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CONFRONTING POPULAR MEDIA'S PRESENTATION OF
SCIENCE WITH CRITICAL THINKING SKILLS

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ABSTRACT

This qualitative research study reflects the observed and reported experiences of fourteen Honors-level Earth and Space Science students from a large urban high school who applied critical thinking skills to the evaluation of the popular media. The students learned how to use and apply critical thinking skills in an effort to become critical evaluators of the popular media. Filters and Leading Questions applied to examples of written and visual media prompted students to think, in a critical way, about the media they were using. This study expresses the trials and errors of the implementation and application of critical skills to explore the popular media. The results of this study indicated that students who learn how to think critically would become effective evaluators of the popular media.

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RESEARCHER STANCE

My interest in critical thinking skills stems from my own questioning nature and search for truths. I have always believed that it is our own independent responsibility to evaluate the information in our lives and give it meaning based on personal education and reflection. In this age of information, it is imperative that we be educated about the opinions we make and the ideas we hold to be true. It is not important that we do not or can not know everything, but that we realize we do not know everything. I believe it is the people who feel they know everything that too often get taken advantage of. We must also take note of the old adage not to believe everything we see and hear. In order for this to occur, we need to be critical thinkers, critical viewers, and critical readers.

This became an even more important issue for me when I became an educator. As a ninth grade Earth and Space Science teacher, I am continually amazed at the perceptions many of my students hold about the world around them. Furthermore, I am frustrated by their perceptions of the people who disseminate this information. Most students are wary of trusting a used car salesman, but if the person is a scientist or a doctor, they often trust the person without any doubt. It is imperative that students become the kind of thinkers who analyze all information, independent of the source. They need to become aware that there are biases in the information that may have personal, financial, or political motives.

I began thinking about ways to help my students with this life skill after a situation that occurred in my classroom. On this particular day, one of my students arrived to class and promptly told me that the United States never actually landed a man on the moon. I asked the student how he came to that conclusion, and the student reported that there had been a show on television the night before that proved we never landed on the moon. This was brought to my attention a number of times that day, as it seemed a large number of my students saw the same show. I was curious, to say the least, and fortunately for me one of my students had taped the program. I took the tape home that night and watched it twice. The program was called *The Moon Landing Hoax*, and had aired on the FOX network. The show was very well done, very convincing, and very wrong. The program, which in its opening remarks claimed to be unbiased, showed about a dozen pieces of “evidence” that proved that human beings had never landed on the moon.

I decided to show some of the program to my classes so that we could have a discussion on this topic. I asked the students who had already viewed the show to try to remain silent until everyone had a chance to see it. What happened next absolutely astounded me. After watching the tape, I asked my students how many of them believed we never landed on the moon, and all the students immediately raised their hands. Each one of them had dismissed everything they had ever learned or thought about one of the greatest achievements in human

history, based on that single television show. To the show's credit, it was well produced, but I was still speechless at its effect.

I was left wondering how many people across the country had the same reaction and, more importantly, how I was going to fix the situation I had created in my classroom. Fortunately, I came across Phil Platt's website www.badastronomy.com, which refuted the information presented in the program with sound scientific arguments. I had my students read the evidence presented on Platt's website and had them compare and contrast the information. Thankfully, they were able to see the obvious errors in the television show and once again believed that the United States had in fact, landed Apollo astronauts on the moon. The amazement then shifted to my students, as they wondered why they had been manipulated by the show. I was left wondering how I could better educate and prepare my students so this would not happen to them again.

Since this situation occurred, I have witnessed many other times when my students have been misled or confused by information in the popular media. For example, as an Earth and Space Science teacher, I get a lot of questions regarding the accuracy of Hollywood's use of science in movies. I also witness a lot of bad science being used in television programs, commercials, and news programs. Books, magazines, and newspapers are also misleading to students both intentionally and unintentionally. During a pilot study I conducted regarding this topic, I found that not only do students often lack critical thinking skills, but they

are many times unable to tell works of fiction from nonfiction. In my pilot study, I asked if examples of popular media could be used to encourage students to think critically. What I found in my small classroom sample was that most students do not have the skills or knowledge to think critically and as such did not perform well when asked to critically evaluate a work of science fiction.

I was further motivated by Dan Brown's novel, *The DaVinci Code*, which spurred a worldwide debate as to the accuracy of the novel. This was a perfect example of people's lack of understanding regarding the difference between fact and fiction. Dan Brown's book was a work of historical fiction, yet many people reacted as if he had rewritten history. On a positive note, however, the debate and dialog that resulted from this book was exactly the kind of conversation I wished my students to engage in. It did not really matter who was right and who was wrong; what mattered was that people were doing research, thinking, and forming opinions on the topic. These are the tools and skills I wish to teach my students so that they may become independent thinkers and problems solvers. Through these techniques, my students will have the ability to develop rational opinions and defend them with supportive evidence.

These personal experiences and the inconclusive outcomes of my pilot study have led me to develop a new question that will provide positive results for my students. My research question is: What will be the observed and reported experiences when students apply critical thinking skill to examples of popular

media? Through this study, I wish to observe what will occur when I teach students critical thinking skills by asking them to apply what they have learned to examples of popular media. One important shortcoming of my pilot study was that too many students did not know what it meant to think critically. So, when asked to view or read something and evaluate it, my students struggled. Through this action research, I want my students to become critical thinkers, critical viewers, and critical readers as I observe their ability to critique the portrayal of science in the popular media.

LITERATURE REVIEW

Introduction

The development of critical thinking skills in our students is one of the most important challenges facing educators today. Furthermore, the dramatic effect the popular media plays in our students necessitates these critical thinking skills. Critical thinking skills will give our students the ability to not only take in information, but also synthesize it and make meaning of it. Defining what constitutes critical thinking is the first step in identifying and teaching critical thinking skills to our students. Our students will need to be versed in media literacy, critical viewing, and critical literacy in order to cope with today's media rich world. Teachers also need an effective method of evaluating critical thinking, so that they can create an environment that perpetuates critical analysis of the world. Using critical literacy and critical viewing skills, our students should be equipped to deal with the multitude of popular media sources.

Critical Thinking

Critical Thinking Definition

In order to conduct research on critical thinking it is important to define what critical thinking is. This is extremely important with regard to critical thinking, because it exists within the paradox that many people have defined it, yet it is not easily or simply defined.

Lipman (2003) defines critical thinking as it pertains to three basic criteria. First, critical thinking must rely on some manner of criteria or judgments upon which we base our opinions. Second, critical thinking must show the ability to self-correct. This is a form of metacognition where the student thinks about his/her thinking. Lastly, critical thinking must show signs of being sensitive to the context in which something is occurring. This can be defined as making decisions and judgments based on the current environment.

A simpler definition held by many educational philosophers is that critical thinking has two basic components. The first is that a student needs to use certain cognitive skills in order to think critically. The second component is that the student is then able to apply these cognitive skills during situations that require them (Edman, Robey, & Bart, 2002). With these two definitions we can begin to identify critical thinking.

Teaching Critical Thinking Skills

There is a tremendous need for educators to teach students how to think critically and develop these necessary life skills. According to one student's response to a survey conducted by Brem, "Real scientists do not have ulterior motives" (2000, p. 6). This type of student opinion illustrates the need for educators to teach critical thinking skills. In the same study, results showed that only 23% of students thought science was useful to test "experts'" credibility (Brem, 2000).

Scaffolding can be an effective method for teaching critical thinking skills, according to Sharma and Hannafin (2002). Scaffolding is the process by which a teacher slowly builds a student skill level, while simultaneously reducing the amount of teacher support. Through this process, an educator can create self-sufficient learners. The study by Sharma and Hannafin discovered five main elements critical to scaffolding learners to be critical thinkers. Student reflection about learning and thinking is the first element. The second element necessary for shaping critical thinking skills is feedback from the teacher. Authentic and unstructured activities are the third element that helps to ensure the students' engagement in critical thinking. Fourth is the students' ability to recognize and adapt to their own individual learning styles. The use of prior knowledge for guiding and refining thinking is the fifth element in scaffolding toward critical thinking (Sharma & Hannafin, 2002).

An excellent example of scaffolding students toward critical thinking comes from a sample unit presented by Owen, Silet, and Brown (1998). Their plan starts with the students' preconceived notions and experiences. The plan stresses the need to move from simple to complex forms of media evaluation. Finally, it is critical that students' viewing practices shift from passive to active. Through this progression of steps, students will develop critical media skills (Owen, Silet, & Brown, 1998).

A study by Maness outlines a three-step procedure for teaching critical thinking skills as they relate to media (2004). Maness offers a framework for teaching critical media skills that asks teachers to listen, activate, and extend. The first step is to listen to the students to gain insight into their prior knowledge and experience. This first step also helps to alleviate many of the educator's biases and assumptions about students' understanding. Second, the educator needs to activate students' critical media skills by offering examples that will involve the students and help to give a clear purpose to the activity. Lastly, is to extend the students' critical thinking skills by teaching them media skills and helping them form connections between themselves and the world around them (Maness, 2004).

Another aspect of teaching critical thinking is making students more empathetic and morally sensitive. This moral sensitivity includes the capacities to identify and interpret different kinds of situations in an ethical framework (Tirri, 1999). Further, Tirri states that, "Moral sensitivity in learning includes awareness of moral dilemmas in the learning environment and capabilities to reflect on them with empathy and role-taking skills" (1999, p. 1). This will allow students to evaluate scientific issues from an ethical and moral standpoint.

Critical Literacy

Critical literacy is a student's ability to read and interpret written works critically (Bean & Moni, 2003). The skills that students need for learning in school should be ones that foster a continually inquiring human mind. This

should include a student's ability to relate and reassess the ideological working of a text, in such diverse applications as an advertisement or political initiative (Langford, 2001).

A recent study by Sadler, Chambers, and Zeidler (2002) pointed out some alarming statistics about critical literacy. This study concluded that 80% of students were able to identify data in what they read, but less than 50% of the students could interpret or describe the data. This study points to the need for educators to teach students to be more critically literate.

The use of young adult fiction is one method for increasing critical literacy and engaging students in critical thinking (Bean & Moni, 2003). Students are often able to relate to the characters and the situations presented in this type of fiction. This enables the teacher to engage the students in critical thinking and critical literacy. Posing questions about the characters and the situations in the fictional book allows the teacher to scaffold up to role playing and more in depth, higher order thinking (Bean & Moni, 2003)

Media Literacy

Having students write reflectively and analytically about media is one method for increasing student media literacy. This is exemplified in a study by Goldthorpe, in which he compared two freshman classes' ability to critically respond to a 30 second TV commercial (1993). The first class was taught how to analyze and make inferences about images and text, and the second was not

taught these skills. Goldthorpe then showed both classes the same TV commercial and had them write responses to prompts, such as, describing sex roles in detail, comparing male “heroes” and female “beauties”. The first group of students who had the mini advertising class far outscored the second class (Goldthorpe, 1993). This affirms the need for students to be guided toward thinking critically.

It is also important that we recognize students’ familiarity with popular media gained through years of exposure. Students are not just passive audiences; they are constantly connecting these media messages to their personal identities and social interactions (Maness, 2004). With this knowledge, it is important that we do not disengage students by educating them against media; rather we need to educate them about media. To this end, we must use students’ prior knowledge and experience in media literacy education. Furthermore, many students already possess some amount of media literacy; they are just unaware how to use it or how it will benefit them (Maness, 2004).

The evaluation of media is an excellent method for developing media literacy. Brooks describes one such method by turning students into critics and having them evaluate some of their favorite forms of media by their favorite artists (1998). This method increases student motivation and engagement in learning critical thinking skills. Through Brooks’ methods, students choose a type of media to critique, such as movies, TV, video games, and music, and

critique the media. They role play a critic and respond to predetermined questions about the media they are evaluating. The students present their evaluation to the rest of the class and give the product a “thumbs up” or “thumbs down” based on their observations (Brooks, 1998).

Critical Viewing

Critical viewing is a student’s ability to watch and thoughtfully evaluate visual materials. This skill is especially important when you consider that according to Semali (1995a), television is on in many American homes for more than seven hours a day. She further reports that most people fail to recognize that their thoughts and opinions are shaped through the popular media. Semali’s research suggests that the majority of teachers personally recognize the importance of critical viewing, but fail to instill this skill on their students (Semali, 1995b).

In order for our students to become critical viewers, we need to teach them some important skills. Cates (1990) has a lot to say about identifying and interpreting biases in movies and television. There are many ways in which filmmakers try to convey hidden messages to the viewer. If students can become aware of these techniques, they can become better critical viewers. These techniques included lighting, dialog, music, character selection, and camera angle. Once students have mastered the identification of these techniques, they are better able to spot them and interpret their meaning.

A study by Zindovic-Vukadinovic shows a dramatic difference in students' ability to read into the codes imbedded in television and motion picture media (1998). In this study, 438 students, 14 years of age, were evaluated based on their ability to recognize visual and cultural codes in cinematic presentations. Zindovic-Vukadinovic states that, "the understanding of the motion-picture and TV pre-supposes the ability to read and understand both groups of codes" (1998, p. 134). However, the study showed a greater tendency for students to understand and decode the cultural and social symbolism as opposed to the visual and special codes. According to Zindovic-Vukaninovic, this could be a result of stereotypes reigning in their environment (1998).

A research study by Abelman and Gubbins clearly expresses the need for critical viewing skills (1999). In this study, the use of television advisory ratings among parents of academically gifted and academically average students was compared. The study found that gifted students watch less television than their classmates and are more likely to watch adult-oriented programs. More alarming was that less than 35% of parents use a television rating system when deciding what their children watch. Furthermore, the majority of parents using the rating system were the parents of the gifted students. These parents were described as high mediators, and their children are the low to moderate television viewers. This means that the parents and children in most need of the television rating system, the academically average students, are the least likely to use the rating

system when selecting appropriate programs (Abelman & Gubbins, 1999). This perceived lack of parental guidance, delineates the need for our students to receive school instruction to help them become independent critical thinkers.

Assessing Critical Thinking

The assessment of critical thinking skills is equally as difficult as defining it. First and foremost, in order to assess critical thinking you need to be able to operationally define it. Edman (2002) tested one method, the Minnesota Test of Critical Thinking II (MTCTII), for validity in a research study. The MTCTII is a test developed by the American Philosophical Association (APA) and consists of 60 multiple-choice questions and 6 open-ended questions. The study concluded that there was a high level of accuracy in the test's ability to identify and evaluate critical thinking.

Rubrics are a simpler method for recognizing and evaluating critical thinking. Although there are many alternative assessment techniques, such as journals and student projects, they are also particularly time intensive for the teacher. Rubrics allow teachers to evaluate critical thinking and problem-solving skills in a quick and accurate manner. The scoring criteria of a rubric gives students a very clear guide to the teacher's expectations. Furthermore, they offer an excellent form of feedback from the teacher, so that students may evaluate their answers and clarify their understandings. Rubrics also allow the teacher to

easily chart change and development from one critical thinking activity to the next (Radford, Ramsey, & Deese, 1995).

Popular Media

Type of Media

According to Semali (1995b), students are more extensively exposed to popular media than ever before and are unequipped to deal with the messages and content. We live in a media driven society that tells us everything we “need” to know, “what” to think, and “what we need.” Semali claims, “Indeed the media, particularly, television has become the nations’ teacher of choice” (1995a, p. 207). Brem (2000) reported that between 60% and 70% of female students acquire knowledge about scientific concepts from the popular media.

More importantly, teachers and parents are not teaching students how to deal with this bombardment of information. Fortuna (2001) notes that 30% of parents and guardians fail to point out inappropriate programming. Further, only 16% of parents discuss commercial content with their children. This is an alarming statistic that means we too often leave our students to fend for themselves when dealing with popular media.

On a positive note, media can be used to increase student motivation and bring education to life. Owen, Silet, and Brown state, “Effective teachers have always been able to create a motivating connection between their subject matter and the students’ s world” (1998, p. 28). Greene (2003) recommends that at the

very least we should expose students to art in various forms. She goes on to explain that movies and television, as a form of art, are capable of bringing historical events alive. Further, these types of media can cause students to form an emotional connection with the material, which creates a much deeper educational experience (Greene, 2003).

Owen, Silet, and Brown offer a plan for teaching television that focuses on three basic principles (1998). First is that we need to address students' preconceived notion that television is just entertainment. Secondly, students must change their viewing habits to become critical viewers. Lastly, once they have developed these critical thinking skills, they will begin to understand the power and consequences television possesses (Owen, Silet, & Brown, 1998).

