

THE EFFECTS OF ROLE-PLAY ON CONCEPT UNDERSTANDING AND  
CRITICAL THINKING SKILLS OF MIDDLE SCHOOL STUDENTS

by

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In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to others under the specified rules of the MSSE program.

Brian Phillips

July 2013

## DEDICATION

I dedicate this capstone project to my wife, Mary Carol Phillips, and our children, Harper and Sam. Mary Carol was my stress relief, my proofreader, and my encouragement all while raising our children almost singlehandedly during this project. My children were my comic relief and my inspiration.

I would also like to thank Woody Malot, Kelly Frank, David Landis, Mike Cook and Bill Patti who provided guidance, encouragement, and supplies to help me succeed; Susan Kelly who was instrumental in proofing my final paper; as well as Jewel Reuter and Patrice Malamis for their constant guidance, motivation, and tireless efforts with proofreading and correcting. Without their help, I would be stuck in a B.S. world instead of moving toward an M.S.S.E. degree.

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## ABSTRACT

In this capstone investigation students learned about environmental science topics through the use of role-play to determine how their understanding of the subject matter would change. The study also looked into the effect of role-play on students' critical thinking, their motivation and attitude, as well as the teacher's motivation and attitude. During two treatment units students were assigned fictitious characters with an array of problems and situations and the students researched the assigned topic through the eyes of their character. At the end of each unit, students gathered for a debate that would take place while in character. A combination of pre and postunit assessments, surveys, interviews, pro and con grids, journal entries, and colleague observations were utilized to gather data about students and the teacher. Results showed an improvement in student understanding, critical thinking, and attitudes and motivation. The results also revealed an improvement in the teacher's attitude and motivation.

## INTRODUCTION AND BACKGROUND

Since I started teaching, I have been experimenting with and altering the way that I teach different topics to try and determine which methods are the best for helping my students absorb information as well as keep them motivated and excited about learning. One method of teaching environmental science topics that I had seen other teachers use, but had never used personally, was role-play. I was not very comfortable with this teaching method, but in recent years I have begun to realize that I need to reach outside of my comfort zone in order to influence more students. This realization led me to want to study the impacts of using role-play in the classroom for my capstone project.

Through the use of role-play in my classroom, there were four main goals that I hoped to accomplish. First, and most importantly, I hoped to help my students improve their understanding of environmental science topics. Second, I hoped to improve my students' ability to use critical thinking skills in classroom discussion. Third, I hoped to help my students stay motivated to learn environmental topics by getting them involved in discussions of the issues as opposed to using a more traditional lecture method. Finally, I hoped to increase my own motivation and improve my own attitude about coming to class by having lessons that were more intellectually stimulating for my students. At the very least, I felt that completing this project would help me add one more tool to my teaching repertoire.

Not only did I hope to accomplish the goals listed above, but I also hoped to help my fellow science teachers by sharing the results of my study with them. I feel confident



that role-play can be an important tool to help students understand decisions that are made around the world each day in all fields of science.

My project focus question was: what are the effects of the use of role-play on middle school students' understanding of environmental science concepts? Reflection upon this focus question led me to the development of my project subquestions, which were as follows: what are the effects of the use of role-play on middle school students' critical thinking skills; what are the effects of the use of role-play on students' attitudes and motivation to learn environmental topics; and what are the effects of the use of role-play on my attitude and motivation as a teacher and my pedagogy?

An important term used in my first subquestion is critical thinking. Critical thinking is defined as being an intellectual process of actively and skillfully conceptualizing, applying, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Critical Thinking Community, 2011). This definition was used to guide the design of assessment tools that were used during the study.

While completing this project I also had several key individuals who helped me. A support team at the school where I teach consisted of Woody Malot, David Landis, Kelly Frank, and Bill Patti. My wife, Mary Carol Phillips, aided me by editing many of my initial rough drafts. My project advisor, Jewel Reuter, along with Patrice Malamis, guided me through the entire writing process and kept me on track. Also, Susan Kelly acted as my reader and helped me to polish my final project paper.

## CONCEPTUAL FRAMEWORK

Helping students acquire meaningful skills for achieving their own learning is a difficult task in education. Novak points out that,

As meaningful learning proceeds, new concept meanings are integrated into our cognitive structure, to greater or lesser extent, depending on how much effort we make to seek this integration, and on the quantity and quality of our existing, relevant cognitive structure. If we learn strictly by rote, essentially no integration of new concept meaning occurs, and existing cognitive structure is not elaborated or reconstructed. (Novak, 2002, p. 551)

Hassard also points out that

Rote, arbitrary acquisition of knowledge is encouraged by poor evaluation practices as well as instruction strategies where teacher rewards quick answers to questions that have little or no relevance to direct experiences with pertinent objects or events. But “hands on” experience is not enough; we also need “minds on experiences.” (Hassard, 1992, p. 554)

My research project on role-play attempted to provide a meaningful learning experience for students that would force them to put effort into their own learning by developing a character involved in a specific issue and then provide them with a hands-on and minds-on experience in the form of a role-play activity. My hope was that by turning away from rote learning and involving students in a real-life simulation through role play, students

would experience a higher level of concept integration as well as build on their critical thinking skills.

Role-play is an educational tool that has been around for quite a while. The use of drama was first cited as a teaching strategy for English students in 1528 (Courtney, 1974). For the next 300 years, the topics of religion, classics, and elocution were taught through role-play in some schools and monasteries in both England and France (Courtney, 1974). Role-play continued to be used in some classrooms throughout the last century, and is beginning to gain popularity as a pedagogical tool. Role-play has not been used extensively in science classrooms, but in the 1980's, inspired by successes within the humanities, some educators and researchers in the United Kingdom began to explore the use of drama in science (Dorion, 2007). A 2003 literature review done by Marianne Odegaard showed that interest in the use of role-play has extended internationally, in particular to Norway, North America, and Australia (Odegaard, 2003). Observations made in the same literature review showed that the role-play activities being used tended to be improvisational role-plays, rather than scripted performances (Odegaard, 2003). This observation holds true for my study since I also used an improvisational style as opposed to a scripted performance. My reason for using this style of role-play was to push students to apply, synthesize, and evaluate what they learned in their research as well as use logical, reflective, and creative thinking while developing their arguments.

Through the implementation of my study, my main goal was to improve the understanding of environmental science concepts among my eighth-grade students. The

use of role-play or drama oriented activities in the primary years have been shown to contribute to both the enjoyment of science and the development of a better understanding of the nature of science (Cakici & Bayir, 2012). Also, empathy is described as a potent vehicle for teaching about moral and ethical issues to students aged 15-16 (Brown, 1995; Claxton, 1997; Duveen & Solomon, 1994). The study of environmental science involves discussions about many moral and ethical issues, therefore, it is very important that my students develop their ability to empathize in order to understand and fully acquire many of the concepts discussed throughout the year.

Cakici and Bayir, in their study about the use of role-play in primary education, also showed that allowing students to express their understanding in a collaborative fashion through role-play may allow children to obtain greater gains in comprehension and understanding as opposed to listening to a teacher or reading a textbook (Cakici & Bayir, 2012). The role-play activities that I designed allow students to discuss, debate, and collaborate to come to conclusions about the problem at hand. According to the study shown above, this set up may allow for deeper student comprehension and understanding. Duveen and Solomon also found that unscripted social simulations in role-play also help convey to students the impact of science and technology on society, with activities that include debates and consensus conferences (1994).

Another study that involved students aged 7 to 11 investigated the advantages of utilizing drama/role-play in developing understanding of basic ecological concepts. The study reported that a structural role-play activity (the Eco Game) used as an active learning strategy, appeared to have an important part to play in generation of concepts

relating to ecology (Bailey & Watson, 1998). More specifically, the study found that test scores of pupils who had played the game were 47% higher than students who had not, and analyses of other data showed a very clean difference in levels of understanding between students who played the game and those who did not (Bailey & Watson, 1998). This study in particular gave me great hope in my study achieving improved student understanding.

Through the implementation of my study, I also hoped to improve my students' abilities to think critically. Thinking in this way would involve conceptualizing, application, synthesis, and evaluation as well as logical, reflective, and creative thinking. Several studies that I came across in my research showed that role-play has been successful in helping students in these areas in the past. For example, several studies found that drama, or drama-type activities such as role-plays, can support learning of cognitive, affective, and technical objectives, especially higher order thinking skills relating to analysis, synthesis, and evaluation (Ellington, Addinall, & Percival, 1981; Harvard-Project-Zero, 2001; Wagner, 1998; Dorion, 2009). Role-playing also enabled the creation of circumstances for effective learning through communication, cooperation, improvisation, and argumentation in a study done with children ages 10 to 11 (Cakici & Bayir, 2012). These studies provide evidence that my students can improve their ability to think critically using role-play strategies.

During the implementation of my study, I not only hoped to help improve my students' understanding of environmental science concepts and improve their critical thinking skills; I also hoped to improve their motivation for learning as well as my own

motivation for teaching while achieving the previous two goals. “Textbook vignettes of historical characters often do not display the intellectual struggles or deep feelings the scientists encountered during their research. These revised histories, ostensibly inspirational, may actually discourage students about their own ability to be scientists” (Abrams & Wandersee, 1995, p. 690). Through the use of role-play, I hoped to avoid portraying the process of science in the way that the textbook vignettes do, as mentioned by Abrams and Wandersee. Studies have shown that role-play can help portray the scientific process in a much more realistic way while also improving student motivation. During Cakici and Bayir’s study, role-playing activities were shown to be the most effective variable in motivating children to learn about the life of a scientist (Cakici & Bayir, 2012). This increase in motivation during role-play activities observed in Cakici & Bayir’s study could be attributed, in part, to each student’s perception of empowerment and ownership during the role-play events (Odegaard, 2003).

Play and humor may also be possible sources for student motivation during role-play activities. McSharry and Jones (2000) point out that role-play is based on play. A student’s desire to play, and therefore to learn, is a fundamental part of human psychology and hence is seen as a potentially powerful resource for children’s learning (McSharry & Jones, 2000). McSharry and Jones go on to say that “the majority of children, particularly younger children, find role-play exercises quite easy and derive a great deal of enjoyment and satisfaction from them” (2000, p. 80). Increased enjoyment and play during role-play activities seemed to be associated with humor in Dorion’s study. The humor was perceived by students as an important aspect of the atypical

atmosphere of the role-play activity and was observed to enhance student attention (Dorion, 2009). In fact, interviews from Dorion's study showed that all students and teachers felt that the drama approach to teaching incorporated social interaction, humor, and a sense of fun that they argued was atypical of their experience with traditional science pedagogy (Dorion, 2009). The incorporation of social interaction, humor, and fun, as shown above, was a significant motivating factor for students and teachers alike.

Role-play is an old teaching technique that is beginning to gain renewed popularity in the classroom. Science classrooms are one of the more recent places that role-play has begun to be used, and the technique shows great promise. Improved understanding of science concepts as well as improved critical thinking skills among students have been witnessed in various studies involving elementary and middle school level students. Studies have also shown that the motivation of students as well as teachers can be improved through the use of role-play in the science classroom. My hope is to support the findings in these past studies and improve the understanding of the impacts of role-play on middle school students.

## METHODOLOGY

### Project Treatment

During the implementation of my capstone project, I included both treatment and nontreatment units to allow for comparison between the two. The nontreatment unit dealt

with organic and nonorganic agriculture and utilized traditional pedagogical methods such as lecture and classroom discussion. One of my treatment unit topics was hydraulic fracturing and the other dealt with cap and trade. While teaching these units, my students were assigned different roles to research and then they met at the end of the unit in a debate setting to test their knowledge of the subject in character.

While covering the topic of organic vs. nonorganic agriculture during the nontreatment unit, I used lecture, video clips, and class discussion to get the students thinking about the positive and negative impacts of these two forms of agriculture. I also tried to encourage them to begin to form their own fact-based opinions about the topic. See Appendix A for my nontreatment unit lesson plan. After completing the nontreatment unit, I completed two treatment units. The first treatment unit focused on hydraulic fracturing and the second treatment unit looked into cap and trade. During the treatment units, I used role-play while teaching the material to attempt to get students more invested in the discussion of controversial topics. Appendices B and C show my first treatment unit lesson plan and my character list for that unit respectively. Appendices D and E are the second treatment unit lesson plan and character list respectively. Appendix F shows the character development worksheet that guided students through the creation of their characters.

