2	2	5	4	4	4
WPI	male	3	cs	4	4	4	4	4	4	4	4	3	4	5	3	4	4	4	3	5	4	4	3	5
WPI	male	3	oth	4	3	4	3	3	1	2	3	1	5	4	3	4	4	3	1	4	3	4	3	3
WPI	male	28	eng	4	5	3	4	5	4	5	5	5	2	3	4	3	5	5	5	2	5	4	5	5
WPI	male	1	ma	4	3	4	3	3	3	3	4	3	3	5	4	2	4	4	3	3	5	4	5	5
WPI	male	1	eng	4	4	5	3	4	3	4	5	2	3	5	2	4	3	5	2	3	5	3	3	3
WPI	male	24	oth	3	3	5	4	4	3	4	4	2	3	4	4	3	3	3	3	3	3	4	3	5
WPI	male	3	eng	2	4	4	4	5	5	5	5	3	4	5	3	4	4	4	4	4	4	5	5	5
WPI	male	2	eng	4	5	4	3	4	1	4	5	2	4	4	4	3	4	5	2	4	4	4	1	4
WPI	male	4	eng	4	4	4	3	5	1	5	5	4	5	4	2	4	5	5	5	5	5	5	2	5
WPI	male	2	eng	4	4	4	4	5	1	5	5	4	5	4	4	3	4	4	4	3	5	4	5	5
WPI	male	2	eng	4	4	4	4	5	4	5	5	4	5	4	4	3	4	4	4	3	5	4	5	4
WPI	male	4	eng	3	4	4	4	4	1	5	5	4	5	4	2	4	5	5	5	5	5	5	2	5
WPI	male	2	eng	2	4	4	4	5	4	5	5	1	4	4	4	4	3	5	5	4	4	4	5	4
WPI	male	1	cs	3	4	2	4	5	2	5	5	1	4	4	4	4	3	5	5	4	4	4	5	5

WPI	male	eng	3	5	4	5	3	5	5	5	5	3	2	5	2	5	4	5	3	2	5	5	5
WPI	male	cs	4	2	4	3	3	4	4	4	4	3	3	4	3	3	4	4	3	4	3	4	4
WPI	male	eng	36	2	3	4	3	4	4	4	5	3	3	3	3	3	3	4	3	3	3	4	4
WPI	male	eng	3	2	4	5	5	5	5	5	5	4	2	5	5	4	4	5	5	4	5	5	5
WPI	male	cs	4	3	5	4	3	5	1	4	5	5	5	4	4	4	4	5	4	5	4	1	5
WPI	male	eng	3	4	4	5	3	4	1	5	5	4	5	4	3	4	4	5	4	5	5	1	5
WPI	male	oth	3	3	4	4	4	4	4	4	4	2	4	5	4	4	4	4	2	4	4	4	4
WPI	male	med	1	2	4	3	3	4	3	4	5	4	2	4	3	4	4	5	4	4	5	3	4
WPI	male	eng	4	4	5	4	3	4	4	4	5	3	4	4	4	4	4	4	4	5	4	4	4
WPI	male	eng	4	4	4	4	3	5	4	5	5	4	2	5	4	4	4	5	3	3	4	4	5
WPI	male	eng	1	4	4	4	4	3	5	4	5	2	5	4	4	4	4	4	2	5	4	5	4
WPI	male	eng	3	3	4	4	4	4	3	3	4	3	5	4	2	4	3	4	4	3	4	2	4
WPI	male	oth	3	2	3	4	3	4	2	3	3	3	4	4	2	3	3	3	3	4	3	2	4
WPI	male	eng	2	2	5	4	4	4	4	4	5	5	2	4	4	2	5	5	5	3	4	4	5

Survey	Gender	Yr	Major	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
WPI	male	1	eng	3	4	2	4	5	2	5	5	3	4	4	4	4	4	4	5	3	4	5	2	5
WPI	male	1	mil	2	5	5	5	5	2	5	5	5	2	4	4	4	2	4	4	4	4	5	2	5
WPI	male	1	cs	2	5	5	5	5	5	5	5	2	4	5	4	2	4	5	4	3	4	5	5
WPI	male	3	cs	2	4	4	4	4	2	4	4	2	3	4	4	4	4	2	3	4	5	2	4
WPI	male	2	eng	2	3	4	3	3	4	3	3	3	5	4	2	4	4	4	4	5	4	4	4
WPI	male	2	cs	2	3	4	3	3	1	3	3	3	4	4	4	4	5	4	4	4	5	1	5
WPI	male	4	cs	4	5	4	3	4	3	4	4	3	2	2	3	5	4	5	3	2	5	3	4
WPI	male	5	eng	4	4	4	3	5	5	4	5	2	4	4	4	4	4	4	2	4	5	4	4
WPI	male	3	cs	4	5	4	4	4	1	5	5	4	4	5	3	4	5	5	4	4	5	1	4
WPI	male	2	eng	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	4	5	5	5
WPI	male	1	oth	4	5	4	5	5	3	5	5	5	3	5	5	5	5	5	5	2	5	3	5
WPI	male	2	eng	3	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	3	4	4	4
WPI	male	2	ma	2	4	2	4	4	4	4	4	4	5	2	4	3	4	4	4	4	4	4	4
WPI	male	3	eng	4	4	4	3	4	2	5	5	3	4	5	4	3	4	5	2	4	5	2	4
WPI	male	2	cs	3	5	4	4	4	3	4	4	3	4	5	3	3	4	5	3	4	4	3	4

WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI	WPI
male	male	male	male	male	male	male	male	male	male	male	male	male	male	male	male
oth	eng	eng	eng	eng	eng	eng	eng	oth	eng	cs	eng	eng	cs	eng	cs
2	1	3	3	3	1	3	4	3	3	1	1	1	2	1	2
4	4	2	4	4	4	2	4	4	2	3	4	4	3	4	3
5	4	5	5	5	4	4	5	5	3	5	4	5	5	4	4
4	4	4	4	5	4	3	5	4	4	4	4	4	4	4	5
4	3	3	4	4	4	3	4	4	3	4	2	5	4	2	5
5	4	4	4	3	4	3	5	5	4	4	4	5	5	4	5
4	4	2	4	3	4	2	5	5	2	2	1	2	5	1	2
5	4	4	5	5	4	3	5	4	5	4	3	5	5	2	5
5	3	5	5	5	4	3	5	5	3	5	4	5	5	1	5
4	3	4	5	2	4	3	3	3	1	1	1	3	4	3	4
5	2	4	2	4	4	3	3	4	4	5	5	5	4	4	5
5	4	5	4	5	3	4	5	5	4	4	2	5	5	4	5
5	3	3	2	4	4	4	3	3	3	5	1	4	4	3	4
5	4	4	4	4	4	3	4	4	2	4	4	3	4	4	4
5	4	4	5	4	4	3	5	5	3	5	3	5	4	4	4
5	3	5	5	5	4	3	5	5	4	5	5	4	4	4	4
4	3	3	5	2	3	4	3	3	1	1	1	3	2	4	2
5	4	4	2	4	4	4	3	3	4	4	5	4	4	4	4
5	4	4	4	5	4	4	5	5	4	4	4	5	5	4	4
5	2	2	5	4	4	3	5	4	2	1	1	3	3	2	2
5	4	5	5	4	4	3	5	5	4	5	4	5	5	4	5

WPI	Sex	Num	Major																				
WPI	male	25	oth	4	4	4	3	4	4	5	5	3	2	5	3	4	4	5	3	4	4	4	4
WPI	male	1	oth	3	5	4	3	4	3	5	5	3	4	4	2	3	5	5	3	4	5	3	4
WPI	male	1	eng	3	5	4	3	4	3	5	5	3	4	4	2	3	5	5	3	4	5	3	4
WPI	male	4	eng	3	4	2	3	4	4	4	4	2	4	4	3	2	4	4	2	4	4	4	4
WPI	male	3	ma	4	5	4	4	5	4	5	5	5	3	4	4	3	4	5	5	3	4	5	4
WPI	male	1	eng	4	4	5	3	4	5	5	5	5	3	4	4	4	4	5	5	3	4	5	5
WPI	male	1	eng	3	5	4	4	4	5	5	5	5	2	5	4	4	4	5	5	3	4	5	4
WPI	male	1	eng	4	5	4	5	5	5	5	5	5	2	4	4	4	4	4	5	4	3	5	5
WPI	male	1	cs	4	5	5	5	5	5	5	5	5	2	5	5	4	5	5	5	5	4	5	5
WPI	male	3	eng	3	5	5	5	5	1	5	5	1	5	4	3	4	3	3	4	4	4	2	5
WPI	male	3	eng	2	4	2	3	3	3	3	3	2	5	4	2	1	4	4	2	5	4	4	5
WPI	male	3	oth	4	4	4	4	4	3	5	5	4	3	4	4	4	4	5	4	3	5	4	4
WPI	male	4	cs	4	5	5	5	5	4	5	5	4	5	5	4	4	4	5	4	3	5	5	5
WPI	male	2	oth	3	4	4	3	4	4	4	4	3	5	4	2	4	4	4	3	5	4	4	5
WPI	male	3	eng	3	5	5	5	5	5	5	5	5	4	2	5	3	4	5	5	4	5	5	5

WPI male	WPI male	WPI male	WSC female	WSC female	WSC female
eng	cs	eng	en	pf	med
3	3	1	2	1	1
4	1	2	3	1	2
5	5	3	3	3	5
5	1	3	2	2	4
4	3	3	2	3	4
5	5	3	3	4	5
3	4	3	1	1	4
5	5	3	3	5	4
5	5	3	3	5	5
4	4	3	3	3	2
5	4	3	4	2	4
5	4	3	4	4	4
3	4	3	3	3	1
4	2	3	4	3	3
4	5	3	4	4	4
5	5	3	4	4	4
3	4	3	4	4	1
5	4	3	3	4	3
4	5	3	5	4	4
3	4	3	2	3	5
5	5	3	4	5	5

6.5. Appendix E: Cgi scripts/html(javascript) code

6.5.1 index.html

```html
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html>
<head>
      <title>
         Nanotechnology IQP
      </title>
      <style type="text/css">
<!--
.style1 {color: #CC0000}
-->
      </style>
</head>
<body>
<div align="center"><h2>Nanotechnology</h2></div>
<div align="center"><h1>IQP 07-08</h1></div>
<div align="center">David Beavers, Calvin Goodrich, Brad Kaufman</div>
<div align="center">
  <p>Supervisor: Nancy Burnham</p>
  <p> </p></div>
<div align="center">
  <p>The survey process should take no more than 15 minutes to complete. All survey questions have the same format.</p>
  <p>Please press the Start button to begin.</p>
  <form method="post" action="cgi-bin/index.cgi">
    <label><!--<span class="style1">Website is currently being updated, please be patient while features are added.</span>--><br />
    <input type="submit" value="Start" />
    </label>
    <p>This site requires Java and Flash to run properly. Most people have these installed already<br />
    but if you are unsure visit the <a href="http://www.java.com/en/download/help/testvm.xml">Java Test Site</a> or the <a
href="http://www.adobe.com/shockwave/welcome/">Flash Test Site</a>.</p>
  </form>
  <p> </p>
  <p>If you have any questions, please contact the<a href=mailto:dbeavers@wpi.edu> webmaster</a>.   </p>
</div>
<p align="center">
          <a href="http://www.wpi.edu/">
          <img src="seal.gif" alt="[WPI]" title="WPI Homepage" width="70" height="32" vspace="5" border="0">
      </a>
</p>
</body>
</html>
```

6.5.2 index.cgi

```perl
#!/usr/bin/perl -wT
use CGI qw(:standard);
# Random Number Generator used for session info
srand(time() ^($$ + ($$ <<15))) ;
$session = rand();
# direct to next step in survey with random number attached to html query
print "Location: ../info.html?$session\n\n";
```

6.5.3 info.html

```html
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<title>Background Information</title>
<!--<script type="text/javascript">
function validate_six(field)
{
with (field)
{
if (value=="6")
  {return true}
else {return false}
}
}

function validate_required(field,alerttxt)
{
with (field)
{
if (value==null||value=="")
  {alert(alerttxt);return false}
else {return true}
}
}
```

```
function validate_form(thisform)
{
with (thisform)
{
if (validate_required(college,"College must be selected.")==false)
           {college.focus();return false}
if (validate_required(class,"Class must be selected.")==false)
  {class.focus();return false}
if (validate_six(class) && (validate_required(age,"Age must be entered if 'Other' is selected under Class.")==false))
           {age.focus();return false}
if (validate_required(major,"Major must be selected.")==false)
           {major.focus();return false}
var session = window.location.search;
document.info.action = "cgi-bin/info.cgi" + session;return true
}
}
function linkWithQuery()
{
           var session = window.location.search
   document.info.action = "cgi-bin/info.cgi" + session;return true
}
</script>-->
<script>
function sessionlink() {
var session = window.location.search
document.info.action = "cgi-bin/info.cgi" + session;return true
}
</script>
</head>
<body>
<div align="center">
  <h1>Your Background Information</h1>
</div>
<div align="left">
  <p align="center">In order to accurately analyze the survey data we must collect a bit of information about you. Please answer
honestly.  <br />
  The answers you provide will be completely anonymous. This form was designed for the colleges of the Worcester<br />
  Consortium and therefore may not properly accommodate survey takers from outside these select colleges.<br />
  All information given will not be given out to any third parties.</p>
</div>
<form id="info" name="info" action="error.html" onsubmit="return sessionlink()" method="post">
  <label>
  <div align="center">
    <p><br />
      College You Attend:
        <select name="college" id="college">
          <option selected="selected" value="">Please Select One ...</option>
          <option value="AMC">Anna Maria College</option>
          <option value="AC">Assumption College</option>
          <option value="AUC">Atlantic Union College</option>
          <option value="BC">Becker College</option>
          <option value="CU">Clark University</option>
          <option value="CHC">College of the Holy Cross</option>
          <option value="CSVM">Cummings School of Veterinary Medicine</option>
          <option value="MCPHS">Mass. College of Pharmacy &amp; Health Sciences</option>
          <option value="NC">Nichols College</option>
          <option value="UMS">UMass Medical School</option>
          <option value="WSC">Worcester State College</option>
          <option value="WPI">Worcester Polytechnic Institute</option>
          <option value="other">Other</option>
        </select>
        <br />
        <br />
        <label><br />
        Gender:
          <input type="radio" name="gender" value="male" id="gender_0" />
Male</label>
          <input type="radio" name="gender" value="female" id="gender_1" />
          <label>Female</label>
          <br />
          <label> </label>
<br />
          <label></label>
        </p>
      <p>
        <label>Class:
        <select name="class" id="class">
          <option selected="selected" value="">Please Select One...</option>
          <option value="1">Freshman</option>
          <option value="2">Sophomore</option>
          <option value="3">Junior</option>
          <option value="4">Senior</option>
          <option value="5">Alum</option>
          <option value="6">Other</option>
                          </select>
        </label>
        </p>
      <p> </p>
      <p>
        <label>If Class is &quot;Other,&quot; please enter your age here:
        <input type="text" size="3" maxlength="3" name="age" id="age" />
        </label>
      </p>
      <p> </p>
```

```html
    <p>
      <label>Major Area of Study:
      <select name="major" id="major">
        <option selected="selected" value="">Please Select One ...</option>
        <option value="ad">Advertising</option>
        <option value="bus">Business</option>
        <option value="cs">Computer Science</option>
        <option value="eng">Engineering</option>
        <option value="en">English</option>
        <option value="fl">Foreign Language</option>
        <option value="ma">Mathematics</option>
        <option value="med">Medical</option>
        <option value="mil">Military</option>
        <option value="mu">Musical</option>
        <option value="pf">Physical Fitness</option>
        <option value="va">Visual Arts</option>
        <option value="oth">Other</option>
      </select>
      </label>
      <br />
    </p>
  </div>
  </label>
  <div align="center">
    <label>
    <input type="submit" name="Submit" id="Submit" value="Submit" />
    </label>
  </div>
  <div align="center"></div>
</form>
<p align="center"> </p>
<p align="center"><a href="http://www.wpi.edu/">
  <img src="seal.gif" alt="[WPI]" title="WPI Homepage" width="70" height="32" vspace="5" border="0">
  </a>
</p>
<div align="right"><a href="mailto:dbeavers@wpi.edu">webmaster</a></div>
</div>
</body>
</html>
```