Science Fiction vs. Science Fact and Science vs. Pseudoscience

Critical thinking skills give us the ability to differentiate between what is and what can be. According to Langford, "We need to hone the skills necessary to differentiate between fact and fiction, examining extrinsic and intrinsic assumptions, remaining focused on the big picture while examining the specific" (2001, p. 19). Fortuna (2001) conducted a survey that found that the majority of students could not differentiate between documentaries and docudramas. Students must first be able to determine what is purposely false before they begin to evaluate media for biases. These statistics show that too many students do not have the ability to even begin the critical viewing process without proper training.

Semali states that a picture taken by a photographer is not necessarily a window into reality (1995a). The picture reflects much more than just the image captured; it is also a reflection of the photographer, the editor, and the viewer. Semali maintains that all media are construction; “The world-view, information and perspective created by both mass media messages and the school curriculum are primarily a construction of reality rather than reality itself” (Semali, 1995a, p. 3). Thus, it is very important that our students be able to formulate their own reality based on their experience and knowledge gained through critical thinking skills.

An article by Morris describes a method for critically analyzing television programs through the use of written program logs (1989). Students record observations about program content in a written log, much like a scientist recording observations of a particular situation. Later the students evaluate their logs and rediscover what familiar programs really contain. They become aware of elements that at first seemed insignificant and listen closely to each others’ observations. Through this method Morris states, “A writer analyzing the sort of commercials that contain rapid simulation of scientific proof note that it ‘is ironic that people accept science but accept it from non-scientists’” (1989, p. 36). These are the types of observations that are critical to help students gain the ability to determine if something is scientifically valid.

Summary

Teaching our students critical thinking skills should allow them to deal intelligently with the popular media. There are a number of methods available for teaching critical thinking, but it appears that we must scaffold our way to this goal. Further, the students also need to be taught how to apply these skills toward examples of popular media. Educators need to help students to develop the ability to watch and read media actively and recognize that media are not just entertainment. Students must realize that the popular media have both cultural and social implications and consequences. We must move our students from absorbers of media, to analytical critics of popular media, through the use of critical thinking skills.

METHODOLOGY

Introduction

In order to understand the scope of this study, the environment in which it was implemented must be examined, as well as the participants who were involved. An examination of the methods that were used to conduct this study is also critical to understanding how the research was conducted. A description of how data were obtained and reviewed is also imperative to the delineation of my research study.

Setting

This study was conducted within the context of an Earth and Space Science curriculum. Specifically, the content being studied during the research period was meteorology and climatology. All materials and activities that were part of this study were integral parts of this curriculum in which all students participated.

This study was conducted in a large high school, approximately 3,000 students, located in an urban area. The study was carried out in a traditional science classroom that has both student desks and lab tables. Each of the six lab tables has a computer with Internet access. Students participated in a variety of activities, and both individual and cooperative work was used in this study.

Participants

The participants of this study were 14 ninth grade Honor level Earth and Space Science students (8 female and 6 male), and the participants were between 15 and 16 years of age. The students come from a wide range of ethnic groups and were equally as diverse with regard to their socio-economic status. The students that attend this high school come from inner city, suburban, and rural environments.

Procedures

Getting Started

My students began the year with an introduction to the scientific method. A working knowledge of the scientific method would be important when assessing examples of popular media for their scientific merit. This eventually led them into the process of designing their honors project, which was an independent scientific experiment that each student conducted (see Appendix A). The scientific method and their experiment were an integral part of developing each student's critical thinking skills.

As I began my research study, each student took a survey (see Appendix B) to determine what their current knowledge base was concerning critical thinking. This survey was followed by two class periods of discussion about critical thinking. During the first period, we discussed what thinking critically was and outlined the major components of critical thinking. During the second

class period, we outlined the steps of how to think critically and had a class discussion that involved some examples. During this time we had a discussion about the differences between .com, .org, .edu, and .gov. We discussed who creates these different types of websites and what that tells us about the validity of the website. We also discussed motivations that affect scientists and their research. We talked about how political, financial, and personal motives affect the validity of scientific research and how it is reported. These two class discussions regarding critical thinking gave my students some background knowledge as well as assessed their prior knowledge. This information created the framework for my study, because now the students were aware of what critical thinking was and more importantly the step of how to begin using critical thinking. The critical thinking skills we discussed during these two class periods were as follows:

Major Components of Critical Thinking

- Perception- This is the way we receive and translate our environment.
- Assumptions- This is the notion that some ideas are accepted as true without proof.
- Emotion- Critical thinkers are able to accept and manage their emotions.
- Language- Spoken and written language has three purposes: to inform, to persuade, and to explain.

- Argument- Good arguments have three basic components: the issues, the reasons, and the conclusions.
- Fallacy- This is reasoning that does not meet the criteria for a good argument.
- Logic- This is considered a method of reasoning out the information we are presented with.
- Problem Solving- This is the ability to create techniques and strategies used to manage information and solve problems.

Major Components of How to Think Critically

- Interpretation- Comprehension and expression of meaning or significance in a wide variety of experiences.
- Analysis- Identification of the intended and actual relationship between statements.
- Evaluation- Ability to assess the credibility of statements and perceptions.
- Inference- Ability to identify elements needed to draw reasonable conclusions.
- Explanation- Statement of one's reasoning making use of sound arguments.
- Self-regulation- Ability to monitor ones cognitive activities.

Next, my students conducted a series of activities designed to develop critical thinking skills by examining examples from the popular media.

Written Material Filters and Leading Questions

I began familiarizing students with the critical thinking filters I designed by asking them to read an article from the local newspaper regarding student dress code at our school. I felt this would be a good topic to start with because I knew the students had a vested interest and felt passionately about the topic. Students read the article and filled out the filter (see Appendix C). This was followed by a class discussion in which the topic was critically assessed. Throughout the course of this study, students were assigned a number of articles to read on various meteorology and climatology topics. Students filled in the filter or responded to Leading Questions for each source read in an effort to move them toward becoming critically literate. Students also worked independently to search for examples of media that could be critically analyzed. For these assignments, the students submitted the media source, as well as a critical critique of media source using the filter.

Visual Media Filters and Leading Questions

A number of different filters and Leading Questions were used to help students to become critical viewers of media. The movies *The Day After Tomorrow* (see Appendix D), *Twister* (see Appendix E), and *The Lorax* (see Appendix F), were used as examples of science fiction movies to be examined

critically as well as act as reinforcements to the meteorology and climatology curriculum. An objective test on the content of the movie, *The Day After Tomorrow*, was also used at this time (see Appendix G). This test was then used as a comparison of student achievement on a basic objective test versus the critical thinking prompts for the movie.

Students also evaluated documentaries, docu-dramas, and news programs for their scientific credibility. Once again, students used a filter or Leading Questions to evaluate media examples, such as *Into Thin Air*, *An Inconvenient Truth*, and *Oil on Ice* (see Appendix H). These media sources were also chosen to augment the meteorology and climatology curriculum.

Group Activities

Through the course of this study, students were guided through an organized debate in which they evaluated and discussed the validity of the evidence supporting the theory of global warming (see Appendix I). Students were divided into two teams, one team defending the position that global warming was occurring as a result of human activity and the other defending global warming as a natural phenomenon. Students researched the evidence for global warming, developed opinions based on the evidence, and then presented this evidence in a formal debate.

Students also conducted a number of experiments and activities designed to reinforce the meteorology and climatology curriculum. During these activities

and while grading these assignments, I made note of signs of critical thinking in both my students' speech and writing.

Surveys and Interviews

Students completed five surveys during this research study. I administered the first survey (see Appendix B) prior to the study to get a baseline for student familiarity with critical thinking and popular media. The second survey gauged students' scientific literacy (see Resources). The third survey (see Appendix J) determined what kind and how much media my students view. The fourth survey (see Appendix K) followed the global warming debate and was used to determine changes in student attitude regarding the global warming issue. Lastly, each student completed an exit survey (Appendix L) and an informal interview (Appendix M) at the conclusion of the research study.

Data Sources and Analysis

Field Log

I used a logbook, in two-column format, to record all my observations and data as I progressed through my study. My field log was an ongoing document in which I recorded my daily classroom observations. The field log also contained all the important data gathered during my study. This field log also contained accounts of student discussions and interview data along with samples of student work. During my research study, I used the left-hand column in my log to record my observations and the right-hand column for recording my observer comments.

During this process, I began reviewing and analyzing my observations and comments. I wrote comments in the margins of my field log that would later become the framework for my indexing codes. These index codes were organized into bins that eventually led me to my theme statements (Ely, Vinz, Downing, & Anzul, 1997).

Student Work

Student work included all activities, worksheets, and media reviews that were completed during this study. These samples of student work were analyzed for signs of critical thinking and became part of my data. I also analyzed student participation in class lectures and discussions about critical thinking. In an effort to quantify some of these data, I made use of a critical thinking rubric (see Appendix N) to evaluate some of the student work.

Surveys and Interviews

All information obtained from surveys and interviews was reviewed and compiled as part of my data. These surveys and interviews aided me in assessing my students' exposure to the popular media and their self-awareness as critical thinkers. Finally data obtained from my surveys and informal student interview provided data on student progression toward becoming critical thinkers.

Summary

This research study developed methods that can be used by all students to increase their critical thinking skills, especially with regard to popular media.

These methods guided students in the direction of critical learning and helped to give them the tools necessary to become independent critical thinkers. I suspect that the skills they learned will be valuable to them throughout their academic and personal lives.

Biases

I realize that I entered into this research with the bias that I believed many students lack the ability to think critically or understand the need for critical evaluation. I planned to teach all students good critical thinking, critical viewing, and critical reading skills, after which I made observations based on their ability to apply this knowledge to works of popular media. I wanted to remain unbiased during this time and simply record what I observed and what my students reported. To make the most accurate report possible of my observations, I collected data in a number of ways. Though the triangulation of data from my field log, student work, and interviews, I believe I have an accurate account of what occurred.

In conclusion, as an action researcher, it was my goal to inform myself with the current research literature, develop sound methods for the implementation of my research question, and remain open to the results. During this time I kept biases to a minimum, so that I would be able to make an accurate record of my observations and be open to the results.

RESEARCHER TRUSTWORTHINESS

As a teacher action researcher, there are a number of points that need to be clarified in order to ensure my trustworthiness and my students' confidentiality. The following steps were taken to ensure that I proceeded in an ethical manner during my research.

To begin my study, I informally interviewed my students with regard to my research question (Holly, Arhar, & Kasten, 2005). In doing so, I hoped to get my students directly involved in my study. I needed for my students to understand what it means to think critically, because they would be reflecting on this idea as part of my study. I believed this interview would not only involve my students, but also educate them as to my research study.

Before I began my research study I drafted a letter (see Appendix O) to the head principal and administration of my school, which explained the scope of my study and requested their permission to conduct the research study. After this approval was obtained, I submitted my research plan to Moravian College's Human Subjects Internal Review Board (HSIRB) for approval. The HSIRB reviewed my research study plan to ensure the safety of my student participants. With a few minor revisions, I received approval for my study from the HSIRB (see Appendix P).

I then distributed a letter (see Appendix Q) to each student during this initial dialog that further delineated the scope of my research study (McLean &

Mohr, 1999). I asked each student to review this letter with his or her parent or guardian. This letter explained to parents how I planned to maintain the anonymity of my students through the use of pseudonyms (Holly, Arhar, & Kasten, 2005). I discussed in the letter that each parent or student had the right to withdraw from the research at any time without penalty. The letter also made it clear that this research study would occur completely within the established curriculum. The letters were signed, granting parental consent, before any student became a participant in my study.

Furthermore, students were informed that they may verbalize their concerns with the guidance department, principal, or myself at any time. They were also informed that they could withdraw from the research study at any time without penalty. All students participated in all activities regardless of their involvement in the study. The students' participation or lack of participation in the research did not affect student grades.

I reviewed all student work in a confidential manner, making sure to protect my students' identities and my data. Data were kept in a locked and secure location. Students did not have access to the research log at any time. All students were assigned pseudonyms to protect their identity. In addition, the key that related the students' real names and pseudonyms was kept locked in a secure location. Research done by Holly, Arhar, and Kasten (2005) supports these techniques.

With regard to student work, I was reflective in my approach to seeking signs of critical thinking. I used a number of data collecting methods, such as, my two-column field log, student work, interviews, and surveys. This broad collection of data enabled me to substantiate my findings through triangulation. This is a method through which a number of different kinds of data will be examined. I also had members of my teacher support group review my data to ensure that I was accurately measuring and identifying the critical thinking of my students (MacLean & Mohr, 1999).

Researcher trustworthiness was very important to me throughout the course of my research study and data collection. I made every effort to maintain myself as an ethical and trustworthy researcher. I also feel that I did everything in my power to ensure the safety, confidentiality, and well being of my students during this study.

MY STORY

This school year started very similarly to past years, but I knew that the next couple of months would be very different from anything I had ever undertaken in my classroom. I planned to challenge my students in an entirely new way and hoped to change the way many of them perceived the information and the world around them. I wanted my students to become active thinkers, instead of passive receptacles absorbing the media's messages without thought.

I found from my pilot study and my review of the literature that students need to be guided and scaffolded toward becoming critical thinkers. My plan was to begin by educating my students about what critical thinking is before helping them to use it. With a working knowledge of critical thinking, I would then start my students along the road to becoming critical thinkers by having them evaluate examples of both written and visual media.

My research and personal experiences have taught me that students need to have structure and guidance in order to become critical thinkers. With my research question, What will be the observed and reported experiences when students apply critical thinking skills to evaluate examples of popular media?, as a guidepost, I set out to develop tools and situations that would lead my students toward becoming critical thinkers.

Before the Storm

Each year I begin the school year with a review of the scientific method. Most students have been exposed to the steps of the scientific method before, but it has been my experience that it never hurts to review this all-important aspect of scientific inquiry. In my Honors Earth and Space Science class, mastery of these concepts is an important part of their success.

All 9th grade honors students must complete an independent research study involving a testable hypothesis. They follow the steps of the scientific method through the course of their study and present their findings at a local science fair to be reviewed in a formal forum. As such, the scientific method becomes an important part of their day-to-day activities as well as their language. I planned to use the scientific method as a starting point and a crucial tool in the implementation of my research study. Students would draw on their knowledge of the scientific method as they began to become critical evaluators of science in the popular media.

It was during the second full week of school that I introduced my research study to the class. I started by explaining to my students that I was conducting a research study of my own, just as they were. I explain to my students what my research question was and how it would impact them. My students seemed to be excited about the fact that I was working on a research project as well. Cindy said, “So you will be working just as hard as we will be, because this honors

project looks like a lot of work.” I said, “Yes, I will, but the end result of my research study will be written up in a book that will be published for anyone to read.” I also made it clear to the class that they would not be doing any more work than any of my other classes, but I would be trying a new way of teaching and observing their class for the results. Chris said, “It sounds cool, we are going to watch movies and evaluate if it is accurate scientifically?” Hank asked, “What movies are we going to watch?” I told the class that watching movies was only going to be a small part of what we were going to do, but when we would watch a movie we would be watching it in a whole new way.

I spent the last part of this class going through the specifics of the consent form. We discussed students’ right to sign or not sign the consent form, and if they did sign, they had the right to withdraw at any time. I made it clear to them that participation in my research study would not affect their grades and reiterated that all my students in all my classes would be doing the same amount of work. This seemed to ease their academic concerns, but they remained excited about the research study and would continue to ask questions about it throughout my study.

The Storm Begins

The following week, when all consent forms had been signed by both parent and student and returned, we began to explore critical thinking in more depth. First, the students completed a survey (see Appendix B) regarding their

familiarity with critical thinking and the popular media. These survey data were used as a baseline for where my students started.

Table 1. *Survey Results*

Question	Average Response
Where would you rate your interest in watching educational science videos? (National Geographic, Nova, etc.)	5.3
Where would you rate your interest in watching science related movies? (Dante's Peak, Day After Tomorrow, etc.)	8.5
How critically do you watch movies? That means you analyze the reality of movies made in Hollywood?	4.9
How much do you think that movies affect people's perception of reality?	7.3

Note. Student responses on a scale of 1-10, 10 being the highest.

The results of this survey showed that most students like educational science movies less than science based Hollywood films. However, the survey showed that most students do not critically view the science based Hollywood movies they watch. Yet, the majority of them do believe that these movies affect people's perception of reality.

After completing the survey we spent two class periods discussing what critical thinking is and how to use critical thinking. It was imperative that if I wanted my students to think critically, they would need to learn as much as possible about critical thinking before I could ask them to use it. The most logical place to start was with a definition of critical thinking. However, critical thinking

is not easily defined and, if you look in ten sources, you will find ten differing definitions.

I explained to my students that at its root critical thinking can be defined as thinking about your thinking. I realized that to the average ninth grade student this would not hold much meaning, I put together eight basic concepts that are accepted as the key components to critical thinking (see Methodology). During the first of the two class periods, we discussed and gave examples of these concepts.