While discussing hydraulic fracturing, I began the unit by discussing some of the basics about hydraulic fracturing with the students. Once everyone had an understanding of the process, students were assigned characters who lived in a fictional town and each of them had various reasons for supporting or opposing hydraulic fracturing as well as



details about what would happen to their character if hydraulic fracturing was either approved or disapproved during a town hall meeting. The students were then asked to research hydraulic fracturing from their character's point of view and form a well supported opinion about hydraulic fracturing. To research their characters, I took my whole class to one of our school's computer labs. I then moved around to individual students to help them sort through the information that they found to insure that the information was from a reliable source and that the information was relevant to his/her character. The students then pieced together the information that they gathered to form a fact based opinion for their character. All of this information was recorded on the character development worksheet (Appendix F).

Once everyone had an opportunity to develop their character's viewpoint, students came together in a town hall meeting to debate the benefits and drawbacks of hydraulic fracturing on their community. Each student was given a specific time allotment to clearly state his/her support or opposition to hydraulic fracturing followed by time for rebuttal. At the end of the discussion, we attempted to come to a final decision between all of our characters about whether or not hydraulic fracturing would be allowed to take place in or near the town. Students were also allowed to work together to try to develop a creative solution to help out everyone involved. Students were encouraged throughout the research process to contact parties actually involved in hydraulic fracturing to help them gain perspective for their individual characters. Appendix C shows the character list for this unit.

The second treatment unit dealing with cap and trade was taught in a similar way to the hydraulic fracturing unit. Students were assigned characters who lived in various locations around the United States. Characters in this unit represented various factory and power plant owners, politicians, and citizens who, once again, had various reasons for supporting or opposing cap and trade legislation. After each student had sufficient time to develop a well supported viewpoint for his/her character the class met in the style of a congressional hearing to discuss the future of cap and trade legislation. In this format, each student was able to share his/her character's experience involving cap and trade as a witness in front of congress. While involved in the hearing, students had the opportunity to argue against each other's viewpoints and give rebuttals as needed. During this treatment unit, I guided my class through the same process that we followed in the hydraulic fracturing unit to develop fact based opinions for their characters.

I felt that these treatment units were effective in helping me answer my project questions for several reasons. First of all, my focus question was simply to find out what effect role-play will have on my students' understanding of environmental topics. Both of my treatment units dealt with environmental topics, so using role-play while teaching these units helped me answer this question when I compared them to the nontreatment unit. More importantly, I wanted to find out if role-play would help my students develop their critical thinking skills. My treatment units were successful in helping develop my students' thinking skills. First, in order to debate effectively, students had to research as many different sides of the topic as they could. The role-play portion of the treatment units required that students work together with others with whom they may not agree, and

it required that they develop solutions that were as beneficial as possible to everyone. Doing these things required logical, reflective, and creative thinking. At the conclusion of both treatment units, we had a class discussion about how the role-play activities helped clarify any misunderstandings or lingering questions that students had about the topics to close the feedback loop.

### Data Collection Instruments

The classes that I chose to use for my treatment units were my eighth-grade Environmental Science classes. I chose this group because of their age. These students are on the verge of entering high school, but many of them struggle to think critically. Critical thinking is a skill that they will need as they make their way through high school and into college. For this reason, I wanted to push them to begin developing this skill now. At the very least, I wanted to expose them to critical thinking before they move on.

The school where I teach is a small, private, boarding and day school in a rural area of northeast Georgia. The whole school, which consists of 6<sup>th</sup> through 12<sup>th</sup> grades, has a total of about 370 students. The students come from many different countries around the world and many different areas of the United States.

The eighth grade consists of 40 students that are split into three classes. The classes are a mix of boarding and day students. There are 75% of the students in class who are day students and they came from the Rabun Gap area, Macon, North Carolina, and Habersham, Georgia. Macon and Habersham are both rural counties with

populations between 33,000 – 43,000 people. The average income in these locations is in the mid \$40,000 range. Rabun County is also a rural area with a population around 15,000 and an average income in the mid \$30,000 range. The remaining 25% of the eighth grade were boarding students who came from Georgia, North Carolina, New York, New Jersey, Alabama, China, and the Bahamas. Approximately 75% of the class is Caucasian, 8% is Asian, 5% is African American, 2% is Bahamian, 2% is Native American, 2% is Indian, and 6% is of unknown ethnicity. All of the students in the eighth grade would fall between the lower middle and upper socioeconomic classes. Most of the students come from families that would be considered middle or upper-middle class. The majority of the students are eager to learn and generally find enjoyment from being at school and learning. The class also works quite well with one another and generally supports each other in their academic pursuits. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

During the implementation of my study, I collected various data for each unit to allow for triangulation. Table 1 shows the triangulation matrix that I used during my study. The data triangulation matrix shows the ways that I collected data from the students and myself in order to answer my focus question and subquestions.

Table 1  
*Data Triangulation Matrix*

Focus Questions	Data Source 1	Data Source 2	Data Source 3
<p><i>Primary Question:</i>            1. What are the effects of the use of debates and role-play on middle school students' comprehension of Environmental Science concepts?</p>	<p>Pre and postunit student assessment: This will help me get a sense of the change in student comprehension before and after each unit.</p>	<p>Pre and Postunit Concept Interviews: Student Interviews will give me a more complete picture of each student's level of comprehension.</p>	<p>Pre and posttreatment student surveys: This will help me assess comprehension of students who may not excel at the other assessment methods and may not be comfortable in an interview setting.</p>
<p><i>Secondary Questions:</i>            2. What are the effects of the use of debates and role-play on middle school students' ability to think critically about Environmental Science topics?</p>	<p>Pre and postunit student assessment: This will help me get a sense of the change in student comprehension before and after each unit.</p>	<p>Pro and Con Grid: This assessment technique will allow me to see how critically students can analyze the environmental topic being studied in each unit.</p>	<p>Pre and posttreatment student surveys: This will help me assess comprehension of students who may not do well with written assessment methods.</p>
<p>3. What are the effects of the use of debates and role-play on students' attitudes and motivation to learn environmental topics?</p>	<p>Pre and Posttreatment Student Interviews: Face to face interviews will help me assess student attitudes and motivation in a candid way.</p>	<p>Pre and Posttreatment Student Surveys: Surveys will help me get a sense of how motivated my class is as a whole and what their attitudes are about the subject matter that we are covering.</p>	<p>Teacher Observation: Keeping a journal during my study will help me see changes over time.</p>
<p>4. What are the effects of the use of debates and role-play on my attitude and motivation as a teacher and my pedagogy?</p>	<p>Pre and Postunit Teacher Survey: I can record my attitude and motivation before beginning the study using prompts.</p>	<p>Teacher Journal with Prompts: Keeping a journal during my study will help me see changes over time.</p>	<p>Colleague Observation: I will use colleague observations to help gauge my attitude and motivation before and during treatment.</p>

Students who were interviewed (either to determine their attitudes and motivation or their comprehension of the concepts) were an even mixture (two each) of high, middle and low-achieving students. I picked these students out of a list that I compiled during the first semester of the year and the same six students were interviewed each time. The interviews were conducted one-on-one in the classroom during our designated tutorial time. The same students were interviewed for all project phases. The interviews were recorded to preserve the original content, and allow for further analysis. A list of pre and postunit concept interview questions can be found in Appendix G. The pre and postintervention student interviews can be found in Appendix H and I, respectively.

Student surveys were in written form and given to all students in my class. Students completed the surveys in class. A copy of the pre and posttreatment student surveys can be found in Appendices J and K, respectively. The student surveys and interviews were very important to my action research project because they gave me a clear picture of how the treatment units affected the students' motivation and attitude toward class as compared to the nontreatment unit.

The "Pro and Con Grid" (Appendix L) required students to make a list of as many good qualities and as many bad qualities as they could relating to the current topic being studied. The grids helped to give me a sense of each student's ability to think critically about each topic.

Pre and postunit student assessments (Appendix M) used during the project contained questions that were designed to probe student's conceptual comprehension of each of the unit topics as well as push them to think critically, reflectively, and creatively

about each of the topics. The pre and postunit assessments consisted of six short-essay questions that required the students to demonstrate proficiency in each category of Bloom's Taxonomy. The same assessment was given at the beginning and the end of each unit so that I could gain a sense of how much each student's conceptual understanding had improved over the course of the unit. I could also get a sense of how much their critical thinking skills had improved.

Finally, the students and I completed journal entries using prompts that were designed to help me gain a sense of everyone's attitudes and motivation regarding class and the subject matter. I felt it was important to gauge my attitude as well as those of my students during the study because any benefits shown by the use of role-play activities may not be worth implementing if the use of role-play is a miserable experience for all involved. The prompts used for my journal entries can be found in Appendix N.

As I collected the data using the tools listed above, I reviewed and organized the data by topic, date, and type. I also wrote down recurring themes and helpful quotes and figures that I noticed in the data. The combination of assessments that I used to gather data about each of my focus and subquestions allowed me to collect both qualitative and quantitative data about each topic. The data gathered during the study has been displayed as tables and charts as well as in the form of key quotes that help illustrate some of the qualitative feedback that I received.

This action research project took place during the spring semester of the 2012-2013 school year between the months of January and February. I began the project with

a non-treatment unit, which was then followed by two treatment units. A detailed timeline of my project can be found in Appendix O.

## DATA AND ANALYSIS

The data for this study were collected using various methods in order to allow for triangulation of the results. To look into how role-play affects my students' understanding of environmental science topics, I utilized pre and postunit assessments, pre and postunit concept interviews, and pre and posttreatment surveys. The overall results of the pre and postunit assessments can be found in Table 2.

By comparing the average test scores of each unit, I gained a sense for how much the treatment method improved student comprehension of the material. A comparison of the pre and postunit assessment class averages and the percent change shows much greater gains in test scores during both of the treatment units compared to the nontreatment unit. Students began treatment units at a much lower level of understanding as shown in the preunit assessment averages. The normalized gain scores, which show the effectiveness of the instruction techniques used, support the trends in the class averages. In other words, there are higher normalized gain scores in the treatment units compared to the nontreatment unit. Analyzing the normalized gain scores also show that the high-achieving students gained



Table 2  
*Pre and Postunit Assessment Average Scores As Well As the Normalized Gain Scores and Percent Change in Each Unit for the Entire Class (N=37)*

Nontreatment				
	Preunit	Postunit	Percent Change (%)	Normalized Gain
All (N=37)	39.6	78.7	98.7	0.65
High (n=7)	50	81.4	79.3	0.63
Middle (n=25)	35.3	76.6	117	0.64
Low (n=5)	38.8	69.6	79.4	0.5
Treatment 1				
	Preunit	Postunit	Percent Change (%)	Normalized Gain
All (N=37)	4.4	95.3	2066	0.95
High (n=7)	10.7	95.1	788.8	0.95
Middle (n=25)	3.3	92.4	2700	0.92
Low (n=5)	0	91.2	9120	0.91
Treatment 2				
	Preunit	Postunit	Percent Change (%)	Normalized Gain
All (N=37)	0	88.6	8860	0.89
High (n=7)	0	92.4	9240	0.92
Middle (n=25)	0	86.9	8690	0.87
Low (n=5)	0	73.8	7380	0.74

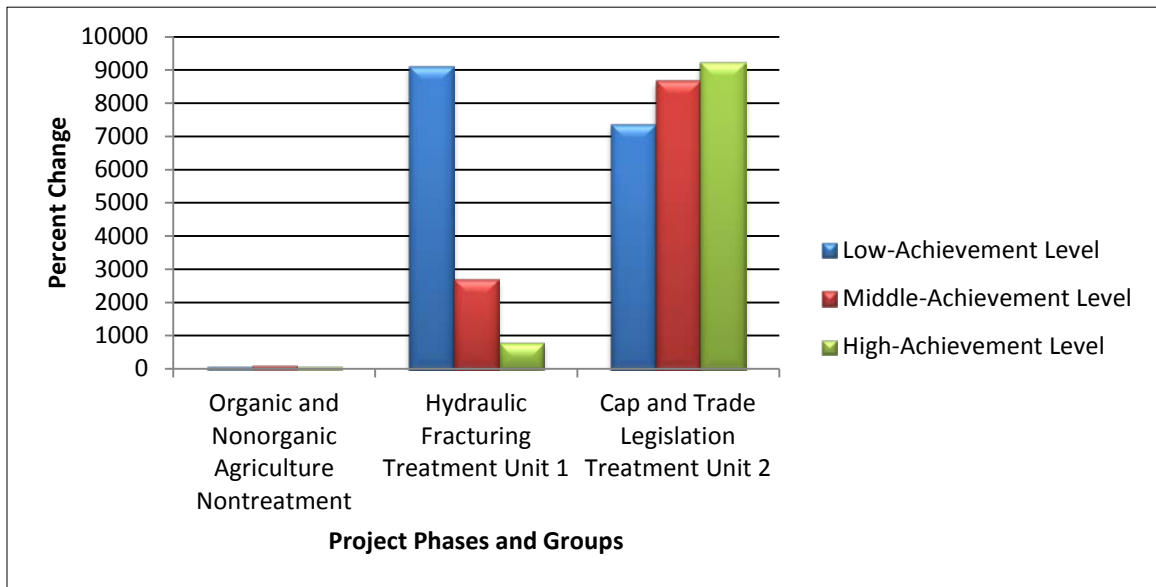
the most from the use of role-play followed closely by the middle-achieving students.

