

AC 2008-754: FRESHMAN ENGINEERING STUDENT PERCEPTIONS ON GLOBAL WARMING

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Freshman Engineering Student Perceptions on Global Warming

Abstract

Managing the problems that global warming is being forecast to cause requires the educated attention of many disciplines. One of these has to be engineering, as engineers are trained in the practical application of science and technology to meet human needs. This paper presents part of our efforts to enlighten our freshman engineering students on these problems. Modifications to an existing freshman course are briefly described that involve global warming issues, with the primary focus of the paper being on the students' perceptions.

A pre-course instrument with 20 questions was used to obtain students' perceptions on the importance of global warming as a problem, if they can have an impact, and if anything can really be done about it. The same instrument was given at the end of the course to help measure the impact of the course content that focused on global warming. The paper includes the perception instrument and comparison of results from the pre and post surveys.

Introduction

The freshman common text used at our university for the 2007-08 academic year is the, "An Inconvenient Truth" authored by the former Vice President Al Gore. Using this book presented us a unique opportunity, as the text focus in the area of world wide interest, global warming, that is going to require careful thought and input from the engineering community. This is also the first time a common text was adapted to our freshman engineering program at our university. Using the text as a starting point, we modified our *EGR 190: Fundamentals of Engineering and Computer Science* course¹ by changing two hours of lecture and four hours of laboratories to a focus on two areas of interest to engineers that involved global warming. The lectures focused on alternative energies and alternative fuels and the labs focused on solar and wind energy sources, and hydrogen fuel cells. In addition, the length of the lectures was increased by a half hour. This additional time was used to present the DVD "An Inconvenient Truth" and its update over a four week period, and provided discussion time on global warming. At the beginning and end of the course the students answered a global warming perception instrument. This paper focuses on the results obtained from this perception instrument.

Methodology

The perception instrument presented in Figure.1 has twenty questions and was given to the students during their first and last lecture periods. Questions 1, 2, 3, 4, 5, 15, and 17 provide insights in areas that are negative towards global warming. Questions 8 and 18 were included to see if elected officials or their parents might have had some influence on their thinking. Questions 6, 7, 10, and 16 involved intuitive thinking on the part of the students. Question 19 was included to see how interested students are to learn about global warming. The rest of the questions involved various global warming issues that appeared to be real from the data being presented through the common text and study groups^{2,3,4,5,6}.

Questions on Global Warming

Rank each question on a scale of one to five.

One = completely disagree **Two** = you got to be kidding **Three** = not sure

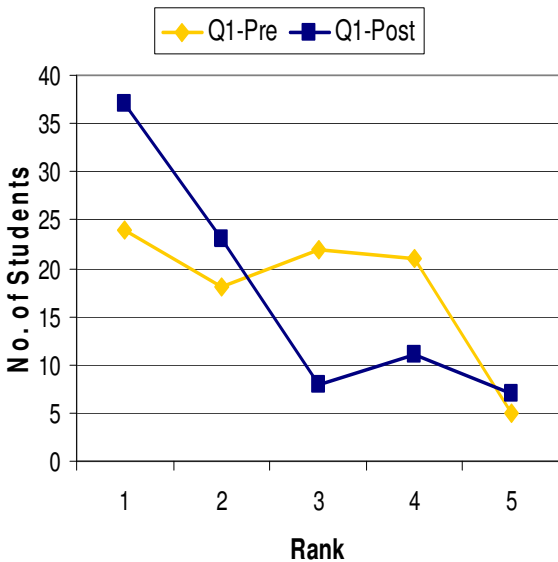
Four = perhaps **Five** = completely agree