I used the overlying theme of biases to tie these eight concepts together. The eight concepts: perception, assumption, emotion, language, argument, fallacy, logic, and problem solving, all rely on the identification of personal biases or the recognition of bias in others. Even though the students could not correctly define critical thinking, they had no problem defining and identifying with these eight concepts. We went through each concept individually by loosely defining it, describing it, and giving an example or two.

When we discussed the concept of emotion as it related to critical thinking we had the following conversation.

Jen: Emotion is how you feel about something or someone.

Mr. Wolf: How does emotion keep us from thinking critically?

Megan: Sometimes you can get so mad at someone that you are not thinking clearly.

Kevin: Or if you really want something, you don't always see the negatives and you only see the positives. Then when you have it you see that there are negatives and you realize that you did not think it through and you realize it is not as good as you thought it was.

Mr. Wolf: Do these two situations contain biases?

Beth: Yes, Megan's biased by her opinion about the person she is mad at, and maybe not seeing the whole situation clearly.

Megan: I am not really mad at anyone; I was just giving an example.

Beth: Yeah, but if you were actually mad at someone you would not be thinking clearly.

I then asked the class if any of them had ever been mad at someone, but they really were not sure of why they were angry. Three or four hands went up, as everyone looked around the room; then more hands went up until the whole class had their hands raised. I then asked them to think about that situation in the context of critical thinking. There was a long period of silence as the class pondered the question.

Mr. Wolf: Well, if critical thinking is thinking about your thinking, what question should you be asking yourself?

Beth: Why am I mad at this person?

Mr. Wolf: So, if you do not know why you are mad at the person, then what does that mean?

Hank: That means that you have no logical reason to be mad.

Mr. Wolf: Exactly, and that is critical thinking.

I was really excited about how this class period went, and could not wait until the next day. I was surprised and happy about how the student really took hold of the concepts and their willingness to participate in the discussion. It seemed that the students were familiar with the concepts of critical thinking from personal experiences, but they did not know the terminology or how they worked together into the larger concept of critical thinking. The students seemed to be more familiar with implementing these concepts as they pertain to others, but not as a measure of self reflection. Being reflective about one's thinking is the next step in becoming a critical thinker.

The following day, I had planned to expand on the concepts of critical thinking and discuss the components, or steps, of how to think critically (see Methodology). I originally planned to discuss these in the same manner as we had discussed the concepts of critical thinking the day before. However, in light of the great discussion we had the day before, I decided to instead explore these steps through the example we had been discussing the day before.

Mr. Wolf: In our discussion from yesterday, what was the emotion that Megan expressed in her hypothetical situation?

Trisha: She was angry or mad at someone.

Mr. Wolf: This is called interpretation, or identifying the problem. So, the interpretation of this situation is that Megan is mad at someone. Have you ever been mad at someone, but were not sure why? The next step in thinking critically is analysis and evaluation. Why are we mad at this person?

Joey: In your example we do not have a reason.

Mr. Wolf: This is followed by inference, or the ability to draw reasonable conclusions. So, is it reasonable to be mad at someone for no reason?

Bobby: Not really, seems illogical to be mad for no reason.

Mr. Wolf: This is followed by explanation, where you make a statement of your reasoning based on a sound argument. Are we making a sound argument for being mad if we have no reason for being mad?

John: No, we are just mad and we have no logical reason, so we should not really be mad, if we think about it.

Mr. Wolf: Excellent, that is called self-regulation or the ability to monitor how and what we think. So, if we act as critical thinkers in this hypothetical situation, we realize that we have no logical reason to be mad and can adjust our thinking as such.

We looked at a few other examples and reviewed the concepts from the day before, and in the end I felt like the students had a good understanding of critical thinking and how to use these skills. It was now time for the students to try to put their skills to use and critically evaluate some media.

Written Media Filters

The first activity that I chose to engage my students in was to familiarize them with the filter that we would be using to evaluate written media. My research indicated that the most effective method to engage students in critical thinking is to prompt them with some Leading Questions.

With this knowledge, I developed the Written Media Filter (see Appendix C) for the critical evaluation of written material. This filter challenged the students to think about who is writing the article, what their credentials are, and why they are writing the article. It further asks the students to critically evaluate the article for main ideas, opinions, emotion, biases, and the use of data.

In an effort to get my students involved, I chose an article from our local newspaper regarding a new dress code that was being instituted in our school district. While I realized that the topic of this article was not scientific in nature, I hoped that the nature of the article would grab my students' attention and get them engaged in the activity. The district was implementing a rather strict dress code, and I knew that the students had strong opinions regarding this issue. I was hoping to draw on these feelings to get the students to critically evaluate this article.

Dress Code Article

1. Does the author have any affiliations or any credentials? If so, what are they?

No

2. What is the main argument made in the article?

Should teachers have a dress code.

3. What is (are) the problems or conflicts or issues associated with this article?

The problem is that they give a strict dress code for students but why don't the teachers have one.

4. What are the possible solutions/resolutions to these problems or issues?

The board is going to leave it up to the teachers what is professional to wear.

Figure 1. Sample 1 Student Responses to filter questions.

1. Does the author have any affiliations or any credentials? If so, what are they?

NO

2. What is the main argument made in the article?

If teachers should follow a dress code is the main argument made in the article.

3. What is (are) the problems or conflicts or issues associated with this article?

The problems associated with the article are that the teachers do not have to follow a strict dress code, but the students do.

4. What are the possible solutions/resolutions to these problems or issues?

The possible solution to the problem is to let everyone wear anything they want as long as it covers everything, with the exception of face, neck, arms, below mid thigh.

Figure 2. Sample 2 Student Responses to filter questions.

I was correct in thinking that the dress code article would draw on the students' emotions, and they were very eager to talk about the article. However, I wanted them to fill in the filter individually and once they got focused, they did a very good job answering the questions. Unfortunately, we only had about ten minutes of class left to discuss the article, which the students were very passionate about. The students admitted that the Written Media Filter made them think about topics they would not have otherwise considered, especially with regard to thinking about who the author was and what his credentials were.

Next, I wanted to see how the students responded to a piece of visual media. I was also interested in their responses on the first survey when I asked them to define science fiction. It appeared that they did not have a good understanding of what constituted a science fiction film.

Sample student definitions of science fiction

Little aliens and X-men and stuff like that!

Based on science ideas or possibilities but not true.

False things in the field of science.

Aliens!

Fake science stuff.

A science related thing that is false.

The fake science kind of like stuff.

Since I planned to use a clip from the *Jurassic Park* movie to make a point during a lesson on the history and evolution of the Earth's atmosphere, I also took this opportunity to use it to address the idea of science fiction. *Jurassic Park* was the perfect choice for this lesson because it exemplifies science fiction. It starts with real scientific facts and theories, cloning, and then evolves into the realm of that which we are not yet able to do, clone dinosaurs. We had a class discussion about the definition of science fiction and why we are not yet able to clone dinosaurs, which was followed by the movie clip.

***Jurassic Park* Movie Clip**

I used a clip from the first *Jurassic Park* movie to illustrate how we obtained verification of the composition and evolution of the Earth's atmosphere. There is a very good close-up view of a piece of amber, fossilized tree sap, during the movie. The amber has a mosquito and some air bubbles trapped inside. In the movie, the scientists are extracting the DNA of dinosaurs from the blood of the mosquito. The movie clip discusses the method the scientists used to clone dinosaurs in order to make the Jurassic Park that gives the film its name. I wanted to see if my students were able to ignore the information regarding DNA and see the pertinent information, the air bubbles. This was the first time we looked at an example of visual media, and instead of using a filter I prompted the students with a Leading Question to consider.

Mr. Wolf: Ok, how did scientist figure out the make-up of past atmospheres?

Beth: From DNA

Mr. Wolf: How can DNA answer the question of the composition of past atmospheres?

Beth: I don't know, but that is what the video clip was about.

At this point the class was stumped, so I backed the video up and paused it on the scene that had the close up shot of the piece of amber.

Mr. Wolf: What do you see?

Bobby: A Mosquito.

Mr. Wolf: Good, but what else?

Cindy: Oh, there are bubbles.

Mr. Wolf: Good, and what is in the bubbles?

Cindy: Air from when the amber was formed?

Mr. Wolf: Correct!

Mr. Wolf: If amber is only a few thousand years old, where did we get air samples from that are millions of years old?

Trisha: From old rocks?

Mr. Wolf: Good, but it is hard to see bubbles in rocks, think about something transparent.

Cindy: From water?

Mr. Wolf: Close.

Cindy: Frozen water, ice?

Mr. Wolf: Good, now we have the answer!

This was an important conversation, because it was essential that my students had a firm understanding of science fiction. In addition, I wanted my students to get used to seeing more than just the surface information in any given example of popular media. These two skills would be critical skills throughout my research study.

Introduction to Global Warming Debate

The next activity I introduced to my students was to be the largest assignment they would be engaged in over the course of this study, and almost all other activities would be born of this larger concept. When I was developing this study, I was looking for a theme that would be both integral to the Earth and Space Science curriculum and inherently controversial. Since I typically start the year with meteorology and climatology, I chose to have my students investigate the theory of global warming. Not only can all topics in meteorology and climatology be taught by investigating global warming, it is a perfect controversy fit for my study. There is also an almost unlimited supply of media, both written and visual, about global warming to support our inquiry.

I decided to have my students conduct a debate (see Appendix I) on the merits of the global warming theory. This would end up being the umbrella assignment that would hang over and be supported by all the other assignments.

I started class by asking the students how many of them had heard of global warming. Every one of my students put their hands up. I then asked how many of them had heard that the human race was causing global warming. Again, every student put his or her hand up. “How are we, people, causing global warming,” I asked? Students offered ideas, such as pollution from cars, factories, and aerosol cans. I asked if there were any other causes that they could think of, and no one had any more ideas.

I then explained that global warming was a theory, not a fact. Furthermore, scientists do not agree on the causes or consequences of global warming. One theory is that man is causing global warming by creating pollution. However, there is a competing theory that global warming is the result of natural events. With this information, I told the class that we would be breaking up into two teams and debating this issue. One team would represent the scientists who believe that man is causing global warming and would be called the Tree Huggers. The other team would be called the Black Smokers and would have to prove that global warming is a natural event and has little or nothing to do with the activities of man. The class really wanted to have the teams divided up so that it was the boys against the girls. I said that would be all right, but I wanted to choose the roles randomly. So I flipped a coin, and the boys would represent the Black Smokers, and the girls would be the Tree Huggers. Once the boys realized they were the Black Smokers, the complaints started.

Hank: This is not fair, because everyone knows that man is causing global warming.

Chris: Yeah, the girls got it easy.

Joey: We are definitely going to lose.

Bobby: Are we going to lose points if we lose, or do we get points for trying?

Mr. Wolf: It is a debate, so if you debate correctly and present your findings you could lose the debate and still get full credit.

Hank: Yeah, but we already know the girls are going to win, so what is the point?

Mr. Wolf: OK, think about this, 12,000 years ago there was a glacier about a mile thick just a few miles north of the Lehigh Valley.

Hank: Yeah, so?

Mr. Wolf: Is the glacier there now?

Hank: No.

Mr. Wolf: Where did it go?

Hank: I guess it melted after the ice age was over?

Mr. Wolf: So it had to warm up on Earth for the glaciers to melt right?

Hank: Yeah.

Mr. Wolf: Well, was man burning fossil fuels 12,000 years ago? Were cavemen driving around in SUVs while they were hunting woolly mammoths?

Hank: No, oh I see. So, it's not our fault!

Mr. Wolf: That is what we are going to have a debate to find out.

It was really interesting to see how the boys' feelings changed on the debate once they realized it might not be a clear-cut issue. They got really excited about the idea of beating the girls, especially since they viewed their side as the tougher of the two. Almost instantly there was a sense of a friendly competition in the class, and our project had officially started.

The Research Begins – Using Filters

Over the course of the next month, my students were working independently to gather knowledge and data regarding the theory of global warming. The students were all looking for different kinds of information, depending on what their role was in the debate and what side of the debate they were on. During this time we discussed the need to review the information they were finding for validity, which included finding a second source that verified the information and data found in the first source. We also began the process of assimilating the information they were finding in an effort to develop and support their opinions as well as set the foundation for a good argument.

Scientific Literacy Survey

At this point I had my students fill out a survey to gauge their level of science literacy (see Resources). My students responded as follows:

Table 2. *Scientific Literacy Survey*

Survey Question	Survey Response
1. Can you identify the scientific issues underlying personal and societal decisions?	Sometimes
2. Are you able to express your views on those issues in appropriate scientific terms?	Sometimes
3. When you evaluate the quality of scientific information, do you consider both its source and the methods used to obtain it?	Rarely
4. Do you feel you make and evaluate arguments based on evidence and apply conclusions from such arguments appropriately?	Sometimes
5. Do you ask questions about what makes you curious and find the answers to those questions?	Rarely
6. Do you read and understand articles about science in the popular media?	Rarely
7. Do you discuss with peers the validity of the conclusions in such articles?	Rarely
8. Can you distinguish between what is and what is not a scientific idea?	Rarely

This survey indicated that the majority of my students do not consider themselves scientifically literate. The critical thinking filters that my students completed

were designed to move them toward critical literacy. This would be accomplished by forming questions that encouraged the students to think critically and to be reflective on science topics in the popular media.

In an effort to help the students get started with their debate research, I assigned them to find an article regarding global warming that supported their position in the debate. In addition, they needed to complete the Written Media Filter (see Appendix C) or News Article Filter (see Appendix R) for their article. This was the first time they completed the filter for a piece of scientific media. The students did a great job in evaluating their articles through their answers to the questions in the filter. The students admitted that it was difficult and a little time consuming, but that it made them think about things they would not have otherwise considered.

The students were assigned a number of these filters to complete throughout the course of the study. Sometimes I allowed the students to choose the article, with certain criteria to follow, and sometimes I assigned them articles that I felt would challenge their critical thinking abilities. For example, I assigned the students an article about the censorship of global warming articles in mainstream journals.

One student selected and critically evaluated an article about what can be done to stop global warming. Using the Written Media Filter, the student examined and wrote about possible solutions to the global warming issue (see

Figures 3 & 4). The filter also prompted the student to examine the advantages and disadvantages of each of these possible solutions. This critical analysis and evaluation of the solutions to global warming presented in the article led the student toward becoming a critical thinker.

The assigned article about the censorship of global warming articles in scientific journals clarifies the need for critical thinkers to be aware of perceptions and assumptions. When a student responded to the filter questions about this article, the student became aware that there might be alternative opinions about global warming, but those opinions may not be in the public spotlight (see Figures 5 & 6). Teaching students to become critical evaluators of media reinforces the need for students to recognize that the popular media should not be used as the definitive source of information.

Global Warming Article Filters

Name [REDACTED] Date _____ Period _____

News Article

- Find a science related article in the newspaper or from an online news site.
- Cut out the article or print it, depending on the source.
- Read the Article!
- Answer the following questions regarding your article.
- Attach your article to this page and turn it in!

Article Title: Stopping Global Warming Starts Here

Article Topic: Global Warming

Name of publication: New Hampshire Public Interest Research Group

Date of publication: 9/27/05

Author(s) _____

Questions

1. Does the author have any affiliations or any credentials? If so, what are they?

No

2. What is the main argument made in the article?

Global warming is a serious problem, yet there are methods of reducing it.

3. What is (are) the problems or conflicts or issues associated with this article?

The Bush Administration's "lack of attention" paid to global warming issues, i.e. its threat to the environment, to public health, and also the many methods that could be used to reduce it.

4. What are the possible solutions/resolutions to these problems or issues?

→ Cutting CO₂ emissions from power plants
 → bring clean energy sources to U.S. (decrease fossil fuels)
 → adopt a clean cars standard to bring 0-emission vehicles
 → stand against energy industry attempts to break laws. ^{in.}

5. Does the author use data in the article? If so, what is it, and where does it come from?

Scientists of Searkey Island → sea level rises 1 1/2 ft. _{2100.}

Figure 3. Front of New Article Filter, Global Warming Article

Name _____ Date _____ Period _____

News Article

6. What evidence or proof or support is offered by the author?

- States that warmest years occurred in last ten years
- Transportation cause of global warming pollution
- All ways NH environment shall be affected
- NH's direct power plant emissions have increased 35%

7. What possible biases or controversies are related to this article or author?

- Quite biased toward Bush administration
 - not realizing America's extreme dependency on fossil fuels
- From New England, very environmentally-minded

8. What are the advantages and disadvantages of this issue?

Advantages

- explains the causes, effects and solutions of global warming

Disadvantages

- only in NH, not global level

9. What is the best solution to this issue, and why?

I believe that because transportation is the main source of CO₂ emissions, the best answer would be to pass a clean car act.