6.5.4 info.cgi

```perl
#!/usr/bin/perl -wT
use CGI qw(:standard);
# declare and set vars from post form
my $college = param('college');
my $gender = param('gender');
my $class = param('class');
my $age = param('age');
my $major = param('major');
# get session variable from html query
my $session = $ENV{QUERY_STRING};
## Error checking
#if college is absent return error
if ($college eq "") {
          print header;
          print start_html("ERROR");
          print "<h2>Please use your browsers back button and select a college</h2>\n";
          print end_html;
          exit;
}
#if gender is absent return error
if ($gender eq "") {
          print header;
          print start_html("ERROR");
          print "<h2>Please use your browsers back button and select a gender</h2>\n";
          print end_html;
          exit;
}
#if class is absent return error
if ($class eq "") {
          print header;
          print start_html("ERROR");
          print "<h2>Please use your browsers back button and select a class</h2>\n";
          print end_html;
          exit;
}
#if class is set to 6 then age must be greater than 6
if ($class==6){
          if ($age<=6||$age eq "") {
                    print header;
                    print start_html("ERROR");
                    print "<h2>Please use your browsers back button and enter your age</h2>\n";
                    print end_html;
                    exit;
          }
}
#if major is absent return error
if ($major eq "") {
          print header;
          print start_html("ERROR");
          print "<h2>Please use your browsers back button and select a major</h2>\n";
          print end_html;
```

```perl
            exit;
}
# define filename to be string and untaint it
## untainting is needed because of perl security measures
my $filename = $session . '.txt';
if ($filename =~ /(.*)/) {
    $filename = $1;
}
## the only way that the session is kept is through javascript on clientside
#if session data does not exists prompt for javascript install
if ($session eq "") {
            print "Location: ../error.html\n\n";
}

# if other is selected under class, take age field and set it to class
if ($class==6) {
            $class = param('age');
}

#create and open file and write gathered info to it
open data, ">sessions/$filename";
print data "$college\n";
print data "$gender\n";
print data "$class\n";
print data "$major\n";
close data;

#transfer to pre-survey page
print "Location: ../qa.html?$session\n\n";

## print vars out to browser (currently only for debugging)
# print header;
# print start_html("Form Answers Session: $session"); #contains session variable in header for debugging
# print "College You Attend: $college\n";
# print "<p> </p>";
# print "Gender: $gender\n";
# print "<p> </p>";
# print "Class: $class\n";
# print "<p> </p>";
# print "Age: $age\n";
# print "<p> </p>";
# print "Major Area of Study: $major\n";
# print "<p> </p>";
# print "Filename to store info: $filename\n";
# print end_html;
```

6.5.5 qa.html

```html
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<title>Pre-Video Survey</title>
<script>
function sessionlink() {
var session = window.location.search
document.qa.action = "cgi-bin/qa.cgi" + session;return true
}
</script>
</head>

<body>
<div align="center">
  <h1>Questions</h1>
</div>
<div align="center">
  <p>Please answer these questions by rating them from strongly disagree to strongly agree. </p>
  <p>Try not to think too much about the response after reading the statement. </p>
  <p>Quite often the first response is the most accurate.</p>
  <p>If you feel that you do not have enough knowledge to answer the question or it does not apply to you then please answer
neutral.</p>
</div>
<form id="qa" name="qa" action="error.html" onSubmit="return sessionlink()" method="post">
  <p align="center"> </p>
  <p align="center"><strong>I am knowledgeable about nanotechnology and its applications.</strong>
    <label></label>
  </p>
  <div align="center">
    <table width="559">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa1" value="1" id="q1_0" />
            </div></td>
        <td><div align="center">
```

```html
            <input type="radio" name="qa1" value="2" id="q1_1" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa1" value="3" id="q1_2" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa1" value="4" id="q1_3" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa1" value="5" id="q1_4" />
        </div></td>
      </tr>
    </table>
</div>
<div align="center">
    <p> </p>
    <p><strong>I support nanotechnology: its research, prospects and uses</strong>.</p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa2" value="1" id="q1_5" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa2" value="2" id="q1_6" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa2" value="3" id="q1_7" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa2" value="4" id="q1_8" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa2" value="5" id="q1_9" />
        </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I am aware of the already expanding presence of nanotechnology.</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa3" value="1" id="q1_10" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa3" value="2" id="q1_11" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa3" value="3" id="q1_12" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa3" value="4" id="q1_13" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa3" value="5" id="q1_14" />
        </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I support the use of topical substances which use nanoparticles.</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa4" value="1" id="q1_15" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa4" value="2" id="q1_16" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa4" value="3" id="q1_17" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qa4" value="4" id="q1_18" />
        </div></td>
        <td><div align="center">
```

```
            <input type="radio" name="qa4" value="5" id="q1_19" />
          </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I support medical practices which include nanotechnology.</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa5" value="1" id="q1_20" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa5" value="2" id="q1_21" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa5" value="3" id="q1_22" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa5" value="4" id="q1_23" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa5" value="5" id="q1_24" />
          </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I approve of possible military use of nanotechnology.</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa6" value="1" id="q1_25" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa6" value="2" id="q1_26" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa6" value="3" id="q1_27" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa6" value="4" id="q1_28" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa6" value="5" id="q1_29" />
          </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I approve of materials which use nanotechnology (nano-materials).</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qa7" value="1" id="q1_30" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa7" value="2" id="q1_31" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa7" value="3" id="q1_32" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa7" value="4" id="q1_33" />
          </div></td>
        <td><div align="center">
            <input type="radio" name="qa7" value="5" id="q1_34" />
          </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I approve of electronics which use nanotechnology (nano-electronics).</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
```

```html
      <td width="125"><div align="center">Neutral</div></td>
      <td width="125"><div align="center">Agree</div></td>
      <td width="125"><div align="center">Strongly Agree</div></td>
    </tr>
    <tr>
      <td><div align="center">
          <input type="radio" name="qa8" value="1" id="q1_35" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa8" value="2" id="q1_36" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa8" value="3" id="q1_37" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa8" value="4" id="q1_38" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa8" value="5" id="q1_39" />
        </div></td>
    </tr>
  </table>
  <p> </p>
  <p><strong>I support the use of self-replicating nanobots.</strong></p>
  <table width="560">
    <tr>
      <td width="125"><div align="center">Strongly Disagree</div></td>
      <td width="125"><div align="center">Disagree</div></td>
      <td width="125"><div align="center">Neutral</div></td>
      <td width="125"><div align="center">Agree</div></td>
      <td width="125"><div align="center">Strongly Agree</div></td>
    </tr>
    <tr>
      <td><div align="center">
          <input type="radio" name="qa9" value="1" id="q1_40" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa9" value="2" id="q1_41" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa9" value="3" id="q1_42" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa9" value="4" id="q1_43" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa9" value="5" id="q1_44" />
        </div></td>
    </tr>
  </table>
  <p> </p>
  <p><strong>I am concerned about the possible abuse of nanotechnology.</strong></p>
  <table width="560">
    <tr>
      <td width="125"><div align="center">Strongly Disagree</div></td>
      <td width="125"><div align="center">Disagree</div></td>
      <td width="125"><div align="center">Neutral</div></td>
      <td width="125"><div align="center">Agree</div></td>
      <td width="125"><div align="center">Strongly Agree</div></td>
    </tr>
    <tr>
      <td><div align="center">
          <input type="radio" name="qa10" value="1" id="q1_45" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa10" value="2" id="q1_46" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa10" value="3" id="q1_47" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa10" value="4" id="q1_48" />
        </div></td>
      <td><div align="center">
          <input type="radio" name="qa10" value="5" id="q1_49" />
        </div></td>
    </tr>
  </table>
  <p>
    <label>
    <input type="submit" name="Submit" id="Submit" value="Submit" />
    </label>
  </p>
  </div>
</form>
<p align="center"> </p>
<p align="center"> </p>
<p align="center"><a href="http://www.wpi.edu/">
  <img src="seal.gif" alt="[WPI]" title="WPI Homepage" width="70" height="32" vspace="5" border="0">
  </a>
</p>
<div align="right"><a href="mailto:dbeavers@wpi.edu">webmaster</a>
</div>
</body>
</html>
```

6.5.6 qa.cgi

```perl
#!/usr/bin/perl -wT
use CGI qw(:standard);
#set vars from post form
my $qa1 = param('qa1');
my $qa2 = param('qa2');
my $qa3 = param('qa3');
my $qa4 = param('qa4');
my $qa5 = param('qa5');
my $qa6 = param('qa6');
my $qa7 = param('qa7');
my $qa8 = param('qa8');
my $qa9 = param('qa9');
my $qa10 = param('qa10');

# session variable
my $session = $ENV{QUERY_STRING};

# define filename to be string and untaint it
my $filename = $session . '.txt';
if ($filename =~ /(.*)/) {
    $filename = $1;
}

#if session data does not exists prompt for javascript install
if ($session eq "") {
            print "Location: ../error.html\n\n";
}

# error correction
if ($qa1 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 1</h2>\n";
            print end_html;
            exit;
}
if ($qa2 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 2</h2>\n";
            print end_html;
            exit;
}
if ($qa3 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 3</h2>\n";
            print end_html;
            exit;
}
if ($qa4 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 4</h2>\n";
            print end_html;
            exit;
}
if ($qa5 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 5</h2>\n";
            print end_html;
            exit;
}
if ($qa6 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 6</h2>\n";
            print end_html;
            exit;
}
if ($qa7 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 7</h2>\n";
            print end_html;
            exit;
}
if ($qa8 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 8</h2>\n";
            print end_html;
            exit;
}
if ($qa9 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 9</h2>\n";
            print end_html;
            exit;
```

```
}
if ($qa10 eq "") {
            print header;
            print start_html("ERROR");
            print "<h2>Please use your browsers back button and select an answer for question 10</h2>\n";
            print end_html;
            exit;
}

#open file and append info to it
open data, ">>sessions/$filename";
print data "$qa1\n";
print data "$qa2\n";
print data "$qa3\n";
print data "$qa4\n";
print data "$qa5\n";
print data "$qa6\n";
print data "$qa7\n";
print data "$qa8\n";
print data "$qa9\n";
print data "$qa10\n";
close data;

#transfer to video page
print "Location: ../video2.html?$session\n\n";

## print results (for debugging only)
# print header;
# print start_html("RESULTS");
# print "Question 1 is $qa1\n";
# print "<p> </p>";
# print "Question 2 is $qa2\n";
# print "<p> </p>";
# print "Question 3 is $qa3\n";
# print "<p> </p>";
# print "Question 4 is $qa4\n";
# print "<p> </p>";
# print "Question 5 is $qa5\n";
# print "<p> </p>";
# print "Question 6 is $qa6\n";
# print "<p> </p>";
# print "Question 7 is $qa7\n";
# print "<p> </p>";
# print "Question 8 is $qa8\n";
# print "<p> </p>";
# print "Question 9 is $qa9\n";
# print "<p> </p>";
# print "Question 10 is $qa10\n";
# print end_html;
```

6.5.7 video2.html

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<title>Nanotech Video</title>
<script type="text/javascript">
function sessionlink() {
var session = window.location.search
document.video.action = "qb.html" + session;return true
}
function MM_CheckFlashVersion(reqVerStr,msg){
  with(navigator){
    var isIE  = (appVersion.indexOf("MSIE") != -1 && userAgent.indexOf("Opera") == -1);
    var isWin = (appVersion.toLowerCase().indexOf("win") != -1);
    if (!isIE || !isWin){
      var flashVer = -1;
      if (plugins && plugins.length > 0){
        var desc = plugins["Shockwave Flash"] ? plugins["Shockwave Flash"].description : "";
        desc = plugins["Shockwave Flash 2.0"] ? plugins["Shockwave Flash 2.0"].description : desc;
        if (desc == "") flashVer = -1;
        else{
          var descArr = desc.split(" ");
          var tempArrMajor = descArr[2].split(".");
          var verMajor = tempArrMajor[0];
          var tempArrMinor = (descArr[3] != "") ? descArr[3].split("r") : descArr[4].split("r");
          var verMinor = (tempArrMinor[1] > 0) ? tempArrMinor[1] : 0;
          flashVer =  parseFloat(verMajor + "." + verMinor);
        }
      }
      // WebTV has Flash Player 4 or lower -- too low for video
      else if (userAgent.toLowerCase().indexOf("webtv") != -1) flashVer = 4.0;

      var verArr = reqVerStr.split(",");
      var reqVer = parseFloat(verArr[0] + "." + verArr[2]);

      if (flashVer < reqVer){
        if (confirm(msg))
          window.location = "http://www.adobe.com/shockwave/download/download.cgi?P1_Prod_Version=ShockwaveFlash";
      }
    }
  }
```

```
}
</script>
<script src="AC_RunActiveContent.js" type="text/javascript"></script>
</head>