1. The science of global warming is too uncertain to act on. _____
2. Water vapor is the most important, abundant greenhouse gas. So if we're going to control a greenhouse gas, we should control it instead of carbon dioxide (CO₂). _____
3. Global warming is just part of a natural cycle. _____
4. We can adapt to climate change.
Civilization has survived droughts and temperature shifts before. _____
5. Mercury in compact florescent lamps represents a significant health risk. _____
6. A lamp fixture is limited to 60 watts. The use a compact florescent lamp whose light output exceeds that of a 60 watt light bulb would not be recommended. _____
7. My car gets 34 mpg on the highway. That hybrid car also gets 34 mpg on the highway.
So, my car's contribution to global warming is about the same as the hybrid. _____
8. My elected officials are familiar with global warming issues. _____
9. Global warming will cause spreading of disease. _____
10. A good investment would be a vacation/retirement home on the coast of Florida. _____
11. The most common greenhouse gas emitted from human activities is methane. _____
12. Greenhouse gases are not good for humans. _____
13. Cutting down trees contributes to global warming. _____
14. Greenhouse gases reflect solar rays. _____
15. Since CO₂ makes up only a tiny part of the atmospheric gas, about 380 parts per million, worrying about it does not make much sense. _____
16. Raising the tax on gasoline would contribute to a reduction in greenhouse gas. _____
17. I really cannot do much myself to reduce global warming. _____
18. My parents are concerned about global warming. _____
19. I read an article about global warming in the past week. _____
20. An increase in the earth's temperature has benefits. _____

Figure 1: Perception instrument on global warming used before and after taking a freshman course that had been modified to include global warming issues of interest to engineers.

Results

The perception instrument was taken by ninety freshman engineering students enrolled in *EGR 190 Fundamentals of Engineering and Computer Science* during the fall 2007 quarter. Their responses were tabulated by question and rank. The results are presented in the form of line graphs to easily see if the students' perception have changed from the start of the quarter to the end of the quarter. Each question's graph is presented with comments beside it.

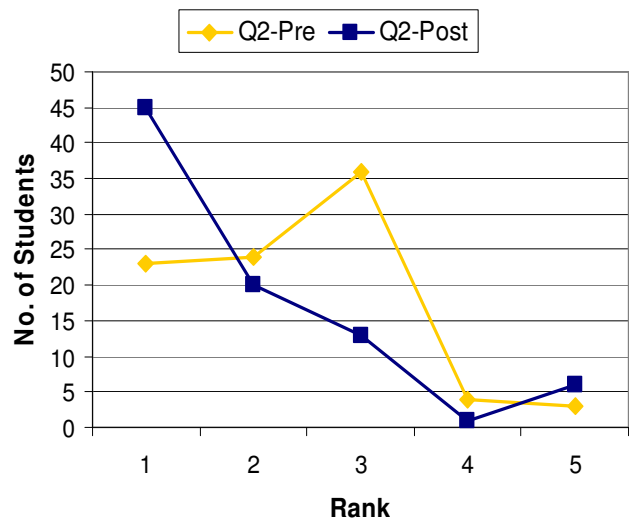


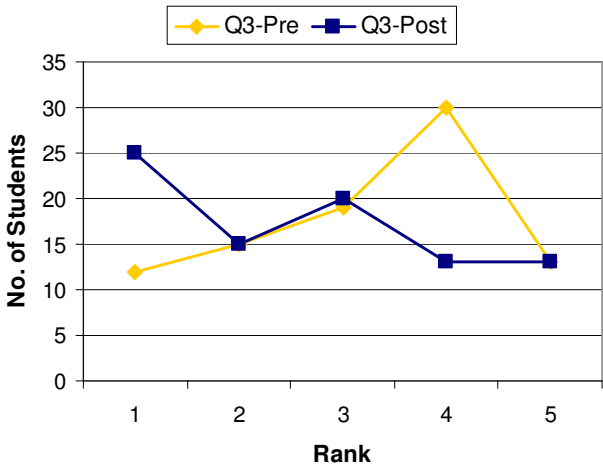
1. The science of global warming is too uncertain to act on.

The post responses looking at ranks 1 & 2 show a 43% increase in disagreement with the question. This indicates that the students underwent a change in perception and felt that something could be done to act upon global warming.