10. My opinion on this issue is?

I don't think its right for the author to pile the blame on to the Bush Administration, but I do like the ideas for the solution to this serious problem.

11. The following information supports my opinion.

The whole of America is responsible, and considering the coverage it receives in the media, they all know it is a problem, so the Bush Administration (though not focusing as much energy as needed) are not to be blamed. The author explains real answers to this very real problem, one that will take centuries to overcome

Figure 4. Back of New Article Filter, Global Warming Article

Name _____ Date _____ Period _____

News Article

- Find a science related article in the newspaper or from an online news site.
- Cut out the article or print it, depending on the source.
- Read the Article!
- Answer the following questions regarding your article.
- Attach your article to this page and turn it in!

Article Title: Leading Scientific Journals 'are censoring debate

Article Topic: Global Warming

Name of publication: Telegraph Group Limited

Date of publication: 1/05/2005

Author(s) Robert Matthews

Questions

1. Does the author have any affiliations or any credentials? If so, what are they?

No

2. What is the main argument made in the article?

That leading scientific journals are biased against research which proves that climate change is not anthropogenic.

3. What is (are) the problems or conflicts or issues associated with this article?

→ anti-global warming scientists aren't getting papers published
 → false information read by the public due to government response
 → journal spokespeople deny it

4. What are the possible solutions/resolutions to these problems or issues?

Perhaps publish your own journal; expose the journals in national media

5. Does the author use data in the article? If so, what is it, and where does it come from?

No

Figure 5. Front of New Article Filter, Global Warming Article

Name _____ Date _____ Period _____

News Article

6. What evidence or proof or support is offered by the author?

He gives the scenarios of several scientists whose research on same topic wasn't published

7. What possible biases or controversies are related to this article or author?

The article doesn't truly represent the journals' views.

8. What are the advantages and disadvantages of this issue?

Advantages: The majority of climatologists do not support anthropogenic global warming

Disadvantages: Public is being given false information

9. What is the best solution to this issue, and why?

I believe the public needs to be informed of the causes of global warming because if fossil fuel emissions are banned then money will be lost.

10. My opinion on this issue is

I will believe the majority of climatologists w/ the most info on the issue, and I need to know more about journal's reasons before making my decision. (though as of now, I am against their actions)

11. The following information supports my opinion.

- Less than 1 out of every 10 climatologists support human-induced global warming

Figure 6. Back of New Article Filter, Global Warming Article

The Day After Tomorrow

The movie *The Day After Tomorrow* was a piece of media that I used and referred to throughout my study. Not only was this a popular movie, but it also was a controversial movie within the scientific community. Hollywood did a great job of taking a natural disaster and sensationalizing it to sell tickets. The popular media hyped it as more of a documentary than a science fiction film, which it was. The scientific community scrambled to get the message out that the movie was a ridiculous, improbable, worst case scenario of the effects of global warming. I wanted my students to study the movie and apply their knowledge of global warming to develop their own opinion supported by facts.

When I first informed my students that we were going to watch portions of *The Day After Tomorrow*, they were excited. I asked how many of them had seen the movie before and three hands went up, but I sensed they were not being honest. I told them we were still going to watch it even if they had all seen it before because we were going to watch it in a whole new way. Following this statement, all but three hands went up. I told them I was glad that so many of them had seen it before, and they could spend less time thinking about the plot and more time thinking about the science. This is when I started to get the blank looks.

Mr. Wolf: Of the students who have seen this movie before, who can tell me what it is about?

Joey: It is about the world ending.

Mr. Wolf: OK, what else is the movie about?

Kevin: It is about how global warming destroys the Earth.

Mr. Wolf: Good, but how does the movie end?

Joey: With the whole world covered in snow, except Mexico. Well, I guess there were some other places too, but basically all the big countries were covered in snow.

Mr. Wolf: What do we call it when the majority of the Earth is covered in snow and ice?

Megan: An ice age.

Mr. Wolf: Right, so the Earth as we know it ends in an ice age.

Mr. Wolf: Kevin, what did you tell me the movie was about?

Kevin: Global Warming, I thought.

Mr. Wolf: So, the movie is about global warming. Someone tell me what global warming is.

All hands go up, which is a good sign because we have been talking about global warming for about a month.

Beth: It is when the Earth heats up over time because the greenhouse effect gets all out of whack, because we are polluting the environment.

Mr. Wolf: Good, so the movie is about the Earth heating up due to global warming, but how does the movie end?

Joey: Yeah, it ends in an ice age. It gets really cold in the movie. That does not make any sense. I saw this movie about 30 times on HBO, but I never thought about that.

Chris: So, basically the movie is garbage? Is that what you are saying?

Mr. Wolf: I did not say that. All I am saying is that I want you to think about the movie and come to your own conclusion. But I want you to think about if the movie is about global warming, why it ends in an ice age. Keep that question in the back of you head as you watch the movie.

This was a great conversation, and I really felt as if I had opened their eyes to something that was right in front of them that they had never seen before. Instead of using a filter, I gave the students four Leading Questions that would hopefully focus them on the science that is presented in the movie. These four questions (see Appendix D) would help them explain why the movie ends in an ice age.

Through the exploration of these four Leading Questions, my students were able to analyze the scientific validity of the information presented in the movie. This created a situation that allowed the students to make inferences about the movie. The ability to make inferences is a very important step in the critical thinking process that is clearly exemplified in these essays (see Figures 7,8,9, &10). The students' writing clearly demonstrates their ability to tell fact from fiction, based on their scientific knowledge of global warming.

Day After Tomorrow Essays



Earth and Space 9

2 November 2006

The Day After Tomorrow

Of course it can happen! Warming temperature are weakening the ice caps, making the outer portions to break off. It will affect the levels because the ice will put more mass in the ocean and more mass means it needs more room so sea levels will rise.

I'm sure if the ocean becomes extremely unbalanced in salinity or temperature it could affect this current. I know, if the current is screwed up, there will be different climate in certain areas but I don't know for sure if it can cause big natural disasters, in fact I doubt it.

I do not believe it will happen so quickly and all in one storm. It will take years for the setup of such storms to occur and, even still, they will not be as big as shown in the movie. It will also take many big storms, not just one gigantic storm, to tear a whole major city to shreds like in the movie.

Right not such knowledge is not confirmable, but right now anything could happen to this planet. The effects of global warming could come and many different ways at many different times or just all at once. Nobody really knows for sure. The fact that another ice age can come is a possibility just as much as the planet getting really warm. This is just too unpredictable.

His evidence for his conclusion is that the ice age actually happened in the movie. He had some sort of weather model that showed the temperature patterns in the past that showed the ice age coming. His hypothesis makes sense for the present day but, again, nobody really can predict the outcome of global warming. The only sure fire way to prove him right was to experience the ice age and by then it would be to late.

Figure 7. Sample Day After Tomorrow Essay.

[REDACTED]
Honors Earth & Space

[REDACTED]
1 November 2006

The Day After Tomorrow Discussion

The Day After Tomorrow is one of the most recent examples of a science fiction movie—heavy on the fiction. Yet, certain aspects of the movie do make some scientific sense. The collapse of ice shelves is expected if global warming should happen, considering the lubricant provided by melt water. Obviously, a rise in sea level would be unavoidable because of the added water of the melted glacier. Another aspect is the shutdown of the North Atlantic “heat pump,” which is the basis of the entire movie. Though the shut down is not likely, it would produce a climate change in the North Atlantic area, seeing as it is a source of some heat. These facts of the movie certainly do not outweigh the falsehood.

The main inaccuracy of this film would have to be the time span. When climatologists predict the climate’s future, they speak in years, not days; the effects of global warming would take more than ten days to ensue. Plus, a massive freeze is not possible for the North Atlantic current is not the main heat factor of Europe and North America. Lastly, the conclusion that Dennis Quaid makes pertaining to the next ice age is supported by the pattern of ice ages in the past, yet it doesn’t make sense for the North Atlantic current is not significant enough to cause this ice age.

Figure 8. Sample Day After Tomorrow Essay.

[REDACTED]
[REDACTED]
Honors Earth and Space Science

31 October 2006

The Day After Tomorrow Questions

The Day After Tomorrow, the movie that Hollywood has so kindly created, describes the potential effects of global warming if supposedly caused by humans. If global warming were to occur many things would occur and many others would not. Both were depicted in the movie in mind boggling scenes with stupendous effects.

The movie shows events of a massive moving glacier collapsing all of a sudden, which in reality could perhaps happen, for increased temperature would shift the ice. Furthermore, the movie also talks about how the North Atlantic heat pump, if global warming continued would cause climate changes. If the heat pump is heated up even more then this causes surrounding areas to become heated up as well therefore causing more hurricanes and other natural disasters. Moreover, the climatologist, Dennis Quaid concludes that an ice age will follow our global warming from a pattern, which would make his hypothesis reasonable.

In addition, many scenes of the movie are not real such as the tornadoes of Los Angeles and the storm surge of New York. This could eventually happen, but not in the time frame given by the movie directors. The same applies to the massive freeze across the Northern Hemisphere, eventually perhaps this would happen, but not in the allotted time frame.

Therefore, Hollywood big directors of the blockbuster hit, *The Day After Tomorrow*, have used reasonable and some tweaked scenes for the movie. Such are real scientific reasons and theories, while others are just exaggerated scenes to make some big bucks.

Figure 9. Sample Day After Tomorrow Essay.

Honors Earth and Space

1 November 2006

The Day After Tomorrow

Viewers of this movie need to keep in mind that this is a science fiction thriller, not a documentary. Sure some events could happen. For instance, collapsing ice shelves in Antarctica is possible. In fact, the Larsen-B ice shelf has already broken off the continent and collapsed. Events like this can cause an unsafe rise in sea levels. Changes in sea level could bring more severe storms such as hurricanes or flooding. Even the shutdown of the North Atlantic heat pump is possible. It can't happen anytime soon, but data shows the heat pump has slightly changed during the era of warmer temperatures. This means it really could shut down sometime, but scientists agree that it couldn't cause another Ice Age. Throughout the movie, viewers become familiar with Hollywood's over exaggeration on global warming. The idea that tornadoes could whip through the entire United States in just a matter of a few days is not realistic. Events this severe occur over a 20-year period. Movie producers put these events within a week time frame to keep the movie on pace. Also, the movie depicts a massive freeze from Europe striking the northern U.S. According to scientific belief, the weather in northern U.S. is caused by Canadian air masses, so it's impossible for the North Atlantic to have this effect on the U.S. Another thing, Dennis Quaid says in the movie that the events caused by the shutdown of the North Atlantic heat pump are the beginning of another Ice Age. This

Figure 10. Sample Day After Tomorrow Essay.

Following the completion of these essays, I had my students take an objective test regarding the movie. The test was composed of 25 multiple choice questions that referred to the characters and the plot of the movie. This objective test required no critical thinking, and was used only to compare the scores from the written responses to the critical thinking prompts (see Table 3).

The results from this comparison showed that the students scored much better on the objective test. Even though this test contained questions about very unimportant scenes from the movie, the students retained and recalled the plot and character descriptions 72% of the time, compared to their ability to answer the critical thinking questions only about 52% of the time.

Popular Media Survey

I conducted a survey (see Appendix J) to find out the kind and amount of popular media that my students were subjected to. I particularly wanted to find out if my students were reflective of some of the numbers I had come across in my research with regard to how much media students are exposed to. I was also very interested to find out what kind of media my students use and why they use it (see Table 4).

Table 3. *The Day After Tomorrow Scores.*

Student Name	Objective Test Score	Critical Thinking Score
Tina	96%	50%
Jen	52%	50%
Hank	60%	50%
Megan	60%	50%
Katie	68%	50%
Cindy	92%	75%
Kevin	64%	50%
Chris	76%	50%
Penny	68%	50%
Beth	84%	75%
Trisha	64%	50%
Bobby	72%	50%
John	64%	25%
Joey	88%	50%
Class Average	72%	52%

Note: This is a comparison of objective test scores with critical thinking scores.

Table 4. Popular Media Survey Results.

Question	Average Response
	Often, Occasionally, Rarely, Never
How often do you read the newspaper?	Occasionally
How often do you read books?	Occasionally
How often do you read magazines?	Rarely
How often do you go to the movies?	Occasionally
How often do you watch movies at home?	Often
How often do you go to popular music concerts?	Never
How often do you go to classical concerts?	Never
How often do you go to theater presentations?	Never
How often do you purchase music on CD?	Rarely
How often do you listen to radio?	Often
How often do you listen to public radio?	Never
How often do you watch television?	Often
How often do you watch Public Television?	Rarely

This survey indicated that my students are frequently exposed to a lot of different types of media. In fact, my students reported that they watched on average almost five and a half hours of television a day, which means that they are watching television during most of the hours that they are at home. Another

important observation was that most students are not or only occasionally exposed to public television and radio.

Oil on Ice

Oil on Ice is a documentary that outlines the positive and negative consequences of drilling for oil in the Alaskan National Wildlife Refuge. The movie explains in detail what the negative effects of drilling for oil would be on the native peoples, the wildlife, and the environment. The documentary contrasts this with the need for our country to become energy self-sufficient, in order to preserve our national security. These two powerful topics collide in this well done documentary, which presents the facts but leaves the viewers to draw their own opinion.

I wanted my students to watch this documentary and think about this topic within the context of global warming. I asked my students to write an opinion paragraph regarding the topics presented in this movie. I was hoping that they would form an opinion and be able to defend it with a well formed argument. I was also hoping that they would make connections between the need to drill for oil in Alaska and its impacts on global warming.

Student essays continue to show the increase in their ability to use critical thinking skills (see Figures 11,12,&13). Specifically, in these sample paragraphs the students are clearly showing their ability to evaluate and make inferences. Furthermore, by requiring them express themselves in the form of an opinion

essay I was attempting to develop their ability to use their explanation skills.

Explanation is the critical thinking skill that enables a student to form valid arguments based on sound opinions. After viewing the *Oil on Ice* documentary, my students were educated in the advantages and disadvantages of drilling for oil in Alaska. This enabled them to compare and contrast all the pertinent variables. As a result, they were able to form their opinions based on the environmental, economic, and cultural implications of drilling.

Oil on Ice Essays

Drilling [REDACTED]

I believe we should not even go near that Alaskan reserve with the word "drill" in mind. In fact, **NONE** of Alaska should be drilled. It is not a lifeless tundra, it has a delicate eco-system that we should enjoy, not tamper with. Our government just wants money, and the oil pumped there will give them that. The oil won't benefit anyone in the US, it mostly gets shipped to Japan and elsewhere. It's not worth it at the cost of the wildlife living there. Bush and his lackys should stop trying to ruin this earth for generations to come.

Figure 11. Sample student response for the *Oil on Ice* documentary.

[REDACTED] Video - Oil on Ice pd. 5/6 10/24/06

I don't think America should drill for oil in the Arctic Wildlife Refuge. We know that the oil will run out eventually, so I don't understand why we would just post-pone the inevitable at the cost of destroying important habitats that do have a good chance at survival. Its like America is fighting to delay an oil shortage at all costs, even by disrupting the life of many Alaskan species. There isn't even that much oil up there. There is no need for more oil, but there are needs for either more efficient uses for oil, or alternate energy sources all together.

Figure 12. Sample student response for the *Oil on Ice* documentary.

[REDACTED]
Honors Earth and Space Science
[REDACTED]

29 October 2006

Oil on Ice

To drill, or not to drill, that is the question concerning the Arctic National Wildlife Refuge. There is oil in this refuge that could make a profit for America, but it is not possible to drill for oil without harming the refuge's environment, which would cause problems for the animals and the Gwich'in Indians who occupy the land. This area of land is one of the only places in Alaska that has not yet been subject to drilling for oil, and there is supposedly a nice amount of oil under the refuge. I do not think that they should drill in the refuge. The indigenous people and the animals will have to find new places to live, and some of the animals are not common, which could cause their extinction if the drilling occurs. This land, which is irreplaceable, will also be ruined if the drilling takes place. All across the world, we are endangering different species and ruining environments, and we need to stop. Just because we will be able to make a profit off of this oil, we still should do anything we can to avoid it. I am glad that I saw this video. It was a very informational video and made me aware of what we are doing to make a quick buck. The movie was well put together and really put an impact on me. I hope that our country will make the right decision and say no to drilling in the Arctic National Wildlife Refuge.

Figure 13. Sample student response for the *Oil on Ice* documentary.