<body onload="MM_CheckFlashVersion('7,0,0,0','Content on this page requires a newer version of Adobe Flash Player. Do you want to
download it now?');">
<div align="center">
  <h1>Nanotechnology Video</h1>
</div>
<div align="center">
  <p>Please watch this short video about nanotechnology and its applications. </p>
  <p>Make sure your speakers are turned on.</p>
</div>
<p> </p>
<div align="center">
<script type="text/javascript">
AC_FL_RunContent(
'codebase','http://fpdownload.macromedia.com/pub/shockwave/cabs/flash/swflash.cab#version=7,0,0,0','name','player','width','480','heig
ht','320','align','middle','id','player','src','player?file=video/IQPvideo.flv&size=false&aplay=true&autorew=false&title=','menu','fal
se','quality','high','bgcolor','#999999','allowscriptaccess','sameDomain','pluginspage','http://www.macromedia.com/go/getflashplayer',
'movie','player?file=video/IQPvideo.flv&size=false&aplay=true&autorew=false&title=' ); //end AC code
</script><noscript><object classid="clsid:d27cdb6e-ae6d-11cf-96b8-444553540000"
codebase="http://fpdownload.macromedia.com/pub/shockwave/cabs/flash/swflash.cab#version=7,0,0,0" name="player" width="480"
height="320" align="middle" id="player">
<param name="movie" value="player.swf?file=video/IQPvideo.flv&amp;size=false&amp;aplay=true&amp;autorew=false&amp;title=" />
<param name="menu" value="false" />
<param name="quality" value="high" />
<param name="bgcolor" value="#999999" />
<embed src="player.swf?file=video/IQPvideo.flv&amp;size=false&amp;aplay=true&amp;autorew=false&amp;title=" menu="false" quality="high"
bgcolor="#999999" width="480" height="320" name="player" align="middle" allowScriptAccess="sameDomain" type="application/x-shockwave-
flash" pluginspage="http://www.macromedia.com/go/getflashplayer" />
</object></noscript></div>
<div align="center"><form action="qb.html" method="post" name="video" onSubmit="return sessionlink()">
  <p>      </p>
  <p>
    <input name="video completed" type="submit" value="Continue" id="video completed" />
    </p>
</form></div>
<p align="center"> </p>
<p align="center"><a href="http://www.wpi.edu/">
  <img src="seal.gif" alt="[WPI]" title="WPI Homepage" width="70" height="32" vspace="5" border="0">
  </a>
</p>
<div align="right"><a href="mailto:dbeavers@wpi.edu">webmaster</a>
</div>
</body>
</html>
```

6.5.8 qb.html

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<title>Post-Video Survey</title>
<script>
function sessionlink() {
var session = window.location.search
document.qb.action = "cgi-bin/qb.cgi" + session;return true
}
</script>
</head>

<body>
<div align="center">
  <h1>Questions</h1>
</div>
<div align="center">
  <p>Please answer these questions by rating them from strongly disagree to strongly agree. </p>
  <p>Try not to think too much about the response after reading the statement. </p>
  <p>Quite often the first response is the most accurate.</p>
  <p>If you feel that you do not have enough knowledge to answer the question or it does not apply to you then please answer
neutral.</p>
</div>
<form id="qb" name="qb" method="post" action="error.html" onSubmit="return sessionlink()">
  <p align="center"> </p>
  <p align="center"><strong>I am conscious that nanotechnology has already emerged in consumer products.</strong></p>
  <div align="center">
    <table width="559">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qb1" value="1" id="q1_0" />
            </div></td>
        <td><div align="center">
          <input type="radio" name="qb1" value="2" id="q1_1" />
```

```html
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb1" value="3" id="q1_2" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb1" value="4" id="q1_3" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb1" value="5" id="q1_4" />
      </div></td>
    </tr>
  </table>
</div>
<div align="center">
  <p> </p>
  <p><strong>I support the use of nanoparticles in skin products.</strong></p>
  <table width="560">
    <tr>
      <td width="125"><div align="center">Strongly Disagree</div></td>
      <td width="125"><div align="center">Disagree</div></td>
      <td width="125"><div align="center">Neutral</div></td>
      <td width="125"><div align="center">Agree</div></td>
      <td width="125"><div align="center">Strongly Agree</div></td>
    </tr>
    <tr>
      <td><div align="center">
        <input type="radio" name="qb2" value="1" id="q1_5" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb2" value="2" id="q1_6" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb2" value="3" id="q1_7" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb2" value="4" id="q1_8" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb2" value="5" id="q1_9" />
      </div></td>
    </tr>
  </table>
  <p> </p>
  <p><strong>I am educated about topics concerning nanotechnology and its applications.</strong></p>
  <table width="560">
    <tr>
      <td width="125"><div align="center">Strongly Disagree</div></td>
      <td width="125"><div align="center">Disagree</div></td>
      <td width="125"><div align="center">Neutral</div></td>
      <td width="125"><div align="center">Agree</div></td>
      <td width="125"><div align="center">Strongly Agree</div></td>
    </tr>
    <tr>
      <td><div align="center">
        <input type="radio" name="qb3" value="1" id="q1_10" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb3" value="2" id="q1_11" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb3" value="3" id="q1_12" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb3" value="4" id="q1_13" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb3" value="5" id="q1_14" />
      </div></td>
    </tr>
  </table>
  <p> </p>
  <p><strong>I approve of nanotechnology and its integration into society.</strong></p>
  <table width="560">
    <tr>
      <td width="125"><div align="center">Strongly Disagree</div></td>
      <td width="125"><div align="center">Disagree</div></td>
      <td width="125"><div align="center">Neutral</div></td>
      <td width="125"><div align="center">Agree</div></td>
      <td width="125"><div align="center">Strongly Agree</div></td>
    </tr>
    <tr>
      <td><div align="center">
        <input type="radio" name="qb4" value="1" id="q1_15" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb4" value="2" id="q1_16" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb4" value="3" id="q1_17" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb4" value="4" id="q1_18" />
      </div></td>
      <td><div align="center">
        <input type="radio" name="qb4" value="5" id="q1_19" />
      </div></td>
```

```
      </div></td>
    </tr>
</table>
<p> </p>
<p><strong>I approve of the use of nano-electronics.</strong></p>
<table width="560">
  <tr>
    <td width="125"><div align="center">Strongly Disagree</div></td>
    <td width="125"><div align="center">Disagree</div></td>
    <td width="125"><div align="center">Neutral</div></td>
    <td width="125"><div align="center">Agree</div></td>
    <td width="125"><div align="center">Strongly Agree</div></td>
  </tr>
  <tr>
    <td><div align="center">
        <input type="radio" name="qb5" value="1" id="q1_20" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb5" value="2" id="q1_21" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb5" value="3" id="q1_22" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb5" value="4" id="q1_23" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb5" value="5" id="q1_24" />
    </div></td>
  </tr>
</table>
<p> </p>
<p><strong>I support the use of self-replicating nanobots.</strong></p>
<table width="560">
  <tr>
    <td width="125"><div align="center">Strongly Disagree</div></td>
    <td width="125"><div align="center">Disagree</div></td>
    <td width="125"><div align="center">Neutral</div></td>
    <td width="125"><div align="center">Agree</div></td>
    <td width="125"><div align="center">Strongly Agree</div></td>
  </tr>
  <tr>
    <td><div align="center">
        <input type="radio" name="qb6" value="1" id="q1_25" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb6" value="2" id="q1_26" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb6" value="3" id="q1_27" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb6" value="4" id="q1_28" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb6" value="5" id="q1_29" />
    </div></td>
  </tr>
</table>
<p> </p>
<p><strong>I am bothered by the possible exploitation of nanotechnology.</strong></p>
<table width="560">
  <tr>
    <td width="125"><div align="center">Strongly Disagree</div></td>
    <td width="125"><div align="center">Disagree</div></td>
    <td width="125"><div align="center">Neutral</div></td>
    <td width="125"><div align="center">Agree</div></td>
    <td width="125"><div align="center">Strongly Agree</div></td>
  </tr>
  <tr>
    <td><div align="center">
        <input type="radio" name="qb7" value="1" id="q1_30" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb7" value="2" id="q1_31" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb7" value="3" id="q1_32" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb7" value="4" id="q1_33" />
    </div></td>
    <td><div align="center">
        <input type="radio" name="qb7" value="5" id="q1_34" />
    </div></td>
  </tr>
</table>
<p> </p>
<p><strong>I support the use of nano-materials.</strong></p>
<table width="560">
  <tr>
    <td width="125"><div align="center">Strongly Disagree</div></td>
    <td width="125"><div align="center">Disagree</div></td>
    <td width="125"><div align="center">Neutral</div></td>
```

```html
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qb8" value="1" id="q1_35" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb8" value="2" id="q1_36" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb8" value="3" id="q1_37" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb8" value="4" id="q1_38" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb8" value="5" id="q1_39" />
        </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I approve of the use of nanotechnology by military.</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qb9" value="1" id="q1_40" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb9" value="2" id="q1_41" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb9" value="3" id="q1_42" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb9" value="4" id="q1_43" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb9" value="5" id="q1_44" />
        </div></td>
      </tr>
    </table>
    <p> </p>
    <p><strong>I support nanotechnology in treating medical problems.</strong></p>
    <table width="560">
      <tr>
        <td width="125"><div align="center">Strongly Disagree</div></td>
        <td width="125"><div align="center">Disagree</div></td>
        <td width="125"><div align="center">Neutral</div></td>
        <td width="125"><div align="center">Agree</div></td>
        <td width="125"><div align="center">Strongly Agree</div></td>
      </tr>
      <tr>
        <td><div align="center">
            <input type="radio" name="qb10" value="1" id="q1_45" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb10" value="2" id="q1_46" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb10" value="3" id="q1_47" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb10" value="4" id="q1_48" />
        </div></td>
        <td><div align="center">
            <input type="radio" name="qb10" value="5" id="q1_49" />
        </div></td>
      </tr>
    </table>
    <p>
      <label>
      <input type="submit" name="Submit" id="Submit" value="Submit" />
      </label>
    </p>
  </div>
</form>
<p align="center"> </p>
<p align="center"> </p>
<p align="center"><a href="http://www.wpi.edu/">
  <img src="seal.gif" alt="[WPI]" title="WPI Homepage" width="70" height="32" vspace="5" border="0">
  </a>
</p>
<div align="right"><a href="mailto:dbeavers@wpi.edu">webmaster</a>
</div>
</body>
</html>
```
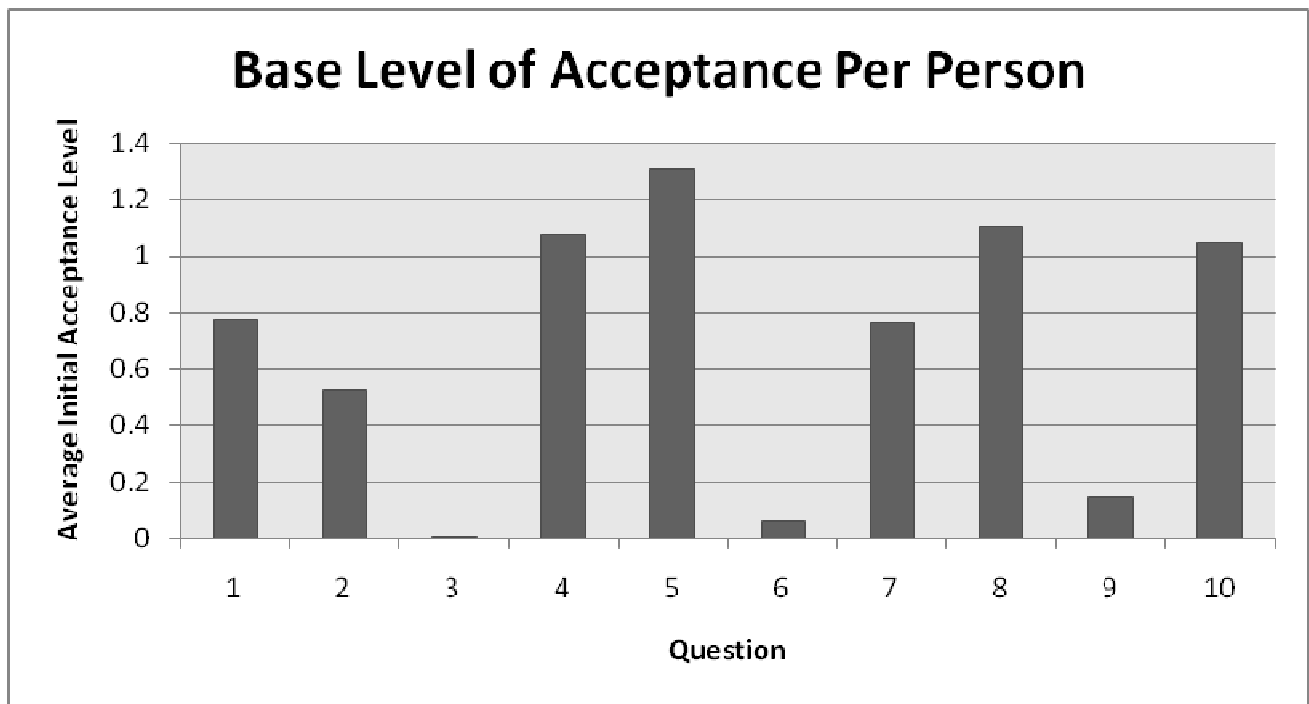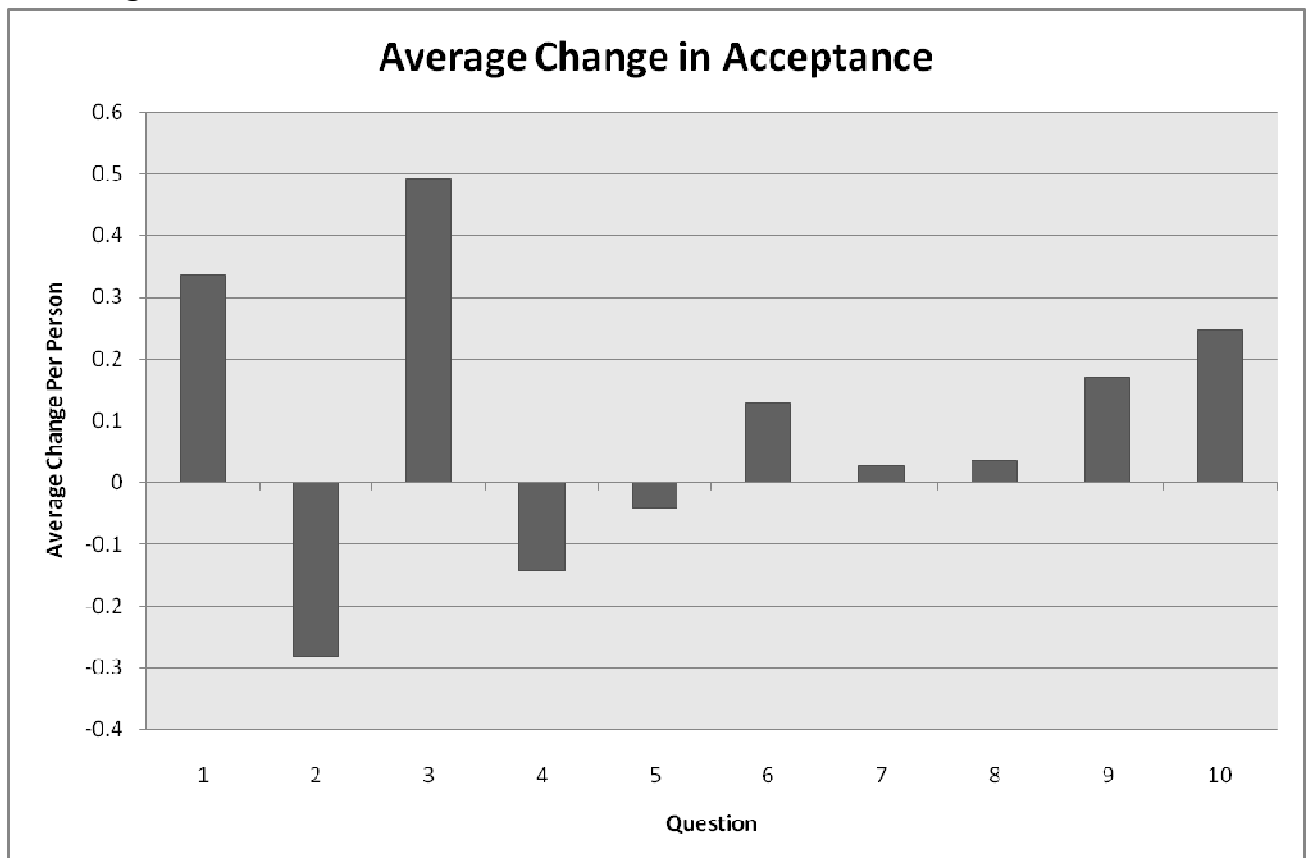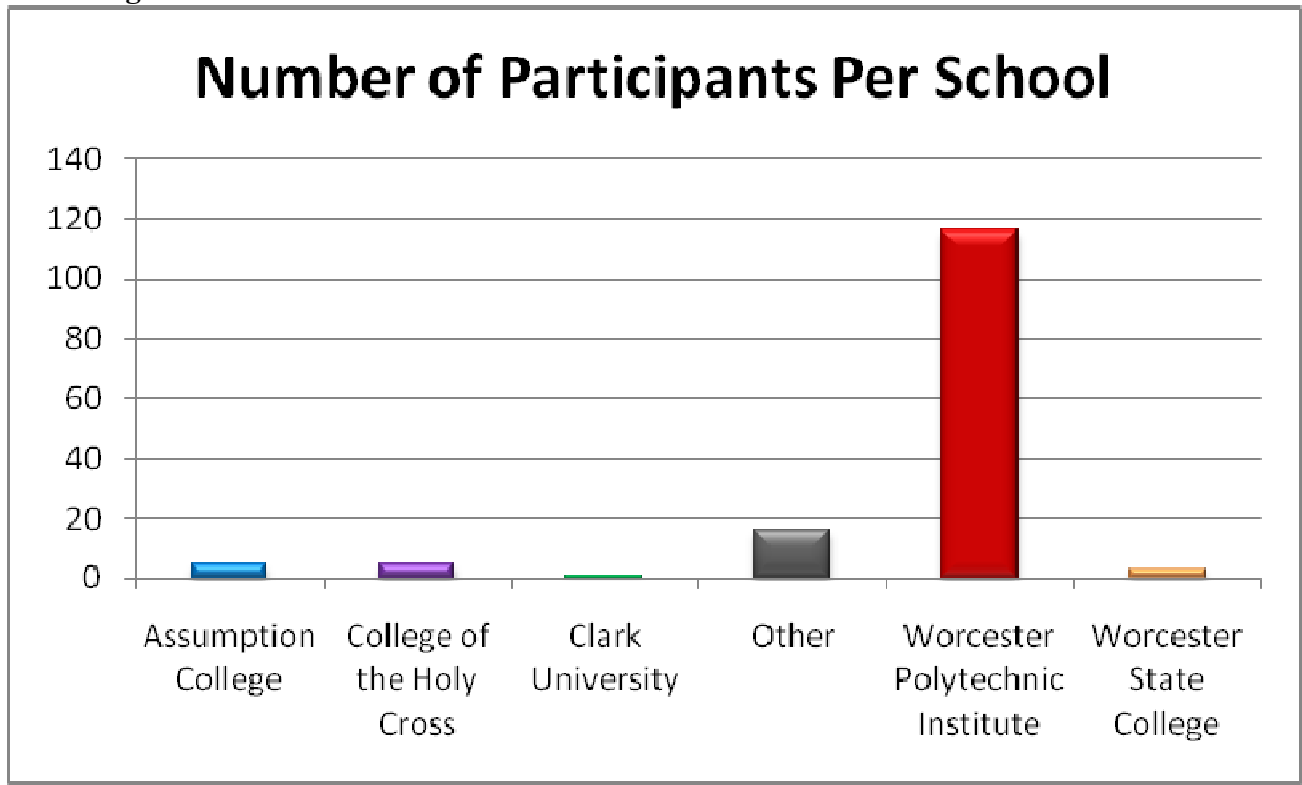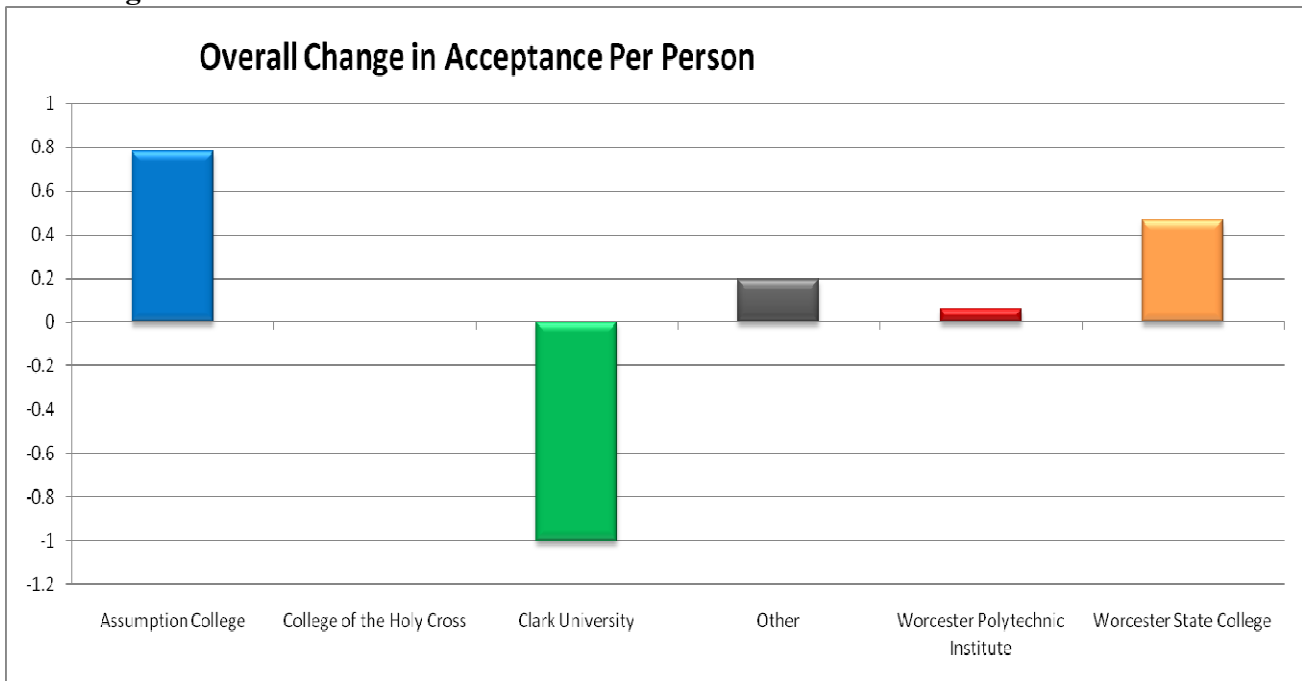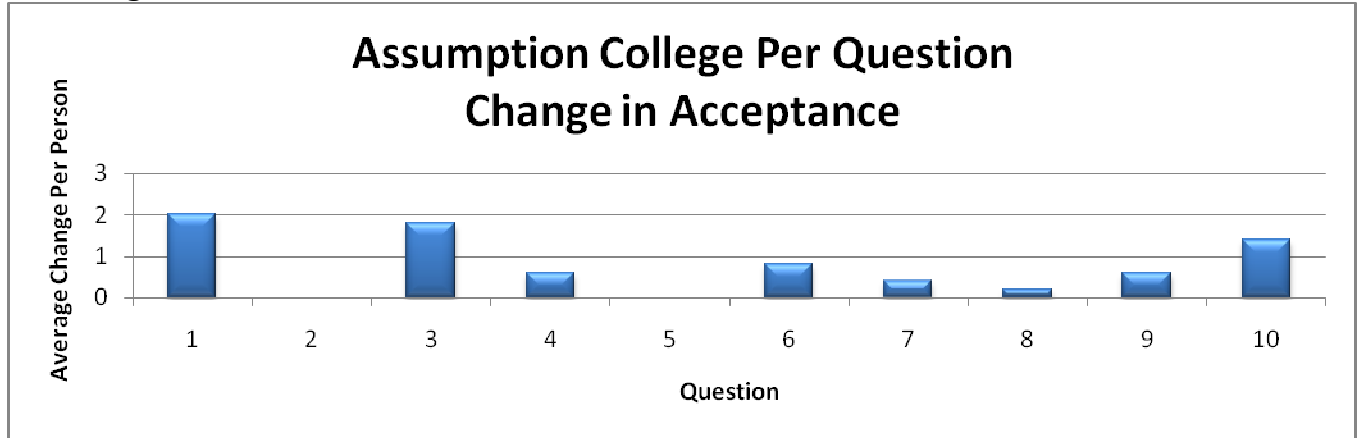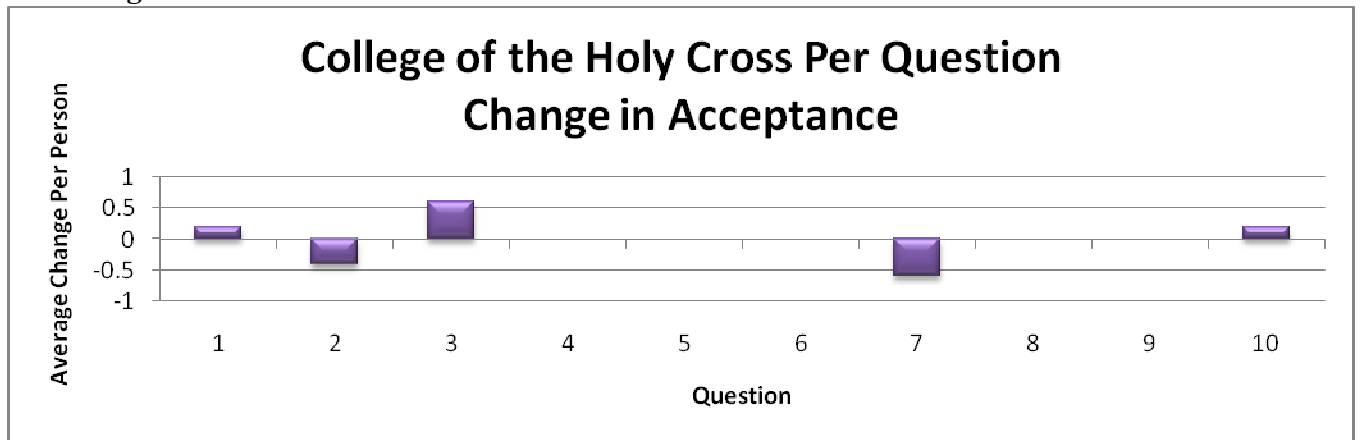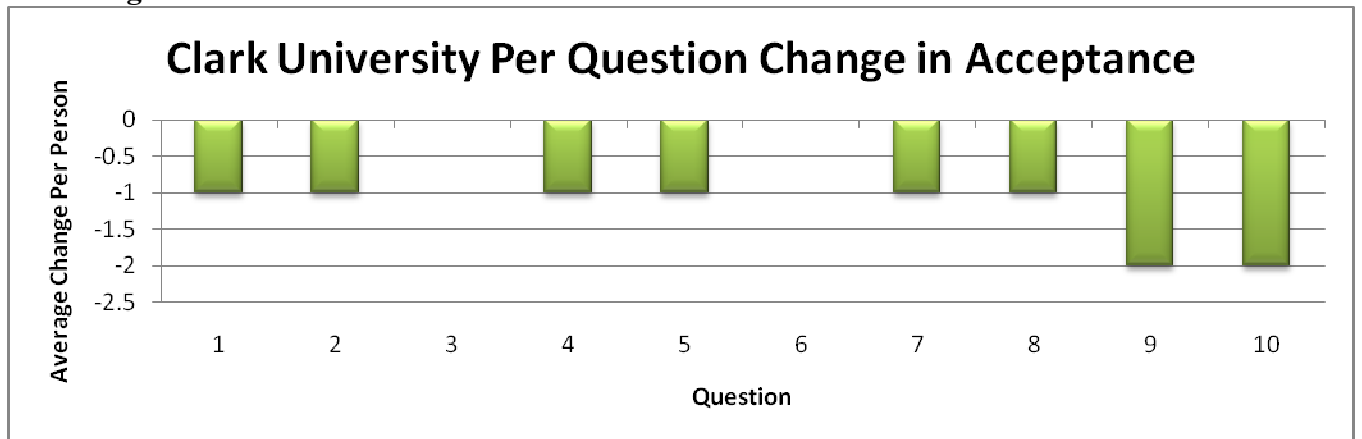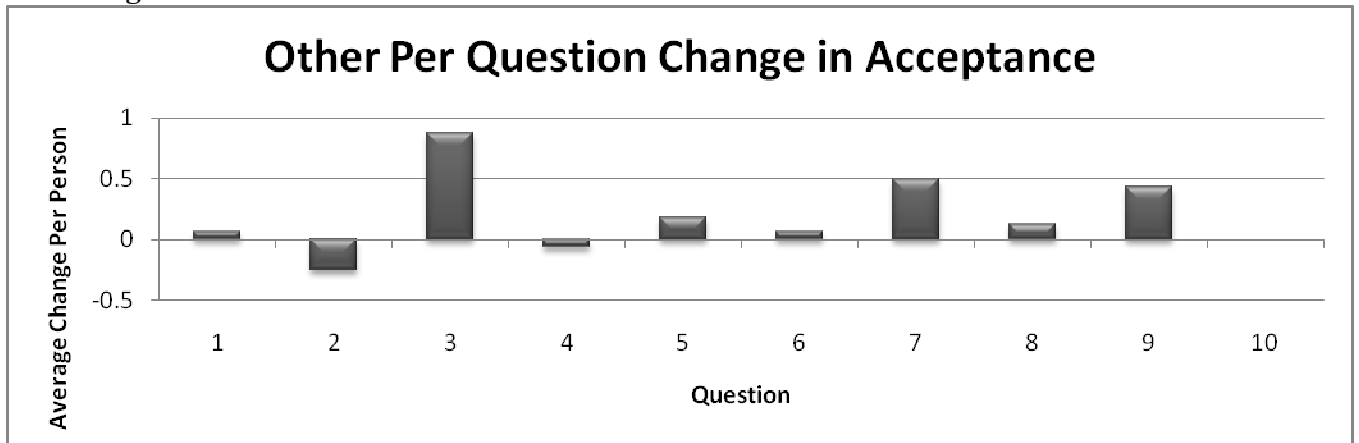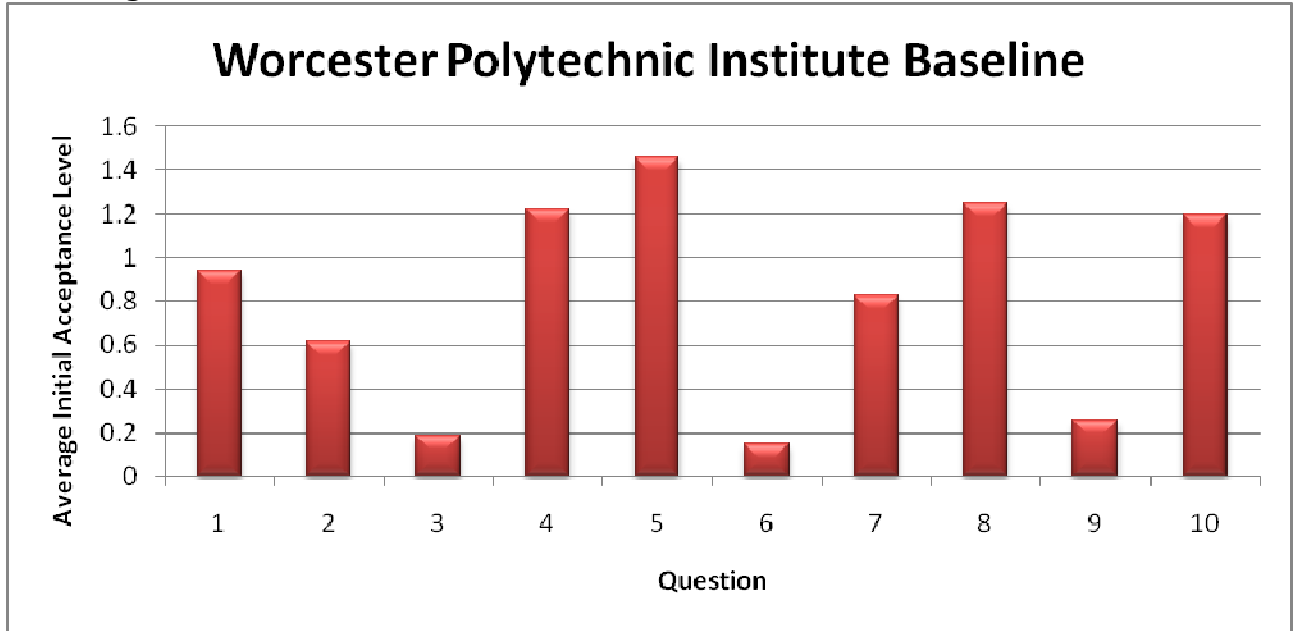
6.5.9 qb.cgi

```perl
#!/usr/bin/perl -wT
use CGI qw(:standard);
#set vars from post form
my $qb1 = param('qb1');
my $qb2 = param('qb2');
my $qb3 = param('qb3');
my $qb4 = param('qb4');
my $qb5 = param('qb5');
my $qb6 = param('qb6');
my $qb7 = param('qb7');
my $qb8 = param('qb8');
my $qb9 = param('qb9');
my $qb10 = param('qb10');

#session variable
my $session = $ENV{QUERY_STRING};

# define filename to be string and untaint it
my $filename = $session . '.txt';
if ($filename =~ /(.*)/) {
    $filename = $1;
}

#if session data does not exists prompt for javascript install
if ($session eq "") {
        print "Location: ../error.html\n\n";
}

#error correction
if ($qb1 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 1</h2>\n";
        print end_html;
        exit;
}
if ($qb2 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 2</h2>\n";
        print end_html;
        exit;
}
if ($qb3 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 3</h2>\n";
        print end_html;
        exit;
}
if ($qb4 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 4</h2>\n";
        print end_html;
        exit;
}
if ($qb5 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 5</h2>\n";
        print end_html;
        exit;
}
if ($qb6 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 6</h2>\n";
        print end_html;
        exit;
}
if ($qb7 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 7</h2>\n";
        print end_html;
        exit;
}
if ($qb8 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 8</h2>\n";
        print end_html;
        exit;
}
if ($qb9 eq "") {
        print header;
        print start_html("ERROR");
        print "<h2>Please use your browsers back button and select an answer for question 9</h2>\n";
        print end_html;
```

```perl
                        exit;
}
if ($qb10 eq "") {
                print header;
                print start_html("ERROR");
                print "<h2>Please use your browsers back button and select an answer for question 10</h2>\n";
                print end_html;
                exit;
}

#open file and append info to it
open data, ">>sessions/$filename";
print data "$qb1\n";
print data "$qb2\n";
print data "$qb3\n";
print data "$qb4\n";
print data "$qb5\n";
print data "$qb6\n";
print data "$qb7\n";
print data "$qb8\n";
print data "$qb9\n";
print data "$qb10\n";
close data;

#transfer to video page
print "Location: ../end.html\n\n";

## print results (for debugging only)
# print header;
# print start_html("RESULTS");
# print "Question 1 is $qb1\n";
# print "<p> </p>";
# print "Question 2 is $qb2\n";
# print "<p> </p>";
# print "Question 3 is $qb3\n";
# print "<p> </p>";
# print "Question 4 is $qb4\n";
# print "<p> </p>";
# print "Question 5 is $qb5\n";
# print "<p> </p>";
# print "Question 6 is $qb6\n";
# print "<p> </p>";
# print "Question 7 is $qb7\n";
# print "<p> </p>";
# print "Question 8 is $qb8\n";
# print "<p> </p>";
# print "Question 9 is $qb9\n";
# print "<p> </p>";
# print "Question 10 is $qb10\n";
# print end_html;
```

