

WHAT ARE EFFECTIVE METHODS OF TEACHING CRITICAL THINKING  
SKILLS TO MIDDLE SCHOOL STUDENTS?

By

Heather E. Kimbrough

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Heather Kimbrough

has been approved for

The Evergreen State College

By

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Dr. Anita Lenges

### Abstract

This paper examines the effectiveness of teaching methods designed to engage middle school students in critical thinking. An examination of the history of teaching critical thinking reveals that despite a rich history of thinkers and philosophers of rational and critical thought, historically schooling has not taught critical thinking but instead obedience and recitation. A critical review of the literature found mixed results within studies at times. Positive results occurred when both teaching critical thinking as its own subject as well as within contexts such as: reading and writing, discussion, group work, computers, reasoning strategies, questioning strategies, and artistic expression. The most effective and motivating methods allowed students to express their ideas and involved content relevant to students' lives. The author provides suggestions for further research of effective and meaningful methods of teaching critical thinking skills to students.

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## CHAPTER ONE: INTRODUCTION

### Relevance/Importance of the Question

With a plethora of information on ways to teach critical thinking, it is important to not believe just any claim as to the effectiveness of any one particular method. Teachers are now teaching critical thinking using a variety of methods in middle schools and as early as elementary school. Knowing what methods of teaching critical thinking skills to middle school students are actually effective will prevent the use of popular but potentially ineffective methods. Why use ineffective methods and waste both the teachers' and the students' time? Right now, teachers are increasing their use of critical thinking strategies in the classroom. So, basing teaching decisions on research-based methods is vital to the facilitation of critical thought in students. The question this paper will seek to answer is: What are effective methods of teaching critical thinking skills to middle school students?

### Rationale

#### Personal Relevance

By exploring what methods of teaching critical thinking (CT) are effective and perhaps which ones are not, I can discover which methods I can apply in my classroom. I plan on teaching social studies and/or language arts to middle school students, with a mid-level humanities endorsement. Both the social studies and language arts disciplines have many opportunities to learn CT skills within them. Students are inundated with information from mass media seeking to persuade them to purchase merchandise; in addition, young adults watch and see a wide range of behavior in media, not all that is desirable. Further, as future citizens in a democracy,

students will need to know how to sort through information and hype to come to informed decisions for voting and other ways of participating as active citizens. Without knowing how to think critically and apply higher-level thinking skills, they might end up being victims to persuasion. This might lead to making poor decisions. They will need to be informed of national affairs to have in-depth conversations about issues that are being voted on in Congress or at the ballots and which will effect them and their families. In addition, my students will be future citizens of a global community and will need to sort through information in order to be informed of our role in foreign affairs and the interaction of nations. Thus, I believe that we do our students a great disservice by only having our students memorize information instead of using higher-level thinking skills, which they are both capable of and in need of in today's society.

#### Importance of question to educational community

A search on Google.com using the search words 'critical thinking' and 'teaching' came up with just more than 4 million hits. A search on Yahoo using the same search words came up with just more than 8 million. Amazon.com has 537 books or other resources that came up when using the same key words. With so much information now concerning teaching critical thinking to students, a teacher could understandably be confused or overwhelmed trying to figure out what advice works and what doesn't.

Yet states have standards requiring teachers to teach critical thinking. For example, the California Department of Education's standards for middle school social studies include teaching students how to distinguish fact from opinion, how to assess

the credibility of sources, as well as how to evaluate information. (California Department of Education website, 1998).

An example of a book for teachers that discusses the new standards states are moving toward is *Best Practice – Today's standards for Teaching & Learning in America's Schools* (Zemelman, Daniels, & Hyde, 2005). This book discusses cognitive standards, such as higher-level thinking skills, honed through such methods as self-monitoring of thinking and inquiry (inside front cover). Many teachers are changing their teaching to facilitate higher-order learning such as analytic reasoning, interpretation, metaphorical thinking, creative design, categorization, hypothesizing, inferences and synthesis. This review of the research literature will seek to challenge or validate this advocacy.

National standards for history include learning multiple perspectives, exploring open-ended questions, analyzing meaning, and evaluating arguments. This type of student thinking requires teachers use other methods than just lecture (Zemelman, Daniels, & Hyde, 2005). In addition to teaching critical thinking skills in social studies, the authors advise teachers to help students synthesize reading material, agree or disagree with the author of texts, hypothesize, and analyze materials. The organization responsible for these national standards is the National Center for History in the Schools (NCHS). It developed its standards in consultation with 30 members from such organizations as the National Council for Social Studies (NCSS) (NCHS website, 2004). In addition to the CT skills urged by the NCHS, the NCSS believes students should develop their own well-reasoned arguments. Learners also need to engage in critical historical inquiry to interpret the past, such as

analyzing the claims made by a variety of sources by validating and weighing the evidence (NCSS website, 2004). The NCSS urges students use these skills within the context of learning about persistent issues and recurring dilemmas in social studies. These thinking skills are at the heart of critical thinking.

In Washington State, the Essential Academic Learning Requirements (EALRs), which are used as benchmarks for student learning, require many of the same critical thinking skills as the national standards. For example, the 7th grade social studies EALRs require students to be able to interpret events and issues, ask historical questions, distinguish fact from judgment and opinion, synthesize and assess information, and propose alternative ways of analyzing and interpreting findings. (Washington State Office of Superintendent of Public Education website, n.d.)

Washington State's standards for other subjects have similar critical thinking requirements. The writing benchmark for grade 7 requires students to create logical arguments by writing analytically using basic and clear logic. Concerning the discipline of math, grade 6-8 EALRs require students analyze in order to verify results, make inferences and conclusions, and evaluate problems (Washington State Office of Superintendent of Public Education website, n.d.)

It is evident from federal and state standards that teachers are being called upon to do more than teach students memorization skills. They are being required to teach critical thinking abilities as an essential requirement. Because of this, it is important for teachers to know what methods have been studied and shown to be effective in teaching critical thinking skills.

From a cultural perspective, our modern society needs individuals who have critical thinking skills (Feuerstein, 1999). In response to this need, the 1990s saw educators trying to establish methods and teaching strategies to cultivate thinking skills in students. The idea that schools need to teach more than just memorization skills gained popularity (Feuerstein, 1999). This view of critical thinking involves more than formal logical reasoning skills. Forming judgments and values and seeing biases in sources is an essential part of critical thinking (CT) because it squares CT skills in the context of a student's life, not just in abstract formal reasoning skills, which may or may not be generalized to the day-to-day needs of students.

The various definitions of CT reflect the complexity and controversy in this area. Psychologists focus on the educational processes underlying students' cognitive development and deal with problem-solving and getting the most from thinking skills; whereas, philosophers tend to focus on logic and causality in thinking. Critical thinking also involves being aware of assumptions that feed into belief systems, whether those belief systems are religious, social, ethical, political or cultural (Feuerstein, 1999).

History, as it is taught in many classrooms, with its emphasis on memorizing facts, does not foster critical thinking. When a child memorizes a fact, and in the case of social studies, highly patriotic ones, and does not learn how to examine beliefs or arguments for rational backing, he or she is learning irrational thinking skills (Paul, 1990). As a result, "educators have a special obligation to scrutinize social studies instruction so as to identify nationalistic bias... Social studies is approached from multiple points of view by the experts in the field ... For students to begin to

understand the nature of social events they must engage in discussion of conflicting interpretations of social phenomena” (Paul, 1990, p. 14). This idea of viewing history from various perspectives is one of the criteria in the national and state standards discussed earlier in this chapter. In fact, for a teacher to make the decision for a student what is the correct frame of reference for viewing history is irresponsible (Paul, 1990).

### Literature Review

One particular review of the literature on critical thinking education showed that the body of research is growing concerning teaching students critical thinking skills. This body of research is informed psychologically and philosophically (Pithers, 2000). One area of this body of research involves fostering students’ ability to initiate questions themselves to pursue and research the question, think critically of the information they find and support one’s argument. Critical thinking in the reviewed research also involves logical thinking skills as well as the disposition to use thinking skills, such as making use of inferences and having a spirit of inquiry. The body of research reviewed by Pithers includes studies at the college level, although the research in this paper concerns only middle school students.

Pithers (2000) states that researchers have found methods that inhibit critical thinking skills among students, including traditional teaching methods such as lecture. A fallacy also circulates that there is one right program to teaching CT skills. But, most writers in the field agree that students must be involved in their own thinking and teachers should act more as facilitators. In addition, CT research is beginning to focus on content-specific CT skills rather than separate CT skills classes. Also,

teaching from multiple perspectives about an issue or concept is also gaining popularity and is being researched. Truth, then, is fluid and open to debate and not rigid and closed (Pithers, 2000).

Another theme in CT research is metacognition as a means to CT development. Such means include facilitating students to reflect on strengths and weaknesses of their thinking processes and teacher modeling of thinking (Pithers, 2000). Researchers have also explored ways to generalize CT across domains. Two different ways of teaching CT are also emerging: 1. high-quality and active teaching and 2. highly-structured but lecture/tutorial teaching. Problem-based learning has also emerged as a means to teach CT (Pithers, 2000).

#### Definition of Terms – What is Critical Thinking?

Literature reviews of definitions of critical thinking show that definitions of this concept vary. According to the study done by (Laird, 1990), the American Philosophical Association headed a long-term process of coming to a consensus among philosophers, educators and experts in critical thinking assessment as to the definition of CT. This is the finding from this study, called the Delphi report, “We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (p. 3). Laird further described these elements of critical thinking as having two components: the specific CT skills ability and metacognitive skills. In addition, people should have the propensity to evaluate evidence independently of one’s own viewpoint (Laird, 1990).

Another literature review of critical thinking methods listed the following as desirable CT skills:

1. Distinguishing between verifiable facts and valuable claims
2. Determining the reliability of a source
3. Determining the factual accuracy of a statement
4. Distinguishing relevant from irrelevant information, claims or reasons
5. Detecting bias
6. Identifying ambiguous or equivocal claims or arguments
7. Recognizing logical inconsistencies of fallacies in a line of reasoning
8. Distinguishing between warranted or unwarranted claims
9. Determining the strength of an argument (Burkhalter, 1993)

In addition, Burkhalter (1993) mentioned the Delphi report by comparing and contrasting the Delphi report with the skills listed above. The conclusions were that the Delphi report adds to the above list by including self-regulation of one's thinking, which has the purpose of being meta-cognitive of one's own bias.

Of course, these are the CT expectations for adults. For middle school students, a definition of CT must take into account the developmental level of adolescents. However, as mentioned earlier in this chapter, the Washington State EALR benchmarks for social studies for 7<sup>th</sup> grade involve many of the thinking skills mentioned above: interpretation, distinguishing fact from judgment and opinion, synthesizing information, analysis and assessment. Also, those listed in the EALRs for writing are: construct a logical argument, discriminate between essential, intriguing, or useful information and trivia, write analytically using basic and clear logic, and

construct a clear narrative or argument (Washington State Office of Superintendent of Public Instruction website, 2004).

So many of the thinking skills teachers are required to teach students in Washington State are quite similar to those listed by Burkhalter (1993). Some of these thinking skills are also in the three highest categories of Bloom's taxonomy of thinking skills. According to Bloom's taxonomy of thinking skills, which was developed by Benjamin Bloom in 1956, the following thinking skills are in the higher-levels: analysis, evaluation and synthesis. The highest level is evaluation, in which a student appraises, assesses, or critiques on a basis of specific standards and criteria; other terms used to describe evaluation in Bloom's are judge, recommend, critique or justify. The level below evaluation is synthesis. For this level, according to the Bloom's taxonomy, students create and combine/integrate ideas into a product, plan or proposal that is new to the students. Create, design, hypothesize, invent and develop are terms used to describe this level. The level below synthesis, according to Bloom's Taxonomy is analysis, which has the sub skills of categorizing, comparing and contrasting and separating terms. For analysis, a student distinguishes, classifies, and relates the assumptions, hypotheses, evidence, or structure of a statement or question.

For the purposes of this paper, I will consider critical thinking to be any of the following: evaluation, analysis, and synthesis. Included in these three main thinking skills are the following subskills: determining the reliability of a source, determining the factual accuracy of a statement, distinguishing relevant from irrelevant information, claims or reasons, detecting bias, identifying ambiguous or equivocal

claims or arguments, recognizing logical inconsistencies or fallacies in a line of reasoning, distinguishing between warranted or unwarranted claims, determining the strength of an argument, distinguishing fact from opinion, seeing stereotype, and proposing alternative ways of analyzing and interpreting findings. Also, the ability to be meta-cognitive of one's beliefs and a willingness to examine and change them when necessary will be considered CT. Since a sector of the professional literature concerning CT involves students thinking of their own questions to investigate and analyzing information found, this will also be one element of the critical thinking defined in this paper. Also, examining multiple perspectives of an issue is also considered CT in this paper.

Also mentioned in my thesis question is the matter of *effective methods* of teaching critical thinking skills. For the purpose of this paper, I will define effective as any instructional method used by a teacher that causes a qualitative or quantitative change that increases or develops the ability of a student to use any of the above critical thinking skills. A change must occur during instruction that increases a student's ability to use critical thinking skills, as evidenced by pre and post-assessment tests for quantitative studies; changes in qualitative studies can be documented through case studies using a variety of data sources. Evidence of critical thinking is defined in this study as various artifacts created by students such as essays or verbal expression.

#### Limits on the research critique

I limit my critique to research involving studies of students at or near the middle school level. Ages 10 to 15 is the range that I limited myself to in the studies I

critiqued. In addition, I limited myself to studies that involved the definition of critical thinking, as defined above.

### Controversies

Can you teach CT directly or does it require knowledge and subject domains?

Two main approaches have arisen from this question: 1. the 'skills approach' in which CT skills are taught that are not linked to any domain and 2. the 'infusion approach', which involves teaching thinking in a specific domain (Feuerstein, 1999).

In addition, the growing body of research literature concerning teaching students critical thinking is not un-contested. And, some researchers suggest that a teacher's conception of learning needs to be congruent with methods that effectively teach CT to students. If a teacher is more teacher-centered in instructional methods, then CT may be inhibited in students. Teachers who believe that teaching should be about facilitating understandings, concept change and intellectual development are better equipped to teach CT to students. This may be a point of contention as teachers may be forced to change long-held practices in order to teach CT effectively (Pithers, R. 2000).

## CHAPTER TWO: HISTORICAL BACKGROUND

In this section of the paper I will address the history of teaching critical thinking in schools. This history will include a cross-cultural view of thinkers who advocated and wrote about reason and other higher-level thought. After this, the section will review the history of American schooling as it pertains to critical thinking. Lastly, the current trends in schooling and critical thinking will be explored. Reviewing this history will set the stage for the subsequent review of the research literature in chapter three.

Western ideas of critical thinking date back to Socrates, who developed a method of questioning that exposed unsubstantiated claims to knowledge. His questioning required that a person examine the rationale behind peoples' opinions on matters. His ideas came from the context of the rhetoric of his times, in which he spoke out against those who spoke persuasively but without adequate evidence. Centuries later, intellectuals supported his ideas – mostly in the 18th, 19th and 20th centuries. These individuals included Voltaire, Newman, and John Stuart Mill (Paul, 1990).