After my students finished their opinion paragraphs, I assigned them to read an article about an oil spill that occurred as a result of the conflict in Lebanon. The *Oil on Ice* documentary described the Exxon Valdez catastrophe rather graphically, and I know it impacted the students. However, I also realized that my students do not have a direct connection with this oil spill because they are too young to remember it happening. However, an oil spill just occurred this year off the coast of Lebanon as a result of Israeli air strikes on Lebanese power plants, causing 15,000 tons of oil to spill into the Mediterranean Sea. This current oil spill is described as worse than the Valdez spill, but it is not getting the same amount of publicity in the United States. Students read this article and completed the Written Media Filter.

One student's responses to the Written Media Filter, continue to show the development of critical thinking skills (see Figures 14 & 15). In this sample, the student's writing clearly shows that she is viewing the use of fossil fuels beyond the consequences of burning them. The student is able to acknowledge that the transportation of oil can have the same catastrophic implications as the mining or burning of fossil fuels. This fact becomes part of her defense when forming a logical and valid argument against the use of fossil fuels.

Lebanon Oil Spill Article

Name [REDACTED] Date 10/16/06 Period 6

News Article

- Find a science related article in the newspaper or from an online news site.
- Cut out the article or print it, depending on the source.
- Read the Article!
- Answer the following questions regarding your article.
- Attach your article to this page and turn it in!

Article Title: Environmental 'crisis' in Lebanon

Article Topic crisis in Lebanon

Name of publication: BBC News

Date of publication: 7/31/06

Author(s) Richard Black

Questions

1. Does the author have any affiliations or any credentials? If so, what are they?
Richard Black does have credentials considering he is the Environment correspondent for BBC News.
2. What is the main argument made in the article?
How our oceans are becoming filled with oil and the amount in the ocean continues to increase.
3. What is (are) the problems or conflicts or issues associated with this article?
Some oil settles at the sea floor threatening tuna spawn area. Prevent turtles from making it the ocean after they hatch. Basically threaten all marine life.
4. What are the possible solutions/resolutions to these problems or issues?
STOP USING OIL or at least stop transporting it by ship. We could also study better ways to run things, that way we don't have to worry about oil spills.
5. Does the author use data in the article? If so, what is it, and where does it come from?
He use numbers and compares them to different years, Not only that but he also quotes people he interviewed.

Figure 14. Front of New Article Filter, Lebanon Oil Spill

Name _____ Date _____ Period _____

News Article

6. What evidence or proof or support is offered by the author?
He talks about different oil spills and how much oil they put in the ocean.
7. What possible biases or controversies are related to this article or author?
There are controversies between environmental groups and oil companies.
8. What are the advantages and disadvantages of this issue?
There really aren't any advantages to oil spills. A disadvantage would be that it is endangering marine life.
9. What is the best solution to this issue, and why?
The best solution for this issue would take more precaution when shipping oil and study ways to run things more efficiently.
10. My opinion on this issue is?
My opinion on this issue is that we need to cut back on our oil use because animals are more important. We use too much oil! Almost every oil spill dumps at least 38,000 tons into our ocean.
11. The following information supports my opinion.
10,000 tons of heavy fuel escapes damaged ships, and spillage from the Exxon Valdez was a little under 40,000 tons of crude oil.

Figure 15. Back of New Article Filter, Lebanon Oil Spill

The Debate

Armed with the knowledge from a minimum of ten articles, three documentaries, and a full length feature film about global warming, my students were ready to debate the theory of global warming. The boys in the class represented the Black Smokers and presented global warming as a natural phenomenon. The girls in the class represented the Tree Huggers and showed that the actions of mankind are responsible for global warming.

During the debate each team presented its findings regarding the three Leading Questions (see Appendix I). For each question, there was an opportunity for each team to present opinions and rebut the opposition. Both teams did a good job of presenting their data and opinions. The students presented the majority of salient topics and information pertinent to each question. As a class, however, they struggled with the rebuttals, which required them to formulate opinions and arguments very quickly. Another observation that I made was that the students presented most of the key ideas, but they did not seem to grasp the larger picture of how it all fits together.

During the debate, the Tree Huggers won the question regarding how carbon dioxide and global temperature have changed over the last 100 years. The teams split the decision on question number two, regarding the causes for global warming. Finally, the third question about the impacts of global warming was won by the Black Smokers. At this point in the debate, the teams were tied and I

decided to base the winner on whichever team won the closing statement. The overall victory went to the Black Smokers because they presented the best defense and summary of the debate in their closing statement. Individual student scores for the debate according to the critical thinking rubric are as follows:

Table 5. Debate Scores

Student Name	Rubric Score 1-4
Chris	4
Megan	3
Cindy	3
Jen	2
Katie	2
Joey	2
Kevin	2
John	2
Penny	2
Beth	2
Trisha	2
Bobby	2
Tina	1
Hank	1
Class Average	2.1

Note. Debate scores with rubric from 1-4.

Debate Exit Survey

Following the debate, my students completed an exit survey used to elicit their ideas and feelings about the debate. According to the survey, before the debate an overwhelming majority of students stated that they did not care about global warming. Following the debate, they rated the issue of global warming as very important. Before the debate, the majority of the students also felt that man was responsible for global warming, and after, they felt that man and nature both played a role in global warming. The most important observation for me was that my students' opinions changed based on their research, and that was my goal. I wanted my students to evaluate the issue and come to their own conclusions. I wanted for them to go through the steps of critical thinking and come to a conclusion that they could effectively defend. Through the use of this debate, I feel that is exactly what happened.

One other interesting response to the debate survey was that the class ranked how much they enjoyed this activity as 3.2 out of 10, indicating that the majority of the class did not enjoy this activity and indicated that the reason was they felt that it was very difficult. However, the class ranked how much they felt they learned during this project as 8.6 out of 10. So, while they indicated that they did not enjoy the project because they felt it was difficult, they learned a lot through this process.

The Lorax

After completing the global warming debate and concluding our class work on climatology, I wanted my students to watch Dr. Seuss' *The Lorax*, a fictional story about the Lorax who is a creature on a quest to save the world from the pollution of a factory. This story draws a number of parallels to society's manufacturing ventures and its impact on the environment. The students were prompted with a number of statements (see Appendix F) to draw connections between the movie and modern society.

The student responses to the Leading Questions I prompted them with prior to watching the movie show the students' ability to empathize with the characters in the movie. Their responses also show an ability to connect this fictional story with real world events and issues. In addition, the students' writing shows an ability to identify their individual impact on the world and recognition of their role in climate change. These are important and powerful steps in students' ability to see the world from other perspectives, which is an extremely important step in becoming a critical thinker. The pastiche graphically displays some of their responses (see Figure 16).

The Lorax

Unless society pulls together and takes a stand

The products being made in the factory that
are polluting the air are in high demand

Corporate executives are caught up in all the
competition and money making

It was "the need" for the fish, birds, and little squirrel-like
fellows that also needed those trees to live

A little littering here and there by millions of people which
accumulates into a massive hunk of garbage

Unless you come to your senses and plant more trees
then the land will never be the same

They think oh its only a few trees there are plenty more,
but if every person thinks the same thing the pretty
soon we will have no more trees

When someone cuts down a tree and gets away with it,
it gives everyone else an excuse to do it as well

Once the last truffula tree was cut down and the last
thneed was made, the need for thneeds ended

It is inevitable and most likely unstoppable
The cutting down of the trees

They do that small thing over and over, it becomes
a big problem but they don't think so

Figure 16. The Lorax Pastiche

An Inconvenient Truth

Following our studies of meteorology and climatology, I was ready to begin wrapping up my study and moving on to the next topic within my curriculum. However, the high point of my research study was about to happen. A few days after watching *The Lorax*, John came into class and asked if we could watch Al Gore's new documentary, *An Inconvenient Truth*. I told John that I was aware that Al Gore had made a documentary about global warming, but that I did not think it was available yet. Hank spoke up and said, "Yeah that looks good, I saw it was coming out soon." One student asked if we were talking about the Vice-President Al Gore, and if so why he had made a movie about global warming. John said, "Al Gore is a big environmentalist and global warming is something that he feels passionate about."

I was totally amazed by this conversation, because not only were the students having a very educated discussion, but they really seemed interested and curious. I told the class I would find out when the movie would be available and we would make time in our schedule to watch it. I looked it up and the movie was going to be available in two weeks. So, I bought a copy of the movie the day it came out and planned to watch it in class the next day. I previewed it the night I bought it and knew my students were going to love the movie not only for the content, but also because the presentation was well done. I was thinking about

what questions I was going to prompt my students with and decided not to prompt them at all. Since it was their idea, I did not want to spoil their excitement by making it feel like another assignment. I also felt it was as good a time as any to pull out the crutches and see how they would respond without any Leading Questions. After watching the movie, which the students did, in fact enjoy, I asked them to write a one-paragraph opinion response to the movie.

Student essays continue to show the evolution of the students' critical thinking skills (see Figures 17, 18, &19). These essays demonstrate the students' ability to incorporate a number of sources of information and experiences to evaluate the popular media presentation. Once again, written as an opinion the essay shows how the students formulated an argument by making use of analysis, evaluation, interpretation, and inference. The use of these critical thinking skills allows them to defend their argument in a valid and logical way. The students were able to accomplish this through the synthesis of all the information they have gained through this experience and putting it together to get a view of the "big picture". This global view enables the students to be actively engaged actively with the material presented in the popular media.

Inconvenient Truth Essays

An Inconvenient Truth

I really liked the movie in the aspect as it is a documentary. Some of the points Al Gore said were very good. Especially the statistics about Carbon Dioxide. Another point I really liked was that of the ice caps melting and how it is affecting the ocean currents (which you would about by watching "A Day After Tomorrow"). Saying that, I don't think Al Gore said anything on how to change. Everyone knows global warming is real but Gore just gave the people someone to blame.

Figure 17. Sample An Inconvenient Truth Essay

[REDACTED]
[REDACTED]

Honors Science 9

30 November 2006

Fact or Fiction

Personally, I found Al Gore's movie quite factual and I agree with most of it. Such as the fact that Global warming is happening and a lot of it is contributed with. I found the ice cap and sea ice information interesting, like how the Artic ice cap has become thinner every year. However the one of the ice selves on Antarctic collapsed because of an earthquake, but was weakened by global warming. My point is that global warming isn't the only cause of ice caps and ice shelves collapsing. I had also found the soil evaporation a little odd considering the fact that deserts have no water in them to evaporate and the fact that do to global warming some areas have become fertile and moist. Therefore I agree with most of the movie, but I'm also a little confused with some things he says. To me the movie was extraordinarily bias!

Figure 18. Sample An Inconvenient Truth Essay



Al Gore: Global Warming

Along with the power that comes with having a say in what goes on in our nation, Al Gore was also granted tons of publicity during his campaign as vice president. With that publicity, he set out to convince the country that global warming is as harmful as advertised and that it's not just going to go away. He backs up his theory with what I believe is solid evidence. The chart he used to show the booming increased temperatures on Earth was not only mind boggling, but also a convincing way to show that global warming is real. In his speech he also mentioned the melting of Arctic ice caps. He talked about the decrease in size in certain caps such as the Larsen B. Gore then went on making plausible points as to what will happen if melting rates continue to sky rocket. Overflowing bodies of water, and other bodies of water even drying out can be the outcome. Throughout his entire presentation, Gore had strong, convincing points concerning global warming. It was difficult not to believe all he had to say. Al Gore is trying to get the news out about global warming not for the publicity, but for all of humankind.

Figure 19. Sample An Inconvenient Truth Essay

The *Inconvenient Truth* essay was the last evaluated assignment in my research study. It was also done without a prompt or Leading Question. However, my students had the highest level of achievement on this activity.

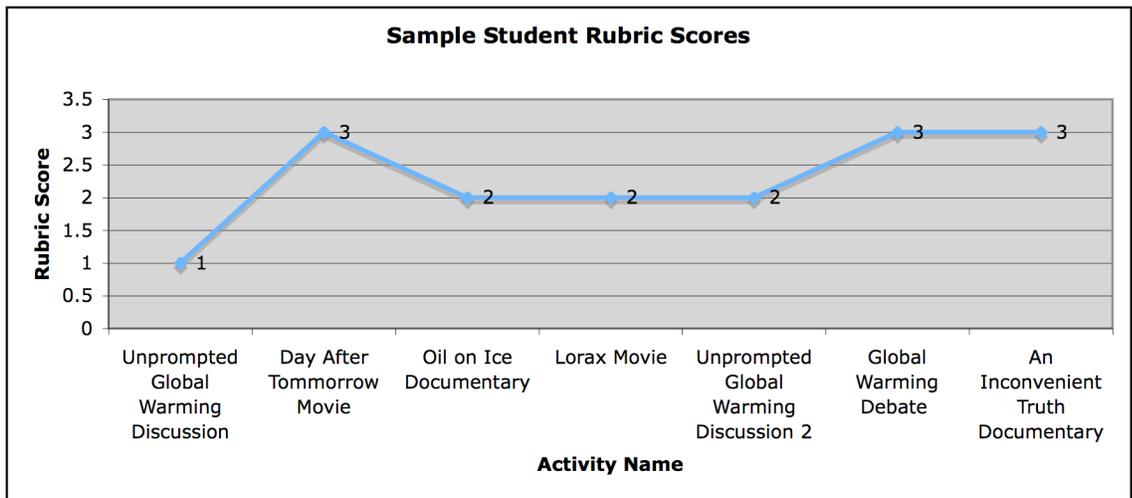


Figure 20. Sample Student Rubric Scores.

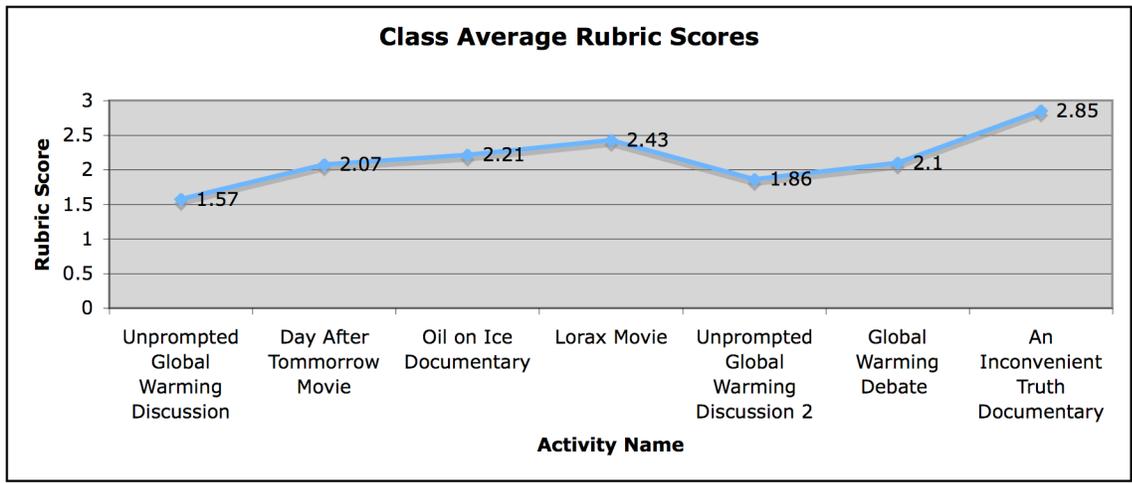


Figure 21. Class Average Rubric Scores

More Research – More Filters

Students continued using filters as we progressed on through the school year. We continued evaluating journal articles, using the Written Media Filter (see Appendix C) that were pertinent to the subject matter we were discussing at the time. The results of these experiences were similar to the previously discussed articles. However, each time we did a new evaluation, there were improvements in the students' critical thinking processes and their comfort with these strategies. We also continued to evaluate visual media in the form of movies, like *Twister*, to decipher science fact from science fiction. We also continued to look at documentaries and docu-dramas, like *Into Thin Air*, as they applied to the content of our studies. In each case, the students applied the Visual Media Filter (see Appendix H) or Leading Questions to direct and enhance their critical thinking. As with the written material, the students' ability to apply their critical thinking skills improved. I also continued to observe that their comfort level with this process steadily increased as well.

The Storm Subsides

On the final day of my data collection, I had the students complete a final survey (see Appendix L), and I informally interviewed (see Appendix M) them. It was at this point that my students and I could look back and reflect on what we had accomplished. The following excerpts from the exit interviews and surveys, speak to the students' understanding of what they learned and how they view its

importance. These final words demonstrate not only what they have learned but how they view its application.

Concluding Words

I never thought so much about what I was watching or reading before, but I now see the importance.

I never realized how many ways the media tries to trick and deceive us, and I am not someone who likes to be fooled.

Watching movies in your class is extremely hard work, none of my other teachers ever really taught me anything with a movie, it was just for fun. But, I will definitely watch movies different in the future, and think more about how the movie is affecting me.

I never really thought about thinking about other peoples motives and the lengths that they would go to deceive others.

