2005-2051
Penn State University NSF GK-12 Project: Using Web-based Education and Interaction with K-12 and College Freshman to Promote Science and Engineering

Elana Chapman /Pennsylvania State University,
Angela Lueking /Pennsylvania State University,
Robin Tallon /Pennsylvania State University,
Leanne Avery /Indiana University of Pennsylvania,
Phil Henning /Henning Group, LLC.,
William Carlsen /Pennsylvania State University,
Daniel Haworth /Pennsylvania State University

Abstract

Penn State University has hosted an NSF-sponsored GK-12 Outreach project for the past five years, and has just begun the second phase of the project. The Penn State project utilizes the talents of many science and engineering graduate students as teachers, mentors and role models for the K-12 classrooms. The project focuses on developing skills of students in the areas of science, technology, engineering and mathematics through the use of Advanced Transportation Technologies. A new project component was devised and implemented--the interaction of K-12 students with college freshman via a website project. The college freshmen were asked to create a website describing a component of "Clean Energy", which was to include an assessment tool to provide feedback on their website. When possible, the college freshmen were encouraged to use active learning and inquiry-based learning concepts. This was encouraged so that the college freshman had an opportunity to practice developing scientific inquiry as a skill through a presentation, and provided the K-12 classroom students a unique opportunity to learn through inquiry. The K-12 students were invited to participate in the research by reviewing and critiquing these websites through feedback via the website to the college freshman. The feedback could take many forms, including specific comments and critique along with a creative assessment tool that the college freshman decided to present with their subject materials. This paper will review the educational outcomes garnered by the students, and provide feedback and analysis from the K-12 and college freshman participants.

Introduction

Inquiry-based learning encourages students to become active learners who engage in hands-on research and subsequently develop the ability to analyze, cope with ambiguity in solving "real world" problems, and explain relationships between phenomena in ways that tie together the conceptual and the observed[1]. It also lends itself particularly well to interactive, computer-

enhanced learning environments, so that most examples of inquiry-based learning you will run across today incorporate new media[1].

Some science educators find that technology complements science learning[2]. In particular, inquiry allows students to interact and experiment with course material in new ways through animation and 3-D visualization, complex search engines, on-demand sound and video, networks of links that allow users to move through material in dynamic ways, easy access to a wide variety of online materials and real-time data, opportunities for collaboration over great distances, and the ability to rapidly number-crunch and diagram data[1].

Not only do these tools allow students to work at their own pace, many web-based projects often appeal to learners because they address a variety of learning styles. Today's students often spend a lot of time using the internet as a resource for learning, research, and game-playing. Researchers find that using games like Jeopardy! Can enhance learning in science classrooms. A game is designed to be extremely engaging while simultaneously challenging students to utilize their knowledge in a novel way[2]. Gabrowski and Price (2003) also find that rather than passive regurgitation of concepts, the game engages the student in an interesting deviation from the class norm[2].

Within the framework of the new phase of the NSF project, a special webpage project was concocted. The webpage project was generated through a question from a K-12 teacher, asking about materials available to teach her students about Nuclear Energy and Clean Energy, but that were designed at a more age appropriate level. An opportunity was uncovered after speaking with a professor at Penn State who teaches a general science class entitled "Energy and the Environment", with a primarily non-technical student audience. For this class, the College Students were required to design a webpage reporting on an aspect of Clean Energy. The professor agreed to ask them to make an additional page for their website that was designed for an audience from 7th thru 12th graders. At the same time, the NSF project used this as an opportunity to research the perspective of the non-technical College Students about scientists and engineers, as well as their opinion of the webpage project's application to their learning of the subject matter. The data collected involved pre-project surveys and post-project surveys, as well as a minute paper asking the students to describe what they believed the K-12 audience should learn from their web site.