The normalized gain scores give greater confidence that the gains in the postunit assessment scores reflect an actual gain in the level of understanding through the use of role-play.

While analyzing the pre and postunit assessment, I also wanted to consider changes in the level of understanding for high, middle, and low-achieving students.

Figure 1 shows the percent change in pre and postassessment scores during each unit for

high, middle, and low-achieving students.

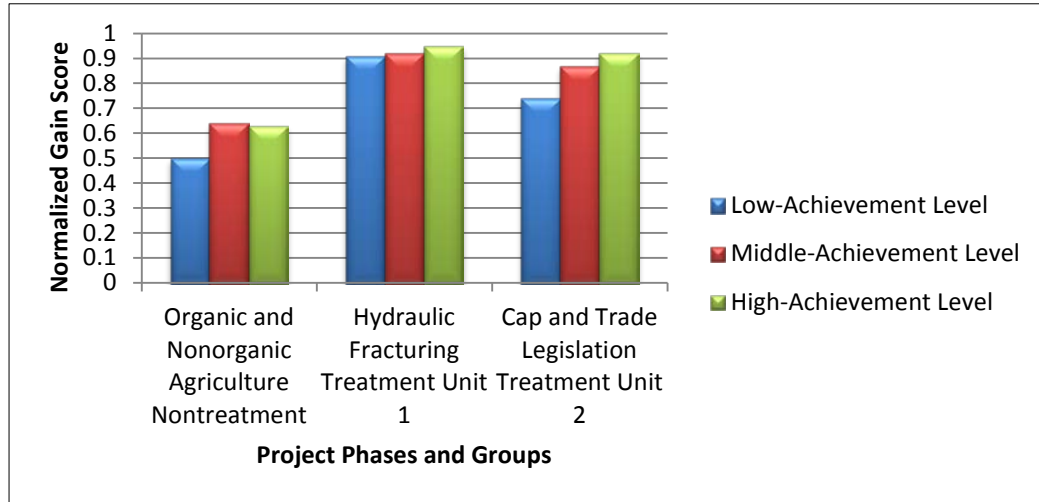


*Figure 1.* Percent change in pre and postunit assessment scores according to academic achievement level, ( $n=7$  for high-achievement level,  $n=25$  for middle-achievement level,  $n=5$  for low-achievement level).

All achievement levels showed larger percent change in their pre and postunit assessment scores during the treatment units. This change in scores can be partially attributed to the fact that students had less previous knowledge about the topics studied in the treatment units than they did about the topic studied in the nontreatment unit. However, students also achieved much higher average scores in all achievement levels during their postunit assessments for the treatment units as shown in Table 2.

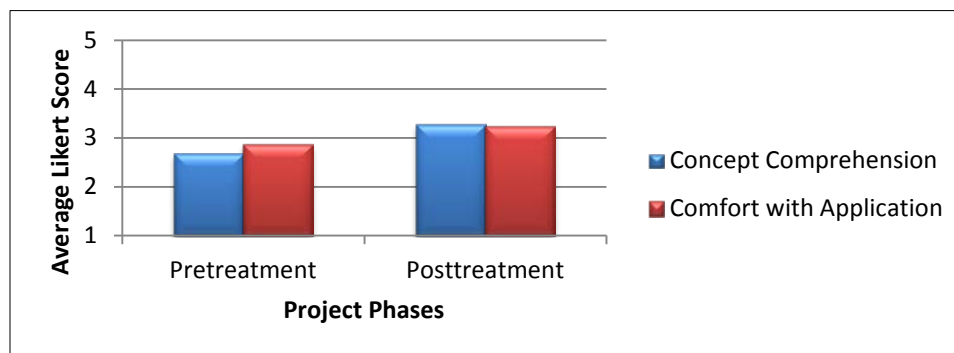
Normalized gain scores for high, middle, and low-achieving students were also much higher during the treatment units. The largest improvement in normalized gain score was made by the low-achieving students between the nontreatment unit and treatment unit one. However, when looking at individual units, middle and high-

achieving students showed the most gain as a result of instruction methods in all three units. These data can be seen in Figure 2.



*Figure 2.* Normalized gain scores between pre and postunit assessments for high, middle, and low-achieving students, ( $n=7$  for high-achieving students,  $n=25$  for middle-achieving students,  $n=5$  for low-achieving students).

The second tool that I used to assess student understanding was a pre and posttreatment survey. Within the pretreatment survey I asked students to rate their perceived comprehension of the concepts that they learned through traditional teaching methods as well as their comfort level in applying the concepts. The students rated their perceived comprehension and comfort level in applying the concepts on a Likert scale, the results of which are shown in Figure 3.



*Figure 3.* Average Likert scale scores showing students' perceived level of comprehension of the concepts and comfort with applying what they had learned during both the pre and posttreatment units, ( $N=42$ ).

*Note.* 1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Completely Agree

The Likert scale results support the findings from the pre and postunit assessments. On average, students had more confidence in their level of understanding of the concepts they were taught using role-play as well as in their comfort with applying those concepts.

The third tool that I utilized to assess the level of understanding of my students was a pre and postunit concept interview that focused on just six students. I chose two students to represent each of three achievement levels (high, middle, and low). Students were interviewed in person and asked to expound upon three different questions about each topic we covered in class both before and after each unit. The following are some of the best examples that show improvement in student understanding as a result of using role-play in the classroom.

A response that was typical of low-achieving students before the nontreatment unit consisted of very shallow remarks that showed some understanding, but had many strong misconceptions. For example, when asked in what ways organic and nonorganic

agriculture might have either a positive or negative effect on the environment, one low-achieving student responded, “Organic agriculture might have a positive effect on humans by helping them to have good growth, but nonorganic agriculture might stop or slow down your growth or even kill you.” It is true that organic agriculture might contribute to good crop growth and be good for your health, but that is also true of nonorganic agriculture. It is also true that nonorganic agriculture has negative impacts, but the student does not specify how. Overall, this answer shows very shallow thought and gives little supporting evidence to any claims that are made.

After the nontreatment unit was completed, the same student answered this question by saying, “The organic stuff can make the plant healthier, or if you put too much you will kill the plant.” If “stuff” means fertilizer, then the student at least shared a solid fact and did not display any misconceptions as he did in the preunit interview. However, the answer was still very simplistic and shallow.

Responses from low-achieving students showed much more depth and explanation after the treatment units. When asked to try to give three reasons to support hydraulic fracturing, one low-achieving student replied, “It will produce resources in our own country instead of having to get the resources from another country, which will cause fewer problems. Fracking helps the economy by creating new jobs. It costs less to heat our houses with the resources retrieved by fracking and it reduces our carbon footprint.” Each of these responses is based in fact and the student went into greater depth when answering the question, which shows a deeper comprehension of the topic.

This pattern continued in the treatment unit two postunit concept interviews. In this instance, the low-achieving student was asked to try to list three reasons to support cap and trade legislation. The student responded by saying, “It will put a cap on, or limit pollution. Little companies could sell their allowances to get more money. Less health risks that come from mercury and CO<sub>2</sub>.” This reply has a couple of factual errors in it, but overall it is a decent answer. The student put much more detail into this answer than the postunit interview in the nontreatment unit and displayed a deeper level of understanding.

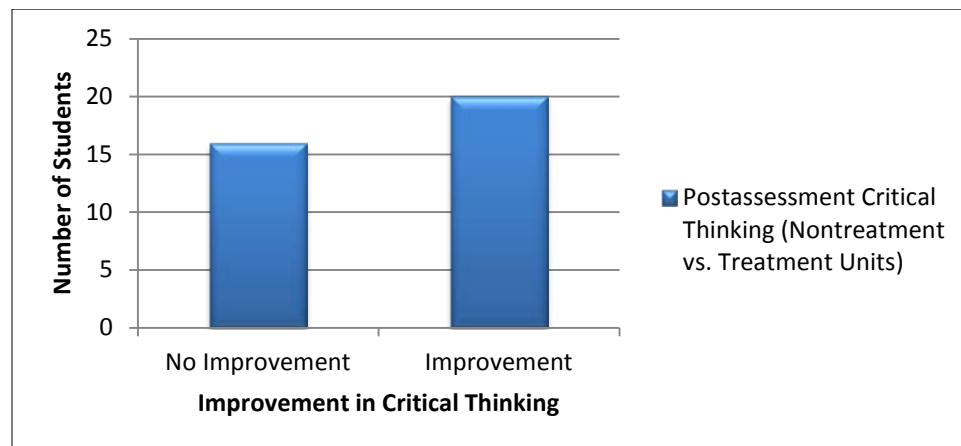
Middle and high-achieving students showed similar improvements in their level of comprehension after the nontreatment and treatment units. Although their scores improved in a similar way, their depth of understanding after the treatment units was obviously greater than after the nontreatment unit. For example, after the nontreatment unit, a middle-achieving student said that organic agriculture was, “cheaper to plant, used less powerful fertilizer, and kept humus in the soil while nonorganic agriculture used more pesticides, used powerful fertilizer and received government subsidies,” when asked for reasons to support organic and nonorganic farming practices. This answer contains some factual errors and does not go into much depth. However, when asked to share reasons to support cap and trade legislation after the second treatment unit, the same student answered, “It controls pollution, it gets rid of acid rain problems, and it gives companies rewards if they are under the cap.” He then went on to explain that companies can get a reward if they are under the cap by selling off excess allowances to other companies. This answer is completely based in fact even though it overstates the

ability for cap and trade to “get rid of acid rain problems”. It shows less factual error and more description than the nontreatment postunit answer did about organic and nonorganic agriculture.

As stated earlier, high-achieving students showed a similar pattern in the nontreatment postunit interview and the treatment postunit interviews, but they typically went into more depth than the low or middle-achieving students. A typical answer from a high-achieving student, after the nontreatment unit, when asked to give reasons to support both organic and nonorganic agriculture, looked like this; “Organic agriculture uses no artificial pesticides that can harm consumers. It creates less of a risk for obesity in the U.S. by using natural ingredients. It also does not ‘wear out’ the soil. Nonorganic agriculture increases jobs in the U.S. by making artificial fertilizers. It is cheaper for the public, and crops grow faster because more essential nutrients are applied.” Again, this answer has several factual errors and overstatements and does not go into much depth.

After the treatment units, answers from the high-achieving students were much more factually correct and went into greater depth. When asked to give reasons to support hydraulic fracking, one high-achieving student replied, “It burns cleaner because the natural gas is more pure than coal. We will be using our own fuel instead of having to buy coal and other stuff to burn. It will also create more jobs to control machines, house workers, and feed workers as well as other needs.” This answer shows much deeper thought and analysis of the subject than the answer dealing with organic and nonorganic agriculture in the nontreatment unit.