2. Water vapor is the most important, abundant greenhouse gas. So if we're going to control a greenhouse gas, we should control it instead of carbon dioxide (CO₂).

The post responses looking at ranks 1 & 2 show a 38% increase in disagreement with the question. This indicates that the students underwent a change in perception that CO₂ was more important than water vapor.



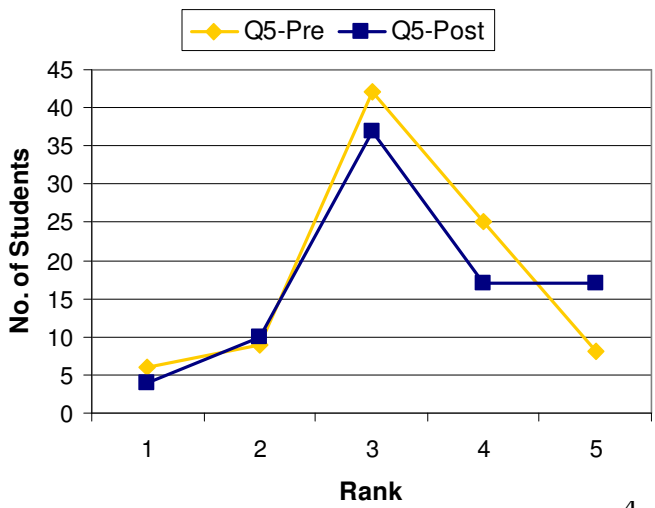
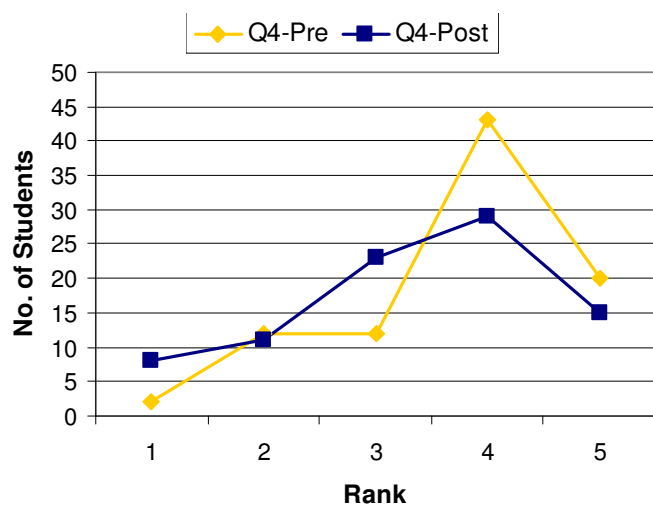


3. Global warming is just part of a natural cycle.

The post responses looking at ranks 1 & 2 show a 48% increase in disagreement with the question. This indicates that the students underwent a change in perception that the global warming that we are now experiencing is not part of a natural cycle.

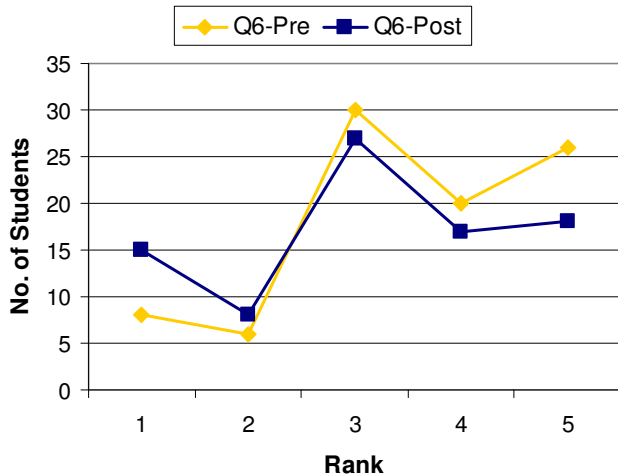
4. We can adapt to climate change. Civilization has survived droughts and temperature shifts before.