Objectives

The project had several objectives which are listed below:

1. Provide an opportunity for K-12 students to learn a about clean energy
2. Provide an opportunity for College Students to communicate about a clean energy topic to a young and friendly audience, and in an inquiring manner
3. Provide an opportunity for College Students to use active learning and inquiry based learning
4. Provide an opportunity for College Students to receive feedback on their webpage from an audience

5. Understand the effectiveness of this project and how it could be improved if it were to be repeated
6. Understand how the project may have changed the view of the College Students about what a scientist or engineer does on the job
7. Understand how the project may have changed the view of the K-12 students about what a scientist or engineer does on the job
8. Determine if the K-12 students thought that the students creating the webpages were scientists or engineers
9. Determine if the College Students understood active learning and inquiry-based learning

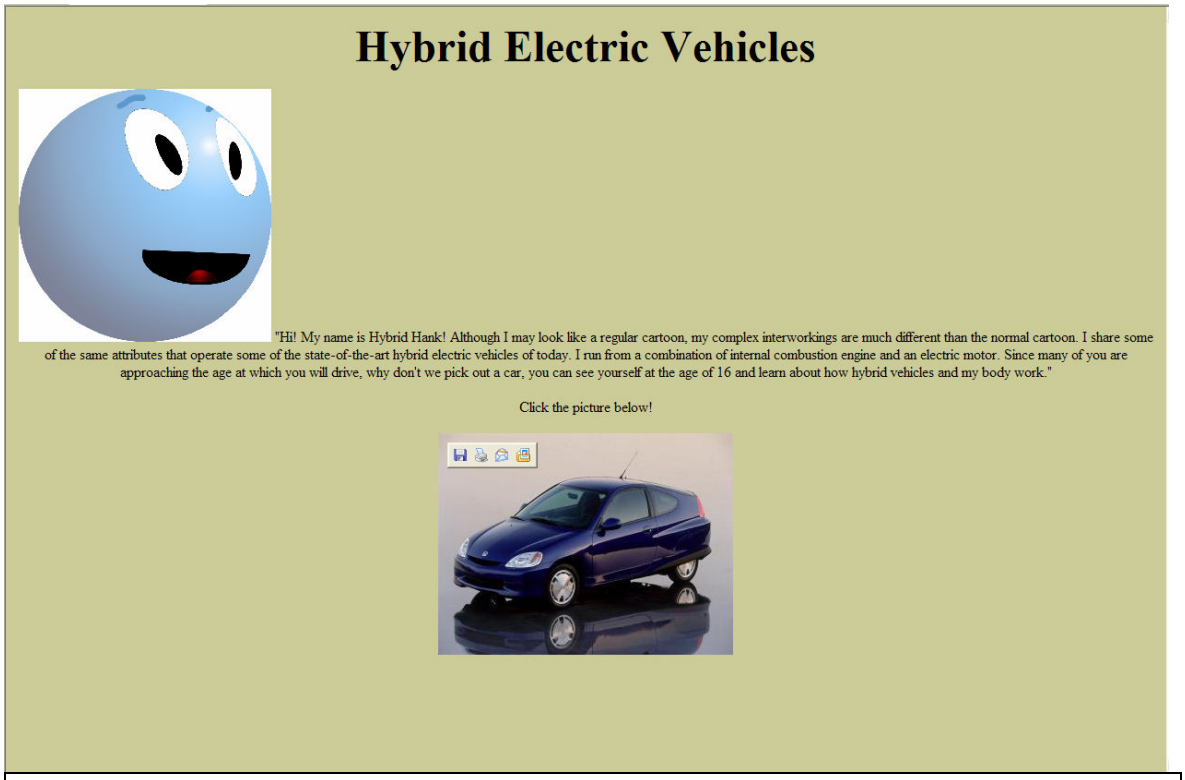
Methodology

For this study, a General Science Class at Penn State university entitled "Energy and the Environment" (EGEE 101) participated in the research. The class comprised mostly college freshman, but also comprised higher level students. Most students in the course were non-science majors, but science and engineering majors are allowed to take the course for credit. As part of the course, the students were instructed that they would be designing a website to explain a concept about clean energy. As part of the website, the students were asked to prepare a section that conveyed the concepts to a 7^{th}-12^{th} grader. The students were divided up into 14 groups of approximately 5-6 students, and thus there were 14 separate websites designed for the K-12 students to review.