While gathering data about student understanding, I also used postunit assessments, pro and con grids, and pre and posttreatment surveys to gain a sense of how the treatment units were affecting each student's critical thinking skills. While assessing student improvement in critical thinking, I first looked at questions on the postunit assessment taken by the students after the nontreatment and treatment units. While reading each student's answers on the nontreatment and treatment postunit assessments, I looked for improvement in each student's ability to conceptualize, apply, synthesize, and/or evaluate the information that they had learned in each unit. I was able to compare each individual student's level of critical thinking on his/her nontreatment unit postunit assessment with his/her demonstrated level of critical thinking on each treatment unit postunit assessment. The results are shown in Figure 4.



*Figure 4.* Number of students showing no improvement and improvement in their critical thinking skills between the nontreatment unit postunit assessment to the treatment unit postunit assessments. Assessments were open-ended, teacher-created essay questions that students had to answer, ( $N=36$ ).

Out of 36 students that I had complete sets of data on, 20 showed improvement in their critical thinking on the treatment unit postunit assessments. For example, on the



nontreatment postunit assessment, students were asked to give an opinion about whether the support of organic or nonorganic agriculture makes our country more sustainable and explain the answer. For full credit on this question, I needed to see evidence of the student evaluating and applying what he/she had learned in order to synthesize a complete answer. One student answered, “Yes, because both can help bring more food into the world. But nonorganic is cheaper so it’s easier for people in poverty to have food which, in some ways is better for people.” This answer simply shares the opinion of the student, points out the obvious, and then uses evidence that is not necessarily true in all cases to give support for nonorganic agriculture. We discussed much more than this during the unit, but the student was not able to recall other facts or examples in sufficient detail to support the points that she wanted to make.

When the same student was asked if hydraulic fracturing and cap and trade could make our country more sustainable after the treatment one and two units respectively and explain her answer, she gave the following answers. When asked about hydraulic fracturing, she replied “Yes, I believe it does because it will reduce the carbon footprint and reduce the cost of heating in our houses. Plus, it will give more jobs and make money with resources. We will have resources in our country instead of from other countries, which will cause less problems.” After having thoroughly discussed the drawbacks and benefits of hydraulic fracturing through role-play, the student was able to pull out four benefits of hydraulic fracturing and support her opinion fairly clearly. The student repeated her improvement in the second treatment unit when asked the same question about cap and trade legislation. The student wrote, “I don’t think that cap and

trade would make our country more sustainable because companies might move overseas, which would have a bad effect on the economy and also it allows big companies to pollute if they get allowances so it would have a bad effect on the air quality.” In this example, the student did not clearly understand how the allowances work, but she was able to form an opinion that was at least partially supported by factual evidence, which is still an improvement over her response on the nontreatment postunit assessment.

Many students showed no improvement in their level of critical thinking on the nontreatment and treatment unit postunit assessments. An example of this was demonstrated by one of my lower achieving students. When asked to explain whether the support of nonorganic or organic agriculture could make our country more sustainable, he simply said, “Yes. We can make food faster to feed people.” This answer showed no hard evidence to support his claim and also shows a lack of complete understanding of the question. When asked the same question about hydraulic fracturing, he said, “Yes. It creates jobs, and lots of money.” In this answer, the student showed that he had picked up on some of the basic facts about hydraulic fracturing, but he did not evaluate and apply these facts in such a way that he was able to answer the question. When asked this question yet again when dealing with cap and trade, the student left the space blank and did not even attempt an answer.

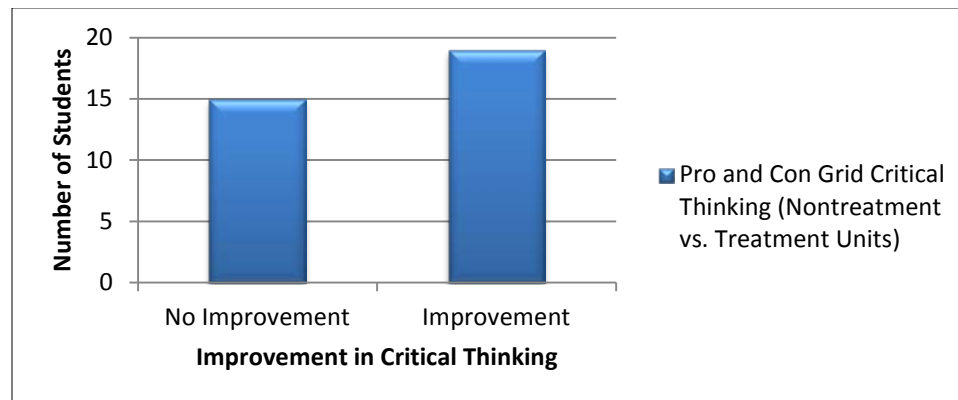
However, some of the students that I included as showing no improvement showed no improvement because they already demonstrated a high level of critical thinking on the nontreatment postunit assessment. This was the case for several of my high-achieving students. One such student gave the following answer when asked to

explain whether the support of organic or nonorganic agriculture would make our country more sustainable. “I believe the support of organic agriculture would allow the people of the nation to be more healthy and not consume pesticides that could harm them in the future. It could also decrease the risk of obesity. The support of nonorganic agriculture would add more food production and get value for what you pay (in portion size).” In this answer, the student was a bit confused about some of the information that she was using for support, but she showed a good ability to give an opinion and to draw on information that she had learned to support her ideas. This student continued to demonstrate this ability in subsequent units. When asked if hydraulic fracturing could make our country more sustainable, the student replied, “I suppose, since hydraulic fracturing pretty much produces its own energy source, and we don’t have to bring in foreign oil and waste a bunch of money. And since the United States would produce an abundance of natural gas.” And when she was asked to explain whether or not cap and trade would make our country more sustainable, she replied, “I believe this legislation will gradually make our nation a cleaner place, create new jobs, and benefit the American people’s well being.” After each unit, this student was able to draw on facts that she learned during the unit (regardless of teaching style) and form an opinion about the topic that was supported with factual evidence.

After each unit, students also completed pro and con grids where they were asked to list and briefly explain pros and cons of each topic that we discussed. At the end of the study I was able to see how well individual students were able to evaluate each topic’s positive and negative aspects, which I was able to use to gain a clearer picture of how the

treatment units affected each student's critical thinking skills. The results are shown in Figure 5.

Overall, 19 students showed improvement in their critical thinking skills and 15 students showed no improvement. Most of the students that showed improvement on the pro and con grids were low and middle-achieving students, which are also the groups that accounted for most of the improvement in critical thinking on the postunit assessments. One low-achieving student completed the pro and con grid after the nontreatment unit by writing "Pro Organic: healthier; Con Organic: costs more, grows slower; Pro



*Figure 5.* Number of students demonstrating either no improvement or improvement on the nontreatment versus the treatment unit pro and con grids that had students make a list of pros and cons for the topic covered in each unit, ( $N=34$ ).

Nonorganic: costs less, grows faster; Con Nonorganic: not as healthy.” These pros and cons for organic and nonorganic agriculture are not completely factually based and they are not very extensive. After the first treatment unit, the same student completed his pro and con grid on hydraulic fracturing by writing “Pros: lowers natural gas price, natural gas is efficient to use, jobs are created, our own fuel source, natural gas burns clean; Cons: carcinogenic chemicals used, can cause earthquakes, we don't completely know

what is in fracking fluid, noisy, habitat fragmentation, lots of space needed, property value goes down, groundwater could be contaminated, when groundwater is contaminated, it is hard to clean up, non-renewable.” After learning about hydraulic fracturing through the use of role-play, this student greatly increased his ability to evaluate the information that he had learned and identify factually based pros and cons about the topic.

A middle-achieving student completed the pro and con grid after the nontreatment unit by writing “Organic Pros: lasts longer, adds humus; Organic Cons: have to use more, more expensive; Nonorganic Pros: cheaper, don’t have to use very much; Nonorganic Cons: doesn’t have as much nutrients, too much can kill it, doesn’t add humus.” Her answers on the pro and con grid display some grasp of factual information regarding organic and nonorganic agriculture, but many of this young lady’s answers are very vague and are not explained well enough to really get a sense for what she is trying to say. However, her pro and con grid after the first treatment unit about hydraulic fracturing said “Pros: cheaper, cleaner than coal, creates jobs, economic boost; Cons: earthquakes, noisy, don’t know what’s in fracking fluid, explosions, can be harmful to workers, linked to cancer, can contaminate water, nonrenewable resource.” This list of pros and cons still lack an explanation for some of her examples that could use an explanation, but all of her examples are based in fact and she was able to think of more examples of pros and cons for this topic than she could for the nontreatment unit.

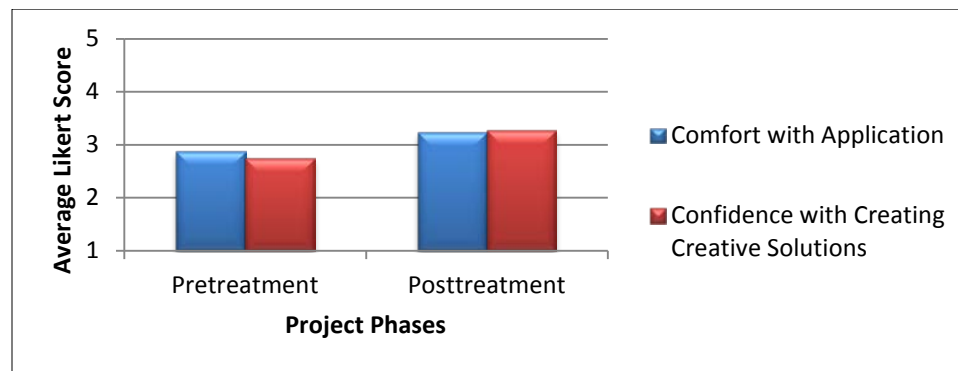
Students who demonstrated a high level of critical thinking on the nontreatment pro and con grid were once again included in the number of students who showed no

improvement in critical thinking. One such student answered the nontreatment pro and con grid by writing “Pros Nonorganic: concentrated nutrients small amounts needed, you know levels of N-P-K, cheaper, quickly available; Cons Nonorganic: soluble in water easily leached out of soil, does not add humus, concentrated nutrients can harm the plants, use synthetic pesticides, uses synthetic fertilizers; Pros Organic: lasts longer in the soil, adds humus to soil, most organic fertilizers will not harm plants, can’t use synthetic fertilizers, can’t use synthetic pesticides; Cons Organic: large amounts of fertilizer needed, nutrient levels are low, varying amounts of nutrients, organic fertilizers must be composted before use, more expensive.” This student’s answer has many pros and cons that are based in fact and explained well. The student did have some pros and cons that were not exactly factual and some that were based on opinion, but she did have an extensive list of factually based pros and cons. After the second treatment unit, this student completed her pro and con grid by saying “Pros: reduces the amount of pollution output, creates job offers, helps the global weather, keeps the environment safe, gives good business to the pollution control businesses, reduces the levels of sulfur and mercury; Cons: loopholes, can relocate factories overseas, can put businesses out of business, expensive equipment needed, operators of power plants will make the customers pay more for energy.” Once again this student demonstrated that she could identify a number of pros and cons that are based in fact, but she did not show an improvement as a result of the use of role-play.

While gathering data about student improvement in critical thinking, I also used pre and posttreatment surveys to get a sense for how each student’s own perception of

his/her critical thinking ability changed as a result of the treatment units. In both the pre and posttreatment survey, students were asked to rate their confidence in applying what they learned and their confidence in coming up with creative solutions to problems dealing with the topics they learned through the use of different teaching styles. The data about student perception of their own abilities followed the other data sources closely. The results are shown in Figure 6.

As shown in Figure 6, after the treatment units, students felt slightly more comfortable with applying concepts that they learned during the treatment units. They felt slightly more confident with their ability to come up with creative solutions to problems posed to them, dealing with the topics they learned about during the treatment units. The results follow very closely the results of the pre and post unit assessments and



*Figure 6.* Average Likert scores on survey questions showing student perception of their own comfort with application and development of creative solutions before and after the treatment units, ( $N=42$ ).

*Note.* 1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Completely Agree

the pro and con grids that showed a slight improvement in student critical thinking after the treatment units, on average.