The history of critical thinking expands across cultures. For example, India had a tradition spanning 2,000 years in advanced logic. Buddhist logicians held public debates. Philosophers from India had premises and conclusions in the form of statements of logic (Hongladarom, 1998). China also had its own indigenous critical thinking. The Mohist was a school of logic formed between 400 B.C. to 300 B.C., which discussed the nature of thought and reason. Chinese logicians similarly discussed logic and the nature of perception (Ronan's book, as cited in Hongladarom,

1998). It is clear from these examples that Western philosophers did not have a monopoly on critical thinking.

However, in America, when early European settlers established schools, critical thinking was not one of the goals. Spring (2005) writes that the founding of the schools was to maintain the authority of religion and government. From the earliest colonies of European Americans, students learned to read and write for the purpose of learning about religion. Religion was infused within the curriculum. The belief that one should let God do their thinking was prevalent (Spring, 2005).

Yet, the ideas had emerged in England that science, intellectual freedom and inquiry would help improve society. The American Revolution, with its ideas of political freedom, helped give birth to the idea of secular education in America. The writer Robert Molesworth, in the early 1700s, disagreed with the use of school for religious obedience and advocated separation of church and schools. Two of Molesworth's friends wrote in *Cato's Letters* about freedom of thought and speech. The *Letters* contained the idea that the more developed a nation was educationally, the more developed they were economically. The First Amendment contained the idea of freedom of expression and speech. So, some societal support for intellectual pursuits arose in the 17th and 18th centuries. These ideas influenced American thinkers, who established academies here. The academies served to support intellectual pursuits by giving students tools to develop knowledge (Spring, 2005).

Then another influence in American schools competed with the freedom of thought advocated in these academies: patriotism. In the 1800s, students learned reading, writing, math and patriotism. Very few teachers taught students to question

this patriotic inoculation. Such questioning of the assumptions underlying nationalistic goals was labeled as “anti-American.” At the time the country was in the middle of expanding both here and abroad. And, in what might have been written today concerning our national affairs, Paul writes that we were “a country on the make, with forests to fell, cities to build, foreign lands to seize, develop, civilize and, if possible, eventually to ‘democratize’” (p. 12). Issues such as whether the United States should govern other countries without their consent were talked about rhetorically by politicians, who espoused the idea that people could be dominated if they were incapable of self-rule. A public, used to appealing to biblical destiny, did not debate statements such as these (Paul, 1990). Horace Mann commented on the grave state of thinking when he said most students did not understand the meaning of the words they read. Reading in the schools, Mann stated, was “a barren action of the organs of speech upon the atmosphere” (Paul, p. 3).

America’s early colleges also focused on memorization. Students learned through rote repetition Latin, Greek and theology. These colleges began in the 17th and 18th centuries and were for the rich. Later, in the 1880s and 1900s, colleges prepared students of lower-socioeconomic classes in trades such as agriculture. Civic education within this context was nationalistic (Paul, 1990).

Teachers within early primary and secondary schools did not lead discussions in order to teach students to question their beliefs and examine arguments. Teachers did not teach analytical or critical thinking skills, as they also were raised to not think this way. Schools emphasized memorization of facts, the basis of academic learning at that time (Paul, 1990). In fact, American schools by and large have not supported

intellectualism. Our society does not value critical thinking and schools have reflected this value by not teaching critical thought historically.

The problem of schools being opposed to critical thinking can be traced to the very first schools of civilizations. Schools traditionally have served to indoctrinate and train members in the behavior norms and worldview of the society in which they are set. Most often these worldviews were religious. Very few schools have served to foster critical thinking. Paul argued that schools today still do not teach students to analyze, synthesize or assess information, but that a movement to introduce these skills to students has begun (Paul, 1990).

Professionals in the field have gone against the grain and introduced new ideas that challenged the emphasis on memorization. Dewey, in 1910, asserted that reflective thinking is active, persistent and carefully considers a belief or form of knowledge while considering the position from which they rise. His writings on education challenged the traditional schools of his time (Dewey, as cited in Feuerstein, 1999). Dewey wrote that existing conditions needed to be scrutinized in order to engage in reasoning. Thinking needed to include active participation in the ever-changing world that students live in and knowledge needed to be seen as not something that is only finished and in the past. (Dewey, 1944).

According to Paul (1990) critical thinking has become a movement in education. In 1986, the California State University system added a requirement that university students learn critical thinking skills. Two years later California's community college system added a similar requirement. Then, in 1990 all 8th grade

students were tested for critical thinking skills as part of their testing in reading/writing, math and social studies.

Is education moving away from the memorization of knowledge to a more reflective-critical stance based on Socratic principles? As mentioned in chapter one, today millions of articles, books and other resources exist on the internet discussing the topic of critical thinking and teaching. And, philosophers are trying to introduce multi-dimensional problem-solving and several frames of reference to counter traditional education's use of a single frame of reference when solving problems (Paul, 1990).

Matthews (1989), writes that now the nation is concerned with competition with countries such as Russia and Japan for higher test scores. Competition with other countries may have contributed to the movement in education to teach higher-level thinking skills. The emphasis on competition and bridging the gap between test scores of other nations and the United States led to the No Child Left Behind law (NCLB), which was passed by the federal government in 2002 and which mandated states raise the test scores of students. But controversy exists about whether this law has helped or hindered students' learning of critical thinking skills because of its emphasis on test scores. The Center for Public Education, for example, states on its website that one of the negative effects of teaching to the test is that it emphasizes memorization of content at the expense of critical thinking (Center for Public Education website, 2006).

The long history of critical thinking plays a role today in U.S. schools. Even though American schools have a background of traditional teaching methods such as

memorization, teachers are increasingly teaching critical thinking in our schools.

Methods that help teach students thinking skills are making their way into the classrooms. The thinking skills that many schools are now wanting teachers to teach are not new but rather date back to our earliest civilizations.

### CHAPTER THREE: CRITICAL REVIEW OF THE LITERATURE

A debate surrounding the teaching of critical thinking skills is whether teachers should teach these skills as a separate skill that can be applied across domains or whether critical thinking skills are context-specific. This chapter reviews and critiques the research literature surrounding these two different approaches. First, this paper critiques the studies involving context-specific CT skills, which is the category most of the studies fell into. Within each of these approaches, the specific teaching methods were also reviewed and analyzed. Second, research articles concerning teaching CT skills as separate skills are reviewed.

Of the research critiqued in this section, themes emerged concerning teaching methods. The majority of articles critiqued in this chapter concern language arts or history, so the following major methods reviewed should be viewed as not being an overall look across domains. The most common methods in the research reviewed for this paper included: writing and reading, discussion, teacher questioning, reasoning strategies, cooperative group work, computer-based inquiry/research, and artistic creations. Teachers or researchers employed and students participated in many more methods, which this paper discussed within each article review.

#### Critical Thinking Skills Taught in Context

##### Reading and Writing

First, this chapter reviews articles employing reading and writing as methods to encourage CT. Many of the researchers and teachers in the articles reviewed for this chapter used these two methods. The first of these studies involves the strategy of writing. Pouit (2002) designed a study in order to find out how giving students

writing structures could help students retrieve ideas from their memories in order to write effective argumentative essays.

Pouit (2002) studied 448 students from four middle schools and two high schools in the suburbs and city of Poitiers, France. Participants were 11-18-year-old students. Researchers divided students into four different age groups, 11-12 (n = 98), 13-14 (n = 109), 15-16 (n = 121) and 17-18 (n = 120). The students in each age group came from several different classrooms. The intervention took place during language art class and philosophy classes.

This study used various methods to illicit ideas from students' long-term memory. One method entailed students writing ideas for arguments to probe their memories, in a list format, then writing an argumentative essay; the second method was presenting thematic cues to probe and assess ideas in students' memories while writing the list. Another group wrote the essays with cues given during the essay-writing instructions. A control group wrote the essays without either method. Students took the tests with a time limit of 10 minutes.

The topic of the essays was favorite ways of vacationing. The 11-12-year-olds and the 13-14-year-olds received the following writing prompt: *Some students prefer going away to summer camp, while others would rather go on a vacation with their parents. Write an essay in which you explain your opinion while trying to convince a classmate who disagrees with you.* Researchers gave the 15-16-year-olds the same prompt but with *youth camp* replacing the words *summer camp* (Pouit, 2002).

For the groups who received cues during the list-writing instruction or during the essay-writing instructions, this was their prompt: *Some students prefer going*

*away to summer camp/youth camp while others would rather go on a vacation with their parents. Write down some ideas about this topic. For example, you might think of things like possible activities, relating to others, and money. I don't want you to write an essay; just jot down some ideas without making sentences* (Pouit, 2002, p. 312).

Researchers analyzed essays by dividing them into four different pre-determined levels: Level 1: texts that gave supporting details for one viewpoint only; Level 2: essays with supporting details for one viewpoint plus refutations for the opposing viewpoint; Level 3: elements of the first two but also at least one argument for the opposing viewpoint either refuted or not; if the essay had a refutation this was a rudimentary counter-argument; Level 4: the fourth type of essay had at least one fully-developed refutation of an argument for an opposing viewpoint.

The second way Pouit (2002) scored the essays was on their structure. This was coded as either aspectualization or topicalization. Aspectualization was main topic, subtopic and properties (describing aspects of subtopics). Topicalization was turning subtopics into new topics. Researchers counted how many topics, subtopics and properties developed the main argument and how many topics, subtopics and properties developed opposing viewpoints.

The researcher found middle school students, as well as high schools students, who wrote out lists of ideas before writing argumentative essays could write essays with more details to support their arguments. However, students did not write out more overall arguments, so the study achieved mixed results.

The method in which researchers gave students cues caused students ages 11-16 to write a higher percentage of level four essays compared to when only writing lists and the control group. For ages 11-12, 16.32% of students in the cue group wrote essays that presented counter arguments plus refutation. Only 6.12% in the group who didn't receive cues wrote level 4 essays. Although, a higher percentage of 11-12 year-olds wrote level one essays when receiving cues than students who did not, giving the study mixed results for this age group. For 13-14 year-olds, a higher percentage of students wrote Level 3 and 4 essays after receiving cues than students who did not. Approximately 20.75% wrote Level 4 and 18.86% wrote Level 3 for the cue group and approximately 18.18% wrote Level 4 and 16.36% wrote Level 3 in the group who did not receive cues (Pouit, 2002).

What is interesting is that students who did not make a list before writing generated more topics than students who did, for the ages 11-12 group  $F(1, 432) = 4.34, p < .03$ . The authors concluded that making the list had no effect. No noticeable effects were obtained for the 13-14 year olds or the 15-16 year olds who used lists compared to those who did not.

The researchers in their conclusions stated that the use of cues were not statistically significant. The authors further stated that students in the 11-12 age group did not apply the knowledge transforming strategy and so did not write elaborate texts, despite that 16% of students receiving cues wrote at the highest level of argumentative text. Pouit also reported that the quantitative aspects of the essays were improved with the methods used but that the qualitative aspects were not. The researcher stated that trying to retrieve ideas from memory was not that crucial to

writing argumentative essays. Because of these results these methods might not be that crucial if teachers are trying to improve the qualitative nature of arguments in persuasive essays. For teachers, the use of cues would probably need to be used with another method because of the results of the study.

In addition, the students who generated only the lists first did not receive the part of the prompt that asks the student to persuade someone of a differing opinion. Also, the report is confusing as to who received which prompt. Because some students were prompted to think of the opposing viewpoint and others were not, this would affect the results of the qualitative measure of the essays. For example, students who received the prompt telling them to consider an opposing viewpoint might have written down ideas with persuasion in mind versus just listing down ideas. So, there seemed to be some inconsistency in prompts. Aside from this, the methods of the study were well designed and the analysis of results seemed thorough.

Another researcher, Werle (2004), also used writing as a method to encourage critical thinking. While the writing strategies in the first article critiqued, Pouit (2002), involved list making and essay writing, with the additional method of giving students prompts, Werle (2004) used a free-write method. Pouit's prompts asked students to argue for summer vacation spots, which might not have been that controversial of a topic to students. Werle, rather than using a topic that was potentially mundane to the student, used a topic that was of concern to the students' well being – violence and its impact on the individual.

Werle (2004) designed a research project to help answer the question: *What is the response of middle school students to hearing about the lived experience of*

*violence?* The researcher wanted to find out if free writing in journals would illicit critical reflection from the students.

Participants were 13 8th grade students, ages 13-15, seven boys and six girls. The students attended a public school in Western Massachusetts. The class had 12 white students and one of mixed race of an unknown composition. The students had mixed abilities. Twenty-four percent of the students in the school were on free or reduced lunch.

After hearing stories from four different adults who had either experienced violence as a victim or as a perpetrator, students wrote down responses to prompts without any format for 2 minutes. The students heard the stories from veterans and a victim of violence over a 6-week period. They heard four stories, each 50 minutes long. Example questions were: *What was your response to the story? What was the main message of the story? What were the storyteller's attitudes about violence? How did these attitudes change as a result of the storyteller's experiences? What did you like about the story? What did you dislike?* The questions at first glance asked for inference, comprehension, opinion or judgments and an expression of feelings (Werle, 2004).

The author used free-writing in order to help students explore their thoughts and reactions and to develop critical thinking surrounding violence. To counter potential violence from or toward students, the study sought to tell stories with more realistic consequences of violence. Victims of violence told their stories as part of a violence prevention curriculum, *Get Real About Violence*. The storytellers, three male

Vietnam veterans and one female abuse survivor, were trained to talk in schools to deglorify war and violence and to help students develop critical thinking skills.

The veteran storytellers, ages 55, 56, and 55, told stories of killing people in Vietnam and other acts of violence. One man, in particular told a graphic story of killing, in which he described realizing he had done something horrible and how it cost him psychologically. The adult victim, 52, discussed living in abusive situations for a long time.

This qualitative study analyzed writing samples using constant comparison and grounded theory. The data sources were classroom observations and students' written responses. A co-researcher helped analyze student responses as well. They took notes on the responses, coded them and then sorted them in emerging categories: insight, emotional responses and positive perception. The categories were congruent with literature on the results of free-writing, so it is unclear whether the categories were completely emergent or were taken from previous studies.

The results reported included examples from each of these categories. The example statements by students that were coded as insight seemed to involve the thinking skills of comparison of two situations, inference, analysis and seeing patterns. In one example, a student responded, "Al will have to deal with his actions for the rest of his life" (p. 84). This statement, depending, on the context, could be the result of several different critical thinking skills. Another statement from a student in the study showed that the student has changed his or her thinking: "He really changed my perception on how hard it is to kill someone and how much we want to hold onto life" (p. 85). This statement shows a students' perception of violence was changed –

that he or she had re-evaluated an old perception and, using information from the speakers, modified it.