For the K-12 students group, the surveying was accomplished from a combined 6^{th} and 7^{th} grade class. Due to the short time frame and computer access issues, only a small sample was accomplished. The students were asked to review a minimum of three websites, but encouraged to look at as many as possible during the class period.

The project data was collected via surveys, website designs, and other response papers in both the College course and the K-12 classroom. In the college class, a pre-project and post-project survey was requested, but for the K-12 class, only a post-project survey was requested. The survey questions can be found at the end of the paper in the Appendix section. A sample website design from Group 13 can be found on the next page. Additionally, the College Students were asked to respond to a minute paper in which they were directed to reflect on the following set of questions: "How will you know if the students understood what you were communicating to them via the website? Do you have some type of activity that will give you feedback? How would you know if what you communicated on your website made sense to the reader?" A minute paper is meant to take only 1-2 minutes of time during a class period, and to collect data from students about experiences in the classroom or about their specific subject knowledge. It was used so that the students could communicate their thoughts in a private way, and not be influenced by other student's answers in a discussion style setting, therefore providing qualitative information.

As a final stage of the data collection, focus groups may be conducted to uncover a deeper understanding of the findings and breakdowns in this project. The researchers are considering a second trial phase, and would like to improve upon the methodology and project implementation with the students.



Webpage from Group 13:

Hi! My name is Hybrid Hank! Although I may look like a regular cartoon, my complex interworkings are much different than the normal cartoon. I share some of the same attributes that operate some of the state-of-the-art hybrid electric vehicles of today. I run from a combination of internal combustion engine and an electric motor. Since many of you are approaching the age at which you will drive, why don't we pick out a car, you can see yourself at the age of 16 and learn about how hybrid vehicles and my body work."

Survey and Project Findings

The surveys were collected, and that data was synthesized into the format presented below. Likert Scale survey data items were analyzed using a frequency analysis using Excel. Individual open-ended survey questions were analyzed using a qualitative methodology[3]. The following sections will present the qualitative data gathered, classroom observations, select quotes from the surveys, and make some conclusions based on the results.

K-12 Classroom Observations

There were 14 websites presented to the 7th grade class at a local charter school. The school we worked with focused on project based education via using a computer, and thus each student had a computer on their desks. The websites presented introductions to energy on topics such as clean coal technology, hybrid electric vehicles, hydrogen and solar power. Students were assigned a minimum of three sites to look at and answer questions. Some students were able to quickly view their sites and move on to others. Some sites had worksheets associated with them, while others were mainly just text. The students seemed to get into the sites and were excited

about learning. The sites had a surprising amount of material on them, which kept them occupied for some time without prompting from the teacher. The NSF Fellow was available for questions, and was busy taking questions from students the entire time. When the students found something that interested them, they called their teacher over to show things they found. After the 7th grade students had an hour to review the sites, the teacher had them stop to take time to answer the surveys, and suggested that they book mark the sites for a later visit.

K-12 Post Project Survey

Since the K-12 students are given a survey as part of their introduction into the NSF project, a post survey was only collected from this group for the webpage project. Based on the data presented below for this survey, the K-12 students had a positive experience with the webpage project, and they believe it aided in their learning about science. Also, most of them liked giving feedback to the other students. As an additional point of observation, they were asked their opinion if the webpages were constructed by scientists and engineers. This was asked to determine if they thought that a scientist is the only kind of college student who can communicate this kind of information, or if all students could. The general idea being evaluated is that one could communicate about science even if one were not a scientist. Most students either agreed that they were scientists or were not sure. (The EGEE 101 class was composed of mostly non-scientists, with only 2-3% being scientists or engineers.)