Here it is obvious that the students had mixed views with most unsure or agreeing with the question in both the pre and post answers. It can be observed from ranks 1&2 that there was a 36% change in disagreement. However, the total number of students disagreeing is very low compared to those that agree. This area is one where the degree of climate change comes into question. Data available does indicate that we can adapt, but with significant change in quality of life. This area needs more emphasis



5. Mercury in compact florescent lamps represents a significant health risk.

There is really no change here. The students were mainly unsure going in and coming out of the course. This indicates that the subject matter was not well covered in the course.

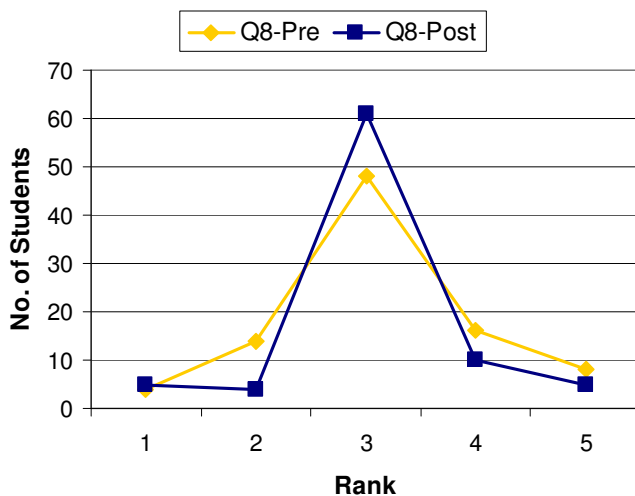
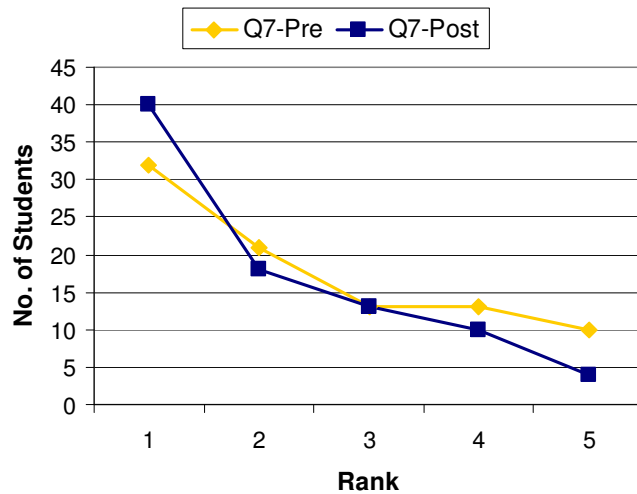


6. A lamp fixture is limited to 60 watts. The use a compact florescent lamp whose light output exceeds that of a 60 watt light bulb would not be recommended.

There is really no change. Reviewing the course reveled that an understanding of “watts”, lumens, and the wattage rating of compact florescent lamps was not well covered. This was also reflected in the final exam.

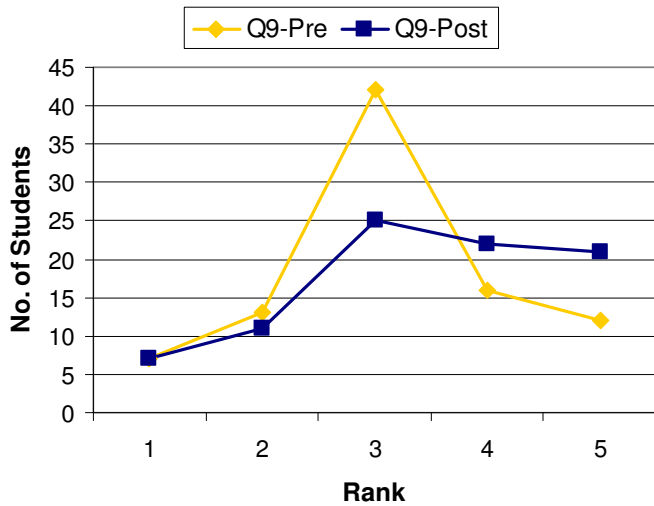
7. My car gets 34 mpg on the highway. That hybrid car also gets 34 mpg on the highway. So, my car’s contribution to global warming is about the same as the hybrid.