Other conclusions the author made were that students responded on an emotional level and expressed positive responses. Examples of emotional responses were students expressing sympathy, empathy, sadness, shock and hope. Students also distanced themselves emotionally from the stories. The reason for this would have been an interesting area to explore but was beyond the scope of the study. Students wrote that the stories were interesting, fun, and engaging. The emotional responses spoke to a component of critical thinking that has not been explored very much. What emotions are involved in a student going through the process of critical thinking and how can teachers handle these? Studies later in this paper explored the social and emotional aspects of critical thinking.

For the responses coded as positive perception/engagement, mostly students stated what they liked or disliked about the speakers – stating pros and cons. Some students backed up their opinions with qualities of the speakers.

Werle (2004) concluded that students were engaged in personal meaningful learning in which they actively processed ideas and drew conclusions. The statements from students might or might not support these findings, depending on the actual statements the speakers made. Two minute responses to each prompt do not seem like enough time to process ideas and draw conclusions. Further more, with the exception of one speaker, students listened while the speakers talked.

After the author summarized the stories that the storytellers told, it seems that some of the insights reported from students did not originate in the minds of the

students but rather could have been a recall of the insight the speakers told them. For example, one student wrote that ‘mental armor’ was a shell around your feelings that prevents you from being able to feel love or other emotions. In the summary of one of the veterans, Werle writes that a veteran discussed how mental armor is a “wall around your emotions” and how he was not able to break through this when he returned from war and this affected his relationships (p. 85). Here, it seemed the student was summarizing what the speaker said. It was unclear as to how much thinking the student actually did.

Other examples of student responses such as “recognize red flags and warning signs of abuse,” and “there is help available if a person is being abused,” seemed like something an adult might say and does not necessarily require critical thinking skills (p. 84). Actual transcripts from the speakers would be needed to determine what statements were made.

Although a student might state a judgment or opinion, what is probably a better indicator of critical thinking is whether the student had thought through evidence, criteria, or weighed pros or cons to arrive at this judgment or analysis. By doing so, the student then might be able to go onto other situations and think critically by her or himself because he or she has gone through the process of critical thinking and so would learn more than if he or she had not.

The third article in this section involved both reading and writing. In Gillespie (2005), the author taught critical thinking and depth of understanding through a unit in which students wrote in multiple genres. As described in the article, students wrote in multiple genres then reflected on their writing in a final portfolio brochure.

Seventh grade students at an independent suburban Maryland school participated in this article. The teacher in the article, who was also the author, modeled the multigenre approach to writing by showing her own multigenre piece based on the book *Pigman*. The teacher wrote a letter to a character from the book, an essay on slang terms in the 1960s, and a fictitious letter from a counselor to parents of a character who was misbehaving in the book. The teacher showed her booklet made up of these various genres of writing, while explaining her frustrations while writing the pieces.

Students then brainstormed genre ideas, coming up with 47 of them. Examples of the genres brainstormed were: advertisement, advice column, book review, business letter, comic strip, diary/journal, editorial, greeting card, hymn, news article, monologue, ransom note, song/rap, and travel guide. Next, the teacher conducted minilessons on the mechanics of writing, such as dialogue and punctuation as well as a Japanese form of poetry.

Students then read the book *A Single Shard* (Park, 2001). They then wrote 10 pieces in seven different genres, plus wrote a reflection for each, explaining how they came up with the idea and its connection to the novel. The teacher gave intermediate deadlines for students, so that students could share with each other what they had written.

Gillespie (2005) found the multigenre approach promoted concept attainment by asking students to think deeply about the novel and to understand various genres of writing. In addition, the author reported that students engaged in some critical thinking skills. Their writing was “insightful, imaginative and playful” (p. 861).

Students also evaluated their own choices and the book during the writings. In many student responses, students wrote about events in the book concerning moral dilemmas. One girl debated the pros and cons of 'regifting' in order to come to a judgment on the matter: 'what seems right does not always turn out to be right. Making the distinctions between right and wrong can often be hard.' She is seeing beyond black and white concepts of right and wrong here. Another student wrote a fictitious suicide note and reflection, in which he analyzed the novel from another point-of-view. He stated that this allowed him to take on another perspective in which he thought of why the character did not commit suicide. Here, the student grapples with a character's motive in an effort to interpret why a character acted as he did.

Another student discussed her reactions to how girls were not allowed to do pottery in the book and how her shock led her to write an essay on the matter. The student critiqued the social customs portrayed in the book and also mentioned the feelings accompanying that critique. Gillespie (2005) stated that being allowed a choice in how to respond to the book empowered the students. The author also mentioned that having an audience of their own peers helped motivate them.

The overall results were that most students demonstrated critical thought in their responses but some did not. The author stated that this result was to be expected in a class with heterogeneous grouping. However, this does not take into account the methods or lack of other support for students in the study who did not demonstrate use of CT skills and how these factors might have led to such results. This lack of discussion of such matters might have been the result of the author also being the teacher. Because of this, interpretation of results may have been biased. In addition,

even though the article was not a formal study, there was no mention of how data was collected or analyzed, other than a reading of student projects.

Still this article contained credible information about how student products demonstrated critical thinking skills. The teacher and results from students indicate that the teacher regularly encouraged students to respond with their own thinking. Transferability of the results might be dependent on how much students in other classrooms are similarly allowed to respond freely and with critical thought. Teachers attempting writing in multiple genres might have to consider how much scaffolding and encouragement of critical thinking students would need in order to achieve similar results as Gillespie.

These three studies researched the ways in which writing could be used by students to develop thinking. The process of writing itself served as a medium for students to process their thinking about literature and other topics. Each study used additional instruction strategies, such as modeling, cues and prompts and minilessons to scaffold students during the writing process. Certain studies used scaffolds more than the others. In addition, one study used literature as the medium students thought about during the writing process. Another study used presentations or prompts as the medium. Studies reviewed in subsequent sections of this chapter also utilize literature and other material in combination with the main methods under study.

## Discussion

The second method researchers used in the articles critiqued in chapter three was discussion. While the studies reviewed in the first section used writing and

reading as the major mediums of critical thinking, this section reviews studies using talk, or discussion as the main avenue for CT.

The first article critiqued in this section is Bowser (1993). Bowser wanted to help students ask questions rather than answer them as well as talk more in class. She included in the article 120 8th grade students of mixed abilities, races and cultures. This author/teacher designed a unit based off of student conversations in an effort to make learning relevant to the student. One day she heard students talking about a television show in which the main character finally learned what his father did at work and gained insights into his behavior at home. So, the teacher invited the students to discuss the topic in class. This discussion turned into an assignment to find out what their parents did at work; the talking also served as a pre-writing strategy in which students thought and talked about ideas without pressure. Bowser found some stories about people on the job for students to read to supplement their discussions. One of the stories was on paper route carriers, which many students in the class were. The unit also involved watching a movie about work life. Students also selected the people they wanted to interview. Many chose their parents and some chose school staff.

The teacher's most effective role is in providing circumstances in which children can discover for themselves what they need to know ... We spent an entire period listening to anecdotes about delivering the news because I felt it was important to let students know that conversation is an essential component of language arts, required of functioning adults (p. 38).

The students met in small groups to create 25 questions each to ask their parents. They then reported out to the class, reading their questions. Students were free to use any questions that the students said, thus sharing knowledge. Bowser also taught interview techniques. After students wrote their interviews of parents, they read them aloud to the class and the class and teacher critiqued them. They evaluated the narratives for whether the answers were probed to give the reader clarity into the question asked. The teacher gave some suggestions on how to probe answers. This is an example of discussion as a method for students to explore critical thought. Students verbally evaluated each others' writing using the criteria of whether they probed answers thoroughly or not. Students also were able to ask each other questions that potentially could scaffold other students to create better interview techniques and better narratives.

Next, students reviewed each other's papers in groups. Students and teacher discussed ways to give positive and constructive feedback. This gave students more opportunity for social interaction as well as more feedback on the writing process. Students shared insights they came to either on their own or after hearing each others' narratives.

Finally, students read their final drafts to each other and voted on which ones they thought were the best. Bowser (1993) agreed on students' choices, stating, "people know good writing even if they don't write that well themselves" (p. 39-40). In addition to the final drafts, students wrote several journal entries of what they would do for a living at certain ages. What was interesting in the responses and in the discussion afterward about them is that all girls wrote they would be married in the

future and all the boys wrote they would be single. The class noticed this pattern as well as the teacher, by reading them aloud and discussing them. Noticing patterns and naming them is an important aspect of analysis.

Some students were anxious during the 3-week unit because the activities were new to them and some complained they weren't 'English'. This led the teacher to ask: "What is English"? Another student replied that English was "reading and nouns and verbs," while another said "spelling and vocabulary, too" (p. 41). The teacher then discussed how important it was to challenge yourself.

Bowser (1993) stated, the study overall, "was an attempt to integrate talk and writing, questioning and discussion, and learning as a shared responsibility between students and teacher. I'm still refining the model, still exploring the role of talk in the classroom" (p. 41).

The decision to vote on the 'best' might have left those students whose narratives were not chosen feeling bad, especially after the amount of effort the students appeared to have put into them. This was an interesting choice on the part of the teacher. The study does not mention if the discussions were recorded and coded in any manner to see how much overall critical thought occurred in the discussions. This might have been because this was not the stated focus of the study but a byproduct of it. Yet, the teacher allowed many opportunities for students to engage in discussion. How well students evaluated each other's assignments was not mentioned. These results would allow the reader to see what the quality of student evaluations were since these contain critical thinking opportunities.

In the second study of the discussion section, conducted by Lynn, Johnson, and Hassan (1999), students engaged in critical debate but also read literature as a medium to spur thought. This collaborative, participatory case study sought to study the beliefs behind a teacher and his efforts to teach his students critical thinking and moral development. The case study also sought to show how the ‘emancipatory pedagogy’ of the teacher in the study helped students develop critical consciousness.

Sixth and 8th grade students from New Road’s La Cienaga middle school participated in this study. The private middle school was set in an affluent and mostly African American neighborhood, Baldwin Hills, in Los Angeles. Approximately 88% of the students at La Cienaga were African American and middle to upper class. Class sizes averaged 12 students and teachers gave personalized instruction. The school was small, with only five classrooms. With plenty of resources, this school had the freedom to adopt curriculum that focused on social justice. The purpose of the school was to create social critics of students. In order to achieve these goals, the school attempted to help students develop critical thinking skills with the purpose of positive social transformation (Lynn, Johnson, & Hassan, 1999).

This portraiture case study was part of a larger ethnographic study. The qualitative research included observations of classroom sessions and interviews over a 9-month period. Sources of data included classroom observations, single and group interviews, informal conversation and brochures or other materials featuring the school. The data was analyzed and categorized systematically, using emancipatory theories and thematic structures.

The teacher under study, Hassan, believed in emancipatory pedagogies and had an activist background. He taught 6th and 8th grade humanities. Hassan engaged students in on-going classroom debates on oppression of African Americans, Mexican Americans and Guatemalan immigrants; the teacher used diverse literature such as *I, Rigoberta Menchu*, an autobiography about a Guatemalan woman's struggles against racial oppression. The teacher had students make connections between the oppression of Menchu and their own experienced oppression. The teacher's classroom had seven tables with two chairs each, with the goal of encouraging dialogue and engagement.

Students also watched the movie *Africans in America*, a public television series; the students then wrote essays and Hassan led them in critiquing the essays through student dialogue. This dialogue led them to discuss denial of rights for African Americans in U.S. history. Another video students watched was one of a mock debate over legislation that would deny the use of schools and hospitals to illegal immigrants. Students took notes on issues in the film then presented opinions on them.

Hassan used student contributions to build on his lessons during discussions; he continually focused students' attention on the concept of internalized racism, without naming it as such during several class periods. When students discussed African Americans calling one another racist words if they had darker skin, he wrote comments from students on the board and asked questions to scaffold students to reasons for this internalized racism. Students made hypotheses about reasons for the name-calling.

In a subsequent lesson, to continue the concept of internalized racism, students listed who they thought were the most beautiful African American women. Then, students discussed with each other their choices. The teacher then stated that the theme of all their choices were light skin and small noses. He then stated: “Most of us think that the lighter you are the better you are ... we should not think that way” (p. 50). The teacher was attempting to have students realize their “uncritical notions about race and skin color prejudice” (p. 50).

Through more dialogue, students continued to discuss the concept of internalized racism, making judgments based on the ideas the students and teacher vocalized. They asked each other questions and also made hypotheses and inferences. Hassan used statements and questions to scaffold student thinking towards critique of racism (Lynn et al., 1999).

The researchers conclude that the results helped students achieve more because the topics debated were relevant to them. The results reported throughout the case study include students engaging in making hypotheses and making judgments during critiques of social justice issues. Lynn et al. (1999) reported that some students were able to counter their internalized racism and become more accepting and aware of themselves and racism. This approach to learning involved a social and personal purpose for critical thought.

However, during interviews, Hassan said he was concerned his message was not getting through and that he was working against societies’ influence on student thinking and behavior. He still had doubts of changes in student thinking about social inequalities. This might have to do with his approach, which involved him telling

students at times what they should not think, rather than placing the responsibility for developing critical thinking on the students' shoulders. Telling students what they can't think is antithesis to critical thought. For example, in the piece of dialogue above discussing skin color, the teacher drew the conclusions or concepts instead of having students do this thinking for themselves. While the teacher had worthy cause for engaging student in becoming more critical and aware of racism and other social justice issues, the approach toward instilling awareness in students was more of one of asking students to believe what he believed rather than having students engage in debate with each other. The teacher's approach seemed to include a lecture quality rather than discussion among students.

The method of discussion in this case study then seemed to place the 'ball' of the discussion in the teacher's hands rather than comments and questions back and forth between students. This brings up an important question, which is: What does discussion look like in the classroom? When does discussion actually become lecture? These questions will be explored in the subsequent critique of discussion articles.

This critique is not meant to ignore the influence of powerful racist realities, which affect students and their thinking. These influences were mentioned by the teacher in this study as well. The students still engaged in such skills as hypothesis making, forming opinions and debate.

In this next article, Wilson and Clark (2000) studied the use of art critique through discussion and other means. Their question was: what are the procedures and strategies used by an experienced teacher of middle school students to look at and talk

about art (LATA). The study included 7th and 8th graders, ages 12-15, in art classes, in two different groups. One class studied was a regular required art class with 7th graders and the other was an advanced elective class for 8th graders. Most students did not have experience in art discussion prior to the study.

The teacher studied, Gilbert Clark, had written about art education practice extensively and had taught art for 20 years. Clark had developed, over the years, methods for looking at and talking about art. The purpose of the strategies of LATA was to encourage open and interpretive dialogue without requiring too much of an art background. The main goal was to see how questions about art could be complex. The teacher also wanted to increase student confidence in dialogue as well as a beginning-level understanding of the attributes of art (Wilson & Clark, 2000).

The researchers used qualitative case study methodology; they used content and comparative analysis to report and interpret the data. The multiple data sources included observations of class sessions, audio taped and videotaped class sessions, transcripts from five interviews of the teacher, and notes from the observations. The interactions between student and teacher were studied during six 45-minute classroom sessions, three of each group. Researchers reached consensus of what had occurred in the classroom through an interview and re-interview method of the teacher.