Questions	Agree	Neutral	Disagree
1. I enjoyed learning bout Clean Energy by reading the websites.	80 %	3 %	3 %
2. I learned about science by doing the projects and quizzes on the websites.	54 %	17 %	14 %
3. I learned something new through this project that I had not already known	69 %	11 %	6 %
4. I liked giving suggestions to other students to help improve their learning.	46 %	31 %	6 %
5. I think the websites were created by scientists and engineers	40 %	23 %	23 %

As additional support of the students' experiences, the following quotes were selected. In some cases, the student is specifically pointing out the group number of the website reviewed (the quotes have not been edited in order to portray original student response).

"group 8 i think that this web-site is really awesome. This website makes everything really easy to understand. For this web-site, you really don't need the words because you could just use the pictures. Group 8 hybird cars combind two or more sources of power. I think you gave a good explaination on hybird vehicles"

"i feel that some kids also helped out with this also. I had fun learning about 'clean coal'"

"the front page has good infermation. The one page that says evolution of solar power that was neat how you had it set up like a time line. Evolution is neat with all the pichers on them. I like the efficiency. I like the way they are talking about the waste and how it helps the eviermen t. You cost one boes not work write. The web was so cool but you need games to play on it."

"14 i think it was all good some could be better. 13 i think it was cool. 1 i looked like someone oure age made it. But great info."

The quotes support the qualitative data collected regarding the students experience of the webpages. They enjoyed the sites, and they seemed to agree that they learned from the sites. Also, it is interesting to note that one student thought that the sites were developed with the help of students like themselves. A series of questions that are evoked from this, " Does the closeness in age of the student teaching the materials impact the learning and enjoyment for the student learning the materials?; Is there something about the closeness in age that gives comfort to the student learner, and thus makes learning easier or more fun?"

College Student Pre-Project Survey

A pre-project survey was handed out as a means to introduce the College Students to the webpage project, and the concepts of active based learning and inquiry based learning.. What was also of interest to the researchers was the answer to questions for both the pre- and post-survey, since some of the same questions would be asked. As is seen below in the data, most students agreed that they could learn through communicating concepts, and work together in a group project. Also, they indicated that they understood what active and inquiry-based learning meant. As another other point of observation, they were asked if they thought they could be a scientist or engineer. As indicated, 37% believe that they could do this, and over 30% were neutral, although they were not majoring in that particular subject. This may indicate that their interest is in the scientific area, but their college major is not. Or, this may indicate that they are confident in their abilities. The question did not probe their interest, but rather their competence. In the final question, they were asked if they could communicate scientific ideas to others, and 59% agreed that they could.

Questions	Agree	Neutral	Disagree
1. Communicating concepts about a subject to others helps to clarify the subject and issues.	93 %	7 %	0 %
2. Doing a project as a group helps to ensure diverse perspectives and ideas are considered.	71 %	26 %	3 %
3. Doing a project as a group means that we divide responsibilities and tasks and all contribute roughly the same amount of work.	79 %	12 %	9 %
4. I understand what the terms active learning or inquiry based learning mean	59 %	34 %	7 %
5. What is active learning?			
6. Describe what a scientist does			
7. Describe what an engineer does			
8. I could be a scientist	37 %	33 %	29 %

9. I could be an engineer	37 %	32 %	30 %
10. I can communicate scientific ideas to others.	59 %	34 %	5 %

Following are samples responses from the short answer questions:

Question 5: What is active learning?

"Active learning is the term that is associated when one is learning new material by doing 'hands on work'. To clarify this, instead of learning new material through lecture and then applying that material, active learning is when a person learns the material in the field, learning and applying at the same time."

"Active learning is learning through the use of activities and discussion. It is participating in some type of activity teaches the lesson."

"Active learning means getting involved with the subject hands on as opposed to just sitting back listening to the teacher speak."

"To participate in class, give your opinions and be interested in the subject."

"Active learning is the process of engaging the learning process in such a way that the student finds ways to teach themselves and actively seeks to answer their own questions."