Here the pre and post answers follow same pattern with a small change in the majority disagreeing with the question. This is an area that was covered fairly well so those still unsure or in agreement just did not get it. This area needs to be revisited to see if it could be presented in a different manner.



8. My elected officials are familiar with global warming issues.

There is no change here. It does appear that for most of them, elected officials had no impact on their perceptions.

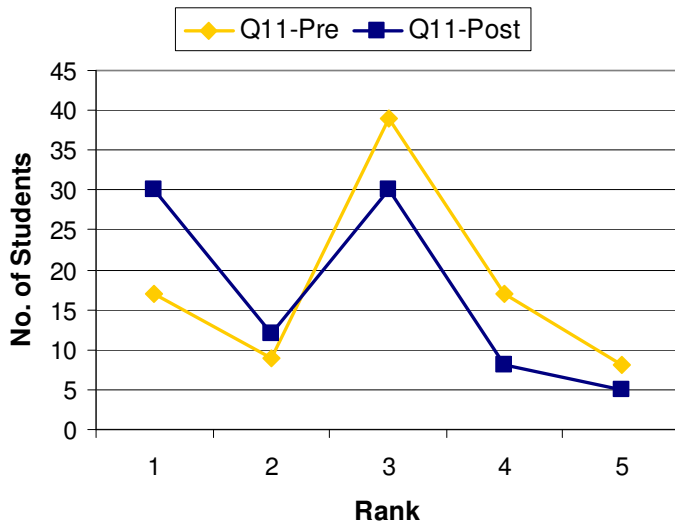
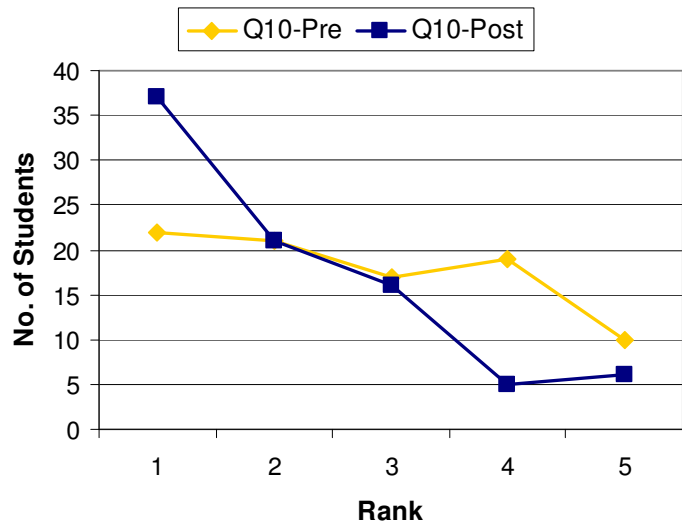


9. Global warming will cause spreading of disease.

There was a 53% increase in the number of students that agreed. However, the course needs to provide more focus on this issue as about half were still undecided or disagreed.

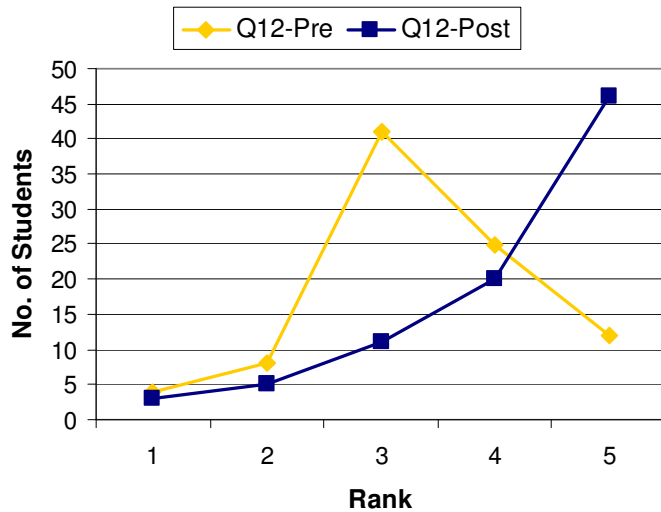
10. A good investment would be a vacation/retirement home on the coast of Florida.