I always just assumed what I read in the newspaper was news and so it was true. But, I now realize that it is only someone's opinion and there might be other views or opinions that don't get published.

I can't believe there are so many things to think about when watching television. Is the show using some devise to sway me, how

do I feel about the information, how am I going to deal with my feelings, and on and on.

I am glad I now know how not to be tricked by the media, because then they don't have power over me! I can't stand be manipulated, and I now see how if you are not always aware you can be taken advantage of, and worst of all you don't even know its happening.

Figure 22. Concluding Words Pastiche

DATA ANALYSIS

In an effort to view my study through the widest lenses possible, I obtained data from a variety of sources. My principal data collection method involved the recording of my observations and observer comments in my field log. This was further supported by examining my students' work for evidence of critical thinking. I also supported my findings with a number of student surveys and student interviews. The triangulation of these data sources gave me a wide view of the findings provided by this study (Hubbard & Power, 2003).

The analysis of these data was conducted primarily in a qualitative way. This was achieved through the use of my researcher field log in which I wrote and reflected on my observations throughout the course of my study. An effort was made to further support my finding by quantifying data wherever possible. My quantitative data were obtained through the use of a rubric (see Appendix D) when analyzing student discussions and student work. I was also able to gather quantitative data through the use of an objective test (see Appendix G).

I analyzed my field log, which was the primary data collection method, throughout my study by keeping a running record of all my observer journals, student work, student surveys, and analytic memos. I created my observer journals using the two-column method (Connelly & Clandinin, 1988). In the left hand column I kept an accurate record of what events and dialog occurred that during each class period. I used the right hand column to record my observer

reflections. I also kept samples of student work and student interviews in my field log in sequential order by date. Any analytic memos that I created or rubrics that I used also became part of the field log. Very early in my study, I began the process of reviewing and analyzing the data (Hubbard & Powers, 2003).

After the first two weeks of data collection, I began coding my field log, including all observer journals, samples of student work, student surveys, and analytic memos. This was done by reviewing and rereading my field log and assigning one or two word codes to the margins (Ely, Vinz, Downing, & Anzul, 1997). These codes reflect data important to the research question I was studying. This process was repeated about once a week, each time starting at the beginning of my field log, throughout my study. Each time I re-coded my field log, I was looking for new insights and connections about the data being collected.

During my study, new questions arose that were related to my research question. These questions became sub-questions within my study and helped to keep me both reflective on my research and focused on achieving the goals of my research question. The following were the four sub-questions that materialized from my research study:

1. What will be the observed and reported experiences when different types of critical thinking filters are applied to examples of popular media?
2. What will be the observed and reported experiences on student motivation when students evaluate science in popular media?

3. What will be the observed and reported experiences conduct an in-depth research project related to a science fiction film?
4. What will be the observed and reported experiences when current events are used to create student motivation?

At the conclusion of my study, I further analyzed my data by grouping related codes together in a process called binning (Arhar, Holly, & Kasten, 2001). The bins that were created reflected codes that were similar in nature and salient to my research question. This process is done as a method of sorting information gathered and beginning the process of assigning meaning to the data (Ely et al., 1997). Once the bins were created, they were placed in a graphic organizer, juxtaposed to one another, in an effort to further examine the similarities and important aspects of the data. Each bin was then assigned a theme that reflected the meaning drawn from the codes within that bin. These themes became the major ideas drawn from the data that had a direct relevance to the research question.

I used a number of analytic memos as a method of reflection and a way to summarize information gathered during my study (Arhar, Holly, & Kasten, 2001). I also created charts and graphs to display some of the quantitative data gathered. Literary devices, such as the pastiche, layered story, vignette, and drama, were also used to analyze the data (Ely et al., 1997).

My researcher support group was also influential in the analysis of my data. They not only acted to support the opinions I was drawing from my study, but also offered alternate opinions. These alternate opinions gave me a wider and less biased view of my data (Arhar, Holly, & Kasten, 2001).

My data were further analyzed by reviewing the work of established educational philosophers. The writings of Dewey (1997), Freire (2003), and Vygotsky (1978) added credibility and support to my research study. By comparing my study to the works of these philosophers, I feel I have drawn significant and sound results.

Bins and Themes

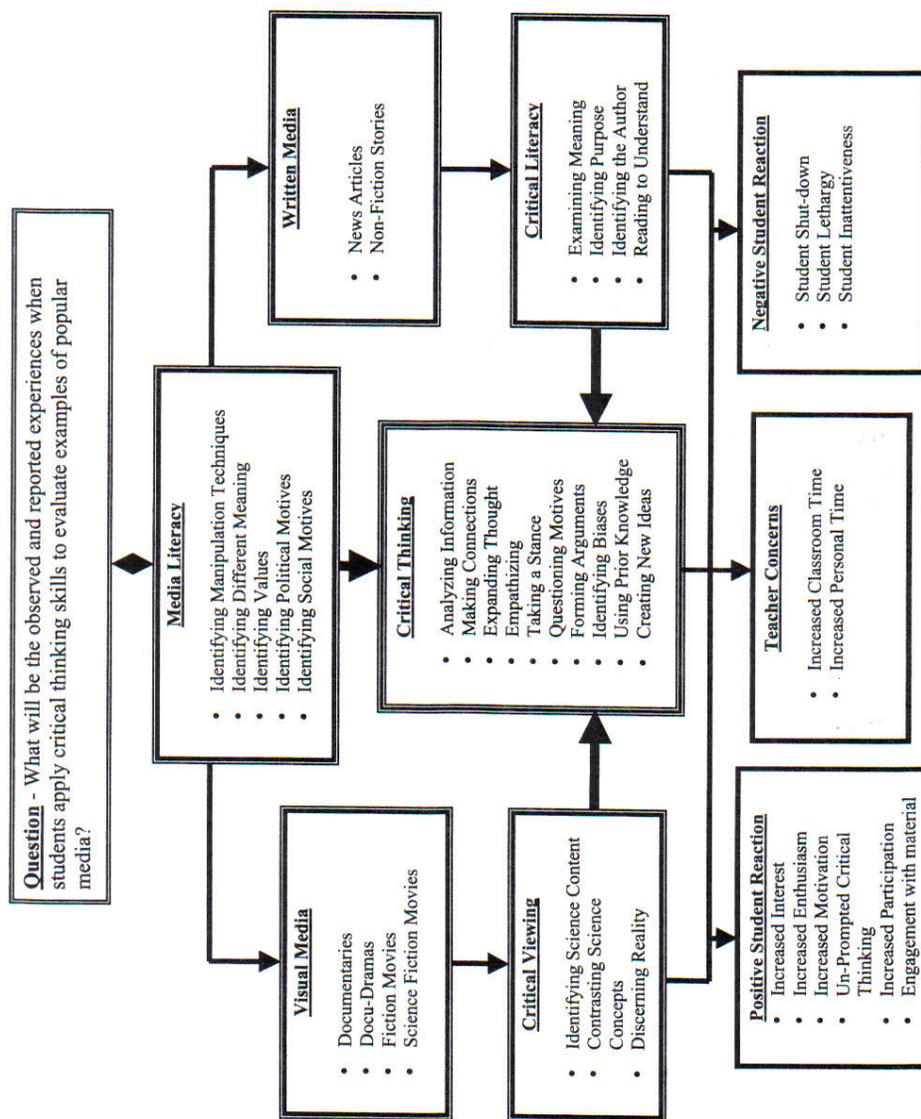


Figure 23. Bins and Themes.

Theme Statements

Media Literacy – Expanding students’ media literacy is the first step in scaffolding students toward becoming critically aware of popular media.

Visual Media – Documentaries and fictional movies are good samples of media that can be critically evaluated by students.

Written Media – News articles and stories are good samples of media that can be critically evaluated by students.

Critical Viewing – The development of critical viewing skills encourages students to become critical evaluators of popular media.

Critical Literacy – The development of critical literacy skills encourages students to become critical evaluators of popular media.

Critical Thinking – Media literacy, critical literacy, and critical viewing skill create the framework for the development of critical thinking skills that can be used to critically evaluate examples of popular media.

Positive Student Reactions – The critical analysis of popular media causes an increase in student enthusiasm and engagement with the course material.

Negative Student Reactions – In order for student to become critical evaluators of media, the teacher must assist them in overcoming their predisposition to be a passive audience.

Teacher Concerns – Teaching students to become critically aware of the popular media requires a large time investment both inside and outside the classroom.

FINDINGS

This research study sought to explore the observed and reported experiences of students using critical thinking skills to evaluate samples of the popular media. Several themes arose from the data collected during this research study. As a result of this study, I have found techniques that can be used to help students become critical thinkers. In addition, I also discovered methods for using these critical thinking skills to evaluate samples of popular media.

Media Literacy – Expanding students’ media literacy is the first step in scaffolding students toward becoming critically aware of popular media.

One of the most important themes that became apparent as a result of this study is that students need to develop media literacy. Maness’ work shows that since we cannot stop students from using media, it is extremely important that we teach them about media (2004). Most important is that students need to develop an understanding of what it means to be a media literate person. Students are accustomed to being passive absorbers of media, and they often do not think about what they are watching or reading beyond the content in the program or article. Furthermore, they do not realize the importance of being a scientifically literate person and questioning the information they are presented with.

Teaching students what it means to be media literate is a first step, which can be accomplished by instructing them on what to look for when using the popular media for information, as supported by Goldthorpe’s findings (1993).

Educating students on manipulation techniques and the identification of differences in meaning are critical to accomplish this goal. Leading students with reflective questions is an effective way of accomplishing this goal. Students will begin to understand the importance of who wrote the information and why they wrote it. This was affirmed in the first filter my students completed when we discussed the importance of identifying the author of the article. The students will also learn to become reflective about the scientific content and how to evaluate it. My students did an excellent job of identifying these concepts when directed to do so through the use of both the Written and Visual Media Filters.

The development of critical thinking skills dramatically enhances the students' ability to critically evaluate the media, which has direct results on their development toward becoming media literate. As the students begin to apply their critical thinking skills to samples of popular media, they begin to be able to identify values, social motives, and political motives. Once students make this realization, they begin to see the importance of becoming media literate persons.

Visual Media – Documentaries and fictional movies are good samples of media that can be critically evaluated by students.

When developing students' critical thinking and media literacy skills, a number of visual media types can be used. With the use of prompts and filters, students can become actively engaged in the visual content. This active

engagement in the media allows students to critically evaluate the content and develop their critical thinking skills.

Documentaries and Docu-Dramas allow for students to evaluate the scientific concepts within the movie for their scientific validity and accuracy. This is extremely important in light of a survey by Fortuna (2001) that showed most students could not differentiate between documentaries and docu-dramas. These types of films also give students an opportunity to critique the scientists and their scientific approach to their studies and theories. As students become critical thinkers, they begin to think about the information presented in these types of movies, not just absorb it.

Science fiction and fictional movies with science content are also excellent tools that can help the development of critical viewing skills. It is extremely important for students to first understand what science fiction is. Research by Langford (2001), showed that we need to teach our students the difference between what is and what can be. Once they understand where science fact becomes science fiction, they can begin to reflect on what science and technology can accomplish and what they might be able to achieve in the future. I think this was personified when my students examined a five-minute clip from *Jurassic Park*. The students were able to pinpoint the exact moment in the movie when the story jumped from the possible to the currently impossible. Again, this is an important step in developing our students as active participants in their media

experiences. Once they accomplish this, they will realize that they can watch movies for enjoyment, but they can also draw knowledge from these experiences.

Written Media – News articles and stories are good samples of media that can be critically evaluated by students.

A number of types of written media can also be used to develop critical thinking and media literacy in our students. By employing filters, we can direct and focus our students' reading and encourage them to think about what they are reading. Once again a very important theme is that we move our students from being passive absorbers of media to active evaluators.

Students can evaluate scientific news articles for their scientific accuracy and their use of the scientific method. It is important that students begin to understand that they do not have to blindly accept everything they read. Through the use of their critical thinking skills, they begin to realize that they can and should develop their own ideas and draw their own conclusions about what they are reading. The large number of articles the students read about global warming speaks to this issue. The students had to not only identify the scientific material in the article, but also apply the pertinent information to their defense during the global warming debate.

Fictional and nonfictional science stories can also be used to develop students' ability to critically evaluate what they are reading. As Bean and Moni (2003) explain, fictional stories that students can relate to are a good medium to

begin engaging students with critical thinking and critical literacy. Any story that is pertinent to the content being studied can be used to engage students in the material. This engagement with the material will reinforce the important theme that students need to become actively engaged with the media they are using.

Critical Viewing – The development of critical viewing skills encourages students to become critical evaluators of popular media.

Once students have an understanding of what media literacy is, they can begin to apply their understanding to the media they view. An important critical viewing attribute is the ability to identify the scientific content in a piece of media. This process of filtering out the unimportant information and focusing on the science content is the first step in the evaluation of visual media information. A research study by Zindovic-Vukadinovic (1998) showed that students were not able to recognize imbedded codes in the media they watch. This clearly illustrates the need for educators to teach students to be critical viewers.

The ability to contrast the scientific information presented with other scientific ideas and theories is a very important critical thinking skill. This is one of the many ways in which we can transform our students into active participants in the media. The need for students to become active, rather than passive, audiences is illustrated in research by Owen, Silet, and Brown (1998). The students are no longer thinking about just the information in an individual presentation, but how the information fits into the larger scientific picture. When

the students viewed Al Gore's *An inconvenient Truth*, they were watching and analyzing the information presented in the context of all they had already learned about global warming. In this way, they were not just absorbing what they were seeing, but critically analyzing the information.

With the large number of science fiction movies that our students are exposed to we also need to address their ability to tell fact from fiction. It is extremely important that our students are able to distinguish what is and what is not reality. This skill can be developed by critiquing science fiction films for that which is science fact and that which is science fiction. This will encourage students to question what is possible and think about what might be possible (Langford, 2001).

Critical Literacy – The development of critical literacy skills encourages students to become critical evaluators of popular media.

Critical literacy skills help students deal with and interpret written works produced by the popular media. Once students are guided toward becoming active readers, they can begin to draw meaning from what they are reading. As they begin to see the bigger picture and examine the meaning of the text, they can begin to formulate ideas as to the purpose of the work. Research by Langford clearly shows the need for students to be involved in what they read in a variety of written media (2001). While attempting to draw meaning from the media and thinking about the purpose, they also begin to see the importance of identifying

the author. Once the author has been identified, the students are able to use their media literacy skills to make judgments about how the author's background and affiliations affect the author's written words.

This active form of reading creates an environment where the students read to understand. Instead of reading just to get it done, they become actively engaged with the text. They are no longer able to gloss over the words without understanding the content. They become readers who not only understand the text they are currently reading, but are drawing further meaning by comparing and contrasting the information with that which they have read before. The Written Media Filters that my students used helped to facilitate this transformation by asking the students Leading Questions about the written works. By requiring the students to answer questions about the written material, the students are forced to become associated with what they are reading. This also creates the type of reader who will go beyond the current text to find answers to their questions.

Critical Thinking – Media literacy, critical literacy, and critical viewing skills create the framework for the development of critical thinking skills that can be used to critically evaluate examples of popular media.

Students must begin by understanding and using basic forms of critical thinking skills, and then gradually work up to more complex forms of critical analysis. Critical thinking skills such as the ability to analyze information and use prior knowledge are key steps in students' ability to understand their own thinking

processes. The students are then able to apply that knowledge to make connections and expand their thoughts regarding the information from the popular media. This is why I began my study by teaching my students what critical thinking is and how to use it. I then built on this framework and slowly developed more advanced critical thinking skills.

Once students understand their own thinking processes, they can also begin to understand how other people's minds might work. They begin to think about potential biases and motives in the information that may affect their perceptions of the popular media. Students must be aware of how biases and motives affect the media they are viewing (Cates 1990). Furthermore, Cates identifies the need for students to understand the methods filmmakers use to convey these hidden messages to unsuspecting audiences. Through this process, students also develop a sense of empathy for people and situations other than their own (Tirri, 1999).

These steps scaffold the students to more advanced forms of critical thinking. For example, students will understand how to form a valid argument, which allows them to take a stance on an issue and defend their opinion logically. This creates a situation where students become evaluators of the information in their lives. As they synthesize this information and form opinions, the students also create new ideas and theories about the world around them. The need to scaffold students toward becoming critical thinkers is supported by Sharma and Hannafin's findings (2002).

Positive Student Reactions – The critical analysis of popular media causes an increase in student enthusiasm and engagement with the course material.