6.5.10 end.html

```html
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
<title>Nanotech IQP Finished!</title>
</head>
<body>
<div align="center">
  <h2>Thank you for taking our Survey</h2>
</div>
<div align="center">
  <p>A little about our project:</p>
  <p>We are an Interactive Qualifying Project Group at WPI doing research on the effect of an <br />
    educational video on the acceptance of nanotechnology.<br />
    <br />
  If you would like to know more feel free to contact any of the following people.</p>
  <p>Students: <br />
    <a href="mailto:dbeavers@wpi.edu">David Beavers<br />
  </a><a href="mailto:kaufmb@wpi.edu">Brad Kaufman<br />
  </a><a href="mailto:ccgood@wpi.edu">Calvin Goodrich</a></p>
  <p>Supervisor: <a href="mailto:nab@wpi.edu">Nancy Burnham</a></p>
  <p> </p>
  <p>For reference information, please visit this <a href="credit.html">link</a>.</p>
  <p>If you would like to see the results so far, please visit this <a href="results.html">link</a>.</p>
</div>
<p align="center"> </p>
<p align="center"><a href="http://www.wpi.edu/">
  <img src="seal.gif" alt="[WPI]" title="WPI Homepage" width="70" height="32" vspace="5" border="0">
  </a>
</p>
<div align="right"><a href="mailto:dbeavers@wpi.edu">webmaster</a>
</div>
</body>
</html>
```