Students sat in groups of four or five at large tables, which were sometimes arranged in a U-Shape around the chalkboard. Clark selected the art images for discussion so that students might be able to relate to them and be interested in talking about them. They were landscapes and portraits from a diverse set of artists: El Graco's *View of Toledo*, Dorothea Lange's *Migrant Mother*, Diego Rivera's *Agrarian*

*Leader Zapata*, Mary Cassatt's *In the Garden*, Pablo Picasso's *Woman with Cape*.

The teacher used large prints of these and taped them to the board during the sessions.

The teacher studied in Wilson and Clark (2000) believed “human interactions and social/emotional responses are critically important because a major goal is to have students become aware of their cognitive abilities and of other people’s reactions to works of art” (p. 44-45). This involved responding to student contributions to the discussion with positive remarks, to encourage students to respond as well as to gain confidence.

The researchers analyzed student and teacher statements during discussions and sorted them into pre-existing categories as well as ones that emerged from the study, in a constant-comparative process. Then, the cards were analyzed for patterns of interactions and procedures of the teacher. Researchers found the teacher used the following methods and strategies: pre-discussion, behavior management strategies, introductory and closing procedures, discussion strategies and review of student responses, and encouragement of higher-level thinking skills such as analyzing elements of art and evaluating them for social and political meanings (Wilson & Clark, 2000).

Clark had the following specific strategies, which structured discussions: 1. initiating questions at the beginning of discussion and switching the path of a discussion. These questions were: open-ended (Tell us what you first noticed in Childhood Garden), asked students for their preferences about the art (Which of these would you like to have at home?), and asked for votes on agreement with another student’s response (How many of you agree with what she just said?), The teacher

used student responses to guide the discussion by using them as topics. He also encouraged several responses to each question. In addition, he used questions to continue dialogue, asking students to add to other students' responses. Another strategy he used was the recitation method, in which he asked a question and a student gave a short answer. Clark had students compare one piece with all the other pieces as well as compare two pieces to each other; he focused students' attention on one aspect of a painting. Students also voted on aspects of what they thought were the artists' intent; they also discussed their likes and dislikes. These categories of strategies used by the teacher were similar to the categories of the pre-existing LATA model. The LATA model, which includes the above strategies, was used to compare and code the strategies used in this study.

The authors' analysis of the interactions between student and teacher showed students became more involved in the discussions and used higher-order thinking skills as well as gave more sophisticated responses the longer they were involved. Students gained confidence in voicing their opinions and analyses. As a result of the discussion methods, students analyzed elements of the art and interpreted art based on their analysis. For example, they came up with reasons why a particular painting was 'disturbing'. Students made judgments and supported those judgments with evidence from the paintings they had analyzed (Wilson & Clark, 2000).

However, it seemed the discussions might have been primarily teacher-directed, with the teacher asking questions and the students answering them and then the teacher responding. The example dialogue the authors included bore out this pattern. This focus on teacher direction is similar to the previous study critiqued,

Lynn, Johnson, and Hassan (1999). The example dialogue counters the authors' conclusion that students had most of the responsibility for the direction of the teacher-guided activities. Yet, the conclusion that students were encouraged to express their opinions and ideas was supported by the example dialogue and methods used. But for students to have responsibility for the direction of the discussion, there would have to be less teacher interjection within the discussions. The teacher was clearly in control of the direction of the discussion dialogue used in the example. This does not mean that students were not able to think critically during these discussions.

In addition, in the closing discussion, Wilson and Clark (2000) stated that when teachers use the methods in this study that students could go on to have discussions of more sophisticated art topics. This statement might not be supported for several reasons. One, this study did not observe the students in subsequent discussions in the art class. With observing three sessions each, this is not enough time to do such things as a delayed post-test. Second, this was a case study, so generalizing results to other settings is not very founded with the evidence presented. The authors may have been making reference to other studies that did in fact find that students could progress to discussions about more advanced art topics, but that was not stated.

The next study involving discussion methods, Stevens (2001), is a qualitative study that researched students' media critical thinking skills. Stevens (2001) studied three questions: What planning must occur that is unique to popular culture lessons? How do lessons incorporating popular culture fit into existing curricula? And how

will students respond to bringing more personal discourse communities into their classrooms? The third question was reviewed for this paper.

This study involved middle school students in 6th grade (social studies), 7th grade (language arts) and 8th grade (science classroom). The author collaborated with the three teachers from these classrooms, in the same school, to integrate critical dialogue into their classrooms.

Instructional methods included discussion formats, inquiry approach, student choice, and group work/presentations. In the science classes, students applied analysis concepts to movements in movies in order to evaluate the scientific nature of the movements. All the teachers were able to have discussions and explore school subject matter with popular culture inclusion. An example of one activity reported was that in the 7th grade language arts class, the students identified and examined themes across multiple sources, including song lyrics, books and movies. The material made a strong connection between students' lives and classroom subjects.

A second example of classroom activities was from the 7th grade social studies class: students used inquiry and examination of radio, television and movie clips. This inquiry process involved exploring and answering specific questions: a) What is the piece of popular culture? b) Who is the intended audience? c) Who is not the intended audience? d) Who stands to benefit from it? e) Who stands either not to advance in society or even to be hurt by it? and f) What does this popular culture and its positioning say about US society at large? One of the elements of critical thinking used in these questions was determining the reliability of a source and detecting bias. Students had to have examples that demonstrated the point they were making.

Stevens (2001) found students were able to analyze and interpret movies and books as well as analyze movies for scientific validity. They took a critical stance during this analysis. In general, researchers found students responded to inclusion of popular culture in the curriculum with a noticeable increase in engagement. The author also reported students used the following thinking skills: application, interpretation, compare/contrast, hypotheses making, writing down conclusions and confirming and rejecting hypotheses, synthesis and analysis. Students had difficulties discussing themes across multiple sources and needed scaffolding to make these connections. The synthesis required scaffolding from the teacher. In addition, not all the students were able to give examples when making judgments about the reliability of sources (Stevens, 2001).

Unfortunately, not many details were used to show specifically how critical thinking occurred, so it was not possible to tell how students did so. In addition, the author did not state explicitly what the research methods used were. From the examples in the study and by how the study was reported, the researcher seemed to have used observation, student and teacher interviews, and recording of interviews. But, since the author does not discuss details about the research methods, it is difficult to critique this aspect of the study.

In this next study, Powell, Stuart, and Makin (1994) wanted to build on studies that helped learning disabled students problem solve with math. The authors wanted to see if they could improve moderately learning disabled students' metacognition and control of their math learning by using non-traditional teaching methods, such as discussion.

Students were enrolled in a school for students with moderate learning disabilities in Britain. The 10 students who participated in this study were in a math class taught by one of the authors. They had a history of low academic achievement and sometimes behavior problems. The class had eight boys and two girls, ages 12-13. The students had varying degrees of low self-esteem about schoolwork and the authors characterized the students' attitudes at the beginning of the study as "nervous defeatism" or "aggressive rejection". The participating students also had a range of social skills, abilities and attitudes. They typically had low levels of verbalization during math tasks.

The school adapted its curriculum to the individual needs of the students. The study used a teaching program that focused on reflection and humanistic needs, not just academic ones. The teachers involved wanted to raise self-esteem, which they saw as a prerequisite to students seeing themselves as effective problem solvers.

Students met three times a week for 2-hour sessions. The teachers divided the sessions into three parts. The first part was a 10-minute opening meeting, when students discussed their math work from the previous session as well as outside contexts involving math, such as in the home; they did so in an open-dialogue format with chairs in a circle. The teacher prompted students to be positive about others' contributions and to praise and accept. The teacher also encouraged students to develop contributions from other students.

The second part consisted of the math work, in which the teachers encouraged students to give descriptions of their math work and thinking processes as they progressed through problems. Students worked in a variety of ways: individually, in

pairs or in small groups. The format of this middle part of the session was not regimented, rather students worked on a variety of problems adapted and designed for students' needs and abilities. In addition, the teacher circulated during this time, working with students one-on-one or with pairs or groups. Each learning situation was organized around the math problem. For example, one group worked together to build a three-dimensional object with materials. Students also made graphs. One teaching method was that the teacher asked students to explain how they made their graphs or other artifacts. This kind of talk by the students is something they did very little of before the study (Powell, Stuart, & Makin, 1994).

During one-on-one conferences with students, both the teacher and the student worked collaboratively to type up students' descriptions of their work, which involved rephrasing and making additions if necessary. The teacher modeled reflection. Teachers also listened to students' communications of their own thinking processes; the teacher commented on these statements to help students become more metacognitive.

The third part of each session was a 15-minute debrief evaluation session in which students recorded their progress and then shared this with the rest of the class. Dialogue was also part of this last session and this was done in a circle, like the opening meetings. The teachers structured this 'evaluative weighting' by asking students to evaluate their work, by considering the following aspects: how work was organized, materials, how they dealt with problems and feelings, and how they related to others. Students rated each area on a five-point scale. For this evaluation session, the teacher allowed students to use multiple ways of presenting. For example,

students could draw visuals to present or collaborate and then present verbally in pairs. Teachers asked questions to encourage students to see their role as problem solvers. For example, the teacher asked one student: “So you learnt some of the advantages of using string, measure and some of the disadvantages.... You learnt from the things that went wrong didn’t you?” and “Can you tell me why you chose this way of measuring” (p. 11)?

The research methods used by Powell, Stuart, and Makin (1994) to gather data included taping of sessions, field notes, student work samples and self-evaluations. The researchers found the taping did not pick up sound very well and was too intrusive so they relied on the note taking and recorded only specific sessions. From these three methods, the researchers analyzed the data. The data was analyzed for metacognition, descriptions of their own problem solving, and how students evaluated themselves. In addition, the data were analyzed for five modes of interaction that were pre-determined from previous research of Phillips (1985). These modes included hypothetical, experiential, argumentation, operational, and expository.

The researchers’ analysis of the data showed that the shortest statements made were in operational mode and often made among peers. The authors concluded that these statements were not reflective or used for planning purposes. As the study progressed, students increased their use of hypothetical and experiential interactions. The researchers stated that these latter two modes involved reflection and evaluation (Powell, Stuart, & Makin, 1994).

During the opening sessions, the authors found that some students began to ask other students about their math work. The discussions also allowed some students

to verbalize the problems and students learned from each other about strategies to work through problems. Powell et al. (1994) noted that during this opening session, students were beginning to talk about their own creative ways they worked through math problems.

For the middle section, teachers found that students organized their work by writing down their ideas about it with the help of the teacher. During this writing process, students became aware of their thoughts and organization of the tasks. The authors found that discussion helped students to think and talk about their own thinking. This was evidenced by the fact that when students revised their original writing of their progress and work descriptions, they were able to extend their ideas (Powell et al., 1994).

For the third part of each session, the self-appraisals, students became more aware of the difficulties they were having on tasks, which helped them evaluate their work. Students also learned about their control of their learning process and strategies for tackling problems.

Results varied depending on the student though. One student made no gains; he mostly restated facts during the closing activity throughout the intervention. The teachers also found that students varied on how much help they needed to reflect or collaborate. Lastly, the author stated that a follow-up study would be needed in order to assess the long-term change in students' reflective thinking skills.

The overall conclusions by the researchers were that students generally improved on tasks and metacognition skills. Students with learning disabilities were able to reflect on thinking and learning, which was affected by the emotional and

social aspects of the program. The authors also reported that the mutual trust developed between teacher and students was necessary to this success.

Several problems exist with stating that the emotional and social aspects helped the students' metacognition. Since no control group of a session that included social and emotional support existed, it is not possible to see if students could have made the same gains without these. In addition, there is no mention as to how the authors recorded the trust of the students to see how much developed. The reliance on notes taken by the researchers right after each session has several potential problems as well. The researchers stopped recording all sessions before the intervention was complete because of technical problems and possible study influence. Without this form of data, it seems like it would be difficult to make exact counts of the modes of interaction that the researchers used to code transactions. The researcher notes of their memories of the sessions could contain some error of how many times the students used each mode of interaction. So, when the researchers reported that students increased in the amount of hypothetical and experiential interactions, the reliance on field notes without transcripts needs to be kept in mind. However, the use of the written student self-evaluations to monitor increase of metacognitive skills seemed a more reliable form of data collection, which helped support the conclusion that the students improved in their metacognition skills. The written evaluations of the students were straight from the student and not remembered by the researchers through memory. They also helped to back up teacher notes from the discussions of the self-evaluations.

This next study, Gruber and Boreen (2003), used discussion to study how students use prior knowledge in literacies to critique social issues. These social issues included gender issues, stereotyping and influence of popular culture. This case study examined how students both interpreted literature and engaged in critical perspective taking. Gruber and Boreen also hypothesized that students' experiences and previous literacy activity would influence how they read, interpreted and wrote about a text.

Participants included 27 8th grade students, age 14, from an English class in a school in England. Their socioeconomic status ranged from lower middle class to upper middle class. They were 60% White, 15% African American and 15% Asian. Several were from Pakistan and Saudi Arabia. The study included 15 females and 12 males. The study also included college students but this was not the part of the study reviewed for this paper.

The teacher in the study read one chapter a day of a book, *The Witches*, to her students, the story of a boy who goes to live with his grandmother after his parents die. Topics of discussion included personification of evil, gender stereotypes, prejudice, and the influence of popular culture on student perceptions of identity. Instructional methods included the teacher asking for student reactions to these concepts as they appeared in the book. She tried to follow how the students commented to help guide the discussion rather than have a pre-determined list of questions. The teacher did, though, have the above concepts she wanted to cover with students. An example of how she tried to follow the students' lead was when the discussion evolved into students critiquing cliques at school and discussing what groups students fit into that were popular, such as having money and sporting ability.

The teacher allowed students to elaborate on their ideas rather than steering discussion back to the book.

The teacher also conducted a lesson on characterization in which students discussed how they would describe categories of persons: grandmothers, teachers, children, etc. Students also discussed social hierarchies of power and subordination after hearing of a head witch in the book who makes the subordinate witches do bad things. The teacher attempted to help them see beyond just good and evil by commenting on how humans can act in both good and bad ways (Gruber & Boreen, 2003).

The teacher also used images from media and had students critique them in a discussion format. They discussed the stereotypes in the images. The teacher gave prompts such as stating that the images might lead to discrimination against those portrayed negatively in the images.

Gruber and Boreen (2003) analyzed multiple data sources: class discussions, observations, interviews, and written commentary from students. They used a case study approach because they wanted to ground the study in students' life experiences. The case study approach also allowed the researchers to embed themselves in the study as the teachers. The researchers also wanted to study social construction of knowledge as students interpreted literature.

While analyzing data, Gruber and Boreen (2003) found discourse patterns and reactions were shaped by previous literacy experiences and prior knowledge. This was fostered when the teacher allowed the students to lead the discussion at times. For example, a girl who had read a book about women who were seen as

witches commented that women in her prior reading were accused of being witches and burned at the stake, while men were not. What ensued was a discussion on how evil was seen as women-oriented, and how women were seen as scapegoats.