Through this study, I also wanted to see how role-play would affect students' attitudes about class and their motivation for coming to and being involved in my

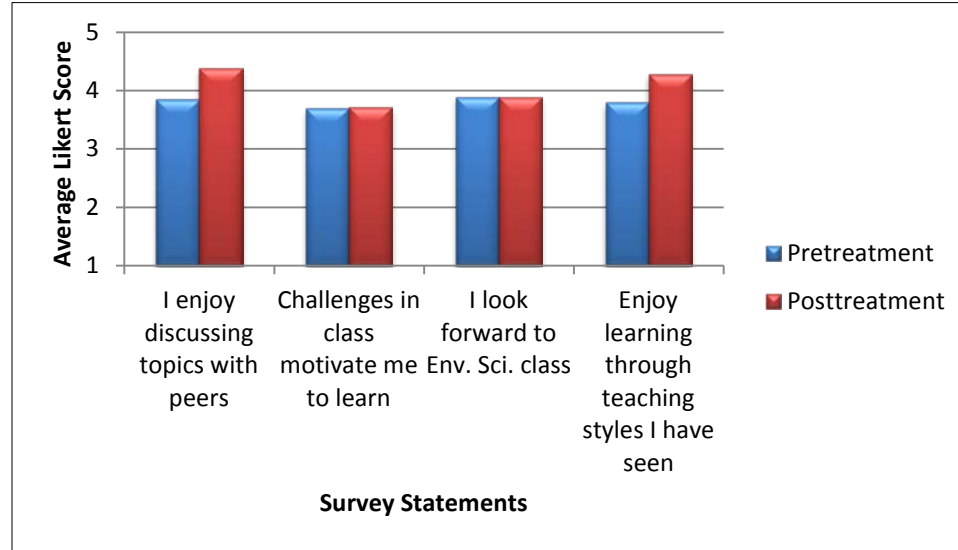
Environmental Science class. To gather data on this topic, I used a combination of pre and posttreatment student interviews, pre and posttreatment student surveys, and my own observations.

In the pretreatment survey, I asked students to rate several statements on a Likert scale. The statements that I asked students to rate were, “I enjoy discussing topics with my peers in a classroom setting,” “The challenges that I am presented with every day in class motivates me to learn about the subject matter,” “I look forward to Environmental Science class,” and “I enjoy learning through the teaching styles that I have been presented with this year.” In the posttreatment survey, I asked students to rate these four statements again on a Likert scale. The results are shown in Figure 7.

As shown in Figure 7, students’ attitudes about being motivated by challenges presented in class and how much they look forward to Environmental Science class remained virtually unchanged from the pre to the posttreatment surveys. However, students seemed to enjoy learning through the use of role-play and discussing topics with their peers while in character quite a bit more after experiencing the treatment units.

On the posttreatment survey, I asked the students to rate four more statements on a Likert scale. These four statements were meant to simply gain a sense of the overall student attitude and motivation toward the treatment units. The statements that I asked





*Figure 7.* Likert score ratings of four comments given on pre and posttreatment surveys, ( $N=42$ ).

*Note.* 1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Completely Agree

the students to rate were, “I enjoy debating with my peers in character,” “The challenge of a debate motivates me to research the subject matter more than a regular class,” “I look forward to Environmental Science class when I know we will be debating in character,” and “I enjoy learning through debates and role-play more than with the traditional class style.” The numbers on the Likert scale ranged from 1 to 5 which correlated to “strongly disagree” to “completely agree” respectively. The average Likert values for each of these statements are shown in Figure 8.

As shown in Figure 8, the average student response for each of these statements fell between “agree” and “completely agree.” These responses show that students did enjoy debating and learning through the use of role-play. They also looked forward to class and felt motivated to research the subject matter when involved in role-play. I even had one student add units onto the Likert scale in order to show how strongly he/she felt about learning using role-play as opposed to traditional teaching methods.

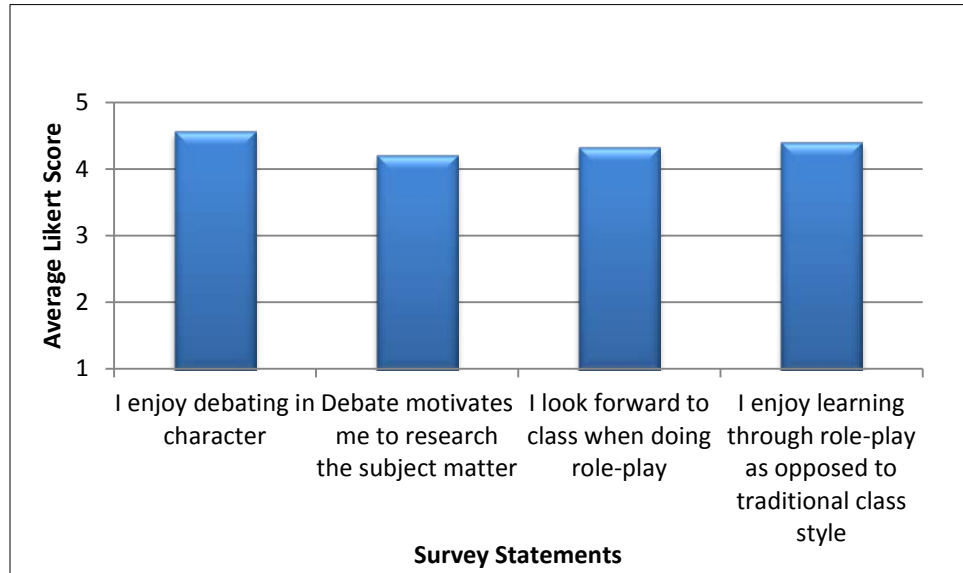


Figure 8. Average Likert scores for four statements on the posttreatment survey, (N=42). Note. 1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Completely Agree

While determining student attitude and motivation as a result of the use of role-play in class, I also attempted to interview low, middle, and high-achieving students before and after treatment to assess attitude and motivation at various achievement levels. I only succeeded in gathering data from low and middle-achieving students on these topics and the data is shown in Figure 9.

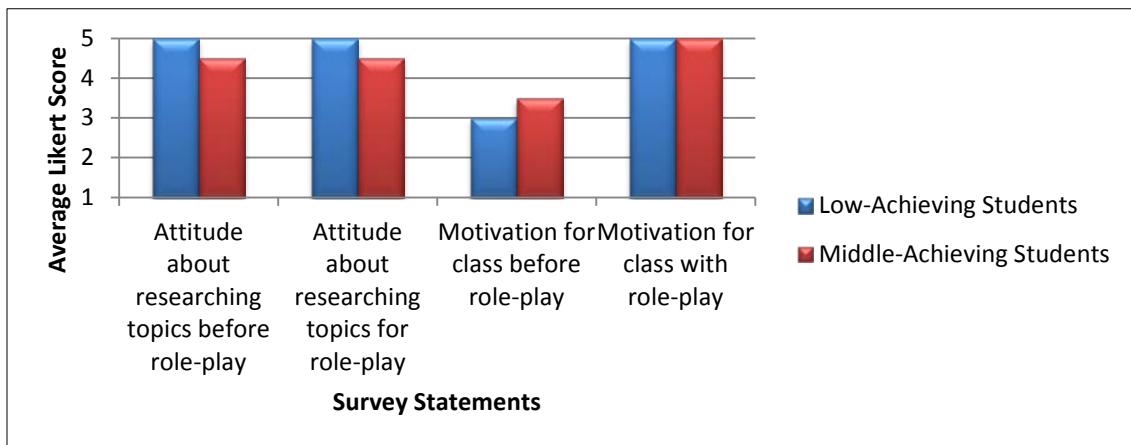


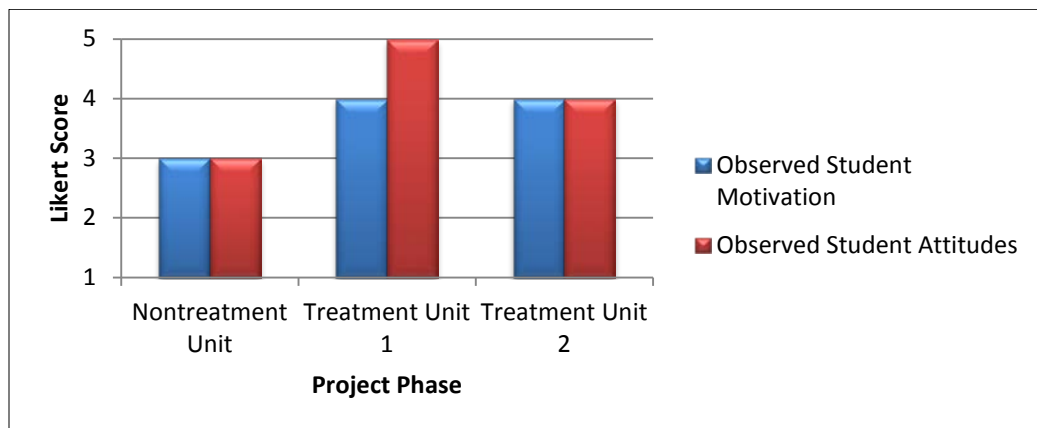
Figure 9. Attitudes and motivation of low and middle-achieving students before and after treatment, (n=2 per group).

*Note.* 1-Strongly Disagree; 2-Disagree; 3-Neutral; 4-Agree; 5-Completely Agree

The students' attitudes about researching topics in class remained the same from pre to posttreatment. Both low and middle-achieving students said that they enjoy researching scientific topics whether it is in a traditional class setting or in a role-play setting. It surprised me that students enjoyed researching topics, but interviewing a greater number of students in each category may have altered these average responses.

Student motivation for learning about environmental science topics increased during the treatment units for both low and middle-achieving students. Both groups agreed that being assigned a character greatly increased their motivation to learn about environmental science topics.

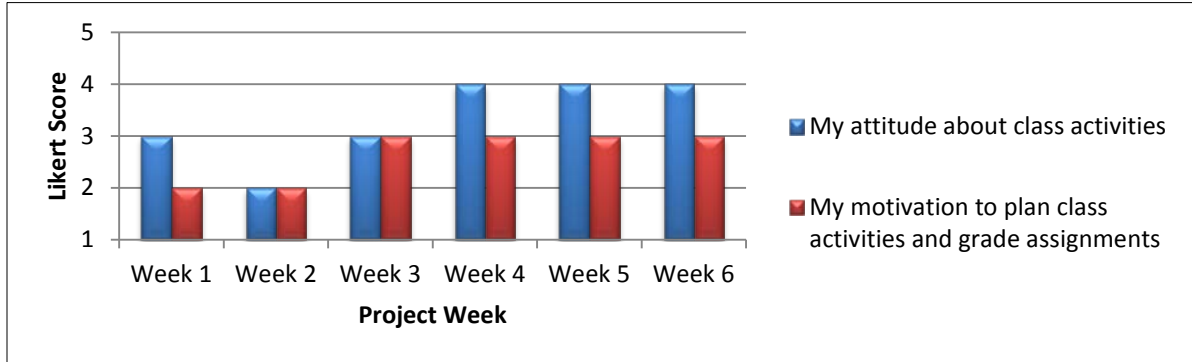
Increased motivation and improved attitudes were also reflected in my own observations of students. Figure 10 shows my assessment of student attitude and motivation throughout the nontreatment and treatment units.



*Figure 10.* My observations of student motivation and attitudes rated on a Likert scale.  
*Note.* 1-Very Unmotivated/Very Poor Attitude; 2-Unmotivated/Poor Attitude; 3-Average Motivation/Average Attitude; 4-Motivated/Good Attitude; 5-Very Motivated/Very Good Attitude

As shown in Figure 10, I saw obvious signs of increased student motivation and improved student attitudes during the treatment units. For example, after the initial treatment unit, I had three students ask if we were going to be able to do another role-play activity. I also had many students say in passing that they really had fun participating in the role-play activity and they wanted to do more lessons using role-play. Another wonderful trend that I observed was the willingness of the students to call professionals in the field that we were studying, to ask for information and advice that might be able to help them develop their character. An example of this was when I had a group of students call the California Air Resources Board to speak with experts about cap and trade legislation. This was the first time that I had ever seen my eighth grade students call professionals in the field of study to gain a better perspective on a topic that we were covering.