6.6. Appendix F: Tables, Equations, and Figures

Table 6.6.1

Question	1	2	3	4	5	6	7	8	9	10
QB	1	2	3	4	5	6	7	8	9	10
QA	3	4	1	2	8	9	10	7	6	5

Table 6.6.2

Question #	Question	P-value	Change after video (significance)
1	I am aware of the already expanding presence of nanotechnology.	0.0001	increase
2	I support the use of topical substances which use nanoparticles.	0.0002	decrease
3	I am knowledgeable about nanotechnology and its applications.	< 0.0001	increase
4	I support nanotechnology: its research, prospects and uses	0.0230	decrease
5	I approve of electronics which use nanotechnology (nano-electronics).	0.4072	no change
6	I support the use of self-replicating nanobots.	0.0463	increase
7	I am concerned about the possible abuse of nanotechnology.	0.7141	no change
8	I approve of materials which use nanotechnology (nano-materials).	0.5169	no change
9	I approve of possible military use of nanotechnology.	0.0055	increase
10	I support medical practices which include nanotechnology.	0.0001	increase

Equation 6.6.1

$$\text{Baseline Acceptance}_{i} = \frac{\sum_{1}^{n} QA_{i}}{n} - 3$$

Equation 6.6.2

$$\text{Average Change in Acceptance per Person} = \frac{\sum_{1}^{n} QB_{i} - QA_{i'}}{n}$$

Figure 6.6.1

Base Level of Acceptance Per Person

Figure 6.6.2

Average Change in Acceptance

Figure 6.6.3

Figure 6.6.4

Figure 6.6.5

Assumption College Per Question Change in Acceptance

Figure 6.6.6

College of the Holy Cross Per Question Change in Acceptance

Figure 6.6.7

Clark University Per Question Change in Acceptance

Figure 6.6.8

Figure 6.6.9a

Figure 6.6.9b
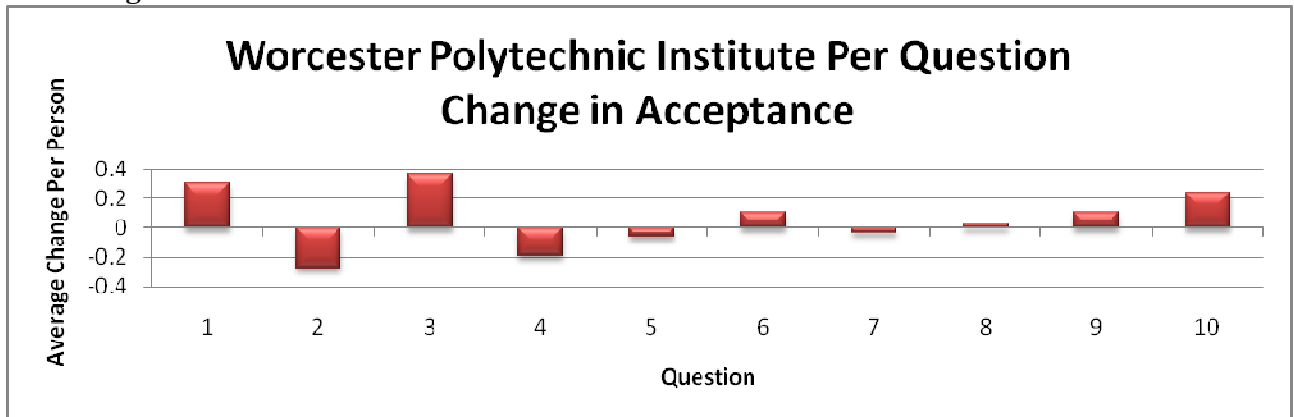
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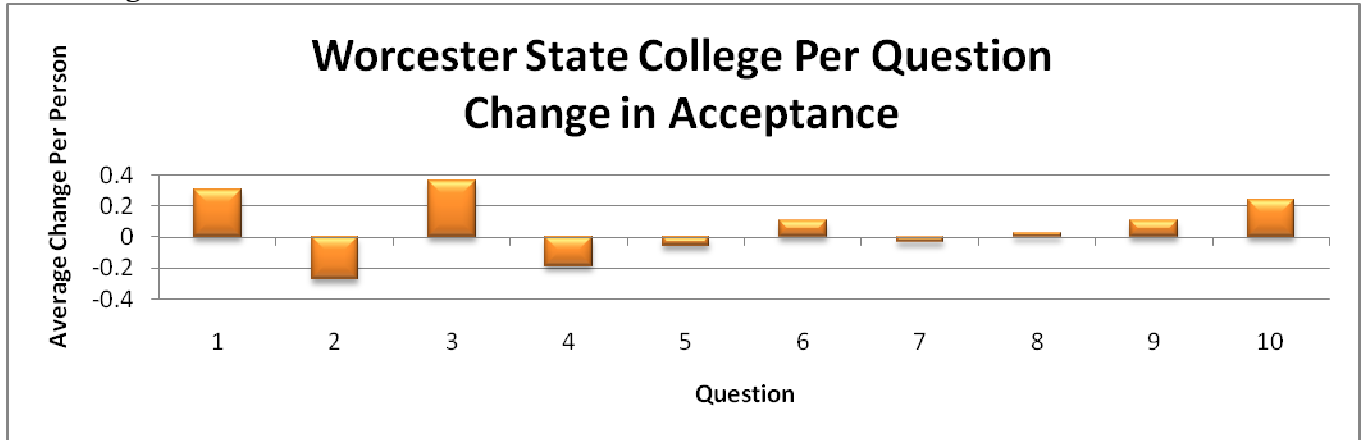
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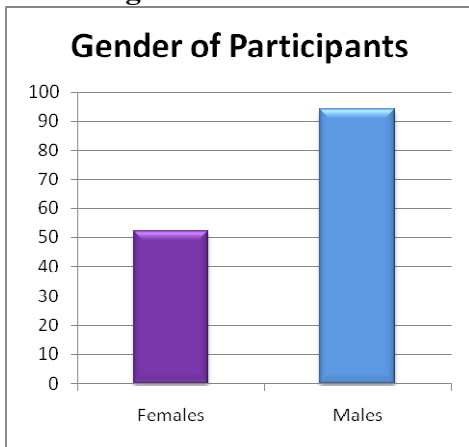
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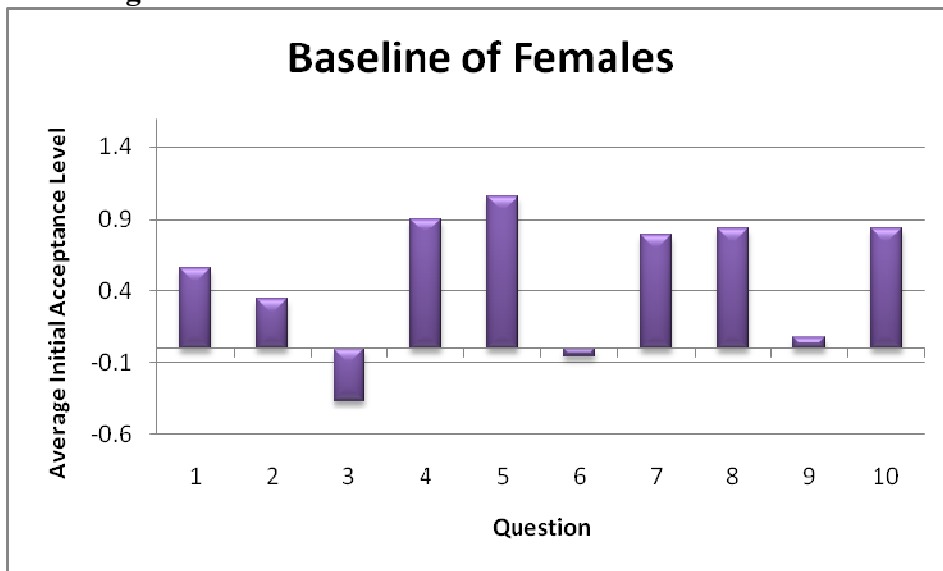
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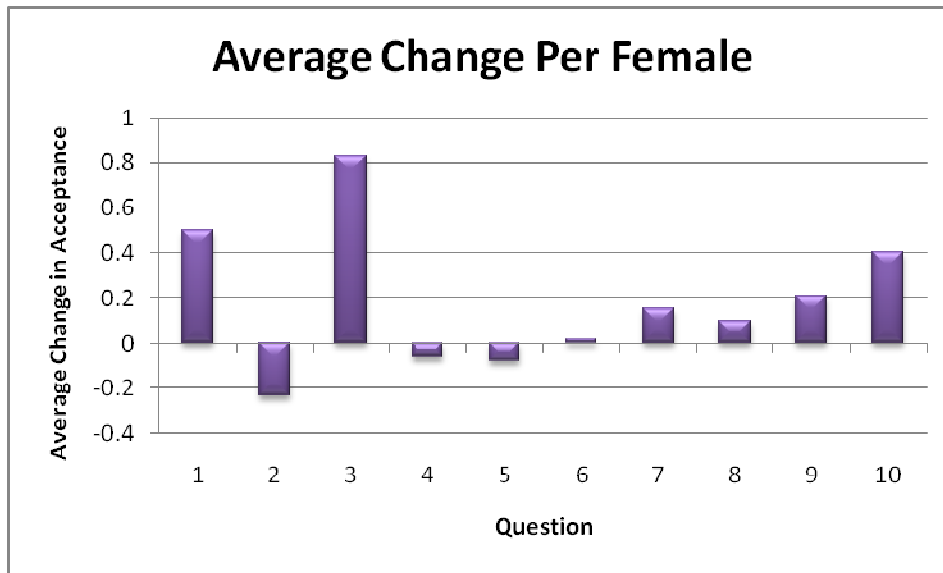
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Figure 6.6.13b