Furthermore when the students brought up the topic of cliques, the students seemed to have originated this connection to their own lives. One boy added to the discussion that in movies he watched, men were the 'bad guys'. Students drew on the movies and books they had already read to make connections to and critique the gender stereotypes in the current book. During the discussion of media images, a boy from Saudi Arabia made a connection to his own life, saying how he was ostracized because of his looks. The teacher found students drew on previous stereotypes of types of women such as grandmothers, which the teacher had students compare to how women were portrayed in the book. In this way the students appear to have engaged in the critical thinking skill of analysis (Gruber & Boreen, 2003).

The teacher found that reading the book and allowing students' interpretations gave opportunity for critical thinking. Students were allowed to develop their own critical thinking and knowledge as well through discussion in the classroom. The teacher found that the girls became annoyed by comments from the boys about 'witchy' women and the boys did not question the portrayal of women as witches. Other results of the discussion were the students interpreted social roles and critiqued them, connecting the portrayal of women in the book and women's roles in their society. Students also voiced their disagreements.

The article does not give very many specifics on how the teacher prompted the student discussions. Such issues as whether the teacher asked more questions or

how much commentary the teacher made compared to students comments were not mentioned. Also the article does not state how the data sources were analyzed. There does not appear to have been any coding of comments into categories of discourse.

This article fits nicely into the contextualized teaching of critical thinking because one of the intents of the study was to use students' prior knowledge. What the authors were arguing in this piece is that students' own diverse experiences and cumulative literacy activity should be incorporated into the discussions of text.

“Awareness of the context-specific nature of literacy practices is especially important for teachers who consider learning as part of an experience that moves beyond the walls of the classroom and instead encompasses students' backgrounds and experiences” (p. 6).

The next study critiqued for the discussion section researched whether students developed higher-level thinking when administrators implemented a Socratic seminar approach at a middle school in Chattanooga, Tennessee (Polite & Adams, 1997). In this case study, Polite and Adams also studied in depth the teacher and student attitudes towards Socratic seminars.

The middle school was set in a working class city. Approximately 220 6th, 7th, and 8th grader students participated, with a racial makeup of 85% white and 15% African American. Approximately 25% of the students participated in a free/reduced lunch program. The 7<sup>th</sup> and 8<sup>th</sup> grade students had participated in 20 of the seminars in the previous year while the 6th graders were new to the Socratic seminar program (Polite & Adams, 1997).

For the seminars, teachers used a wide range of topics, readings, art and scientific demonstrations. Teachers facilitated the seminars in a variety of subjects. Teachers developed discussion questions themselves. These questions ranged from low to high thinking levels.

Researchers analyzed the following data sources: interviews with teachers, observations of team meetings and seminar sessions for one year, and official documents. There was no mention of what type of official documents. For the student interviews, researchers chose a random sample of 36 students. The interviews were one-on-one. A way in which Polite and Adams (1997) assessed the data included analyzing how students resolved discussion conflicts during the seminars. Researchers also calculated percentage of metacognition and formal operations.

The study achieved mixed results. Eighty percent of students observed showed intermittent or more frequent metacognitive skills or formal operations. Polite and Adams (1997) stated this is significant because it counters Piagetian ideas that students of this age would not be able to do this. Girls showed more consistent metacognitive skills, with 33% using the skills and 0% for boys. Boys showed more intermittent performance in this area than consistent. In addition, a disconnect arose between the goal of the seminars and how teachers implemented them. For example, some teachers simply wrote basic recall questions for students to answer. Not surprisingly, some faculty did not see the advantage of the seminars over traditional discussion methods. Students reported not being able to understand topics that were too abstract. Students also stated not liking topics they felt were irrelevant to them.

Two-thirds of students reported use of elaborate resolution strategies. The researchers also found from the data students could express their opinions and ideas and hear different interpretations as well as respond to these interpretations. One of the students Polite and Adams (1997) interviewed stated they sometimes changed their mind after listening to another's opinion. "When you're in seminar, you want to talk more than when you're in regular school because you're supposed to be sitting there being quiet in regular class," one student stated. Another 8th grade student stated, "I think some teachers are just teaching the subject. The seminar way causes you to understand it and stuff like that" (p. 273-274).

Polite and Adams (1997) found the teachers could use more training in differentiating the Socratic seminar approach from other approaches as well as in understanding the rationale behind it. Some teachers, however, did report use of discussion facilitation techniques such as more wait time and allowing students to voice their own conclusions. These vastly different approaches could be one reason why teachers had such mixed results.

In addition, reception by teachers on the readings used for the seminars also varied. Students discussed readings that contained African American characters. Three teachers complained that this focus did not reflect the students, although 15% of students at the school were African American. Some teachers noted the materials were not interesting to students.

This case study pointed to a possible difference in teacher reception and willingness to implement critical thinking programs when they are not the one's initiating such efforts. This was illustrated by the fact that half the teachers made

comments unfavorable to the methods. In addition, this study also mentioned how when a teacher does not fully understand the purpose of Socratic seminars, he or she might use methods that keep students thinking on a comprehension or recall basis rather than the higher-level thinking the discussion format was intended to facilitate.

The study did not mention what official documents were used in the study, which makes it difficult to see whether these were test scores, demographic reports or other type of documents. More information on the kinds of metacognition and critical thinking the students engaged in would have benefited the purposes of this review. Yet what was good about this study is it delved into the process of implementing a critical thinking program and potential barriers to such a program.

In this next study Brozo, Walter, and Placker (2002) studied students in a class who analyzed media ads and television as well as literature for images of male aggression. Teachers taught the critical analysis skills to 14 7th grade male students and two 7th grade females. The students were African American and Hispanic. Most lived in poverty in a city in south Texas in a neighborhood called Molina. The neighborhood had crack houses and gang members in public housing. Students sometimes showed physical evidence of violence against them.

This case study involved an 8-week unit on language arts and ‘real men.’ Three teachers helped teach and develop this unit – two female and one male. The teachers designed the course with the purpose to engage students in critical interrogation on the topics of masculinity and violence. The 1988 novel by Myers, *Scorpions*, served as the center of the unit. The events in the novel were similar to the

events the students lived with in their own neighborhood (Brozo, Walter, & Placker, 2002).

Methods included a project to prepare students for discussions. First, teachers had students document male behavior as portrayed in television they watched. Second, students read the daily newspaper and recorded the number of handgun-related crimes and the gender of the perpetrator and the victims. Students then discussed their findings by making connections between violence in the novel and in the media, a form of analysis (seeing patterns). Another activity to help prepare students for discussion was journal writing, in which students were asked to reflect on alternatives to violence.

Discussion methods included asking students questions to help them elaborate on topics the students raised, such as police profiling and police harassment. The authors stated: “The realities of these young people ... left us disturbed as it should. To insist that literacy is the key to virtuous cycles of private and professional life without acknowledging the influence of race and class would be callous and naïve” (p. 3).

Brozo et al. (2002) showed flexibility in their theory building and data, as they realized that their initial assumption that teaching media literacy would help prevent students from using violence in their own lives was not the whole picture. As a result, discussing social issues relevant to the students’ lives became a part of the teachers’ approach and instruction.

Methods that followed this realization changed the direction of the unit. Brozo et al. (2002) asked students to brainstorm on ways to counter the injustices the

students noticed in their community by using nonviolent means. This teaching strategy transformed the original concept of the unit of male violence in literature to the everyday lives of the students and resulted in the generation of proposals by the students to help counter inequities in their lives. After the brainstorming, teachers continued with a paired media image analysis with students finding examples of poor and good male behavior in magazines. The students were asked to make an ongoing log of how males were portrayed in media. Students were asked to put the portrayals in 8 specific categories using a typology from other authors, such as ‘abusive’ and ‘good Samaritan’. Teachers asked them to describe why the images fit each category.

Teachers then conducted small group discussions in which teachers asked students to consider the effect the portrayals had on their own behavior. Next, students responded to a prompt in their journals which asked them to imagine they were one of the characters in the book talking to another about the use of guns. They debated in two groups this problem. The teachers asked students to adopt and argue from a specific perspective on gun violence.

The researchers found the students were able to engage in analysis then make evaluations based on these analyses. Results included students talking about the violence in their own environment and evaluating media using criteria of violence. For the activity on male images in magazines, the teachers in the study found students were able to critically analyze and understand how men were portrayed. However, students were not able to find very many positive portrayals.

Results of the debate on gun violence were that students on each side stated their perspective. Students countered with their own position and also picked out

weaknesses in each other's position, showing some evaluation of another's arguments. Each student made at least one contribution. During the discussions and other activities, students engaged in analysis, evaluation and forming judgments.

A pre-post attitude survey on students' attitudes toward male violence found a change, although the authors admitted this may be the students saying what they thought teachers wanted to hear. The use of a self-report by students on their attitudes as to the topic is not as reliable a method to record change in attitudes as the statements of the students throughout the unit. Analysis of the sessions for changes in attitudes might be more effective.

Brozo et al (2002) mention discussion techniques such as asking questions to prompt thinking but more details as to how students arrived at their analysis and evaluation could have helped in analyzing what scaffolding the students received. Also, despite changing directions midway because of student realities, the teachers returned to the original goal of the unit. This possibly prevented more critique of the social inequities the students reported. Teachers had mixed results when they did this. This return to having students make connections between their own life and behaviors and violence in media seemed to have an underlying assumption that the teens were behaving badly or would in the future. Since the teachers set the topic of the unit, this perception came from adults and might not have reflected the reality of how the students conducted their lives.

The studies reviewed in this section on discussion included multiple activities designed to help students develop critical thinking skills. Some had mixed results. These studies included effective questioning or other prompts during discussion and

other scaffolding to help students expand their thinking. Some studies in this section show how powerful thinking was when students had the freedom to voice their ideas. This section also included methods shown to not be as effective, such as too much prompting and not giving students enough control over their own judgments and evaluations.

### Teacher questioning

This next section takes a look at the use of questioning during discussions or in other teaching models. This section reviews studies that focused on the use of questioning. While the studies in the previous section included questioning as one technique during discussions, this section focuses on questioning specifically. The studies achieved varying degrees of success depending on how the teacher asked the questions.

The first study in the teacher questioning section is a case study by Oliver and Lalik (2004). These two researchers engaged in critical inquiry with four African American girls from an all 8th grade middle school, in an effort to critique the way girls' bodies were portrayed in the school's activities and curriculum. Approximately 70% of the students at the school were African American and 30% white. Questions explored were: How did the researcher initiate and engage students in the inquiry process? And, how did the girls interact with the researcher? Oliver and Lalik hoped the girls would end up thinking critically about cultural implications of images of girls' bodies.

This study involved an examination of the way in which Oliver interacted with the girls to get them to think critically. A large portion of the dialogue examined

involved questions, so this is why this article is in this section. The example discussions in the report involve both researcher and students offering opinions. In addition, the researcher asked questions that asked students to elaborate on their comments.

Oliver worked with two groups of four girls in 26 sessions, 60 minutes long, one day a week from September to May. Oliver focused on one of the groups for this case study. She created the processes and topic of critique, scaffolding students with various strategies to critically write and speak. These methods included written biographies, making maps with the theme of places/persons of social interaction, looking through magazines and cutting out images that made them feel good or bad and ones that sent messages about female bodies; students also journaled about body image. The researcher read and gave feedback to the girls each week on their journals. The girls also took photos of body image.

The next part of the study entailed the main inquiry activities: an examination of personal knowledge about the focus topic, taking surveys with questions the girls created to assess boys' and girls' perceptions of the beauty walk, analyzing the data from the survey and identifying patterns and then interpreting the results. Students and researcher collaborated on questions for the survey. An example of a few questions the student thought of was: Who is in the Beauty Walk that you want to see? and What kind of girls? This reveals the student was seeing the situation from a critical angle because stating 'kind' showed she was thinking of attributes, an aspect of analysis. The researcher modeled interviewing skills and then the students practiced by interviewing each other. Girls entered this pageant and were judged on

their appearances by other students. The researcher had students analyze responses to the survey for examples of unfairness, giving several examples and using questions to prompt this concept. The girls then wrote a letter to an editor critiquing the pageant. Another method used was brainstorming.

In analyzing verbal interactions, the researchers used feminist and critical pedagogy, and found participation patterns. Transcripts were analyzed for these patterns.

The girls began to critique the beauty walk with longer statements than from the beginning of the case study. These statements included judgments with reasons. When the researcher used the technique of questioning for elaboration, two of the girls responded with their own critiques. During brainstorming, the girls listed that the girls were judged by their size, hair length, and light skin during the pageant. Another girl thought up criteria for beauty in music, linking the critique to other areas of their lives. The discussion surrounding the answers to the questionnaire took frequent prompting to reach the level of critique. The girls did though, once prompted at this point, go on to draw interpretations and became more critical of the walk after reading answers from other girls. For example, the letter writing resulted in written arguments against the beauty walk with supporting details. The teacher also had them put in the letter possible pros.

Oliver and Lalik's (2004) evaluation of the use of questioning in this study found the way in which questions were used actually alienated the girls more than inspired them to think critically; the researchers' final analysis also found the dialogue mostly originated from the researcher rather than the girls. For example, the

researcher who interacted with the girls found one of them wanted to be in the walk. She asked her a series of questions: “You’re going to be in it? So tell me a little bit about it? .. What is it? Why is it here? What do you do? Who’s in it? Who’s not? Who wins? Who judges”? When the girl failed to answer her questions to her satisfaction, the researcher stated: “You’re gonna be in something (and) you don’t even know what it is!” The girl answered, “I want to be in it, but I’m afraid I’ll lose.” The researcher continued: “Why do you want to be in it?” The researcher asked several more questions and the girl gave one line answers (p. 563).

Oliver and Lalik (2004) concluded that the case study helped girls develop some skills in critical inquiry. The authors also mention that even though students voiced statements that were favorable of the walk, the researcher did not follow these to discuss an alternative viewpoint other than her own. “Furthermore, by developing a curriculum that focused heavily on a criticism of the Beauty Walk, we wonder whether we did not inadvertently replace one form of hegemonic discourse with another ... Our micro-level analysis suggests that our approach may be viewed as an example of how those in power promote their desired discourse” (p. 585). They wondered if they could have approached the case differently in order to help nurture critical thought.

The example dialogue in which the researcher questioned the girl bordered on interrogation versus scaffolding a students’ thinking. At first, Oliver and Lalik (2004) reported this as being because the girl was afraid and also desired being in the pageant, rather than perhaps because the girl felt interrogated by the researcher. The underlying assumptions of the researcher’s questions were that the girl was wrong for

wanting to be in the pageant. The girls got defensive at the statements of the researcher and said they didn't care. Oliver and Lalik stated that their choosing of the topic may have led the girls to be somewhat resistant. The researcher inserting her own judgments and using questioning in the manner in which she did may have led to the resistance. The girls seemed pressured to think a certain way.