The final topic on which I gathered data during my study was my own attitude and motivation toward class as a result of using role-play in the classroom. To collect data on my own attitude and motivation over the course of the study, I used weekly teacher surveys and journal prompts as well as observation by a colleague. In my weekly survey and journal, I used a Likert scale to gauge changes in my attitude and motivation as well as prompts to help guide my comments in the journal entries. The results of the Likert scale ratings can be seen in Figure 11.



*Figure 11.* Likert scores of my attitude and motivation throughout my study.

*Note.* 1-Very Unmotivated/Very Poor Attitude; 2-Unmotivated/Poor Attitude; 3-Average Motivation/Average Attitude; 4-Motivated/Good Attitude; 5-Very Motivated/Very Good Attitude

As shown in Figure 11, my attitude about class activities taking place fluctuated a bit during the study. The 2 rating during week two can be partly explained by my anxiety about beginning the role-play activities. A journal entry during week two stated, “I am a bit nervous about how my treatment units are going to work out in reality. I hope that the students actually learn something and that I don’t make a fool of myself while acting.” Once I actually got the students started on their role play activities, my attitude improved as I saw how they were taking to it, and I even got excited during the final three weeks of the study when the students were giving me some positive feedback about their experience with role-play. A journal entry after the first treatment unit stated, “The students seemed to really have a good time today! Several of them wore costumes for the occasion and said several good things about the experience afterward. I get the sense that they may have even learned something in the process.”

My motivation for planning class activities and grading assignments remained fairly low throughout the study. However, during the treatment units, I did find myself more motivated to plan out class activities. I cannot say that I ever got really motivated

to grade assignments, but positive student feedback about the role-play experience made me want to do all that I could to make class fun and productive. I even got into the spirit by putting together costumes for my characters during the role-play activities. The students particularly enjoyed my powdered wig when I was the mayor of Shaleville, and my orange face paint when I transformed into Speaker of the House, John Boehner.

A colleague also joined my class during each unit and commented on what he observed as far as the success of the use of role-play and my attitude and motivation during class. My colleague made the comment, “Everything went very well during the role-play activities and you did a great job acting as a moderator.” He also commented on my “increased level of energy” during the treatment units, but he was not sure if the increase in energy was because of the difference in teaching style or simply me being in character. My colleague also commented that “Some classes were more productive because the students were obviously better prepared.”

## INTERPRETATION AND CONCLUSION

After having used role-play in the classroom and gathered data about its impact on me and my students, there are several conclusions that can be drawn. Some of these conclusions met my expectations, while others fell short of what I hoped to see as a result of the study.

Role-play did seem to have a fairly large impact on my students’ comprehension of environmental science topics. The normalized gain scores on the students’ pre and

postunit assessment scores showed large gains, especially for the high and low-achieving students. The middle-achieving students also showed improvement in their normalized gain scores; the gain just was not as great as with the high and low-achieving students. When I first inspected the pre and postunit assessment scores, I could see a much greater improvement in the scores on the treatment unit test scores, but the students also performed much worse on the preunit assessment during the treatment units than they did on the nontreatment unit. Seeing the improvement in the normalized gain scores helped confirm that the improvement that I saw could be attributed largely to the teaching style and not just improvement from a lower starting point.

Students not only performed better on the treatment unit assessments, but they also felt like they had a higher level of understanding after the treatment units. Students felt more comfortable applying the concepts that they learned during the treatment units. This was shown in the pre and posttreatment surveys that the students took. A larger gain in student confidence in their level of understanding and their ability to apply concepts, but at least there was clear gain in the data.

Students showed an improvement in their level of critical thinking as a result of the use of role-play. The gain in the level of critical thinking was clear, but it was not as large of a gain as I would have hoped. The majority of the students that displayed an improvement in their level of critical thinking were the middle-achieving students. Low-achieving students, for the most part, continued to display very shallow and poorly thought-out answers on their postunit assessments, even after the treatment units. High-achieving students may not show improvement in their level of critical thinking as a

result of the treatment units, simply because they already showed a high level of critical thinking on the nontreatment unit postunit assessment. These students may have been limited in their expression by the design of the assessment.

While involved in role-play activities, students also said that they felt more motivated to learn. A large part of the increase in student motivation seemed to be rooted in the students each having their own character. Each student knew at the beginning of each treatment unit that he/she would need to know his/her character very well in order to be able to argue effectively during the class discussion at the end of the unit. The students knew that they would have to prepare well in order to share valid points during the discussion. This seemed to be a strong motivator.

Students reported that their attitudes did not improve very much as a result of the use of role-play on the pre and posttreatment surveys, but students were very much in agreement when asked if they enjoyed learning through role-play. I am not quite sure what the cause is for this difference, but my observation of the students showed a definite improvement in student attitudes during the treatment units. Student attitudes improved greatly during the first treatment unit, and then fell off a little bit during the second treatment unit, but still remained quite high. I noticed the student attitude during the second treatment unit (even though it remained fairly high) slipped down a bit simply because some of the novelty had worn off. Role-play was not a brand new concept to them during the second treatment unit so they were not as excited about it, but they still enjoyed getting into their characters and discussing the topic through them.



I also enjoyed working with the students through the use of role-play. It was a pleasure to see the students learn about topics through their own research and by debating with their peers rather than lecturing to them and having them complete the usual homework assignments. I have a renewed confidence in my students' abilities to teach themselves with my guidance instead of providing them the information every step of the way. My anxiety about becoming a character of my own also disappeared after just a few minutes of the first role-play debate and I was able to relax and enjoy the class.

Even though I enjoyed the role-play debates and classes took less time to plan since the students were working more individually, I did not feel much more motivated to grade student work. However, it was more of a pleasure to grade assignments that students seemed to enjoy doing as opposed to grading assignments that students obviously did not enjoy.

If I had the opportunity to do this project again, these are the changes I would make to improve the results. I would extend the time a bit more so that debates could be more thorough and so that I would have a better chance of catching students who are absent for any reason. During the study, all of the debates ran over into a second class period, and some of the students were just finding their flow when we had to halt the debate and move on to the assessment because of time restrictions. Several students were also absent at key points in the process, which did not allow for me to gather as much data as I could have. Extending the period for the study would have allowed for me to extend the debates and even possibly delay portions of the unit for a day when students are absent so that I would not have to move on without collecting data from them.

Also, if I were to do this study again, I would go back and tweak some of the characters in the role-play activities. As I learned more about hydraulic fracturing and cap and trade legislation, I discovered that some of my characters were not placed in completely accurate situations. For example, several factory owners in the cap and trade role-play activity got the same number of allowances for pollution and that is not how allowances are actually given out. During my own research I discovered that factories and power plants are actually given pollution allowances based on how much they are polluting. Dirtier factories and power plants get more allowances at the beginning of a cap and trade regime and then all allowances are decreased over time. Other characters had developed health problems that were supposed to be a result of hydraulic fracturing, but the class was debating about whether or not to let hydraulic fracturing take place in their town.

#### VALUE

Completing this study has taught me several things about my students and myself as a teacher. First of all, I discovered that role play is very useful in an Environmental Science classroom. In Environmental Science, students are often discussing complex issues that involve interactions between people of various backgrounds, nature, and politics. It is often very difficult for students to grasp all of these different aspects to gain a clear picture of why various environmental decisions are made in the way that they are. Role-play allows the students to step into the roles of various characters and then discuss topics with people who have widely varying opinions. This helped my students gain a

deeper comprehension of the topics that we discussed. This is also a technique that they can use in other classes. When they are reading about a specific character in a novel, or an historic figure, the stories will come to life more if they try to imagine themselves in the shoes of that character using role-play. This will help them gain a more complete comprehension of the subject they are studying.

This capstone project can also be valuable for other teachers and classroom researchers who are looking for ways to help their students gain a more complete comprehension of their subject matter and think more critically about what they have learned. Even if teachers are not teaching about hydraulic fracturing or cap and trade legislation, this capstone project provides a basic framework for developing and evaluating role-play activities. I have also shared some of the changes that I would make if I were to do this again, which might help other educators avoid the same pitfalls that I experienced if they utilize my research.

During this study, I also feel that I increased my level of professionalism. By working through this process, I was forced to plan for my classes well in advance, which I have not always been able to do in the past. I also broadened my experience with teaching strategies and I experimented with a new structure for class time. The teaching strategy that I experimented with was obviously role-play, but the use of role-play also forced me to structure my classes differently. In the past, I have been very reluctant to free up my students to learn on their own without my guidance during class. As students developed their own characters, I set them free to research the topic at hand without my constant guidance and supervision. I regularly checked on students to assess their

progress and I was pleasantly surprised and relieved when I saw what many students created. This experience has made me much more comfortable with leaving more of the responsibility of learning in each individual student's hands.

Future researchers who may be interested in role-play might want to attempt a more extended study. As shown in my data, students were enthusiastic about the first role-play activity, but the second role-play activity lost a little bit of its luster for some students. They were still happy to participate and enjoyed it more than a regular style of class, but they were not as excited about the process the second time around. It would be interesting to see what would happen to student enthusiasm if role-play was used regularly throughout the school year. It would also be interesting to see if students continued to show deeper comprehension of the subject matter and increased levels of critical thinking, or if critical thinking and comprehension would drop off if enthusiasm fell. It might also be a challenge for the teacher to keep the role-play activities fun and entertaining through variety.

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APPENDICES

APPENDIX A

NONTREATMENT UNIT LESSON PLAN



## Lesson Plan

Teacher: Brian Phillips

Class: 8<sup>th</sup> Grade Environmental Science

Topic: Organic vs. Nonorganic Agriculture

Learning Objectives: Students will be able to identify factually supported benefits and drawbacks of both organic and nonorganic agriculture. Students will be able to identify the primary nutrients present in fertile soils and describe the effect of farming on natural soil fertility. Students will be able to compare the advantages and disadvantages of using synthetic fertilizers with the use of “organic” or natural fertilizers. Students will be able to relate the conditions that cause the banning of a pesticide and describe circumstances in which you would allow an exemption to the ban of a pesticide. Students will be able to describe some alternative methods for controlling pests.

Introduction: Agriculture is of the utmost importance to all of us, but agriculture has a huge impact on the world around us. During this unit we will examine the pros and cons of organic agriculture and compare this form of agriculture with traditional nonorganic agriculture.

Activities: This unit will begin with a viewing of the documentary film *King Corn* followed by a discussion over the ideas shared in the film. We will then discuss concepts from chapters 3.7, 3.11, and 3.12 in the *Environmental Science: How the World Works and Your Place in it* text. While covering these chapters, we will incorporate chapter readings, chapter questions, lecture, and in class discussion as we learn about organic and inorganic fertilizers, pesticides, and natural methods of pest control.

Materials/Resources: The documentary film *King Corn*, the *Environmental Science: How the World Works and Your Place in it 3<sup>rd</sup> ed.* Textbook by Jane L. Person, internet.

Assessment: I will assess the students using the chapter questions and a video quiz while covering the unit. Our summative assessment will be a written test consisting of 6 essay questions.

APPENDIX B

TREATMENT UNIT 1 LESSON PLAN

## Lesson Plan

Teacher: Brian Phillips

Class: 8<sup>th</sup> Grade Environmental Science

Topic: Hydraulic Fracturing

Learning Objectives: Students will be able to identify factually supported benefits and drawbacks of hydraulic fracturing. Students will be able to describe the process of hydraulic fracturing. Students will be able to discuss issues involved with hydraulic fracturing using real life benefits and concerns to build a well supported viewpoint. Students will be able to describe some alternatives to hydraulic fracturing and use real life data to discuss the potential of these alternatives.

Introduction: Energy is something that our country needs in abundance to support our daily lives and our economy. With non-renewable energy sources beginning to level off in their supply, people are looking for new ways to provide the energy that we need. Hydraulic fracturing is a relatively new process for collecting natural gas that is fairly abundant in the United States. The abundance of this energy source and the fact that it is found in our own country is attracting a lot of attention and kicking off an explosion of activity. The benefits of this energy source are obvious, but many people are beginning to see cause for concern about this new method for collecting natural gas. During this unit we will examine the benefits and concerns surrounding hydraulic fracturing by acting out a scenario in a fictitious town. In conclusion, the townsfolk in our fictitious story will make a decision about hydraulic fracturing in their town.