Question 6: Describe what a scientist does.

"A scientist tries to look for solutions and find out as much truth as they can about the world we live in through experiments and study. They work towards finding absolute truths, but nothing is ever 100% certain in science."

"A scientist questions things, makes theories and hypothesizes, designs experiments, performs experiments, tests their hypothesis, and makes conclusions."

"A scientist makes a hypothesis about something and then does experiments to test their hypotheses."

Question 7: Describe what an engineer does.

"Engineers use math and science to solve practical problems. They also design, manufacture, and build such items as houses, bridges, etc."

"An engineer is someone who invents or creates new thing things. This is much like the job of the scientist in the fact that they would also use the scientific process in their work."

"An engineer takes the theories that scientists develop and then apply them in the field and in everyday life, to see if the theories can work outside of the laboratory. An engineer will also examine the theories and fine tune them if necessary, in order to make them work outside of a laboratory."

College Student Minute Paper

To reinforce the aspect of creating an active learning component to the project, and to reinforce that the College Students should have something on their website that would provide them a feedback mechanism, the researchers decided to give a "Minute Paper" assignment to the class. A minute paper is something that takes only a few minutes of class times, and asks the students to provide feedback on a specific question. This is usually done as a way to help reinforce a

concept in the classroom, and to give the teacher immediate feedback on a topic. In regards to the webpage project, the students were asked to answer the following question in their minute paper: "How would they know if the 7-12th students understood what they were trying to convey through the webpage?" The day that the minute paper was done, there was widespread confusion when the students were asked the question. The professor then reworded and restated the question until the students were confident with their understanding.

The College Students did know that they would be receiving feedback from the 7-12th students after they had viewed their webpages, and before the final survey. And, it had been suggested to them that they create something that would be a game or puzzle to help the student understand the topic. However, after reading through the minute papers, it seems that the College Students had a good idea of what they were trying to express, but did not know how to translate that into some kind of feedback mechanism. They were very interested in making sure that their pages conveyed the message, and were fun and interesting for the 7-12th students.

Here are some of the minute paper's to support the findings:

"Our website is about clean skies initiative. My part talks about clean coal projects and maybe it would be a good idea to add the pros and cons of those projects. In that way, the students would have a better idea of the different projects."

"If the kids can answer and figure out the games we created, this will be a measure of success. They should also take away the harmful effects of burning coal, and what clean coal technology is available. They should understand what measures the government is taking to aid in using clean coal. Finally, the kids should know broadly how clean coal will affect the environment, society, and the economy."

"We would know if we offered a quiz at the end of the website (not graded, just for fun) to test their knowledge. Also, a ticker to show how many times the website has been 'hit' or looked at. Students should be able to repeat basic info from the website (words, some definitions, explanations but not specific details)."

"My group's project deals with clean coal technology. Our website presents the major concepts of our research on a very basic level, geared specifically toward 7th graders. Our site includes an explanation of what clean coal technology is, government policies promoting clean coal, and even a page with interactive learning games. I would hope that after viewing our site, a middle schooler could walk away with a basic knowledge and understanding of what clean coal technology is and why it's so important. I would also hope they would be excited for the prospect of moving from coal-fired plants to clean coal plants in the coming future."

"In order to determine if our group website in successful or not, the students should be able to actively participate in a discussion about Hybrid Electric Vehicles. They should be able to understand the advantages and disadvantages, and be able to make some comparisons to gasoline vehicles. Also, they should be able to identify the effect on the environment and the economy."

College Student Post Project Survey

The following post-project survey was taken after the webpages were reviewed by the K-12 students. The College Students were only given a few minutes to review the feedback from the K-12 students. In some instances, there were some groups that did not have specific feedback, either due to the lack of an active based learning tool on their website, or the lack of critique from the K-12 students. As can be seen in the data below, the College Students believed that the webpage project helped increase their knowledge of the subject, helped them in clarifying the

concepts to others, and that they liked to have members of their audience review their webpages. However, only 39% agreed that they benefited from the feedback from the K-12 students. Also, even though 61% said that they understood what active learning meant, only half of the webpages had a component on them for active learning for the K-12 students.