The examination of survey results might have been an opportunity for the girls to analyze and come up with their own patterns they discovered rather than have the adult in the situation label the pattern for them. Yet, the girls did draw analogies between the pageant and other social situations in which women displayed their bodies. Adding 'pros' to the letters did not allow the girls to give equal consideration to pros and cons of the contest. Also, the researcher's bias toward the cons was evident from the beginning, giving the girls a clear idea of what conclusion the researcher expected them to write in the letter. Therefore, this exercise was not one in which the students were able to weigh the ideas on their own to form their own judgment. The authors mention as much in their conclusions.

While Oliver and Lalik (2004) analyzed their questioning patterns, they did not set out to use questioning in any particular manner. This next study analyzed planned questioning and its effect on critical thinking. Rickford (2001) explored the question: What are the effects of teaching culturally relevant text with strategic higher-order questioning of interpretation and evaluation on the reading comprehension and enjoyment of 'at-risk' students?

Students from a combined 6th/7th grade middle-school classroom in an urban setting in northern California participated in the study. The 25 low-income, 'at-risk'

students, were mostly African American, yet the class also contained Latinos and Pacific Islanders (Tongans, Samoans, and Fijians). More than half of the students scored below the 50th percentile on the 1994 California Test of Basic Skills; seven scored at or around the 10th percentile.

During this 2-year study (1994-1996), Rickford (2001) used texts containing ethnic folk tales and contemporary narratives. The goal of this was for students to see their own culture validated and reflected in the content. Three stories were African American folktales and three were contemporary African American short stories.

Rickford (2001) used nine questions in the study: three comprehension (recall/retrieve factual information) and six higher order questions (analytical, interpretive and critical evaluation.) Examples of the higher-order thinking questions:

1. Moral judgment: Was it right or wrong for the woman to lose her temper and scream at the children? Give a reason for your answer.
2. Favorite character: Who is your favorite character in the whole story? Explain why you like the character.
3. Character feelings and qualities: How do you think the children felt after the old woman got angry ....? Why did they feel this way? Give a reason for your answer.
4. Explanation of situation: How would you help him through this difficult time? What would you say or what would you do?
5. How would you end the story if you were the author and could write a different ending?

For the higher order questions students were asked to take a position and

defend it with a valid argument. Students also had to choose a character that they liked the best and back up their choice with reasons from the text. The 'character feelings and qualities' questions (#3 above) asked students to infer the feelings of a character after an event and then back up their inference with three qualities to justify the answer. Questions testing deductive reasoning asked students to give an explanation for a character's behavior and back it up with details from the story as well as interpret it with information from their own life. Students read the questions after reading texts.

Researchers asked students the questions in the same form and structure across all the narratives for internal consistency. A group of six students at a research university rated their answers. Raters were trained to rate questions according to a rubric. The three recall questions were multiple choice and students earned 1-3 points depending on their answer. The higher-level questions were awarded 0-3 points. Interrater reliability index was 100% for questions at the literal level and 75% to 92% for the various higher-level questions.

Results were as follows: for the lower-end recall questions, students received mean scores of 60%. Students earned 79% on the higher order interpretive and critical evaluation questions, and 75% on the creative reading questions. Mean scores for the higher-level questions ranged from 74% to 90%. Rickford (2001) reported that the higher order questions gained higher scores and also elicited creative, empathetic responses. These questions allowed students to problem solve and immerse themselves in thinking. Students showed a good deal of argumentation, persuasion and interpretation.

Rickford (2001) analyzed the answers and gave reasons why the scores were lower for the lower-end cognitive questions: these questions were decontextualized and required finding narrative minutiae and attention to subtle linguistic cues. Rickford concluded that higher-order thinking questions allowed deeper engagement with the texts and that a mix of literal and higher-order skills were necessary. At risk youth can be helped to stay motivated and achieve more by including culturally congruent text, the researcher argued. “This study shows that weak readers are not necessarily weak thinkers. On the contrary, when afforded the opportunity and adequate scaffolding in terms of both text and question, they are quite capable of demonstrating critical and original thought” (p. 384).

Rickford (2001) also stated that the approach was applicable for all populations of ethnic minority and at-risk students in the United States and nationally because culturally congruent text enhances possibility for learning and growth. The generalization of these findings to all minority groups is a stretch considering the sample of students was only from one classroom. A larger randomly sampled number of students would be needed to be able to generalize to more settings. In addition, a control group using text from non-congruent cultures was not done and so the difference in scores and answers from non-congruent text was not recorded for a comparison. Students may have scored just as high with text not culturally congruent. However, the results from this study do suggest that asking higher-order questions elicit higher-order thinking.

In another questioning technique article, Weir (1998) used embedded questions in text to help 15 remedial middle school readers improve their

understanding of text. The specific thinking skills she wanted to develop in students were inferring, prediction and questioning the text.

Weir posed questions that were intended to develop student metacognition as students read the materials. She also used comprehension-level questions. Other teaching methods Weir used were: having the class read the text together and having students stop to answer the questions, as well as giving students options to draw their answer if they wanted to. Students also discussed answers. The author prompted students to write notes in margins and write down any questions they had. She also read pages aloud to students. Students gradually moved to working with partners in the same format and then alone. For an independent work assignment, Weir had students read a text independently using the same format, plus do final presentations. Finally, Weir had students write in journals the strategies they had tried in the unit.

Weir analyzed data from journals and student answers to the questions. Weir found students interpreted and applied their comprehension of the texts. They drew opinions and found evidence from the text to support their ideas. Students also came up with themes among the stories from the unit. From the journals, Weir found they were developing metacognitive awareness. For the final presentations, students summarized their short story, showed the graphic organizer collage they made, plus interpreted the theme they found in the stories. Students used art work to express themes and exhibited high levels of understanding of text's themes. While the overall purpose Weir had in mind was metacognition, the students showed at times judgments and support of those judgments as well as evaluation of text.

Weir does not give specifics as to how she analyzed the sources of data or how the data was collected. In addition, details as to how the students exhibited metacognition were not given. So it is difficult to critique how rigorous a process of data collection and analysis took place. The use of art work though gave students another option to express their knowledge and thinking.

The articles in this section described use of questioning by teachers, geared toward helping students develop critical thought. Each study was different as to how teachers asked students questions. The results differed. While it would be too much of a stretch to say the responses differed depending on how teachers asked the questions, each study obtained varying results of critical thought. The first study reviewed saw students becoming resistant when a researcher asked them questions in a semi-interrogating manner. When the teacher asked students questions in a way that did not cause defensive responses in students, students were free to think more about the topic at hand. The studies reviewed suggest that *how* a teacher asks questions as well as what questions he or she asks effects whether a student develops critical thinking skills in the classroom.

### Reasoning strategies

This next section describes studies on reasoning strategies instead of questioning strategies. Reasoning strategies are perhaps at the heart of critical thinking. Students engaged in reasoning in the articles reviewed in the previous sections, but not in a formalized manner. Students analyzed, compared and contrasted, and formed judgments in most of the studies reviewed so far. And, at times these critical thinking skills have been both in-depth and personally relevant to

students' lives. What this section does is review researchers who taught more formalized reasoning strategies in conjunction with content.

In this first study, De La Paz (2005) hypothesized students would increase their reasoning skills by using a specific reasoning strategy to analyze documents of conflicting views/information. He predicted students would consequently improve their writing of argumentative essays about controversial historical events by using this reasoning strategy.

The study took place at a suburban school in Northern California. The demographic profile of the students was: 43% Asian, 20% White, 15% Filipino, 13% Hispanic, 3% African American, and 3% Pacific Islander. Fifteen percent of the students qualified for the federal Free and Reduced lunch program.

De La Paz (2005) had teachers teach to a pool of 8th grade students, from whom 70 were chosen for the post-test. Researchers chose the final group of students for the post-test because they mastered the strategies taught to them. In addition, 25 students were interviewed out of these students. Students were of mixed abilities, above average (N=19), average ability (N=39), and special education students (N=12). The above average students were considered talented writers because they received scores higher than the mean on a standardized writing test.

The control group consisted of 62 8th grade students. This group consisted of 46 average ability students and 17 above average ones. The scores of the control group on standardized tests were similar to those of the experimental group. No significant differences were found in the test scores of standardized tests of the two groups in reading, math and language arts. Their WIAT scores in spelling and writing

did not have any significant differences, according to the ANOVA analysis done.

Three separate one-way ANOVAs found the scores the same:  $F(2,131) = 0.407$ ,  $MSE = 161.573$ ,  $p = .525$ (effect size = 0.12). Their written expression also had no significant differences:  $F(2,131) = 0.003$ ,  $MSE = 118.49$ ,  $p = .957$ (effect size = 0.01). These factors helped to make the experimental group and control group equivalent.

The research design for this quantitative study was a pre-post test, control and experimental group. The pre-test consisted of students writing essays on the Indian Removal Act of 1838. The post-test consisted of reading materials on the US-Mexican war and writing an argumentative essay. The control group read each set of materials for the pre and post-test and wrote the essays. They did not receive instruction. The reading materials were chosen for equivalent difficulty level as well as for containing enough information so students could argue both for or against a particular position. An ANOVA tested for effects of the prompts on the pre and post-tests and found the prompts were of comparable difficulty.

Teachers taught a self-regulation strategy development model (SRSD). This was chosen for its effectiveness in other studies to teach complex cognition. SRSD was designed to help students move toward independent learning in stages. The stages are: 1. teacher modeling 2. collaborative group work 3. independent self-regulation strategies and 4. fading prompts and other scaffolds. Two teachers taught cooperatively. Students learned the historical reasoning skills from a social studies teacher then went to the language arts teacher for the writing instruction.

They taught the reasoning strategy during a unit on the Westward expansion, 1830s to 1880s. The 22-day unit was an integrated approach in both language arts and

social studies. Students learned to analyze sources and write argumentative essays. Students spent 12 days learning historical reasoning skills and 10 days learning how to write position papers. Students read of four different events during the instruction phase, each of which contained primary sources of two differing perspectives and a textbook account. The focus was on the causes or consequences of the events. For example, students read John D Lee's confession as one primary source material.

In this well-structured instruction, teachers introduced the historical reasoning strategy by giving students an overview of the purpose and components of the method. They told students they were to judge the credibility and writer's presence of a source. Students had a visual/graphic organizer to look at the strategy during the overview. Questions teachers prompted students to answer were: What is the author's purpose? Do the supporting reasons and explanations make sense? and Do you find evidence of bias? For the second question, teachers taught students to look for inconsistencies and this would mean a source's legitimacy could be questioned. For the third question, teachers taught students to look at word choice and the presentation of only one side as indicating bias.

After the introduction, teachers had students pre-write. Then to teach students how to develop, evaluate and organize ideas, teachers modeled the reasoning strategies then students practiced until they mastered the heuristic steps. The first part of the reasoning strategy was corroboration. Students then broke into small groups to apply the reasoning skills through collaborative essays, using the third topic materials. Teachers then scaffolded discussions to develop student understanding. Teachers used questions to help students examine evidence. Then, teachers faded

prompts with the 4th and 5th Western expansion events, during which students practiced the strategies again independently. Teachers used guided instruction over the course of several days to do so. In small groups, students read and paraphrased events, then cooperatively wrote notes.

For the writing strategy application, students used the comparison of the accounts of two different persons done during the reasoning strategy to write an argumentative essay. Students began by journaling about a time when they tried to convince another person of something they wanted to do and whether they were able to do so or not. Then, they discussed in groups their outcomes. Next, students brainstormed, then organized ideas using an advanced organizer, which prompted them to write counter-arguments with supporting details. The students also learned several mnemonic devices to help them generate ideas on two sides of the event before deciding on one side to argue for. The first of these mnemonic devices was: STOP (Suspend Judgment, Take a Side, Organize Ideas, Plan more as you write). The second was DARE (Develop a topic sentence, Add supporting details, Reject an argument for the other side, End with conclusion).

The next day the teacher modeled the argument planning strategy. Half the class read an essay stating the massacre could have been prevented, while the other half of the class read one that argued it could not have been. The students then studied the introductions and third paragraphs of these essays to compare the similarity in structure.

Researchers in the De La Paz (2005) study audio recorded all instruction. An independent person checked the transcripts of these lessons with the original lesson

plans for consistency. This comparison found that the two teachers followed the procedures 100% of the time. Four observers also took notes on the interactions between teachers and students, as a further check on the validity of the teaching.

After students wrote their own essays individually using the essay structure learned, researchers read them and 12 students who did not master the techniques were eliminated from the experimental pool and did not take the post-test. Five of these 12 were learning disabled. Researchers concluded that the students who did not master the essays had time management issues.

For the post-test essay, students wrote whether the United States or Mexico was responsible for the war. Teachers followed identical testing procedures for both groups. Researchers graded the essays using the following multiple measures: 1. number of words written 2. persuasive quality using an holistic persuasive writing rating scale using blind coders, who did not know the purpose or conditions of the study or the names of students 3. the number of arguments, and historical accuracy and understanding, and social validation. The persuasive quality and number of arguments results and criteria were included in this review (De La Paz, 2005).

The essays were scored on a scale of 0-6, with 0 being the lowest. The essays were recopied by a researcher to prevent rating bias for poor handwriting or spelling errors. Rater reliability was .93 (Pearson product-moment correlation). Differences were discussed by the raters and resolved.

Results for the means and standard deviations were: 1. for persuasiveness, students in the experimental group received a mean score of 2.9 (out of 6 possible) on the pretest and a mean score of 4.1 on the posttest. There was a standard deviation of

.9 on the pre-test and 1.0 on the post-test. This was an improvement of 1.2. This is in comparison with students in the control group, who scored a mean of 2.6 on the post-test for the persuasive aspect. This is a difference of 1.5 points. Students in the control did not take the pre-test. An ANOVA test found the experimental group's papers to be significantly more persuasive than the control groups ( $F(1,131) = 58.259$ ,  $MSE = 1.352$ ,  $p = .000$  (effect size = 1.19)).

For the argument section of the essays, students in the experimental group had a pre-test mean score of .9 (.9 arguments per 100 words) and a mean post-test score of 1.4 (1.4 arguments per 100 words). Students in the control group had 0.8 arguments per 100 words on the post-test. This is less than the score of the students who received the intervention. De La Paz (2005) found the difference between the control and experimental group mean scores at post-test to be significant:  $F(1, 131) = 50.642$ ,  $MSE = 0.216$ ,  $p = .000$  (effect size = 1.17).

In addition, the difference in scores between different ability students was also measured. Students with disabilities scored a mean 3.2 on the post-test in the persuasive category. Students with average abilities scored a mean of 4.1 and students with above average abilities scored 4.7. This difference was found to be significant. All the groups of students increased their mean score in persuasiveness from the pre-test to the post-test.

Statistical analysis by De La Paz (2005) of the experimental group and control group from pre to post-test showed significant differences in length, persuasiveness, number of arguments and accuracy of historical content. Students wrote significantly better papers if they were in the experimental group than did the ones who did not

receive instruction in the strategies. Therefore, the combined use of the historical reasoning strategy and writing instruction caused the improved student papers.