Activities: This unit will begin with a lecture style introduction to the concept of hydraulic fracturing. Students will then be assigned characters from a fictitious town. Each character will have reasons for either being in support of or being against hydraulic fracturing. Students will then research hydraulic fracturing from the perspective of their character to develop a factually supported viewpoint for their character in terms of hydraulic fracturing. Students will then come together in a town hall meeting format to discuss hydraulic fracturing and how it could be beneficial or detrimental for their town. The class as a whole will try to reach an agreement about whether or not hydraulic fracturing should be allowed in their town.

Materials/Resources: Character information sheet, Internet, costume materials or props (optional)

Assessment: I will assess the students using their character development assignment as well as their performance during the town hall meeting. Our summative assessment will be a written test consisting of 6 essay questions.

APPENDIX C

TREATMENT UNIT 1 CHARACTER LIST

### Hydraulic Fracturing Character List

1. Owner of a well drilling company – You are the owner or a well drilling company that got hit hard with the housing market crash. Your main source of income was drilling wells for new private residences. Hydraulic fracturing provides you with an opportunity to put your employees back to work. If the decision is made to not allow hydraulic fracturing, you will have to lay off most of your work force and you may have to go out of business and find a new career. Do research to find out how much of a benefit hydraulic fracturing can be to you.
2. Town resident on well water – You live in an area of the town that is very close to where the hydraulic fracturing will take place. Do research to find out what if any effect hydraulic fracturing could potentially have on you and your family.
3. Climate controlled storage facility owner – You own a storage facility that has hundreds of individual units available for people to rent. You are using heating oil to control temperatures in your units during the cold winter months and costs are getting high. Do research to determine what kinds of benefits you could get from a local fracking operation.
4. Hallifrack Co. co-owner and operator – You co-own the hydraulic fracturing company that is trying to gain access to the area around and within the town of Shaleville. Gaining access to this land would increase profits 300% and would really impress your investors who have begun to consider halting investments that have been made in your company.
5. Hallifrack Co. co-owner and operator – You co-own the hydraulic fracturing company that is trying to gain access to the area around and within the town of Shaleville. Gaining access to this land would increase profits 300% and would really impress your investors who have begun to consider halting investments that have been made in your company.
6. Department of Environmental Protection Officer – You work for the state department of environmental protection and you are in charge of protecting air and water quality in the district that includes Shaleville. You are also part of the climate change advisory board for the state. Part of this role includes looking for ways to help reduce the state's carbon footprint. Failure to do your job could jeopardize your relationship with the people in the community, which would greatly increase the difficulty of your job.
7. Resident of Shaleville – You recently moved to Shaleville when your previous home in another state was destroyed by a methane explosion that occurred shortly after a fracking operation was started nearby. You were able to get a reasonable settlement, which allowed you to move several hundred miles away from your previous location. In the move you had to leave behind close friends and family members. You do not want to have to move again and you are extremely reluctant to have more drilling going on near your home.

8. Shaleville resident working for the USGS – You are in charge of monitoring local fault lines that run under the town of Shaleville. The fault lines have been dormant for over 100 years, only causing small tremors periodically. Several historic landmarks in Shaleville sit on top of the fault line and could potentially be heavily damaged even by a fairly small earthquake.
9. Shaleville resident – You live a short distance downhill from the future proposed site of a fracking fluid holding pond. You have a history of cancer in the family and you have three young children with respiratory problems. You do not have enough money to move your family if there are ever any negative impacts from the holding pond.
10. Shaleville resident – You own a large tract of land outside of town that has large reserves of natural gas underneath it. The owners of Hallifrack Co. have been in discussions with you about buying your mineral rights. If you sell your mineral rights to Hallifrack Co. you could retire 10 years early and leave a large inheritance to each of your children. Otherwise, your land is barely worth more than it was the day you bought it, which is a little more than you owe on your current debts.
11. Fluid owner and operator – You are the owner of a fracking fluid manufacturer called “Fruid”. Your fracking fluid has proven to be one of the most effective in the industry and Hallifrack Co. is interested in using your fluid at its possible Shaleville site. Landing this new account would mean big holiday bonuses to you and your project heads. You’ve had your eyes on the Bugatti Veyron for a while now and you are getting excited about the possibility of having one in your driveway.
12. Shaleville Renewables owner and operator – You are the owner of a local renewable energy company that designs and installs renewable energy packages. Local fracking would greatly reduce the cost of natural gas and would greatly increase the competition for your company.
13. Town resident on well water – You live in an area of the town that is very close to where the hydraulic fracturing will take place. Do research to find out what if any effect hydraulic fracturing could potentially have on you and your family.
14. Unemployed Shaleville Resident – You have been unemployed for 2 years now and you are desperate for work. You have only a high school diploma and your experience is mainly in construction. Right now you are interested in either working for Hallifrack or Shaleville Renewables. You are mainly interested in salary and benefits because you have been falling further into debt.

APPENDIX D

TREATMENT UNIT 2 LESSON PLAN

## Lesson Plan

Teacher: Brian Phillips

Class: 8<sup>th</sup> Grade Environmental Science

Topic: Cap and Trade

Learning Objectives: Students will be able to identify factually supported benefits and drawbacks of cap and trade legislation. Students will be able to describe the changes proposed by cap and trade legislation. Students will be able to discuss issues involved with cap and trade using real life benefits and concerns to build a well supported viewpoint. Students will be able to affectively argue various points surrounding the issue of cap and trade to arrive at a consensus agreement about the issue.

Introduction: As population grows, so does demand for energy and goods. The production of goods and the generation of electricity almost always produce unwanted byproducts that are dispersed in our soil, water, and atmosphere. When seeking ways to reduce the amount of pollution that is generated through these processes, legislation is often required to provide a framework for solving the problem as well as holding various parties responsible for their part of the effort. Cap and trade is one such piece of legislation that has been argued back and forth by various parties. During this unit we will examine the benefits and concerns surrounding cap and trade legislation by acting out a scenario set in the United States. To conclude this unit, students will come together in a congressional hearing to make a decision about cap and trade legislation.

Activities: This unit will begin with a lecture style introduction to the concept of cap and trade. Students will then be assigned characters in various government positions as well as citizens from around the United States. Each character will have reasons for either being in support of or being against cap and trade. Students will then research cap and trade legislation from the perspective of their character to develop a factually supported viewpoint for their character in terms of cap and trade. Students will then come together in a congressional hearing format to discuss cap and trade and how it could be beneficial or detrimental to their individual interests. The class as a whole will try to reach an agreement about whether or not cap and trade legislation should be passed or what changes need to be made before legislation is passed.

Materials/Resources: Character information sheet, Internet, costume materials or props (optional)

Assessment: I will assess the students using their character development assignment as well as their performance during the town hall meeting. Our summative assessment will be a written test consisting of 6 essay questions.



APPENDIX E

TREATMENT UNIT 2 CHARACTER LIST

## Cap and Trade Character List

1. Factory Operator – You are the owner and operator of a factory. You have kept up with air quality measures and you have put a lot of effort into making sure that your factory does not cause air pollution for your community. Because you have been diligent about controlling pollution, the new Cap and Trade legislation will mean that you will receive an excess of allowances. More income for your factory means that you could add on a new manufacturing floor that would have a significant impact on your overall profits.
2. Factory Operator – You are the owner and operator of a factory. You have kept up with air quality measures and you have put a lot of effort into making sure that your factory does not cause air pollution for your community. Because you have been diligent about controlling pollution, the new Cap and Trade legislation will mean that you will receive an excess of allowances. More income for your factory means that you could add on a new manufacturing floor that would have a significant impact on your overall profits.
3. Factory Operator – You are the owner and operator of a factory. In order to maintain the highest profits possible, you have been putting off adding pollution controls to your factory. If the cap and trade legislation passes, you will have to install extensive pollution control measures on your factory, which would take a huge chunk out of your profits. Your decline in profit could also cause you to lose investors, which could cause your factory to have to shut down. You are looking into the possibility of moving your operation overseas where there are no pollution controls in order to maintain your profit margin if the cost of pollution controls are too high. You have hundreds of employees that work for you and have worked in your factory for their entire career.
4. Factory Operator – You are the owner and operator of a factory. In order to maintain the highest profits possible, you have been putting off adding pollution controls to your factory. If the cap and trade legislation passes, you will have to install extensive pollution control measures on your factory, which would take a huge chunk out of your profits. Your decline in profit could also cause you to lose investors, which could cause your factory to have to shut down. You have hundreds of employees that work for you and have worked in your factory for their entire career.
5. Manufacturer of Pollution Control Equipment – You own a business that designs, builds, and installs pollution control equipment for various industries. Cap and trade legislation, if it passes, would create a large increase in your customer base. The large increase in business would allow you to hire many new workers and it would increase your profit drastically. You are making a comfortable living right now, so you would be

able to afford giving discounts on your services to new customers, but keeping your prices where they are will allow you to get that second house on the beach that you have always dreamed about.

6. Manufacturer of Pollution Control Equipment – You own a business that designs, builds, and installs pollution control equipment for various industries. Cap and trade legislation, if it passes, would create a large increase in your customer base. Your business has been struggling in the past, so an increase in business would help make your business profitable so you could keep your workers employed and maybe even expand if you increase your business enough.

7. Renewable Energy Business Owner – You run a business that sells and installs various pieces of equipment for generating renewable energy. So far, business has been slow. Your customers are mostly private home owners who feel that they have a moral obligation to help the environment. The cost of renewable energy systems is a bit higher than the cost of generating electricity with fossil fuels. Cap and trade legislation would raise the price of using fossil fuels, which will make your business more competitive.

8. Acid Deposition Scientist - You are an expert in acid deposition and you have been asked to give your testimony at the hearing so that everyone will be informed about the effects of acid deposition. You are required as a scientist to give your unbiased, factual assessment of the impacts of acid deposition.

9. Fisherman – You are a lifelong fisherman. Your family has been fishing for 7 generations and your son has just begun joining you on fishing trips. In the last 30 years, you have had increasing difficulty selling your fish because of mercury contamination. Today, you are just barely getting by on your income and if things get much worse, your family will have to stop fishing.

10. Coal Fired Power Plant Operator – You are the operator of a coal fired power plant and you have been putting off installing pollution controls in order to remain competitive in the energy market. Cap and trade legislation would force you to switch to more expensive sources of coal that contain lower levels of sulfur and mercury. The legislation would also require you to install expensive pollution control equipment. In order to maintain your current level of profits, you will have no choice but to charge your customers more for electricity.

11. Citizen – You work in the factory that is considering moving overseas if pollution controls are too expensive. If you lost your job, you would not be able to get by. You already struggle to pay your power bills even though you live just down the road from the power plant. You also have 3 young children that all suffer from asthma. One of your

children was also born with brain damage as well as hearing and vision problems. Medical bills are adding up.

12. Citizen – You work in the factory that is considering moving overseas if pollution controls are too expensive. If you lost your job, you would not be able to get by. You already struggle to pay your power bills even though you live just down the road from the power plant. At this point, you consider yourself lucky for not having any children. You feel that if you lose your job, at least it will just be you and your wife who have to figure out what to do instead of the two of you and your children. You have tried to have children, but each pregnancy resulted in a miscarriage or severely premature birth.

13. Politician – You are one of the politicians who will be voting on the cap and trade legislation. Your campaign has been heavily financed by the coal lobby. If cap and trade legislation passes, they will begin funding another political figure that can get results for their cause. This will almost certainly mean the end of your political career.

14. Politician – You are one of the politicians who will be voting on the cap and trade legislation. Your campaign has been heavily financed by the renewable energy lobby. If cap and trade legislation does not pass, they will begin funding another political figure that can get results for their cause. This will almost certainly mean the end of your political career.

APPENDIX F

CHARACTER DEVELOPMENT WORKSHEET

**Character Development Worksheet**

Your Name: \_\_\_\_\_

Character Name: \_\_\_\_\_

1. What is your full name?
2. Do you have a nickname?
3. Where were you born?
4. Where do you live in Shaleville?
  
5. Do you have any brothers and sisters? How many older and younger?
  
6. What is your favorite childhood memory?
  
7. Did you go to college or are you in college?
8. What subjects did you or do you excel in?
9. Are you now a member of any clubs, organizations, or religious congregations?
  