Average Change Per Male

Figure 6.6.14a

Number of Participants by Major
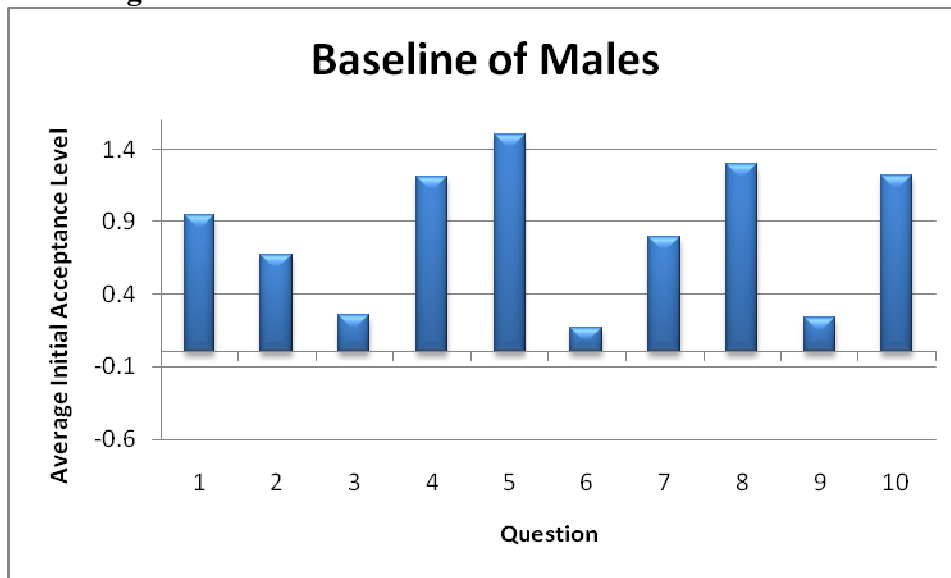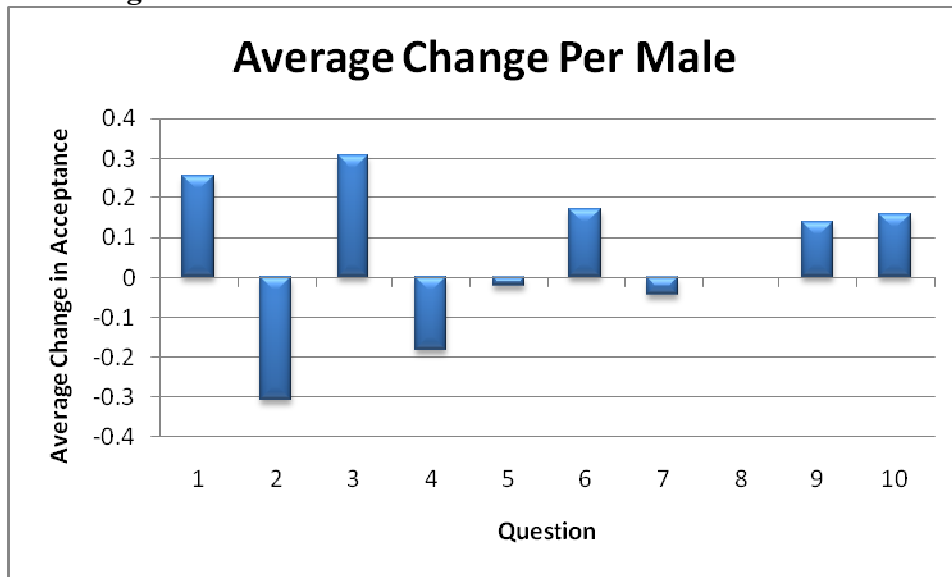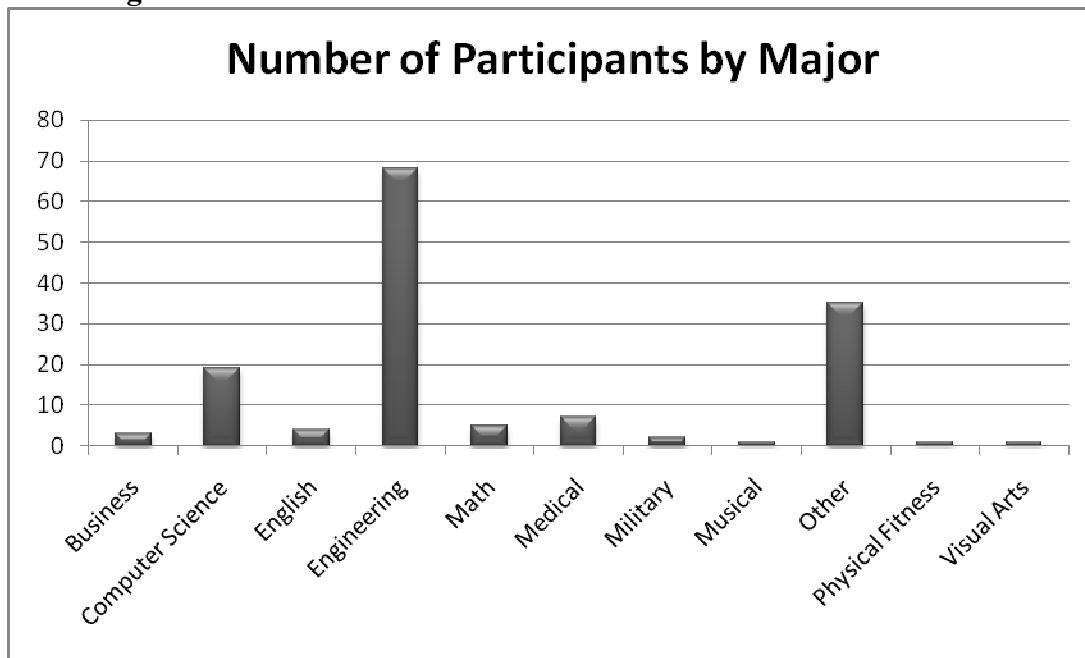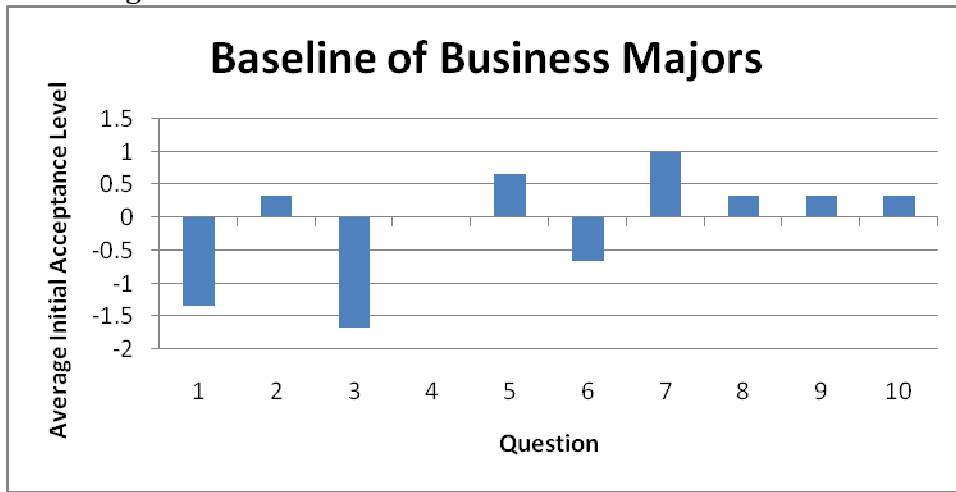
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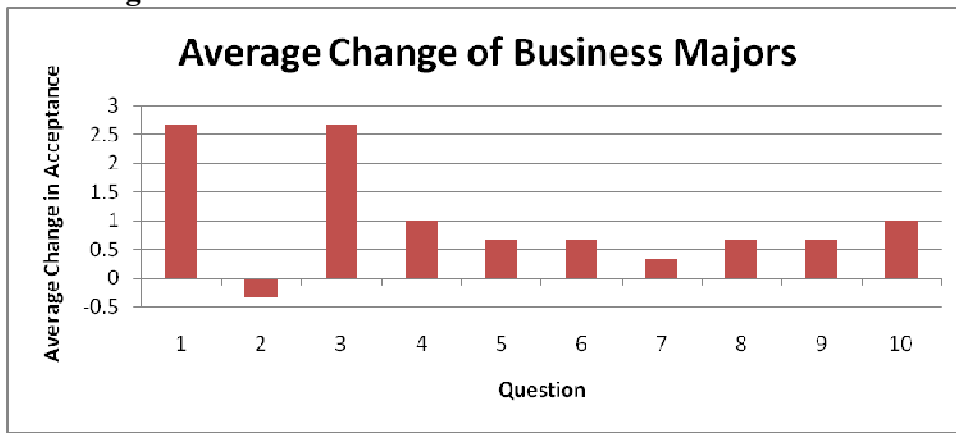
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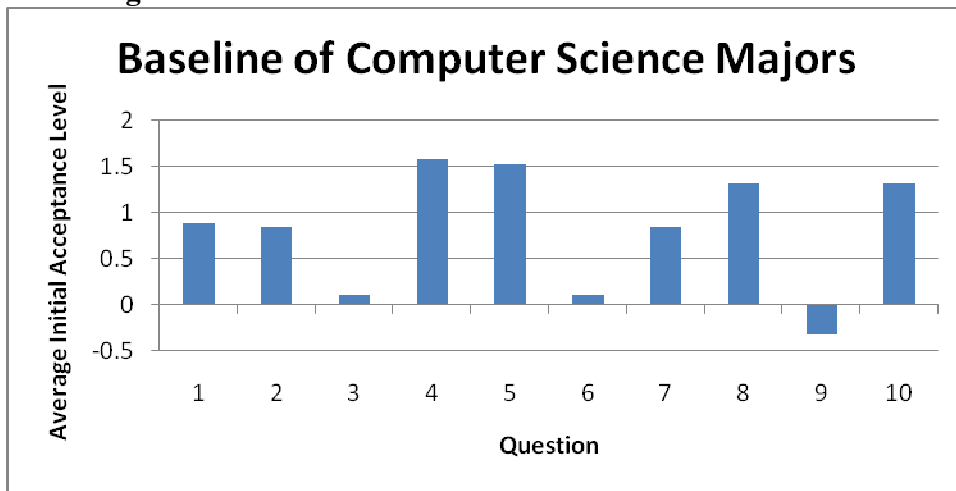
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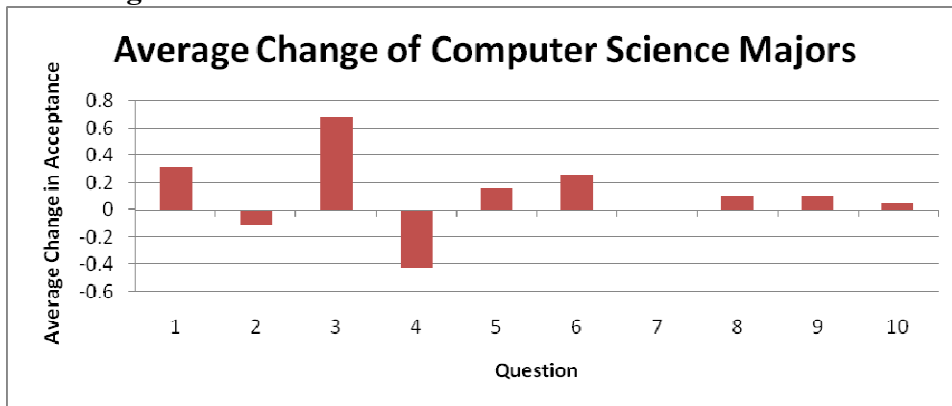
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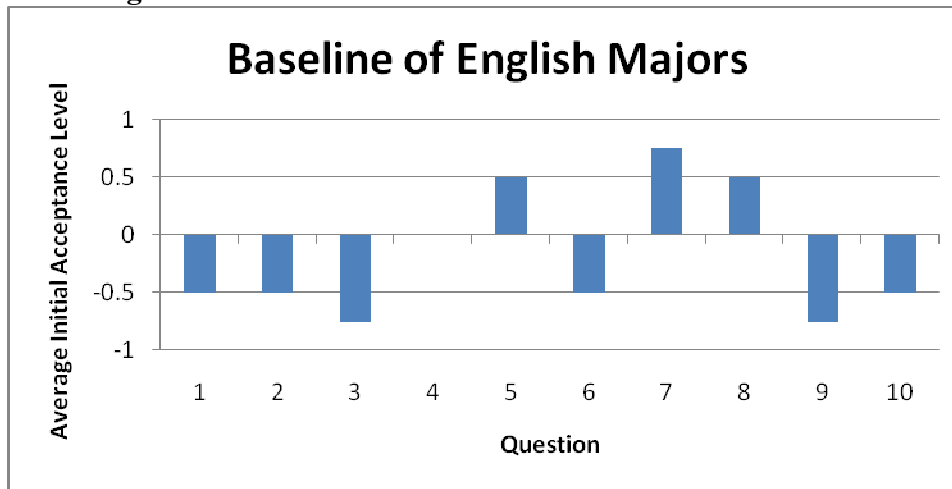
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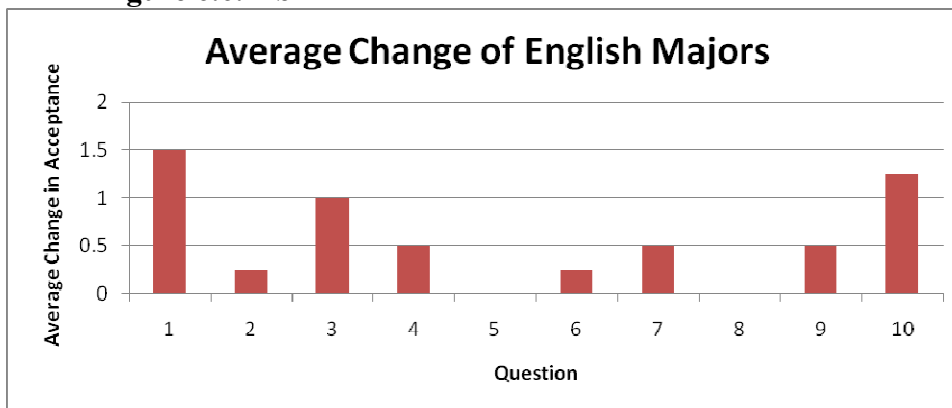
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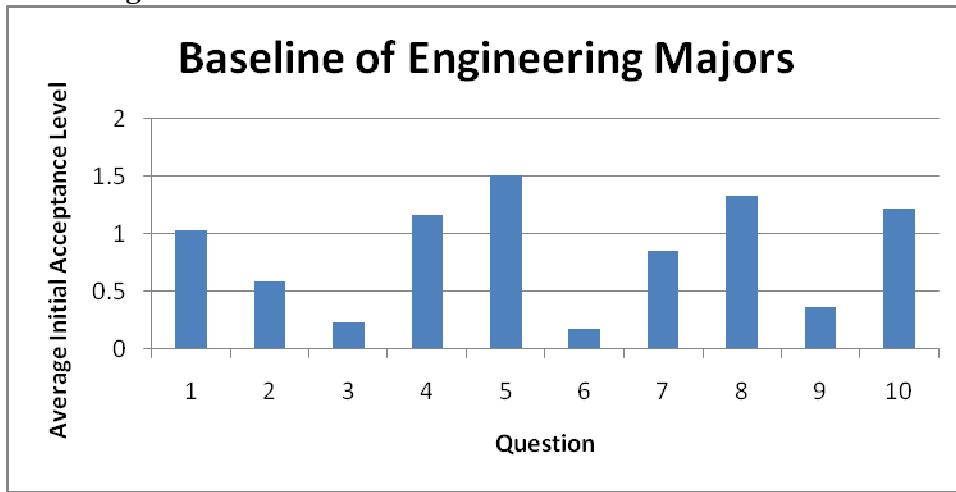
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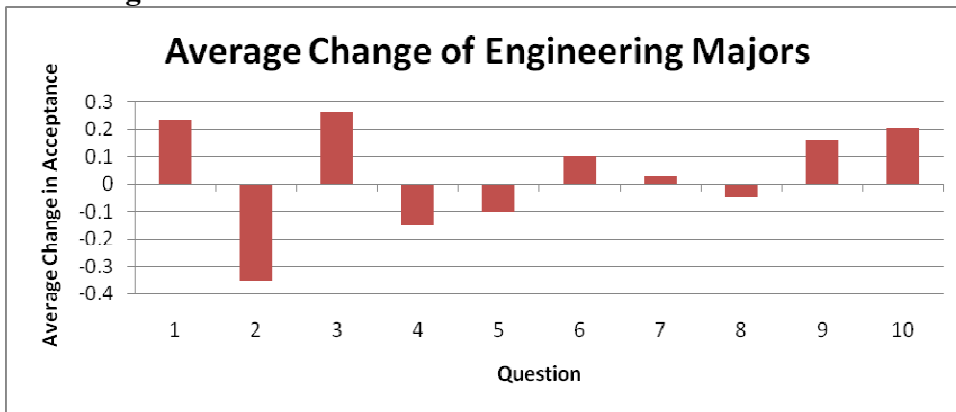
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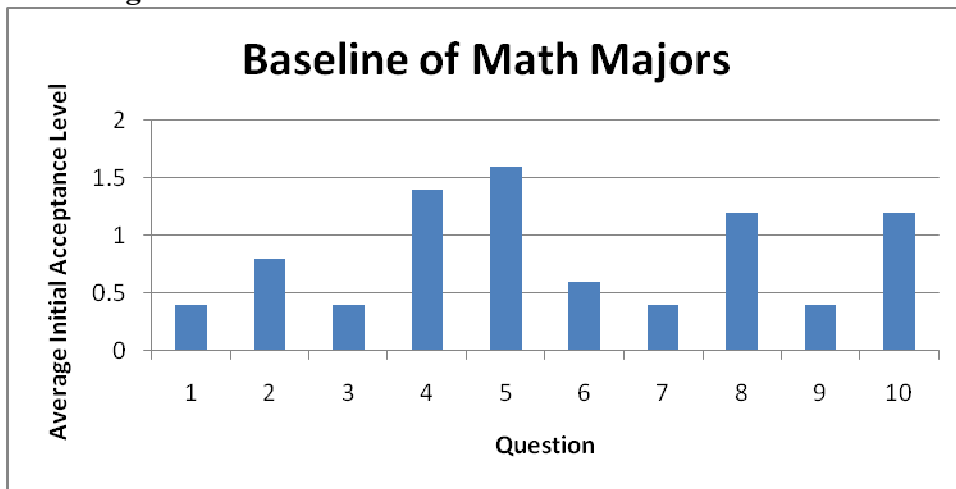