As an additional data point, the students were asked if preparing the webpage portion of the project for the 7^{th} -12^{th} graders (the College Students original assignment was for this age group) helped them to gain a greater understanding about science or learn materials from the course, the students were divided between agree, neutral, and disagree. This may indicate a couple of items: 1) the College Students found the webpage project helpful, but not the 7^{th} -12^{th} component, 2) there was some confusion in the post-project survey questions that separate out the main webpage project from the 7^{th} -12^{th} grade portion, and 3) because only about 50% created an active learning portion of their webpage for the 7^{th} -12^{th} students, they did not receive feedback on their website. As a following part of this project, a focus group of participants may help to clarify some of these issues.

Questions	Agree	Neutral	Disagree
1. This project has increased my knowledge about Energy & the Environment	82 %	15 %	3 %
2. Communicating concepts about Energy & the Environment to others has clarified my understanding of these issues.	65 %	31 %	5 %
3. Doing this project as a group helped to ensure that diverse perspectives and ideas were presented to our target audience.	55 %	31 %	13 %
4. I would consider my group to be interdisciplinary.	71 %	24 %	5 %
5. I appreciated the opportunity to have members of the target audience evaluate our project.	63 %	34 %	3 %
6. I benefited from the feedback given by the K-12 students.	39 %	53 %	8 %
6. I changed my website in some way after reading the feedback given to me by the K-12 students.	13 %	58 %	29 %
7. This project provided me with an educational opportunity I would not otherwise have had at the 100 level.	45 %	39 %	16 %
8. The project was a reasonable amount of work given the credit for the course and the relative percent of my grade.	60 %	24 %	16 %
9. I understand what the terms active learning or inquiry based learning mean after doing this project	61 %	32 %	5 %
10. What is active learning?			

11. Describe what a scientist does			
12. Describe what an engineer does			
13. Preparing the website portion of the project for 7-12 grade students helped me to gain a greater understanding of science	32 %	34 %	32 %
14. Preparing the website portion of the project for 7-12 grade students helped me to gain a better understanding of concepts taught in this course	39 %	30 %	29 %
Other Comments: Please feel free to describe your experience working on this project			

As evidenced by the answers to question 10, the majority of the students understood what the term active learning meant, but not all. As support of this, here are some of the answers to that question:

"Learning with a hands on approach"

"Instead of lecturing, it allows the student to be directly involved in the learning process, either by conducting research, doing a project, etc."

"Having students engage in some investigation so that they learn the materials based on their findings"

"Working with others"

"Continuously learning"

As additional support of the College Students' experience, some quotes were selected from the "Other Comments" section (these quotes are also not edited to maintain the integrity of student writing).

"it was a very good idea and i wish i had the opportunity to check out the websites when i was in k-12"

"comment question 10: this is not to suggest that i understand it because of the project, i simply still understand it after the project"

Many of the free comments received from the students had to do with either the problems that they had with working in groups where some did all of the work and others didn't do any or a very small amount. Also, they felt there was a lot of work for this course, but it is unclear if that was because of the comparison between other sections of the EGEE101 course, the webpage project for this course, or the 7^{th}-12^{th} grade part of this project.

Debrief of Webpage Project with College Class Professor

A day after the webpage project was completed in the college classroom, a debrief meeting was held with all researchers. A few observations were noted to help to explain this data, and to prepare revisions to this project for future use. Observations:

1) Even though the active learning was mentioned as part of the project, and a minute paper with the College Students occurred a couple of days before the webpages were due, many

of the groups did not include anything that pertained to active learning or inquiry based learning for the K-12 students.
2) The College Students expressed to the class professor that the assignment of "7-12th grade" was too broad for the College Students to make a page because the students could not cover the material at each grade level.
3) In looking at the survey for the college classroom, we were left with the following question which did not get answered: How did the project affect the students in the EGEE 101 class?