As can be seen, the number of students recognizing that coastal areas may be under water increased. This was a significant point made in the video. The number of those undecided stayed the same.



11. The most common greenhouse gas emitted from human activities is methane.

There was a 61% increase in ranks 1&2. However, the number of undecided or agreeing was still high. The global warming data shows that CO₂ is our main contribution, but coupled with global warming is the release of a lot of methane. This may be a point of confusion.

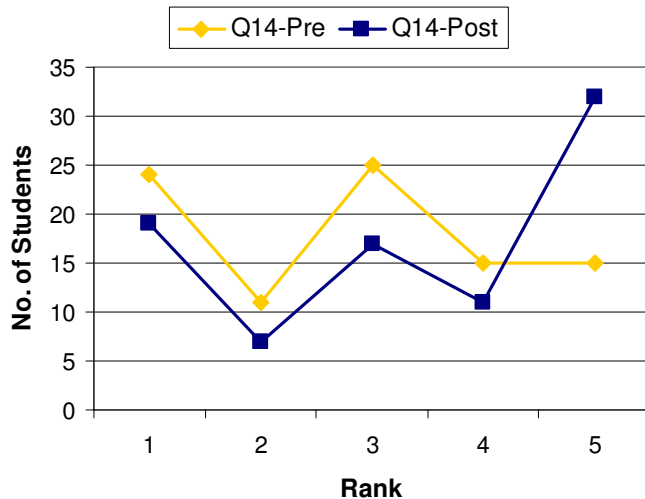
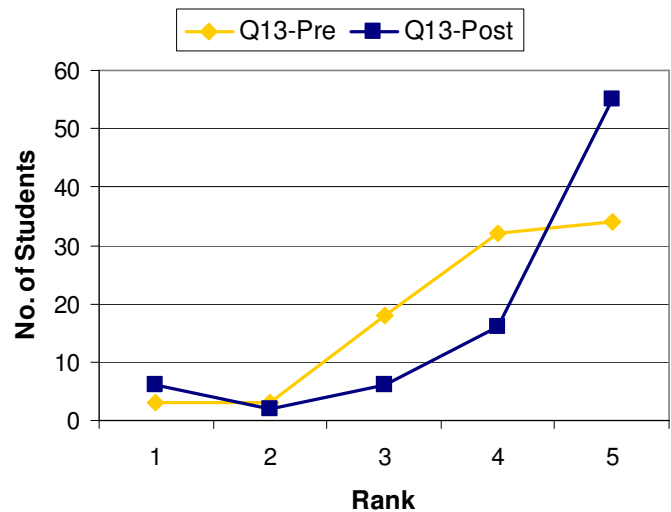


12. Greenhouse gases are not good for humans.

Looking at ranks 4&5 the graphs show a significant increase, 78% in understanding this issue.

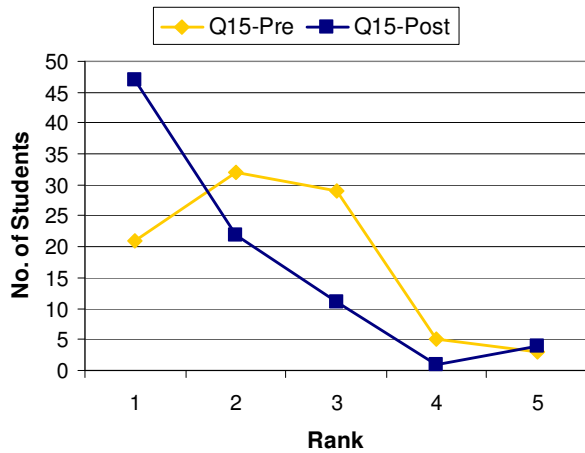
13. Cutting down trees contributes to global warming.