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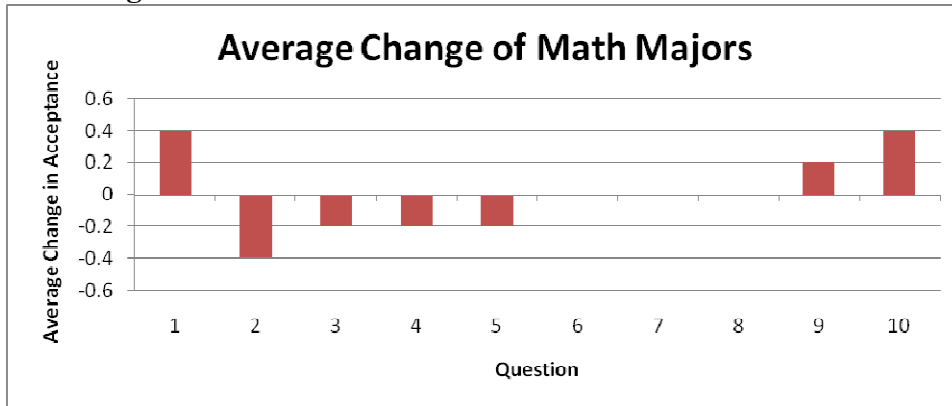
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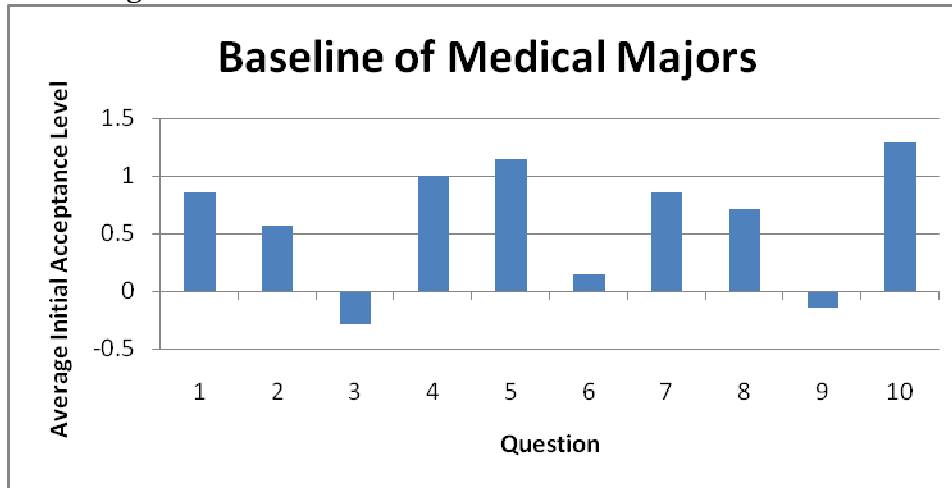
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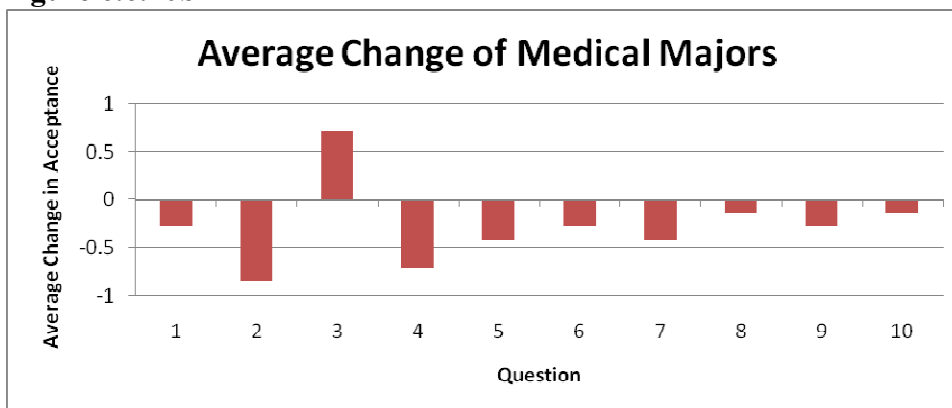
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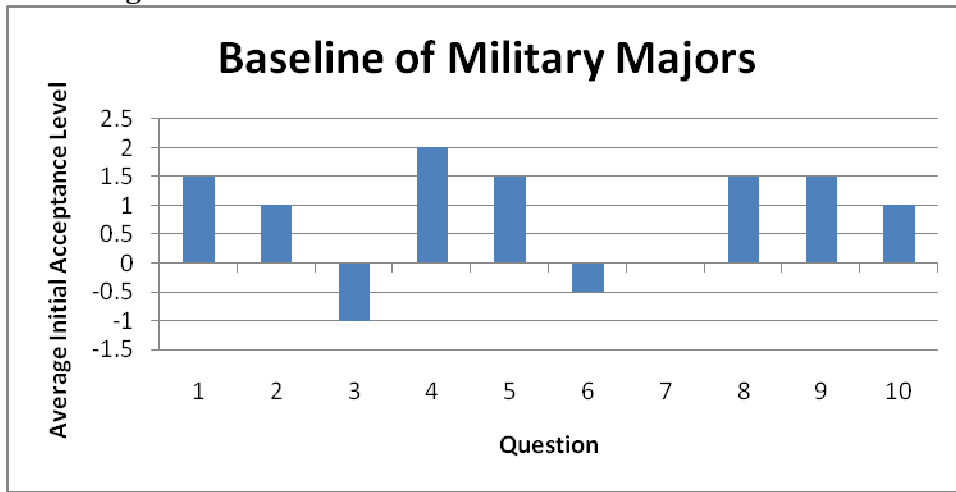
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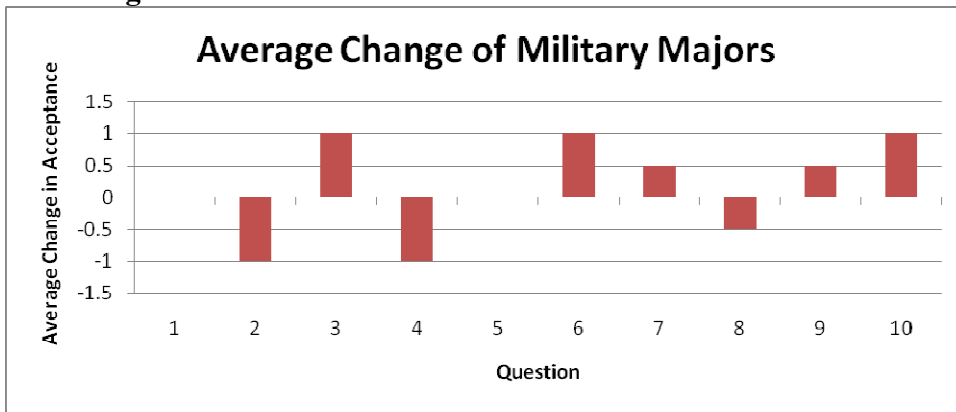
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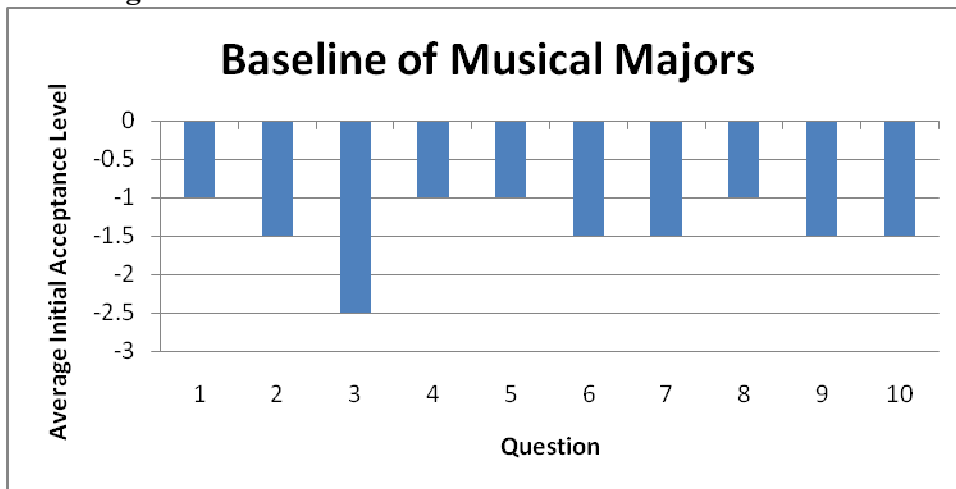
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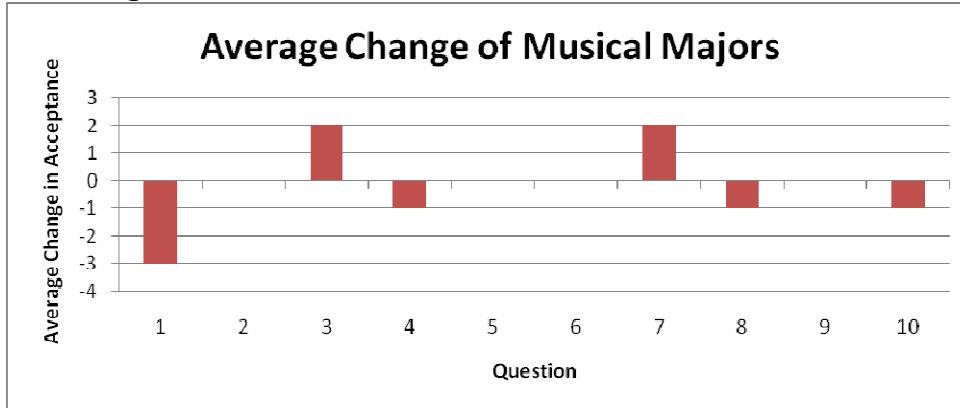
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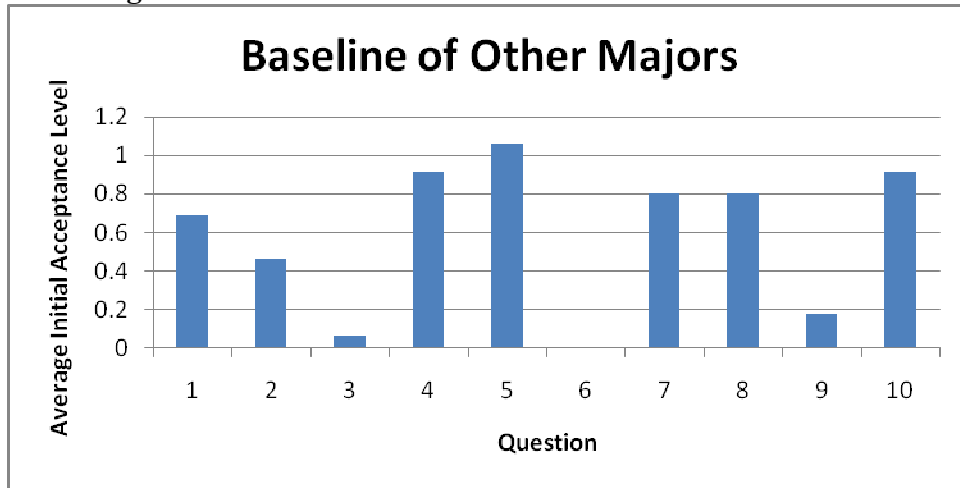
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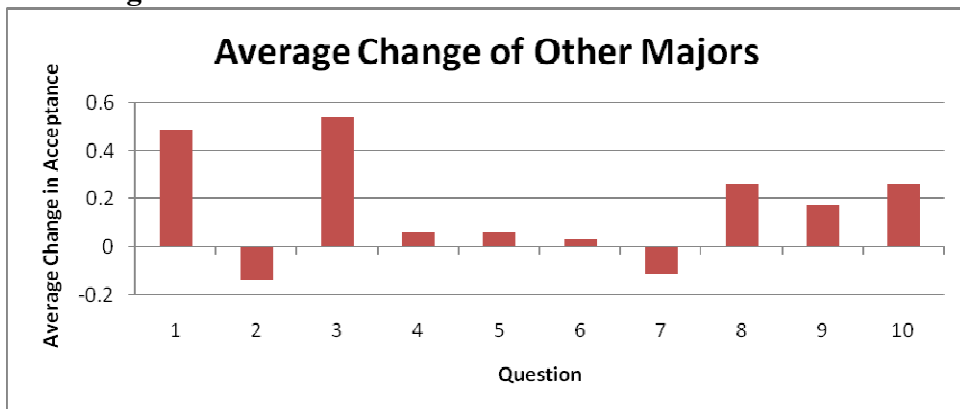
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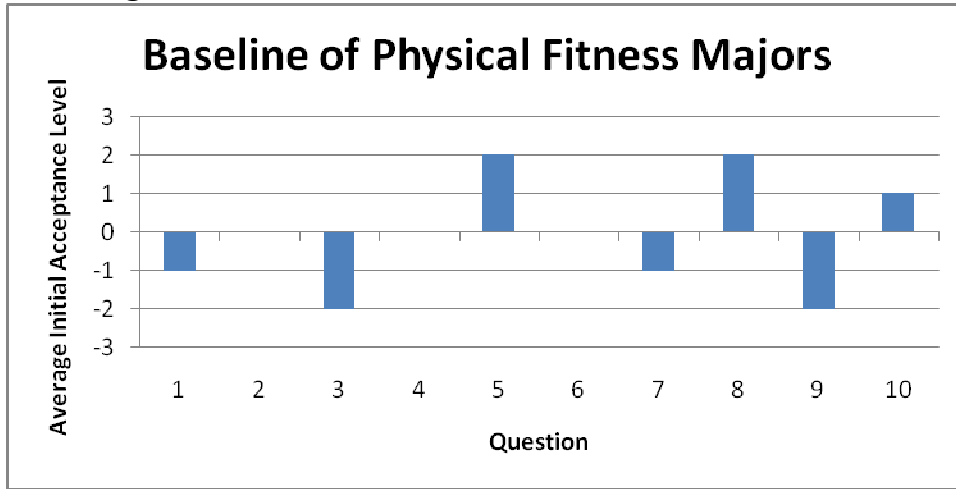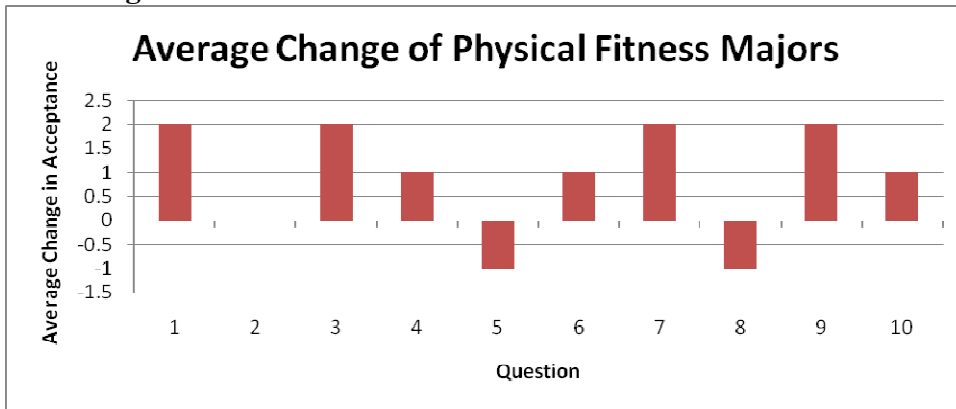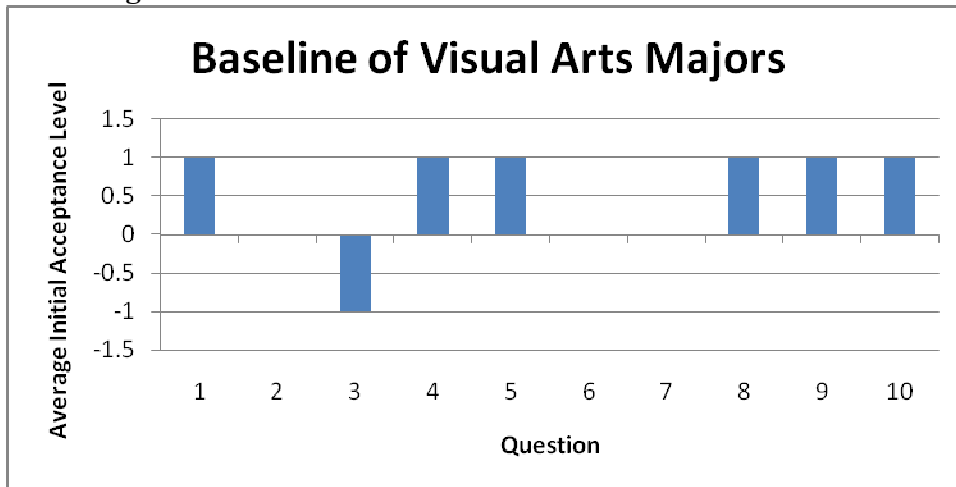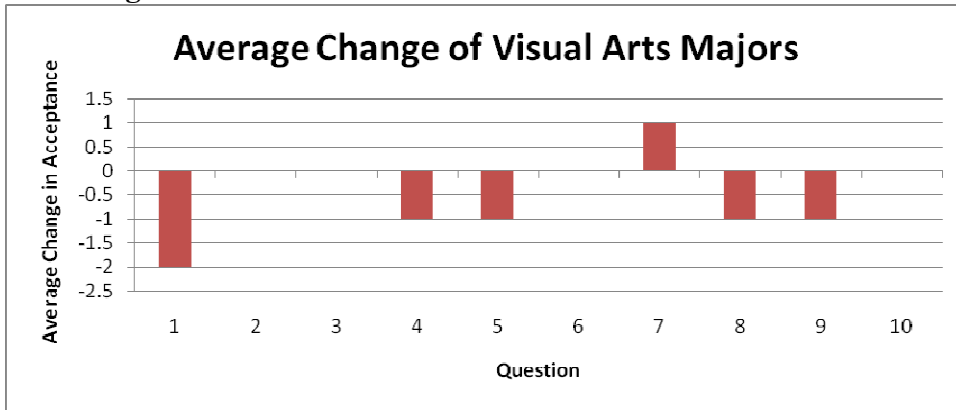