10. What do you enjoy doing most in your free time?
  
11. What kind of music do you enjoy listening to?
  
12. What do you do for exercise?
  
13. In what forms of entertainment/ recreation do you enjoy and/ or take part?
  
14. What is your favorite sport? Do you follow it professionally?
  
15. What is your favorite time of day? Why?
  
16. What is your favorite season? Why?
  
17. What is your view on hydraulic fracturing/cap and trade legislation?
  
18. What factual support do you have for your viewpoint? List facts and arguments that you have to support your character's views below.

APPENDIX G

PRE AND POSTUNIT CONCEPT INTERVIEWS

### Pre and Postunit Concept Interviews

I will use these questions to gauge progress in student comprehension of the key concepts learned in each nontreatment and treatment unit. Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. List three reasons to support and three reasons to reject (hydraulic fracturing, cap and trade). During my nontreatment unit I will ask interviewees to list three reasons to support both organic and nonorganic farming. Explain your answer.
2. Why is (organic and nonorganic agriculture, hydraulic fracturing, cap and trade) an important issue that we need to thoughtfully consider and make wise decisions about? Explain your answer.
3. In what ways might (organic and nonorganic agriculture, hydraulic fracturing, cap and trade) have either a positive or negative effect on the environment? Explain your answer.



APPENDIX H

PREINTERVENTION STUDENT INTERVIEW

## Preintervention Student Interview

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. How much do you look forward to coming to science class? Rate how much you look forward to coming to science class on a scale of 1-5 and explain your answer. "I do not like coming to science class" 1 2 3 4 5 "I really look forward to science class".
2. What activities in class help you to learn best? Explain
3. Does the current class structure make you feel motivated about learning? Rate your level of motivation and explain. "Not motivated at all" 1 2 3 4 5 "Very motivated".
4. How engaged are you in classroom activities? Rate your level of engagement in class activities on a scale of 1-5 and explain. "Completely disengaged" 1 2 3 4 5 "Completely engaged".
5. Rate the enjoyment that you get from researching given topics from 1-5. "I find no enjoyment in researching topics" 1 2 3 4 5 "Researching is one of my favorite things to do at school". Explain your rating. How much do you like to research topics?
6. Do you enjoy debating topics with your peers? Rate your enjoyment for debating topics from 1-5. "Debating topics is my least favorite thing to do at school." 1 2 3 4 5 "Debating topics with my peers is my favorite school activity." Explain your rating.

APPENDIX I

POSTINTERVENTION STUDENT INTERVIEW

## Postintervention Student Interview

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. How much do you look forward to coming to science class? Explain.
  
2. What activities in class help you to learn best?
  
3. Does the current class structure make you feel motivated about learning?  
Explain.
  
4. How did the treatment units alter your attitude about coming to Environmental Science class?
  
5. If you can, explain what it was about the treatment units that altered your attitude in either a positive or negative way. If the treatment units had no effect on your attitude, explain why your attitude remained unchanged.
  
6. Rate your attitude about researching topics in the way that you did during the role play activities. "I despised researching topics for role play." 1 2 3 4 5 "I enjoyed researching topics for my role very much."
  
7. How would you have rated your attitude about researching topics before the role play activities? 1 2 3 4 5

8. Did having a character to research and play have a positive or negative effect on your motivation to learn the subject matter? Explain.
9. Rate your motivation. “Having a character greatly decreased my motivation to learn about Environmental Science.” 1 2 3 4 5 “Having a character greatly increased my motivation to learn about Environmental Science.”
10. How would you have rated your motivation to learn about Environmental Science before using role play? “Not motivated at all.” 1 2 3 4 5 “Very motivated.”
11. Did the opportunity to debate about the subject matter in character have an effect on your motivation to research different aspects of the topic?
12. Do you think that you would have been more or less motivated to research the subject matter and develop a fact-based opinion about it if you were simply having a debate with your classmates as yourself?
13. Would you prefer to use debate and role-play to learn about future environmental science topics, or would you prefer to use methods like those you saw during the non-treatment unit?

APPENDIX J

PRETREATMENT STUDENT SURVEY

## Pretreatment Student Survey

Directions: Circle the number (1-5) that most accurately describes how you feel about each of the statements below. Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1 – Completely Agree, 2 – Agree, 3 – Neutral, 4 – Disagree, 5 – Strongly Disagree

- I enjoy discussing topics with my peers in a classroom setting. 1 2 3 4 5

- The challenges that I am presented with every day in class  
motivates me to learn about the subject matter. 1 2 3 4 5

- I look forward to Environmental Science class. 1 2 3 4 5

- I enjoy learning through the teaching styles that I have been  
presented with this year. 1 2 3 4 5

- I feel that I have a strong comprehension of the concepts that  
I have learned through traditional teaching methods. 1 2 3 4 5

- I feel comfortable applying the concepts that I have learned  
through traditional teaching methods. 1 2 3 4 5

- I can come up with creative solutions to problems that I have  
learned about through traditional methods. 1 2 3 4 5

Directions: Answer the following questions to the best of your ability.

1. Describe your level of motivation to learn about environmental science topics.
2. What would you do to improve upon a traditional environmental science class?
3. What activities help you learn the best? Explain.

APPENDIX K

POSTTREATMENT STUDENT SURVEY



## Posttreatment Student Survey

Directions: Circle the number (1-5) that most accurately describes how you feel about each of the statements listed below. Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1 – Completely Agree, 2 – Agree, 3 – Neutral, 4 – Disagree, 5 – Strongly Disagree

- I enjoy discussing topics with my peers in a classroom setting. 1 2 3 4 5
- The challenges that I am presented with every day in class  
motivates me to learn about the subject matter. 1 2 3 4 5
- I look forward to Environmental Science class. 1 2 3 4 5
- I enjoy learning through the teaching styles that I have been  
presented with this year. 1 2 3 4 5
- I feel that I have a strong comprehension of the concepts that  
I have learned through traditional teaching methods. 1 2 3 4 5
- I feel comfortable applying the concepts that I have learned  
through traditional teaching methods. 1 2 3 4 5
- I can come up with creative solutions to problems that I have  
learned about through traditional methods. 1 2 3 4 5
- I enjoy debating with my peers in character. 1 2 3 4 5
- The challenge of a debate motivates me to research the  
subject matter more than a regular class. 1 2 3 4 5
- I look forward to Environmental Science class when I

- know we will be debating in character. 1 2 3 4 5
- I enjoy learning through debates and role-play more  
than with the traditional class style. 1 2 3 4 5
- I feel like I have a better comprehension of the concepts that  
I learned through the use of the role-play. 1 2 3 4 5
- I feel more comfortable applying the concepts that I have  
learned through the use of role-play. 1 2 3 4 5
- I feel that learning about many sides of an issue through the  
use of role-play helps me come up with creative solutions  
to the problem at hand. 1 2 3 4 5

Directions: Answer the following questions to the best of your ability.

1. Explain how developing a character affected your motivation to learn about the subject matter.
2. What would you do to improve upon the **role-play and debates** that you took part in?
3. What class activity helps you to learn best? Explain.
4. Describe your level of motivation to learn about environmental science topics.
5. What would you do to improve upon a **traditional** environmental science class?

APPENDIX L

PRO AND CON GRID

Pro and Con Grid

Name: \_\_\_\_\_

Directions: List as many pros and cons about cap and trade legislation as you can think of in the grid below. Below each statement, give a very brief explanation explaining why the item is a pro or a con.

Pros

Cons



APPENDIX M

PRE AND POSTUNIT STUDENT ASSESSMENT

## Pre and Postunit Student Assessment

Name: \_\_\_\_\_

Directions: Answer the following questions to the best of your ability. Use complete sentences. Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. What is (hydraulic fracturing, cap and trade)? [During the nontreatment unit about organic and nonorganic agriculture, I will ask about the difference between the two.]
2. Decisions about (hydraulic fracturing, cap and trade, organic or nonorganic agriculture) are being made every day. Even though you may not have been aware of these issues until now, how might decisions about these topics affect you (either positively or negatively) as a student here at Rabun Gap?
3. As we discussed earlier in the year, everything on our planet is interconnected. This means that (organic or nonorganic agriculture, hydraulic fracturing, cap and trade) will have an effect on water quality in some way. Briefly describe how (organic or nonorganic agriculture, hydraulic fracturing, cap and trade) will have either a positive or negative effect on either surface or ground water quality.
4. Explain how (organic or nonorganic agriculture, hydraulic fracturing, cap and trade) could have a positive influence on the economy of the United States.
5. Does the support of (organic or nonorganic agriculture, hydraulic fracturing, cap and trade) make our country more sustainable? Explain.

6. Based on what you have learned in this unit, what is your personal opinion about (organic and nonorganic agriculture, hydraulic fracturing, cap and trade)? Provide support for your opinion.

APPENDIX N

JOURNAL ENTRY PROMPTS



## Journal Entry Prompts –

- How motivated do the students seem to be to work on their class assignments? Rate the student motivation level. 1 being “Least motivated”, 5 being “Most motivated” and explain your answer.  
1 2 3 4 5
- Do the attitudes of the students seem to be unchanged by the classroom activities taking place, or have their attitudes about class changed since beginning this unit? Rate the amount of change in attitude that you have seen. 1 being “No change” and 5 being “Great change” and explain your answer.  
1 2 3 4 5
- What is my attitude about the class activities taking place this week? Rate your attitude on a scale of 1 to 5. 1 being “Really foul”, 5 being “Wet your pants excited”. Explain your answer.
- Do I feel more motivated to plan class time and grade assignments than normal? Rate your motivation on a scale of 1 to 5. 1 being “Much less motivated than usual”, 5 being “Give me more things to grade. I can’t get enough.” Explain your level of motivation.
- Do I feel like role-play should be a significant part of my pedagogy? Rate your opinion on a scale of 1-5. 1 being “Definitely Not“ and 5 being “For Sure”. Explain your answer.

APPENDIX O

DETAILED PROJECT TIMELINE

### Project Timeline

- Jan. 4** – My initial **Snapshot, Nontreatment Preunit Assessment**. Start **Nontreatment Preunit Concept Interviews**
- Jan. 7 – Introduction to Organic and Nonorganic agriculture along with my initial **Journal Entry**
- Jan. 8 – Begin watching either *King Corn* or *Food Beware: The French Organic Revolution*
- Jan. 10 – Film quiz and discussion
- Jan. 14 – Begin discussing Ch. 3.7 – Fertilizers: Organic vs. Inorganic
- Jan. 15 – **Journal Entry**. Continue discussing Ch. 3.7 and discuss chapter questions. Also, learn about Rachel Carson
- Jan. 16 – Cover Ch. 3.11 – The Banning of Pesticides using in class discussion and chapter questions
- Jan. 17 – Discuss alternatives to pesticides, such as Integrated Pest Management. Students will complete the **Postunit Assessment**. Start **Postunit Concept Interviews**.
- Jan. 21 – 2 hour class. **Student Surveys & Invented Dialogue** in class. **Pro and Con Grid** will carry over for homework.
- Jan. 23** – Beginning of Treatment Unit 1 – Fracking. Start **Preunit Concept Interviews**.
- Jan. 29 – **Journal Entry**, Fracking Intro., **Preunit Assessment**.
- Jan. 30 – Character assignments and begin research and preparation
- Feb. 5 – **Journal Entry**, town-hall meeting discussing fracking
- Feb. 6 – Wrap up discussion, draw conclusion, homework – **Invented Dialogue and Pro and Con Grid**
- Feb. 7 – **Postunit Assessment**, begin **Postunit Concept Interviews**
- Feb. 11** – Beginning of Treatment Unit 2 – Cap and Trade. **Preunit Assessment**. Start **Preunit Concept Interviews**.
- Feb. 12 – **Journal Entry**, Cap and Trade Intro., Character assignment. Begin research and preparation.
- Feb. 19 – **Journal Entry**, Congressional Hearing about Cap and Trade.
- Feb. 20 – Wrap up discussion, draw conclusion.
- Feb. 21 – **Invented Dialogue, Pro and Con Grid**
- Feb. 25 – **Postunit Assessment, Final Journal Entry, Begin Postunit Concept Interviews, My Final Snapshot**
- Feb. 28** – My study should conclude by this date. Feb. 29 begins Spring Break.