Student interest, motivation, and enthusiasm increase when using examples of popular media to teach science content and critical thinking skills. Using popular media to teach subject matter creates a connection between the material and the students, which makes for an effective teaching strategy (Owen, Silet, & Brown, 1998). This increase is most likely due to the fact that the students are familiar with and enjoy the popular media in their lives. Using popular media is also a dynamic way of bringing the subject to life and engaging the students in the material (Greene, 2003). As a result, student participation is also increased, making for a much more active discussion. This increased participation creates an environment where the students are deeply engaged in the material being taught. In seeing the relevance and how it affects their lives, students take ownership in the material. I also think the sense of empowerment that critical thinking gives the students adds to their enjoyment of the material.

The biggest benefit of directing students toward becoming critical thinkers is to no longer have to guide their critical thinking. Un-prompted critical thinking responses become the norm, as the students begin to use their critical thinking skills automatically. Critical thinking becomes a natural and logical way of looking at information, and students become independent critical evaluators of the popular media.

Negative Student Reactions – In order for students to become critical evaluators of media, the teacher must assist them in overcoming their predisposition to be a passive audience.

Certain negative student reactions must be overcome in order for students to evolve into critical evaluators of media. Students are accustomed to shutting down their brains when exposed to the popular media. They also exhibit signs of lethargy and inattentiveness when viewing media in the classroom, because they feel it does not contain important content and it is for enjoyment purposes only. This became evident to me after my pilot study, and the development of the media filters and Leading Questions were designed to not only foster critical thinking, but engage the students in the media. These are all negative habits that are associated with students who are passive absorbers of the popular media. As students become active viewers and readers, these bad habits become less of a concern (Owen, Silet, & Brown, 1998).

Teacher Concerns – Teaching students to become critically aware of the popular media requires a large time investment both inside and outside the classroom.

The benefits of teaching students to become critical evaluators of popular media are numerous. However, these benefits come at a cost, and that cost entails a time investment by the teacher. A block of time must be established to teach students about critical thinking and media literacy, followed by the time that must be created to give students an opportunity to practice their new skills. This

consists of time given in class to view and read samples of popular media, as well as class discussion.

In addition, a teacher wanting to teach critical thinking skills must be willing to devote a number of hours of personal time as well. Previewing and pre-reading samples of popular media to find good content and appropriate material is essential to creating good sources for student evaluation. The development of critical thinking filters, Leading Questions, and prompts also requires a large amount of teacher preparation. While the development of rubrics can quicken some of the assessment, the evaluation of these types of assignments is time intensive for the teacher (Randford, Ramsey, & Deese 1995).

NEXT STEPS

Through the process of being reflective throughout this study, I have identified topics that would advance and build on this research. I have identified four sub-questions through my research that would make for interesting research studies or avenues to extend the findings of this study.

What will be the observed and reported experiences when different types of critical thinking filters are applied to examples of popular media?

During my research study, I used filters to lead my students through the process of developing critical thinking skills. I also used Leading Questions and prompts to encourage my students to think critically. Further research could be conducted to determine if filters have an advantage over single question prompts. One could also manipulate the filters themselves in an effort to identify the qualities of effective filters. The goal would be to try to identify the filter type that is most effective in developing critical thinking skills.

What will be the observed and reported experiences on student motivation when students evaluate science in popular media?

Through the implementation of my research study, I observed an increase in motivation in my students. A research study could be conducted to quantify or qualify if this is a result of the use of popular media. Students seemed to enjoy the media as a source of knowledge, especially after they felt the empowerment of critical thinking skills. The goal of such a study should try to identify if the use of

popular media in the classroom does in fact increase student motivation in the subject area.

What will be the observed and reported experiences when students conduct an in-depth research project related to a science fiction film?

During my research study, I used a number of science fiction films to illustrate various topics in my curriculum. I used the movies because the content was appropriate to what was being studied and they served as sources of media for my students to evaluate. I believe a study could be conducted to see if using a science fiction movie as a guiding theme enhances student achievement. For example, a good science fiction movie about time travel could be used to illustrate a number of salient topics in an advanced physics class. The goal of such a study would be to observe the effects of such an approach.

What will be the observed and reported experiences when current events are used to create student motivation?

My research study required students to read and evaluate news articles on a number of topics. When asked to read and reflect on these articles, my students were very eager to participate in class discussions. I thought perhaps their increase in motivation came from a sense of being connected with the world and a sense of how their lives are affected by these topics. The goal of such a study would be to determine if using current events to teach science topics does in fact increase student motivation.

Conclusion

I also believe there would be benefit in repeating this study under different circumstances. For example, this study was conducted in a ninth grade class, but I believe it could be repeated in any grade level where the students are developmentally ready to become critical thinkers. My participants were Honors students, but I believe this research would be effective in other academic levels as well. This study was conducted within an Earth and Space Science curriculum, but would most likely work with any subject matter. I feel this type of approach would work universally across any science related subject and would also be particularly useful in a social studies curriculum.

Repeating this study in other situations or exploring new avenues of related research will help to validate my initial findings. The ultimate goal is to develop tools and strategies that will enhance our students' ability to become and thrive as critical thinkers, media literate persons, and evaluators of the information presented in the popular media.

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RESOURCES

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APPENDIX A

Name _____ Date _____ Period _____

**Honor Project
Idea Filter**

Project Title: _____

Consider the project you are doing. Use the following questions to help you decide if it is the one for you.

1. Was this my number 1 choice? Why?
2. Does this project really interest me enough to work with it for six months?
3. What concepts do I need to understand?
4. What equipment do I think I need? Is it available?
5. What skills do I need to learn to conduct the study?
6. Can I complete this project in the time I have to do it?
7. Is this project doable?

APPENDIX B

Survey

1. On a scale of 1-10 (10 being the highest), where would you rate your interest in watching educational science videos? (Ex. National Geographic, Nova, etc.)

10 9 8 7 6 5 4 3 2 1

Comments –

2. On a scale of 1-10 (10 being the highest), where would you rate your interest in science related movies? (Ex. Dantes Peak, Day after tomorrow, etc.)

10 9 8 7 6 5 4 3 2 1

Comments –

3. What is the definition of **science fiction**; please write this in your own words.
4. What is your first impression when a teacher tells you that the class will be watching a video?
5. Do you think that movies made in Hollywood (ex. Day After Tomorrow) can be used to learn science. Please explain your response.

6. On a scale of 1-10 (10 being the Very Critical), how critically do you watch movies? That means you analyze the reality of movies made in Hollywood.

10 9 8 7 6 5 4 3 2 1

Comments –

7. On a scale of 1-10 (10 being the most), how much do you think movies affect peoples perceptions of reality?

10 9 8 7 6 5 4 3 2 1

Comments –

Any other comments you may have regarding these topics-

APPENDIX C

Name _____ Date _____ Period _____

Critical Thinking
News Filter *Written Material*

1. Who wrote this information?
2. What is the source of this publication?
3. How would you rate the credibility of the sources in the first two questions?
4. What is the main idea of the article?
5. Is the author using his own ideas or someone else's?
6. How does the article make you feel?
7. Could there be another side or opinion regarding this information, (what would it be)?
8. What are the possible sources of bias in this article?
9. What kind of tactics does the author use to persuade the reader?
10. Does the article contain data, if so how is it used?

APPENDIX D

Discussion Questions for *The Day After Tomorrow*

The Day After Tomorrow is the latest Hollywood blockbuster disaster flick, this time about a sudden, dramatic change in climate that causes disasters around the world. Below, we provide you with some questions to help you assess the potential validity of some of the changes depicted in the movie. We'll discuss these as a group afterwards, so take some notes as you watch. You should turn in a **typed** one-page report on the movie that includes responses to these items.

1. The opening scene shows the collapse of a massive ice shelf (a floating glacier) in Antarctica. Could this really happen? If so, how might it affect global sea level?

2. The central premise of the film is that global warming could lead to the shutdown of the North Atlantic "heat pump" (probably the major driver of global ocean circulation), causing extreme changes in climate around the world. Is this possible?

3. In the film, tornadoes whip through Los Angeles, and New York is buried by a storm surge of Biblical proportions – all in a matter of days. Could an eco-Armageddon really happen so quickly with these effects?

4. The movie depicts a massive freeze sweeping across Europe and then striking the northern half of the United States, resulting in a mass migration to Mexico for survival. Is this how global warming is likely to develop in the next century? Why or why not?

5. In the movie, Dennis Quaid, who plays the hero as an intrepid climatologist with the National Oceanic and Atmospheric Administration, has a scientific epiphany when he concludes that the unfolding catastrophe represents the dawn of another Ice Age 10,000 years in the making. What is his evidence for this conclusion? Does his hypothesis really make sense? Why or why not?

APPENDIX E

Name _____ Date _____ Period _____

Critical Thinking
Science Fiction Vs. Science Fact Filter

1. What is the name of the Movie or Book?
2. What is the main idea of the story?
3. What is the, *what if*, of this movie or book?
4. What are the uses of good science in the movie?
5. What are the examples of science fiction used in the movie?
6. Is this a work of mostly fiction or mostly fact?
7. How does the movie or book make you feel?
8. What kind of tactics and bias are used to affect the viewer or reader?

Name _____ Date _____ Period _____

Day After Tomorrow Movie Quiz

9. What was Jack's main method of transportation when going to New York City to rescue Sam?

- A. walking
B. flying
C. driving
D. none of these

10. What did Sam, and the rest of the people, in the library throw into the fireplace to keep warm?

- A. Furniture
B. wood
C. books
D. clothing

11. In Australia, there was a record for the highest _____?

- A. Blizzard
B. Typhoon
C. Hurricane
D. Tornado

12. When Sam was calling his dad in the phone booth, telling him he was going to find a place to stay that night, what was his complaint about his surroundings?

- A. "Ewww... this place is filthy."
B. "This guy is trying to take Laura from me, Dad!"
C. "Man it's so cold in here, I'm freezing."
D. "Ugg... this smell is unbearable Dad."

13. After the Decathlon there was a party, Sam had a name tag, what did it say?

- A. Yoda
B. Bryan
C. Sam
D. Joyce

14. In the movie, how many planes and helicopters crash?

- A. 3 planes and 2 helicopters
B. 2 planes and 2 helicopters
C. 1 plane and no helicopters
D. 2 planes and 3 helicopters

Name _____ Date _____ Period _____

Day After Tomorrow Movie Quiz

15. When Laura was helping the people trapped inside the cab, they did not speak English. What language did they speak?

- A. Portuguese
B. Spanish
C. Latin
D. French

16. When Jack Hall was talking on the phone to Terry Rapson, he said, "This onstrom is going to change the face of our planet." What was the response?

- A. "Save as many as you can."
B. "Just worry about the President."
C. "Try and save everyone."
D. "I don't know what to do."

17. When the water was coming into New York City, and Laura was helping the people that were in the cab, Sam cam after her, then later Laura told Sam what?

- A. "Thanks for coming back for me, that was really brave."
B. "You risked your life for me, you are so brave Sam."
C. "Thanks for risking your life for me."
D. "That was close, we could have died."

18. The ocean destroyed the Statue of Liberty when the waves got too high for it.

- A. True
B. False

19. There was a zoo in this movie, what kinds of animals did it contain?

- A. Bears, wolves, deer
B. Birds, dogs, bears
C. Wolves, horses, dogs
D. Birds, wolves, tigers

20. Jack told the Vice President, that they only had 6 to 8 weeks until the worst would happen, but that changed, what was the new deadline?

- A. 7 to 10 days
B. 2 to 3 weeks
C. 5 to 7 days
D. 3 to 5 weeks

21. Laura and Sam were playing a game, in the room with the fireplace, it was a question, answer game, Laura asked, what was your favorite vacation? Sam's first answer was what?

- A. "I was with my father."
B. "Besides this one?"
C. "I was with my mom and aunt in Miami."
D. "This one, to New York"

Name _____ Date _____ Period _____

Day After Tomorrow Movie Quiz

22. What was the water in New York referred to?

- A. "An ocean city"
- B. "New York Ocean"
- C. "A hurrican of water"
- D. "A wall of water"

23. While Sam, Brian, and J.D., were in the boat, Brian opened up a cupboard, what was in it?

- A. a raft
- B. food
- C. medicine
- D. frozen cups

24. At the end of the movie a plane came and picked up the survivors in New York.

- A. True
- B. False

25. Also at the end of the movie, a person from the government came into a room and was talking to the Vice President, what were his first words?

- A. "Hello Mr. President."
- B. "There are survivors!!"
- C. "Mr. Vice President?"
- D. "I'm so glad to see you."

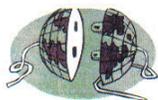
APPENDIX H

Name _____ Date _____ Period _____

Critical Thinking
News Filter *Visual Material*

1. Who produced this program?
2. Who is the narrator of the program?
3. How would you rate the credibility of the sources in the first two questions?
4. What is the main idea of the program?
5. Do they quote sources for their information, if yes who, are they credible?
6. How does the program make you feel?
7. Could there be another side or opinion regarding this information, (what would it be)?
8. What are the possible sources of bias in this program?
9. What kinds of tactics are used to persuade the viewer?
10. Does the program utilize data, if so how is it used?

APPENDIX I



Earth Science Debate Global Warming? Tree Huggers vs. Black Smokers



Background

Students will be placed into two groups, representing the opposing side on this issue. The first group, which we will call the *Tree Huggers*, will defend the theory that global warming **is occurring as a result of human actions**. The second group, named the *Black Smokers*, will provide evidence that global warming is a result of **natural fluctuations in Earth's climate**. The two teams will then meet on the battlefield to debate this current issue.

What is expected of me?

- On the first day of this activity the topic of the greenhouse effect and global warming will be introduced. Students will then be placed into two groups and given some introductory materials to get started.
- Once in their groups students will choose a team leader, who will be reporting the group's progress to myself. Next students will break up into four small groups, each of which will be responsible for researching a different aspect of their team's position.
- This is a group activity that requires the participation of every student. So each student will be collecting data and doing research, which will be presented during the debate. Remember your team is only as strong as your weakest link.
- I expect everyone will take this project seriously and do their share of the work. Group leaders should inform me of any student who is not pulling their own weight.
- The two groups will then participate in a debate about the scientific merits of global warming. As participants offer their views, they should support their position with evidence drawn from their research. Positions and evidence should be scrutinized by the group according to *scientific merit, verifiability, weight of evidences, and influences by outside parties*.

What do I need to do?

Project Total 150pts

- | | |
|--|------------|
| • Research: (20pts) | Due: _____ |
| • Global Warming Questions: (30pts) | Due: _____ |
| • Essay: (25pts) | |
| ○ Rough Draft | Due: _____ |
| ○ Final Copy | Due: _____ |
| • Debate: (75pts) | Due: _____ |

To Get Started

Try googling the "global warming debate" or "global warming controversy". Also research greenhouse effect and global warming. Try www.noaa.gov and www.nasa.gov. Remember to double check and document your sources.

**Earth Science Debate
Global Warming?
Tree Huggers vs. Black Smokers**

Requirement Guidelines

Research – (20pts)

Each student will submit a **minimum of five references**, in the form of a printout or photocopy of the source. Attach a **handwritten** document to each source that contains the bibliography (according to MLA format), and notes (no less than 5) for each source. These sources must be relevant to your role in the debate. **Your 5 sources may contain no more than 2 .com sites!**

Global Warming Questions –(30pts)

Each student will complete the *global warming question sheet*. You may choose **any 10** questions from the sheet to answer. You may do them in any order, but you **must indicate the question number and rewrite the question**. There is no minimum requirement to answer the question and long as you answer the question **completely and accurately**. These questions must be submitted on a separate sheet of paper and may be **typed or handwritten**.

Bonus Opportunity (+10)- Answer all 15 questions, following the above method, and receive 10 bonus points.

Essay – (25pts)

Each student will write an essay *describing their stance according to their role in the debate*. The essay must follow MLA format and be free of spelling and grammatical errors. Your essay must contain an introductory paragraph, 3 supporting paragraphs, and a concluding paragraph.

Rough Draft – Must be **hand written**, and follow the above stated requirements.

Final Essay - This essay **must be typed**, and again follow all above stated guidelines, using a **standard 11-12 font** and **double-spaced**.

Debate - (75pts)

Individual Points – (60pts.)

- **References- (10pts.)** Each student will submit an annotated bibliography prior to the debate with no less than 10 references (*no more than four of which may be .com sites*)
- **References sited during debate – (10pts)** Each student is required to site the source of technical information presented during the debate.
- **Depth of Knowledge – (20pts)** Each student is expected to have mastered the information pertinent to his or her role in the debate.
- **Communication Skills – (10pts)** Each student will be expected to speak clearly and with purpose.
- **Group Contribution – (10pts)** Each student will be expected to contribute to the overall group effort.

Group Points – (15pts.)

Each team will be **well prepared** to engage in competitive banter. This means that students will be aware of **individual roles and timing**. The debate should **run smoothly**.