Figure 6.6.24b

Figure 6.6.25a

Figure 6.6.25b

6.7. Appendix G: T-Test

1. I am aware of the already expanding presence of nanotechnology.

The two-tailed P value = 0.0001 - extremely statistically significant.

Confidence interval:
The mean of QA3 before video minus QB1 after video equals -0.34
95% confidence interval of this difference: From -0.51 to -0.17

Intermediate values used in calculations:
t = 3.9783
df = 145
standard error of difference = 0.086

Group	QA3 before video	QB1 after video
Mean	3.80	4.14
SD	0.91	0.76
SEM	0.08	0.06
N	146	146

2. I support the use of topical substances which use nanoparticles.

The two-tailed P value = 0.0002 - extremely statistically significant.

Confidence interval:
The mean of QA4 before video minus QB2 after video equals 0.28
95% confidence interval of this difference: From 0.14 to 0.42

Intermediate values used in calculations:
t = 3.8697
df = 145
standard error of difference = 0.073

Group	QA4 before video	QB2 after video
Mean	3.55	3.27
SD	0.70	0.90
SEM	0.06	0.07
N	146	146

3. I am knowledgeable about nanotechnology and its applications.

Two-tailed P value < 0.0001 - extremely statistically significant.

Confidence interval:
 The mean of QA1 before video minus QB3 after video equals -0.49
 95% confidence interval of this difference: From -0.66 to -0.33

Intermediate values used in calculations:
 t = 5.8490
 df = 145
 standard error of difference = 0.084

Group	QA1 before video	QB3 after video
Mean	3.03	3.53
SD	1.04	0.82
SEM	0.09	0.07
N	146	146

4. I support nanotechnology: its research, prospects and uses

The two-tailed P value = 0.0230 - statistically significant.

Confidence interval:
 The mean of QA2 before video minus QB4 after video equals 0.14
 95% confidence interval of this difference: From 0.02 to 0.25

Intermediate values used in calculations:
 t = 2.2975
 df = 145
 standard error of difference = 0.060

Group	QA2 before video	QB4 after video
Mean	4.10	3.97
SD	0.74	0.64
SEM	0.06	0.05
N	146	146

5. I approve of electronics which use nanotechnology (nano-electronics).

The two-tailed P value = 0.4072 - **not statistically significant.**

Confidence interval:
  The mean of QA8 before video minus QB5 after video equals 0.04
  95% confidence interval of this difference: From -0.06 to 0.14

Intermediate values used in calculations:
  t = 0.8312
  df = 145
  standard error of difference = 0.049

Group	QA8 before video	QB5 after video
Mean	4.34	4.30
SD	0.74	0.68
SEM	0.06	0.06
N	146	146

6. I support the use of self-replicating nanobots.

The two-tailed P value = 0.0463 - statistically significant.

Confidence interval:
  The mean of QA9 before video minus QB6 after video equals -0.12
  95% confidence interval of this difference: From -0.23 to -0.00

Intermediate values used in calculations:
  t = 2.0103
  df = 145
  standard error of difference = 0.058

Group	QA9 before video	QB6 after video
Mean	3.09	3.21
SD	0.95	1.00
SEM	0.08	0.08
N	146	146

7. I am concerned about the possible abuse of nanotechnology.

The two-tailed P value = 0.7141 - **not statistically significant.**

Confidence interval:
The mean of QA10 before video minus QB7 after video equals -0.03
95% confidence interval of this difference: From -0.17 to 0.12

Intermediate values used in calculations:
t = 0.3671
df = 145
standard error of difference = 0.075

Group	QA10 before video	QB7 after video
Mean	3.79	3.82
SD	0.90	0.89
SEM	0.07	0.07
N	146	146

8. I approve of materials which use nanotechnology (nano-materials).

The two-tailed P value = 0.5169 - **not statistically significant.**

Confidence interval:
The mean of QA7 before video minus QB8 after video equals -0.03
95% confidence interval of this difference: From -0.14 to 0.07

Intermediate values used in calculations:
t = 0.6497
df = 145
standard error of difference = 0.053

Group	QA7 before video	QB8 after video
Mean	4.13	4.16
SD	0.75	0.64
SEM	0.06	0.05
N	146	146

9. I approve of possible military use of nanotechnology.

The two-tailed P value = 0.0055 - very statistically significant.

Confidence interval:
The mean of QA6 before video minus QB9 after video equals -0.16
95% confidence interval of this difference: From -0.28 to -0.05

Intermediate values used in calculations:
t = 2.8177
df = 145
standard error of difference = 0.058

Group	QA6 before video	QB9 after video
Mean	3.18	3.34
SD	1.17	1.22
SEM	0.10	0.10
N	146	146

10. I support medical practices which include nanotechnology.

The two-tailed P value = 0.0001 - extremely statistically significant.

Confidence interval:
The mean of QA5 before video minus QB10 after video equals -0.25
95% confidence interval of this difference: From -0.37 to -0.12

Intermediate values used in calculations:
t = 3.9350
df = 145
standard error of difference = 0.063

Group	QA5 before video	QB10 after video
Mean	4.08	4.33
SD	0.74	0.73
SEM	0.06	0.06
N	146	146