The post-test was only on a select number of the students who took the pre-test. The authors justified this exclusion by stating that students who were excluded had time management issues anyway and probably lack of motivation or other affective issues, despite the fact that five out of the 12 excluded had learning disabilities. De La Paz (2005) stated, though, that more independent practice and additional teacher modeling might have allowed these students to master the strategies. These two interpretations of the results seemed to contradict one another. De La Paz stated in their conclusions that limiting the post-test to students who mastered the strategies was one of the limitations of the study.

One possible problem with not giving a pre-test to the control group is that the experimental group took both the pre- and post-test; a learning effect from the pre-test might have occurred and effected the final scores. One important result though was that students of differing abilities scored differently after the intervention. This could be interpreted as meaning students need different scaffolding depending on their abilities in order to reach their fullest potential. Overall, the conclusions the researchers made in student outcomes seemed supported by the data reported.

This next study, by Wolf (2003), also researched the use of a reasoning strategy, but instead of argumentative essays, this researcher measured whether the reasoning strategy called Big6 effected students' metacognition. The key researcher question was, How does Big6 support metacognition strategies and knowledge management in students? Big6 also involves students evaluating and analyzing

information in relation to questions they generate. So this article was reviewed for these thinking skills as well.

The Wolf (2003) study included 18 upper-middle class 8th grade students; 17 were White and one East Indian. The school was a private school in a major southwestern city, which emphasized integrated critical thinking and technology in the curriculum.

The intervention took place in the students' regular classroom, with their regular teacher providing technological support. Outside researchers conducted the intervention. The duration of the intervention was 12, 85-minute class sessions.

The method of information problem solving, Big6, was developed by Eisenberg and Kerkowitz (1998) to help with information searching for projects. The critical thinking aspect of the Big6 model involves evaluation of information and strategies. After students list possible sources, they evaluate the best ones. Students also evaluate their final product and their problem-solving skills when they are finished. Big6 is non-subject specific so it was designed to be used in multiple disciplines (Wolf, 2003). The content used with the Big6 strategy concerned the African American civil rights movement. Each student had a computer plus a database CD-Rom to access content, other websites and the scaffolding integrated in the computer program. Students took the role of reporters for a school newspaper, writing articles on the 35th anniversary of the Selma March.

The CD-ROM had resources and tools and provided the Big6 training materials within it. Primary source material available on the CD-ROM were photos,

videos, audio recordings, and newspaper articles on 26 civil rights events. However, students mostly researched materials related to the Selma March. The DP database also had metacognitive scaffolds, guides, with prompts to help students figure out which information to focus on – people, goals, causes, description, opinions, or quotes for and against a position. Another scaffold consisted of a journal imbedded in the computer program, prompting students to reflect on their completed work and to plan their next steps. This journal also prompted students to summarize their progress and describe any problems or successes.

To begin the instruction, researchers gave students a packet with details for each step of Big6 and a packet with a guide to the project, which detailed the assignment, plus milestones for each step. The students practiced a problem to solve using the Big6 steps.

Next, students sampled information in the database in a scavenger hunt style. The students then received training in newspaper writing and Big6. The students had 3 days for research of the Selma March using the metacognitive scaffolds embedded in the computer program, such as gathering and evaluating progress. Students then had 2 days to write rough drafts of the news stories. Then, they reviewed each others' stories and gave feedback to each other (using guides). They then had 2 more days to revise.

Data researchers from the Wolf (2003) study analyzed student logs, journals and articles, recorded teacher and student interactions, and post-activity interviews. The DP program tracked students' activity and researchers coded transcripts of this.

The journals were examined for insights and metacognitive thought processes. Teachers also recorded audio of their interactions with students. The researchers transcribed the audio and analyzed them for metacognition and scaffolding. The articles were analyzed using detailed evaluation rubrics. Wolf (2003) defined metacognition as thinking about thinking, references to knowledge and control of factors that affect learning, such as knowledge of self, the task at hand, and the strategies to be employed.

Data showed the metacognitive scaffolds allowed management of complex cognitive tasks and processes. Students also were able to label what step they were on during the project. The students reflected on where they were and what their next step was. Students also used multiple sources to write their stories. There was some evidence that students had evaluated the articles at least a little because they noted that they considered the quality of information of the articles they read. In addition, students showed evidence of having evaluated the articles they wrote in order to improve them. Consequently, Wolf (2003) concluded that Big6 might work as a metacognitive scaffold. The students relied on the scaffolds to write in an unfamiliar genre. Ideally, this process could be transferred to other problems and scaffolds gradually removed.

The conclusions and results did not say much about how students analyzed and evaluated information. The research question focused on metacognition so this is understandable. Still the researchers did not mention what categories of metacognitive thinking processes they analyzed. Such details might have helped the

reader see the specific thinking skills involved and how well the intervention was in helping students analyze and evaluate sources.

In another study using a reasoning strategy, Daniel (2005) used Philosophy for Children (P4C), a strategy designed to help students develop dialogical critical thinking processes through discussion. Daniel (2005) modified the approach for math – P4CM.

Participants were 240 students ages 10-12 from three countries – Australia, Mexico and Canada. Eight different groups participated, two in Australia, three in Mexico and three in Canada. Each group averaged 30 students with 50% girls and 50% boys. Socioeconomic status in four of the groups was considered privileged; three groups were underprivileged and one poor. One group had used P4C since preschool; another group for 1 year and six groups had no prior experience with the strategy. The intervention took place in three stages during the school year at beginning, middle and end. Daniels (1996) and researchers used the P4CM approach for 1 hour per week per group.

Students participated in the following steps: 1. they read a chapter from a philosophical novel by reading aloud with each student taking turns. 2. students created questions and then questioned concepts or situations. 3. they then had a discussion. The goal of this was for students to find answers and contribute to a group perspective. An example question explored by the students was: Does a perfect cube exist?

Philosophy for Children was developed by philosopher Matthew Lipman and was used in 50 countries at the time of the study. The method was also called the

Socratic approach because of the use of philosophical questions to stimulate thinking. The method also used group discussions. Daniel (2005) stated the purpose of critical thinking was to counter “thoughtless action” and “uncritical thinking” and to figure out relevant information from irrelevant for one’s objective. To do so, a learner could use criteria, form judgments, self-correct, and also use sensitivity to context.

During the conversations in the study, the teachers prompted students at times to use the language specific to the method, asking such questions as: What is your justification when you say ...? What criteria are you basing this on? Do you have a counterexample? What could you add to improve this point of view? Do you agree with what was just said? How would you organize the criteria that were just voiced? How was the group’s perspective evolved between the beginning and the end of the exchange? Specific discussion techniques the students learned were to restate what the previous person had said before offering their own statements or to rephrase another’s statement.

Researchers videotaped for 60 minutes three times a year for each group. The recordings took place in the beginning of the year, the middle and the end. They made 24 recordings total with 30-32 pages of transcripts per recording.

The researchers analyzed processes for critical thinking development and cognitive development. Daniel (2005) used a grounded theory and socio-constructivist approach, which involved construction of theories empirically based on social phenomena for meaning. Before beginning the research, the authors took coding from a precursor study that found five types of exchanges among students: 1. anecdotal (‘I’-centered and no justification of viewpoints and addressed to teacher) 2.

monologue (brief, simple, to teacher and has difficulty justifying viewpoints) 3. dialogical (presupposes listening skills of divergent perspectives and integrated into own viewpoint-and interdependence of viewpoints) 4. semi-critical dialogue (almost critical form, well-justified criticisms and dialogue but doesn't influence others so initial perspective remains unchanged), and 5. critical dialogue (appearance of negotiation of viewpoints – open and temporary processes and conclusions that served as a hypothesis for future reflection on initial idea modified). Researchers also had a typology of thinking modes and epistemological stages to cross reference when coding the transcripts.

Researchers then gave the transcripts to an outside professional who verified the content, which was in the original languages. For data reliability, the principle researcher blind coded the data, removing all names, locations and time of year identifiers. Then, the data was blind coded a second time. Co-researchers analyzed in original languages and when differences in coding occurred, they were resolved through consensus after discussion.

Coding occurred in stages. First, researchers labeled cognitive skills. Then, these skills were put into categories of thinking modes. The thinking modes were 1. logical - informal logic, convergence and coherence in language 2. creative – student thought of original or divergent items or relations that changed group's thinking 3. responsible – reflection on human behavior or morals, or 4. meta-cognitive – evaluated thinking/viewpoints to improve them.

The third step in coding was statements were analyzed for epistemological perspectives: 1. egocentricity - grounded in personal statements and no justification

given 2. relativism - tolerant and open-minded toward plurality but no evaluation of viewpoints or doubt 3. inter-subjectivity – motivated to construct meaning with peers, critical evaluation, justified statements, or uncertainty.

Daniel (2005) and researchers then cross-tabulated the thinking modes and the epistemological perspectives and put them into a table. The coding from this table was then applied to the transcripts.

Results showed that a general pattern emerged in all eight groups. By mid-year, dialogue among students emerged that was longer but non-critical, semi-abstract logical, contextualized creative thinking and metacognition at the relativism level. By spring, the dialogue was largely semi-critical in all four thinking modes and wavered between relativism and inter-related and between unreflective acceptance to conscious evaluation. Those groups with prior exposure to P4C training ended up with more critical dialogue and inter-subjectivity by the end of the year.

Daniel (2005) concluded the study caused the beginning of the process of critical thinking in young students ages 10-12. According to the researchers, two conditions seemed necessary for this, the P4C-modified strategy and teachers scaffolding of students to develop multi-modal and complex thought.

Daniel (2005) stated that learning to dialogue in a critical manner and learning to reflect critically is a complex task for young people, and takes time. Nevertheless, the ensuing learning acquired is in keeping with a form of education that will allow young people to successfully face the challenges that are inherent in the expansion of knowledge and in the increasing complexity of life in society. That is, learning to manage diversity of opinions for collective enrichment; understanding that

uncertainty and ambiguity are a necessary transition toward attaining a significant solution.

The study was well-structured and the coding of statements very precise. The results seemed reliable based on the coding and way in which the transcripts were analyzed. The researchers compared their results with each other and also used coders who knew the original languages of the students. One thing the study did not have was a control group. The control group would have allowed the results to be compared to that of the experimental group.

In another study involving reasoning skills, Feuerstein (1999), students learned analysis skills surrounding media advertisements and television shows. The research tested three hypotheses: 1. Students receiving media literacy intervention will have greater gains in analysis of media than peers who did not receive this education 2. Students who are low to medium achieving will demonstrate gains more than high achieving students who did not receive intervention, and 3. As students receive more and more training in media literacy, their CT skills will increase.

Participants in Feuerstein (1999) were 273 students, ages 10-12, in six primary schools. All students were from Haifa, Israel. Each school in the research group had three classes, between 20-30 students. Three socio-economic groups were in each class: medium-high, medium and low-medium. Three schools with 119 students total participated in the experimental group. The control group consisted of 154 students.

The overall intervention involved students generating questions, responding to and evaluating their own work and making conclusions while critiquing mediums

such as television, radio and advertisements. All students participated in the pre-test of watching television series and newspaper advertisements. The students studied media literacy (ML) for 1-2 hours a week out of a total of 30 hours a week of classroom time.

The same set of questions were given to students to have consistency in intervention. The authors stated that this was intended to cut down on errors and deviations. The six concepts used in the questions were: media Agencies, categories, technologies, languages, audiences and representations. Students used empirical and conceptual aspects to answer these questions. The questions were: 1. Who is communicating and why? (media agencies) 2. What type of text is it? (categories) 3. How is it produced? (technologies) 4. How do we know what it means? (languages) 5. Who receives it, and what sense do they make of it? (audiences), and 6. How does it present its subject (representations). These questions appeared to be at the analysis level.

In addition, the following instructional activities were used during the intervention: research, defining and locating problems, processing information, decision making, drawing conclusions and evaluating these conclusions. Students created their own media products during the classes.

The research design was a control group and experimental group in pre-post test design. Measurements included the following multiple sources: qualitative data of media and language tests, quantitative measures of class observations, teacher questionnaires, interviews with media teachers and focus group interviews with students. The researchers collected qualitative data to check for reliability of the

hypotheses and to check for different perspectives concerning the television series used in the study. The teachers were trained in ML skills instruction and were supervised by a ML specialist. The control group studied the regular school curriculum and had a different teacher.

Test material included pre-post tests involving a language and media test. The tests were adapted to local Israeli media texts. Assessment of the tests consisted of a 10-scale continuum of media analysis abilities. The test items consisted of questions related to language, content, narrative, production and values. The tests were scored by an assistant and analyzed through computer methodologies (t-test, chi-test and r-Spearman). High literacy was defined as evaluation abilities and low literacy was considered to be understanding and interpreting.

According to the pre-post test given to the control and intervention group, Feuerstein (1999) found a significant difference in the language and narrative aspects of the test. The research group's mean score increased from 3.66 to 6.36 in the language test and the control group's mean score only increased from 2.18 to 2.44. For the narrative test scores, the intervention group's mean score increased from 4.8 to 7.11 while the control group only increased from 2.4 to 3.49.

Some other important findings were that students from low-socioeconomic levels improved more in their test scores than high socio-economic status (SES) students in the media narrative post-test. Feuerstein (1999) stated this might be that this group had a better teacher and also received more instruction in use of language and media production. Another important score variance was with the high-medium SES students who refused to answer some questions because they were offended by

one of the television series they watched. This series, the American *Beverly-Hills*, which was unrelated to their culture, was the source of their offended responses. So their scores were lower. Therefore, the differences in scores between high and low SES students may need to be qualified according to this unforeseen factor.

Feuerstein (1999) also stated the students were given multi-faceted tasks, which required them to defend their choices with evidence, which is evaluation. In addition, students invented creative solutions to multi-faceted problems, which nurtured their thinking skills. However, the author stated that the research was still being analyzed and these were initial results, so only the quantitative data was analyzed at the time of the publication.

The conclusions given by Feuerstein (1999) were that the ML program used in the study promoted media analysis skills as evidenced by the test scores. Students from low to medium achieving classes can increase their scores more than high-socio economic students when given systematic teacher mediation. However, this conclusion was contradicted by the author's own explanation of the differences in scores as possibly being attributed to a better teacher. Therefore, these results probably needed to be qualified. The group of low-socio economic status students received more systematic intervention and involved producing video clips and using media language more than the high-socio economic group. So, for the low SES status students, it might be said that the more intense the intervention, the higher the score.

The use of a control group in this study gave reliability to the results reported in the experimental group. The control group gave the scores of the experimental group something to be compared to. The differences in their scores seemed reliable

given the manner in which researchers analyzed and coded the data. The scores were run through computer technology using various statistical tests mentioned earlier. In addition, because the researchers used multiple data sources, results are further made reliable. However, this would be true more so if the results for the qualitative measures had been reported and not still in the analysis stage.

A fourth study in which researchers taught reasoning skills to students was Leshowitz (1993), which researched the following questions: What is the effectiveness of an instructional intervention directed specifically at teaching critical thinking skills to a diverse group of students enrolled in special education programs?