Here the change can be seen as a decrease in undecided and possibly, a large increase in agreement. The small numbers in ranks 1&2 did not change much.



14. Greenhouse gases reflect solar rays.

Here is an indication of confusion on how global warming is caused by the green house gasses. The method of presenting this information needs improvements.

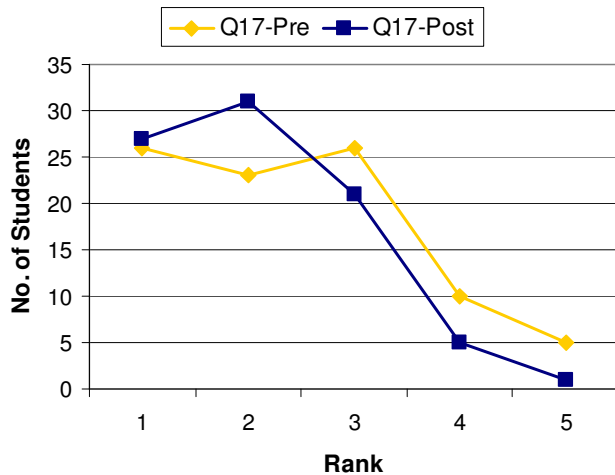
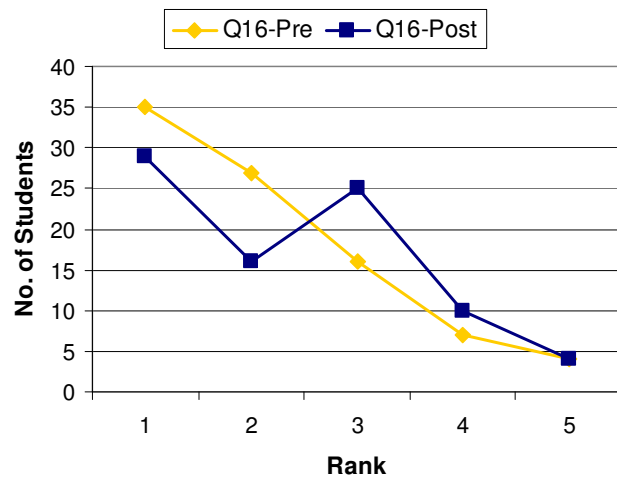


15. Since CO₂ makes up only a tiny part of the atmospheric gas, about 380 parts per million, worrying about it does not make much sense.

Obviously, students gained a better understanding of this issue with a 135% increase in disagreement.

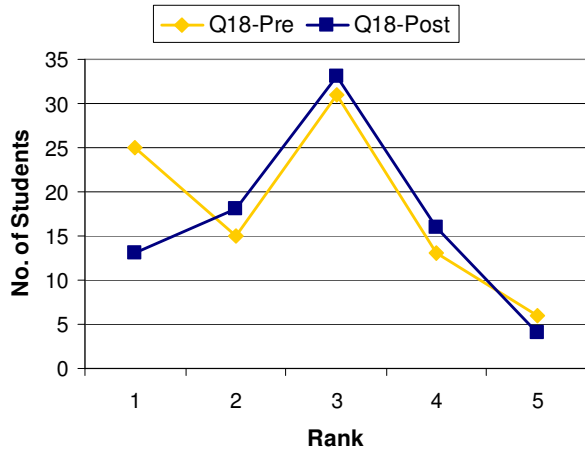
16. Raising the tax on gasoline would contribute to a reduction in greenhouse gas.

This shows an increase in undecided. It appears that the concept of increasing cost to decrease usage is not on the students radar screen at this point. Nor is the idea that the increased revenue could go to alternative energy development. These points were not covered in the course but need to be.