Name _____ Date _____ Period _____

GLOBAL WARMING QUESTION SHEET

Directions – Choose any 10 of the following questions to answer. Your answers must be in sentence form and hand written on notebook paper. Please indicate the number of the question, rewrite the question, and then answer the question. A number of sentences will be required to fully answer each question.

1. What is global warming?
2. What are the causes of Global Warming?
3. What is the greenhouse effect, and how is it related to global warming?
4. What are "greenhouse gases?"
5. What NATURAL events increase global warming?
6. What are fossil fuels and how are they contributing to global warming?
7. What evidence supports the idea that global warming is taking place?
8. What are some possible consequences of continued global warming?
9. What are some ways to reduce global warming?
10. Are there any efforts currently underway to slow global warming?
11. What legislation (law) has there been to address global warming?
12. Have the effects of global warming already been felt? If so, where on Earth?
13. How has deforestation contributed to global warming?
14. What can we learn about the greenhouse effect by looking at Mars and Venus?
15. Has Earth's global average temperature changed over the past century, what is the evidence?

GLOBAL WARMING DEBATE

TOPICS TO BE DISCUSSED AND TIMELINE

OPENING REMARKS - TREE HUGGERS (2MIN)

OPENING REMARKS - BLACK SMOKERS (2MIN)

TOPICS

1. **WHAT HAS HAPPENED TO THE GLOBAL TEMPERATURE AND CARBON DIOXIDE LEVELS OF THE ATMOSPHERE DURING THE LAST CENTURY? WHAT IS THE EVIDENCE?**

POINT – BLACK SMOKERS (3MIN)

COUNTER POINT – TREE HUGGERS (3MIN)

REBUTTAL – BLACK SMOKERS (2 MIN)

REBUTTAL – TREE HUGGERS (2MIN)

2. **WHAT ARE THE CAUSES OF GLOBAL WARMING AND WHAT IS THE EVIDENCE THAT IT IS OCCURRING?**

POINT – TREE HUGGERS (5MIN)

COUNTER POINT – BLACK SMOKERS (5MIN)

REBUTTAL – TREE HUGGERS (2 MIN)

REBUTTAL – BLACK SMOKERS (2MIN)

3. **WHAT ARE THE IMPACTS OF GLOBAL WARMING, CLIMATE CHANGE, AND WHAT SHOULD BE DONE REGARDING THIS ISSUE?**

POINT – BLACK SMOKERS (3MIN)

COUNTER POINT – TREE HUGGERS (3MIN)

REBUTTAL – BLACK SMOKERS (2 MIN)

REBUTTAL – TREE HUGGERS (2MIN)

3-MINUTE BREAK TO ORGANIZE CLOSING STATEMENTS.

CLOSING REMARKS - TREE HUGGERS (2MIN)

CLOSING REMARKS - BLACK SMOKERS (2MIN)

Name _____ Date _____ Period _____

Global Warming vs. Ozone Depletion

Greenhouse Effect – Global Warming

1. What is the greenhouse effect?
2. What is global warming
3. What are the greenhouse gases?
4. Is the greenhouse effect bad? What about global warming?

Ozone Layer – Ozone Depletion

5. What is ozone and the ozone layer?
6. What is ultraviolet radiation?
7. What are chlorofluorocarbons and how do they effect ozone?
8. What is the theory of ozone depletion and what is the effect?

APPENDIX J

POPULAR MEDIA SURVEY

Please fill out the following survey as honestly as possible.

1. How often do you read the newspaper? (Please circle the best response)

often occasionally rarely never

2. If you read a newspaper(s), which one(s) do you read?

3. Did you look at a newspaper today? YES NO

If so, why?

3. How often do you read books? (Please circle the best response)

often occasionally rarely never

4. If you read books, what kind do you normally read (ie, romance, mystery, sports, fantasy, etc.)? Please list all the types you like to read.

5. What was the name of the last book you read for pleasure (not a school assign.)

6. How often do you read magazines? (Please circle the best response)

often occasionally rarely never

7. If you read magazine(s), which one(s) do you read?

8. What is the title of your favorite magazine, and why do you like it?

9. How often do you go to the movies?

often occasionally rarely never

10. How often do you watch movies at home, on DVD, VHS, HBO, etc.

often occasionally rarely never

11. What type of movies do you usually watch? (Action/Adventure, Comedy, Drama, etc.)

12. How often do you go to popular music concerts?

often occasionally rarely never

POPULAR MEDIA SURVEY

13. How often do you do to classical music concerts?

often occasionally rarely never

14. How often to you go to theater presentations? (ie. State Theater, Broadway, etc.)

often occasionally rarely never

15. How often do you purchase music on CD?

often occasionally rarely never

16. How often do you download music (legally or illegally) from the Internet?

17. What kind of music do you like to listen to? (Rock, Rap, Alternative, etc.)

18. How often do you listen to the radio?

often occasionally rarely never

19. What station do you usually listen to? Why?

20. Do you ever listen to public radio? (NPR, etc.)

21. How often do you watch television?

often occasionally rarely never

22. How many hours a day, on average, do you watch TV.

23. What are your three favorite TV channels?

24. What are your three favorite TV shows?

25. Who is your favorite TV personality?

26. How often do you watch PBS or other Public Television?

often occasionally rarely never

27. Do you record TV shows when your not home to watch later? _____ YES _____ NO
If yes explain why!

28. Do you record one show, while you are watching another? _____ YES _____ NO
If yes explain why!

APPENDIX K

Name _____ Date _____ Period _____

Debate – Exit Survey

If you could have chosen your own team, which one would you have chosen?

Tree Huggers or Black Smokers

Why?-

Which team did you end up representing? **Tree Hugger or Black Smoker**

1. Which best describes your opinion about global warming **before** we began working on the debate?
 - a. Believed Global Warming was a fact
 - b. Did Not Believe in Global Warming
 - c. Did Not Care

2. Which best describes what you thought the cause of global warming was **before** we began working on the debate?
 - a. Man was causing global warming
 - b. Global warming was a natural event

3. **After completing** the debate how important of an issue do you think global warming is in our society today? **10 very important – 1 not very important**

10 9 8 7 6 5 4 3 2 1

4. **After completing** the debate what do you feel is the cause of global warming?

10 All Man **1 All Nature**

10 9 8 7 6 5 4 3 2 1

5. **After completing** the debate how urgently do you feel we need to deal with this issue? **10 – Being right Now** **1- In the distant future**

10 9 8 7 6 5 4 3 2 1

What team would you NOW chose to represent? **Tree Hugger or Black Smoker**

Why? –

Name _____ Date _____ Period _____

Debate – Exit Survey

What do you feel are the two most important things you learned during this debate?

Explain each!

1.

2.

Name 2 things you think would help solve this problem? *Explain each!*

1.

2.

Explain something you could do to help with this problem

On a scale of 1 to 10 (10 being the best) how much did you enjoy this project?

Be honest!

10 9 8 7 6 5 4 3 2 1

On a scale of 1 to 10 (10 being the most) how much did you learn during this project?

Be honest!

10 9 8 7 6 5 4 3 2 1

APPENDIX M

Protocol for informal student interviews

The following interview questions will be asked of all student participants in my study. The interview questions will be asked upon completion of my study, will be asked on an individual basis, and kept confidential. Students will be informed to answer the questions honestly as their answers will not be graded or affect their grades in any way. Student responses will be recorded on a document similar to this, and designated with each student's pseudo name.

Interview Questions:

1. Approximately how many hours of television do you watch per week?
2. Approximately how many movies do you watch per week?
What kind of movies do you usually watch?
3. Do you watch public television, educational television, or documentaries on a regular basis?
4. How many books have you read in the past 6 months?
5. Do you feel that you are affected by television advertisements?
6. Do you feel that you are aware of biases in media?
7. What type of biases are you familiar with in media?
8. Do you feel that you will continue to evaluate media critically in the future?
9. Why do you feel it is important to critically evaluate media?
10. Have you or do you plan to tell others about what you have learned?

APPENDIX N

Critical Thinking Rubric

Score	Identifiers
4	<ul style="list-style-type: none"> A. Analyzes key information, questions, and problems clearly and precisely. B. Evaluates material with insight C. Uses inference to reason carefully from clearly stated premises to important implications and consequences. D. Uses deductive and inductive reasoning and problem-solving skills consistently and with ease.
3	<ul style="list-style-type: none"> A. Analyzes key information, questions, and problems competently B. Evaluates material competently. C. Uses inference to reason competently from clearly stated premises to important implications and consequences. D. Uses deductive and inductive reasoning and problem-solving skills competently.
2	<ul style="list-style-type: none"> A. Analyze some key information, question, and problems competently. B. Evaluates material inconsistently. C. Uses inference to reason inconsistently from clearly stated premises to implications and consequences. D. Uses deductive and inductive reasoning and problem-solving skills inconsistently and weakly.
1	<ul style="list-style-type: none"> A. Is unable to analyze information, questions, and problems or does so superficially. B. Is unable to evaluate material or does so superficially. C. Is unable to or infrequently uses inferences to reason from clearly stated premises or recognize implications and consequences. D. Is unable to or infrequently uses deductive and inductive reasoning and problem-solving skills.

4 = High level of excellence in critical thinking ability and performance.

3 = Demonstrable and competent level of critical thinking ability and performance.

2 = Minimal or inconsistent level of critical thinking ability and performance.

1 = Poor or unacceptable level of critical thinking ability and performance.

APPENDIX O

April 22, 2005

Dear [REDACTED]

I am currently enrolled in a graduate program at Moravian College, in which I am working toward my master's degree in Curriculum and Instruction. This program is an action research based degree, which allows us, as educators, to implement practices that have positive effects on our students. This program encourages us to reflect on what our student's need, and methods of effective instruction.

During the Fall 2006 semester, I will be conducting an action research study. This study will provide the data necessary to complete my thesis as part of my Masters requirements. The following is the research question I have chosen, "What are the observed and reported experiences when students apply critical thinking skills to examples of popular media?" I plan to examine how popular media influences student's ideas about science and how it can create misconceptions regarding scientific principles. I plan to study student's critical thinking skills as they pertain to overcoming falsehoods presented in literature, television, and movies.

During my research I have found that many students have formed preconceived notions about science from experience with popular media. Unfortunately, Hollywood has no interest in our student's education and has no vested interest in using sound scientific principles. Furthermore, research states that many students do not have the ability to tell fact from fiction, or real science from science fiction. I believe this to be a result of poor critical thinking skills among our students.

I plan to gather information to support my study through student interviews, surveys, work samples, observation, and evaluation. I will be interviewing students about their thoughts and feeling both formally and informally. Additionally, I will be collecting samples of student work to analyze for evidence of critical thinking skills. Finally, the students will be asked to perform a survey both before and after the research.

This study will take place entirely within the curriculum guidelines for this class, and there are no anticipated risks in this study. All media used will be age appropriate and follow all copyright laws. This study is designed to increase the critical thinking skills of all my students, however participation in the study is entirely voluntary and will not affect the students grade in any way. Any student may withdraw from the study at any time. If a student is withdrawn, or the parent or guardian chooses not to have them be part of the study, I will not use any information pertaining to the student in my study.

All the student's names will be kept confidential. The name of any student, faculty member, cooperating teacher, or cooperating institution will not appear in any written report or publication of the study or its findings. Only my name and the names of my sponsoring professors will appear in this study. Minor details of the students writing may be altered to ensure confidentiality. All research materials will be secured in a protected location.

My faculty sponsor is Dr. Charlotte Zales. She can be contacted at Moravian College by phone at 610-625-798 or by email at czales@moravian.edu

If you have any questions or concerns about my in-class project, please feel free to contact me at your earliest convenience. If not, please sign and return this letter. Thank you for your help.

Sincerely,

Jacob H. Wolf

I attest that I am the principal of the teacher conducting this research study, that I have read and understand this consent form, and received a copy. Jacob Wolf has my permission to conduct this study at Easton Area High School.

Principal's Name [REDACTED]

Principal's Signature [REDACTED]

Date [REDACTED]

APPENDIX P

MORAVIAN COLLEGE

August 28, 2006

Jacob H. Wolf
626 Lynn St.
Bethlehem, PA 18015

Dear Jacob H. Wolf:

The Moravian College Human Subjects Internal Review Board has accepted your proposal: "Confronting Popular Media's presentation of science with Critical Thinking Skills." Given the materials submitted, your proposal received an expedited review. A copy of your proposal will remain with the HSIRB Chair.

Please note that if you intend on venturing into other topics than the ones indicated in your proposal, you must inform the HSIRB about what those topics will be.

Should any other aspect of your research change or extend past one year of the date of this letter, you must file those changes or extensions with the HSIRB before implementation.

This letter has been sent to you through U.S. Mail and e-mail. Please do not hesitate to contact me by telephone (610-861-1415) or through e-mail (medwh02@moravian.edu) should you have any questions about the committee's requests.

Debra Wetcher-Hendricks
Chair, Human Subjects Internal Review Board
Moravian College
610-861-1415

APPENDIX Q



MORAVIAN COLLEGE
A SMALL NATIONAL TREASURE

Department of Education
1200 Main Street
Bethlehem, Pennsylvania 18018-6650

TEL 610 861-1558
FAX 610 861-1696
WEB www.moravian.edu

August 24, 2006

Dear Parent or Guardian,

I am currently enrolled in a graduate program at Moravian College, in which I am working toward my master's degree in Curriculum and Instruction. This program is an action research based degree, which allows us, as educators, to implement practices that have positive effects on our students. This program encourages us to reflect on what our student's need, and methods of effective instruction.

During the fall semester of 2006 I will be conducting my thesis study. The following is the research question I have chosen, "What will be the observed and reported experiences when critical thinking skills are applied to examples of popular media?" I plan to examine how popular media influences student's ideas about science and how it can create misconceptions regarding scientific principles. I plan to study student's critical thinking skills as they pertain to overcoming falsehoods presented in literature, television, and movies.

During my research I have found that many students have formed preconceived notions about science from experience with popular media. Unfortunately, Hollywood has no interest in our student's education and has no vested interest in using sound scientific principles. Furthermore, research states that many students do not have the ability to tell fact from fiction, or real science from science fiction. I believe this to be a result of poor critical thinking skills among our students.

I plan to gather information to support my study through student interviews, surveys, work samples, observation, and evaluation. All students will have the opportunity to provide feedback to me through these methods. I will only use information collected from students who have permission to participate in the study in any written reports of my research. All of the students' names will be kept confidential, as well as, the names of teachers, staff, and school names. Any information that may reveal a student's identity will be altered to protect their identity. No name will be included on work samples or in any report of my study. All research materials will be kept in a secure location in my home. All data gathered during the study will be destroyed at the conclusion of the study.

All students will be participating in this study on critical thinking, as it will occur within the context of the regular course curriculum; therefore no student will be singled out as a participant or non-participant. Your child will only be considered a subject in my study if I receive your written permission below. Your child may withdraw from the study at any time without any penalty. Withdrawal or nonparticipation in the study, will not affect your child's grades. If your child withdraws, I agree that I will not use any data pertaining to your child in any written reports of my research. Please notify me by phone or in writing if your child wishes to withdraw from the study.

If you have any questions of concerns about my research at any time, please contact the principal or myself at school 610-250-2481 or e-mail me at wolffj@eastonsd.org. My faculty sponsor is Dr. Charlotte Zales. She can be contacted at Moravian College by phone at 610-625-7958 or e-mail at czales@moravian.edu.

If you approve of your child being a participant in my teacher research, please sign and return the bottom portion of this letter. Thank you for your help.

Sincerely,

Jacob H. Wolf

I understand that Mr. Wolf will be observing and collection data as part of his research on popular media's affect on student critical thinking skills, and my child has permission to be a participant in the study.

Child's name _____

Parent/ Guardian Signature _____

Date

9/14/06

APPENDIX R

Name _____ Date _____ Period _____

News Article

- Find a science related article in the newspaper or from an online news site.
- Cut out the article or print it, depending on the source.
- Read the Article!
- Answer the following questions regarding your article.
- Attach your article to this page and turn it in!

Article Title: _____

Article Topic _____

Name of publication: _____

Date of publication: _____

Author(s) _____

Questions

1. Does the author have any affiliations or any credentials? If so, what are they?
2. What is the main argument made in the article?
3. What is (are) the problems or conflicts or issues associated with this article?
4. What are the possible solutions/resolutions to these problems or issues?
5. Does the author use data in the article? If so, what is it, and where does it come from?

Name _____ Date _____ Period _____

News Article

6. What evidence or proof or support is offered by the author?

7. What possible biases or controversies are related to this article or author?

8. What are the advantages and disadvantages of this issue?

9. What is the best solution to this issue, and why?

10. My opinion on this issue is

11. The following information supports my opinion.