Conclusions

Overall, most of the objectives of the project were accomplished. The webpages were well constructed by the College Students and age appropriate for the K-12 students who viewed them. The K-12 students seemed enthusiastic about the content, learned about Clean Energy, and were happy to provide feedback to the College Students. The 7th-12th students believed that the majority of the students creating the webpages were scientists and engineers, when in actuality, they were not. It was easier for the 7th-12th students to provide feedback to the College Students when there was an active learning or inquiry-based learning component to the website. More than 60% of the College Students understood what active and inquiry-based learning meant, when only 50% of them had something of this nature on their webpage. The College Students did not receive much feedback, or time to review the feedback they did receive, which did not seem to have an impact on the College Students, as indicated in the data. However, the College Students did not seem to agree that designing a separate webpage for an audience of 7th -12th graders had an impact on their learning. This suggests some misunderstanding in the project directions to the College Students, or a lack of tying together the purpose of their work to what they learned in the class. It was clear from viewing their webpages that the College Students did not clearly understand what inquiry based learning and active learning meant, although they were being taught with this method in the class, and were asked the question in the surveys.

The following objectives were not obtained as a result of this project. Through further evaluation and focus groups contact with the students, this may be achieved.

- Understand the effectiveness of this project and how it could be improved if it were to be repeated
- Understand how the project may have changed the view of the College Students about what a scientist and engineer do on the job
- Understand how the project may have changed the view of the K-12 students about what a scientist and engineer do on the job

Acknowledgements

This project has been supported by the National Science Foundation, under the NSF Graduate Teaching Fellowship in K-12 Education (DGE-0338240).

Bibliography

1. (NITLE, 2003). http://newsletter.nitle.org/v1_n3_fall2002/features_ibl.php

2. **"**Simple HTML Templates for Creating Science Oriented Jeopardy! Games for Active Learning" Joseph J. Grabowski* and Michelle L. Price. *J. Chem. Ed.*, **2003**, *80*, 967.

3. Patton, M. (1990). Qualitative Evaluation and Research Methods. Sage Publications. Newbury Park.

Appendix

College Student Surveys

Pre Website Project Participation Survey on Educational Outcomes

This survey asks you some questions about your experience with this project. Please circle the one that reflects your opinion:

1. Communicating concepts about a subject to others helps to clarify the subject and issues.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

2. Doing a project as a group helps to ensure diverse perspectives and ideas are considered..
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

3. Doing a project as a group means that we divide responsibilities and tasks and all contribute roughly the same amount of work.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

4. I understand what the terms active learning or inquiry based learning mean
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

5. What is active learning?

6. Describe what a scientist does

7. Describe what an engineer does

8. I could be a scientist
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

9. I could be an engineer
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

10.. I can communicate scientific ideas to others .
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

Post Website Project Participation Survey on Educational Outcomes

This survey asks you some questions about your experience with this project. Please circle the one that reflects your opinion:

1. This project has increased my knowledge about Energy & the Environment
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

2. Communicating concepts about Energy & the Environment to others has clarified my understanding of these issues.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

3. Doing this project as a group helped to ensure that diverse perspectives and ideas were presented to our target audience.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

4. I would consider my group to be interdisciplinary.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

5. I appreciated the opportunity to have members of the target audience evaluate our project.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

6. I benefited from the feedback given by the K-12 students.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

6. I changed my website in some way after reading the feedback given to me by the K-12 students.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

7. This project provided me with an educational opportunity I would not otherwise have had at the 100 level.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

8. The project was a reasonable amount of work given the credit for the course and the relative percent of my grade.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

9. I understand what the terms active learning or inquiry based learning mean after doing this project
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

10. What is active learning?

11. Describe what a scientist does

12. Describe what an engineer does

13. Preparing the website portion of the project for 7-12 grade students helped me to gain a better understanding of science
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