17. I really cannot do much myself to reduce global warming.

The number of students undecided decreased and the 1&2 ranking increased indicating that the students had gained more knowledge about what they could do.

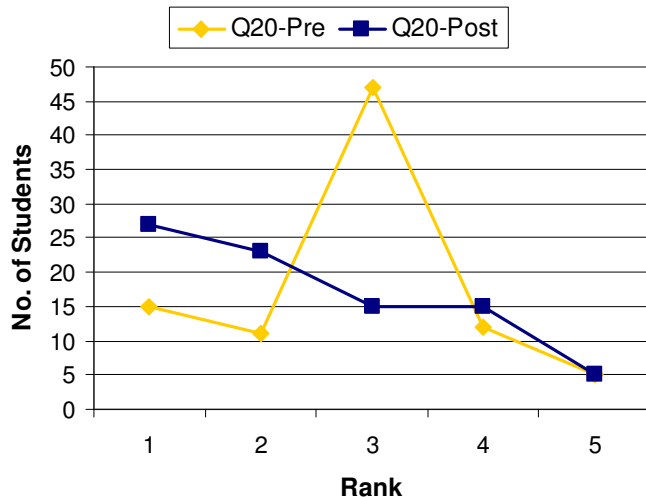
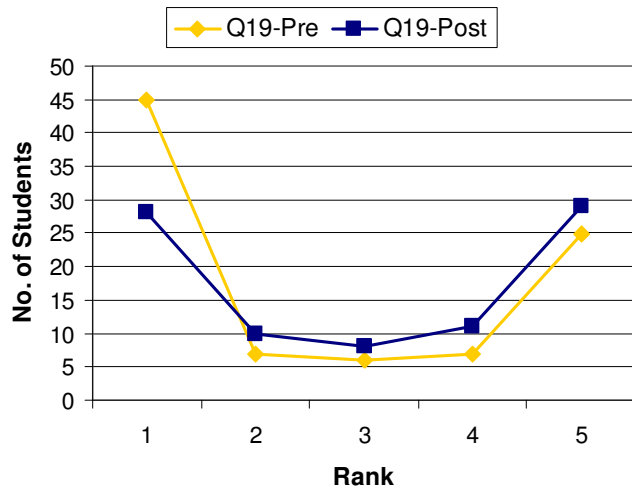


18. My parents are concerned about global warming.

Contact with their parents is pretty limited during the course and this is reflected in the graphs. There was a 44% decrease in disagreement but this was not shown as a gain in the area of agreement.

19. I read an article about global warming in the past week.

No real change here. About half of the class ranked 1 or 2 at the beginning and end of the course. In hindsight, this question is better answered as yes or no.



20. An increase in the earth's temperature has benefits.

There was a 93% increase in rankings 1&2 indicating that the students considered the negative impact of global warming to be significantly more than the benefits such as opening navigation routes and access to more oil and gas in the Arctic. However the question did address benefits directly. So, there is the possibility that the students did not see the benefits or did not consider them

as benefits.

Conclusion

The students' pre rankings on questions 1, 2, 3, 4, 5, 15, and 17 showed that they were inclined positively towards global warming issues. The post rankings showed a positive increase with the exception of question five involving a mercury hazard which was not well covered in class. Questions 8 and 18 involving elected officials and parents were mainly undecided, indicating that officials and parents had not made much impact on the students in the area of global warming. Questions 6, 7, 10, & 16 which involved intuitive thinking did not show much change overall, although the rankings favoring global warming issues did increase. The rest of the questions showed an increased level of positive perceptions about global warming from pre to post. Overall, the post perceptions indicate that the students did gain an understanding of the problems regarding global warming. Some of the areas require more emphasis during the lectures, i.e. understanding of watts, mercury hazards and human adaptation to global warming. Overall, the post perceptions indicate that the students did gain an understanding of the problems related to global warming. The instructors perceive that students enjoyed the focus, actively participated in discussions, and finished the class by being better educated on global warming issues that require educated attention of engineers very soon.

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