14. Preparing the website portion of the project for 7-12 grade students helped me to gain a better understanding of concepts taught in this course
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

Other Comments: Please feel free to describe your experience working on this project

K-12 Student Survey (Post Project)

K-12 Student Post Website Project Participation Survey on Educational Outcomes

This survey asks you some questions about your experience with this project. Please circle the one that reflects your opinion:

1. I enjoyed learning bout Clean Energy by reading the websites.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

2. I learned about science by doing the projects and quizzes on the websites.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

3. I learned something new through this project that I had not already known
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

4. I liked giving suggestions to other students to help improve their learning.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

5. I think the websites were created by scientists and engineers
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

Other Comments:

For a website without an activity sheet:

If the website did not have an activity sheet with it, please provide comments about the website and about your understanding of it.

Group Number _____(from the website)

Biographical Information

ELANA CHAPMAN /PENNSYLVANIA STATE UNIVERSITY
Elana is a PhD Candidate in Fuel Science in the Department of Energy & Geo-Environmental Engineering at the Pennsylvania State University. She is also a candidate for a Masters in Mechanical Engineering. Over the last 3 years, she has been involved with the phase I and phase ii of the NSF project, as well as the Future Truck and Challenge X student competitions sponsored by Argonne National Laboratory.

ANGELA LEUKING /PENNSYLVANIA STATE UNIVERSITY
Angela is an Assistant Professor in the Department of Energy & Geo-Environmental Engineering at the Pennsylvania State University. She incorporated the web design and outreach project into her teaching of "EGEE 101: Energy & the Environment"; she has also taught courses relating to green engineering, hydrogen technology, and environmental design. Her research interests are in green technologies, such as hydrogen and fuel cells.

ROBIN TALLON /PENNSYLVANIA STATE UNIVERSITY
Robin is a senior research aide at the Pennsylvania Transportation Institute (PTI), an interdisciplinary research unit of the College of Engineering. Having over 20 years experience in vehicle- and safety-related transportation research at PTI, she has been involved in the NSF-sponsored GK-12 project focusing on advanced transportation technologies since its inception in 1999.

LEANNE AVERY /INDIANA UNIVERSITY OF PENNSYLVANIA
Leanne is an Associate Professor of Science Education in the Department of Biology at IUP. She provides professional development in education for Project Fellows and coordinates interactions between Fellows and IUP pre-service teachers to implement engineering concepts in K-12 classrooms. She teaches courses in Biology and Education. Her research interests are in enhancing pre-service elementary teachers' self-efficacy for science and science teaching.

PHIL HENNING /HENNING GROUP, LLC.
Phil Henning serves as the outside evaluator for the Penn State NSF GK12 GREATT Project and is principal of The Henning Group, LLC which provides consulting services in technical and scientific curriculum development, evaluation and research. He has taught for 26 years at the Pennsylvania College of Technology and holds a Ph.D. in Instructional Systems from Penn State.

WILLIAM CARLSEN /PENNSYLVANIA STATE UNIVERSITY
Bill is a Professor of Science Education in Penn State's College of Education, and is serving as interim director of the university's new Center for Science and the Schools. His published research has included studies of science teacher subject-matter knowledge, science curriculum, and engineering design in secondary school classrooms. His current research focuses on the use of web-mediated peer review of original scientific research by high school students and pre-service science teachers.

DANIEL HAWORTH /PENNSYLVANIA STATE UNIVERSITY
Daniel is an Associate Professor of Mechanical Engineering in the Department of Mechanical & Nuclear Engineering at the Pennsylvania State University. His research pertains to the computational thermal-fluids sciences, with an emphasis on advanced propulsion systems. He is PI of Penn State's Track 2 GK-12 project, "Graduate Research and Education in Advanced Transportation Technology (GREATT)." He has been faculty advisor to Penn State's Advanced Vehicle Technology Competition teams since 2001, and teaches related courses pertaining to hybrid vehicles.