This study involved 22 students in grades 7th through 12th. The middle school and high school groups contained low socio-economic status students with learning disabilities from a suburban area of Arizona. They were identified by the school district as either educationally or cognitively disadvantaged. Fifteen of the students were White and seven Hispanic. Students were enrolled in four different classes. One was a junior high class, or 13-16 years old (four girls and six boys) with IQs of 85-110; two were high school classes and another was a junior high school class of students with severe emotional difficulties (13-15 years old and five boys).

The control group included 33 students in a regular education English class in 11th grade from the same low socio-economic status and ethnic identity as the research group. The methods and results reviewed for this paper were for the middle school students.

Leshowitz (1993) used statistical-methodological reasoning applied to common information sources such as advertisements with the goal of teaching critical

analysis of problems faced in daily life. The goal was to teach students to evaluate claims in advertisements and articles based on facts and proof rather than opinion and personal beliefs. Teachers taught higher-order thinking to students using the principles of scientific method, such as proposing questions as testable hypotheses, analyzing information in terms of independent and dependent variables, using experimental control to establish causal connections, and reaching conclusions based on valid evidence.

The study involved a pre-post design, a series of 25 45-minute lessons each school day over a 4-6 week period. The pre-test was a short-answer quiz. The quiz required students look at an advertisement and evaluate it for characteristics and validity and to graph information. The students were also asked to analyze a scientific study for effectiveness and validity. Answers to the test were judged on the following criteria: identification of claims (analysis), graph of the actual data, and explanation of whether the data constituted proof of the claim (evaluation). The posttest consisted of comparable measurements. The control group was given the same test.

The instruction was divided into two parts: 1. evaluation of fact and opinion in advertisements and 2. evaluation of scientific studies. For the advertisement piece, students were instructed in what constituted a fact, proof and opinions. They learned these through analysis of information from print advertisements. For the evaluation of studies part, the major method used was Socratic dialogue rather than direct instruction to foster student thinking and learning from one another. In the first part of the evaluation piece of the instruction, students were asked to state the underlying question of an article that described a study in it. Then, through discussion, students

were guided to find what was found by the study and whether the findings supported the conclusion of the article as well as how the author answered the question.

Students used one technique in particular to analyze the articles – graphic representation of the dependent and independent variables, which reduced the reading demands of the students. Diagrams and graphs (x-y plots) were used to help students visualize the reasoning process and see relationships between variables. The graphs also were designed to help students summarize the main point of the article. Students were asked to evaluate claims by whether a causal relationship was found between the variables. They were taught specific rules: 1. Is there a relationship between the antecedent condition (independent variable) and the effect (dependent variable)? 2. Does the independent variable precede the dependent variable in time? 3. Can the effect be attributed to the independent variable? The students were to consider possible confounding variables. Faulty information and faulty judgments were used to foster critical inquiry. They analyzed multiple studies.

The two instructors in Leshowitz (1993) independently scored the test. A randomized one-way analysis of variance model was used to assess interrater reliability. The assessment found a correlation coefficient of reliability to be  $R = .89$ . The reliability of the tests was assessed using Cronbach's alpha. An alpha score of .51 found a moderate subtest consistency for testing critical thinking.

Researchers found the improvement in overall test performance was significant,  $F(1, 21) = 79.29, p < .01$ . Performance improved on all the subtests. The graph subtests showed the greatest improvement. The claim subtest had an  $F(1, 21) = 12.47, p < .01$ ; graph subtest,  $F(1, 21) = 88.58, p < .01$ ; and the proof subtest,  $F(1, 21)$

= 8.79,  $p < .01$ . Sixteen of the 22 students showed improvement in overall performance on the critical thinking test. The researchers did not report which 16 students these were. The overall posttest performance of the treatment group was significantly higher than the performance of the control group.  $F(1, 53) = 29.59$ ,  $p < .01$ .

In addition to the conclusions above, Leshowitz (1993) stated the improvement in scores reflected significant changes in several important information-processing skills of critical thinking: 1. summarizing quantitative data 2. grasping relationships between variables, 3. abstracting critical elements of the situation 4. evaluating causal connections 5. recognizing facts/opinions and evaluating the relevance of data to the claim. In addition, the researchers reported that students made significant improvements in ability to 1. identify the principal claim made in an article 2. graph the relevant data 3. evaluate the claims made in the article and explain their support or rejection of the claims based on data. The performance exceeded that of a control group of regular education students who did not receive the intervention. Leshowitz (1993), suggested follow-up studies needed to be conducted to see if students retained the critical thinking skills in different situations.

Leshowitz (1993) also stated that the study suggested dialogue format instruction can cause educational benefits. Also, the authors stated that the research indicated strategies could include learning disabled students in critical thinking instruction, such as the use of graphics to compensate for reading difficulties.

The conclusions made by the authors seemed consistent and valid based on the data presented. The use of a control group and pre-test helped compare the scores

of the experimental group, lending further validity to the conclusions. This study is important because it was inclusive of non-typical students and helped show that learning disabled students are capable of improving their critical thinking skills with specialized instruction, such as the use of graphs.

Studies in this section varied as far as how elaborate the use of reasoning strategies. Some involved using graphic organizers with prompts, guided instruction, modeling and computers. Others consisted of discussion and questions designed to foster a set of reasoning skills that could potentially be applied to different situations.

#### Cooperative group work

This next section explores the use of cooperative group work. These studies show the importance of social interaction in the development of critical thinking skills.

Kerr (1998) explored the use of collaborative writing in small groups. This study researched the benefits of collaborative writing in small groups and the value of a social-cognitive approach of learning for middle school students.

Participants included 8th grade students in Kerr's classroom. The focus of this article was one group of four students, two girls and two boys. The researcher chose this group because it was working well.

Methods included writing a proposal cooperatively in a small group during a writing workshop. The proposal asked them to identify a problem at the school, propose a solution to this problem, then write a letter addressed to the principal of the school. The group worked through the problem of whether 6th graders should be allowed to go to dances.

Kerr (1998) noted the students' conversation at first was at times fragmented and appeared aimless. Yet, they arrived at several solutions to the problem, such as an earlier dance. The students wrote down their solutions as they discussed them. Students asked clarifying questions of each other, and talked about the pros and cons of courses of action.

The researcher-teacher taped the sessions and analyzed these tapes for patterns of social interaction that supported learning. No pre-determined categories of learning used for coding purposes were mentioned.

Kerr (1998) sought to find out the importance of social interaction in the development of critical thought when analyzing the tapes. An example of when thinking might have been fostered from social interaction was when one group member added onto another's idea by giving an example. What happened next was another group member was able to come up with another idea to contribute to the argument behind their proposal after listening to two other group members' interactions.

The exploratory talk served as a scaffold. The group discussed counter arguments for two solutions, weighing the options. They asked each other questions to expand on the counter arguments. The 'more capable peer' scaffolded another peer so that they talked through more developed counter-arguments. One student took on teacher directives and questioning, which the author noted was most likely internalized 'teacher talk'. This student asked such questions as: "OK, what do you guys ... what do you think Mr. Thomas (the principal) would say" (p. 6-7)? This 'meta-language' developed through negotiations as well. Another student also used

these meta-type statements, asking questions and stating directives, which the author noted showed that critical thinking was developing and was probably heard by teachers and internalized prior to the study. By the end of the group work, students wrote a well-written letter of the problem with workable solutions, as their final product (Kerr, 1998).

Kerr (1998) stated: “Learning what a counter argument is and to what kind of discourse the term usually is applied has helped these students be adept at using the normal discourse of an established knowledge community in the academic world, a world they will perhaps wish to become full members of in the future” (p. 5).

As stated above, this study looked at only one group out of all the groups in the class, which does not allow the reader to see how effective the method was for the other groups. Also, only a few sessions were recorded; more sessions of the students’ interactions could have helped show more about how the students worked together. In addition, no pre-determined coding was reported. This was a small study however and did not present itself as a study that would use such methods.

In a second study exploring cooperative work, Hudgins and Riesenmy (1994) studied students working in groups and as a whole class. Researchers tried to find out how students performed on problem-solving and content tests after receiving the teaching of critical thinking skills as compared to students who didn’t learn these skills.

Hudgins and Riesenmy (1994) predicted students in the two experimental groups would both learn the science concepts and material equally well and that the

group who was taught the critical thinking skills would outperform on the problem-solving measures: task definition, planning and the quality of the answers.

Fifty 4th, 5th and 6th grade students were in the two experimental groups; 16 students were in a control group. The students were from six different Catholic elementary schools in St. Louis. Their socioeconomic status was middle to upper class and they were mostly White. All 10 teachers in the study were White women with at least five years teaching experience each.

One experimental group involved students conducting experiments to test the effect of gravity in their science class in small groups of four. This experimental group (E-1) was taught self-directed critical thinking skills while learning the content. The groups of four worked collaboratively and were taught roles within the groups, each corresponding to a thinking skill. The groups had two boys and two girls each. The second experimental group (E-2) worked as a whole group with their regular teacher. Students in this group were from 4th and 5th grade classes of 20-24 students, with six pre-determined students, three boys and three girls, from each class having data collected on. Both these two experimental groups used the same science equipment, but with different teachers. The instruction consisted of 14 lessons exploring gravity on four different concepts, reaction time, pendulums, projectiles and motion.

Children in the control group were selected from classes in which teachers taught science in a way in which students were able to explore manipulatives in a laboratory. This was so that the achievement of students who were allowed to explore science without direct teaching in thinking skills could be compared with students

who were taught specific thinking skills (E-1) and with students who were taught science directly (E-2).

The teacher in E1 encouraged each child to learn and use all four of the thinking skills. Students learned and practiced the following roles: task definer, planner, monitor, and challenger. The students switched roles each time their group met, with each student playing each role approximately four times over the course of the 14 lessons. The students read aloud the definitions of their role before each session, then paraphrased them. The teacher in the E-1 group prompted, scaffolded, monitored and assisted in improving the thinking skills of the students.

Intervention in the E-2 group, in which students did not work in groups nor receive thinking skills instruction, consisted of a teacher teaching the same gravity lesson with the same lab materials. The teacher set up demonstrations in the same way as the E-1 group, except gave students directions on the first step of experiment. In addition, the teachers in the E-2 group taught in a more directed manner. They first reviewed previous content then students read the problems aloud. Although students in this group performed the same experiment, teachers did not set up how the experiment would be conducted nor evaluate the outcomes, as the teacher did in group E-1. So, they did not create strategies.

Hudgins and Riesenmy (1994) were interested in studying the disposition aspect of critical thinking, which they defined as, “the tendency of the thinker to apply the intellectual skills of critical thinking to a new occasion for such thinking and to do so under one’s own volition,” without teacher assistance and correctly (p. 3). The authors use the phrase ‘self-directed critical thinking’ to capture this

disposition. The authors defined critical thinking as the ability to “use information or evidence that bears upon that claim or argument, in order to decide its tenability” (p. 3). This relates to the definition in chapter one involving assessing the validity of claims or arguments.

The authors had a different view of the conditions necessary for critical thinking than the studies reviewed in this paper in which students collaborated together and critical thinking was seen as a phenomena of social interaction. The researchers of Hudgins and Riesenmy (1994) stated that the student must use critical thinking spontaneously and correctly for it to be a valid act of critical thinking. Even though these authors defined the problem-solving task as similar to Kerr in that students in groups defined a problem, made a plan and then made sure that the plan is valid and supportive, the thinking still needed to be shown on a post-test as originating within the learner. The issue was the matter of what was seen as the acceptable origin of the critical thinking for the purposes of the study. The critical thinking on the post-test needed to be made without hints or cues and used on a new problem.

The research was a field-based pre-post control group experimental design. The teachers self-selected which group to teach in. They then participated in 15 hours of training, involving both content and teaching skills. The teachers also practiced and discussed ways to limit their control of student thinking processes.

Students participated in a pre-test designed to measure their science knowledge and critical thinking and a mean test determined there was no significant differences among the students. The science test had a reliability coefficient of .85

(Spearman/Brown prophecy formula). After intervention, the students took the same test, along with two problems-solving lessons. For the problem-solving tests, students wrote data, answers and diagrams on paper and verbalized their thinking, which was audio taped. Hudgins and Riesenmy (1994) used the same procedures for the test for all students.

The problem solving sessions were transcribed and each group given a code that concealed which group each child was from. The transcripts were blind scored with an interrater reliability of .80 using the Pearson correlation coefficients for all three subcategories. The post-tests were scored for independent work and correct and reasonable solutions. Subcategories scored for were planning, task definition and quality of answer. Students were deducted points if they required prompting from the testers. Data was analyzed for a total of 66 students (Hudgins & Riesenmy, 1994).

As hypothesized, students in the two experimental groups did not differ significantly in their science knowledge tests. E-1's mean score was 18.8 and E-2's was 18.4. However, the control group received a mean score of 10.8, which was lower than both experimental groups. The t-values for the experimental groups were 2.8,  $df = 36$  ( $p < .01$ ) for E-1; 3.2,  $df = 42$  ( $p < .01$ ).

For the problem solving test, E-1 scored significantly higher on the task definition part than E-2s, with both experimental groups scoring significantly higher than the control group. Researchers tabulated the scores by proportion of high to low scores for the pendulum problem, 17 high scorers compared to 5 for E-1, with a proportion of .77 ( $n = 17$ ) and .23 ( $n = 5$ ). E-2 had 10 high scorers compared to 18

low scorers on task definition, with a proportion score of .36 (n = 10) and .64 (n = 18). The control group had 0 high scorers and 16 low.

However, for the planning strategy part of the test E-1 and E-2 students scored the same, with both groups scoring significantly higher than the control group.

Proportion scores were as follows for the pendulum problem: E-1 (14 high scorers to 8 low, .64 and .36 respectively); E-2 (10 high and 18 low, .36 and .64 respectively) and control (1 high and 15 low, .06 and .94 respectively).

A significantly higher proportion of E-1 students scored higher on the quality of answers than the E-2 students did, but just on one of the two problems. For the other problem, E-1s scored just below significantly higher than E-2s. Proportion scores were: E-1 (15 high and 7 low, .68 and .32 respectively) and E-2 (6 high and 2 low, .21 and .79 respectively). Only eight students in the E-2 group were included in the scoring for the quality of answers and Hudgins and Riesenmy (1994) make no mention of why this was or whether this might have effected the scores. The control group scored significantly lower than the E-2 and E-1s on the quality of answers (0 high and 16 low scorers). Except the E-2 group did not have a significantly higher score than the control group on one of the problems.

Both experimental groups were approximately equal in ability to learn new content knowledge and achieved higher scores than the control group. The E-1 and E-2 groups did not differ from each other on planning during the problem solving, which involved selection and organization of relevant information to solve the problem.

Hudgins and Riesenmy (1994) interpreted the results as meaning that students needed content knowledge in order to think effectively to solve problems, which is why the control group scored lower than the experimental groups. The control group scored lower in the thinking realm because they did not receive training in independent critical thinking.

Hudgins and Riesenmy (1994) concluded the group that was taught critical thinking scored higher because they were taught the thinking skills of task definition, organizing data, monitoring their own progress and challenging each other's positions. This enabled them to generalize these skills to solve problems with content familiar to them. Defining a task first allowed a student to select only necessary information, or variable, to work with in order to get a correct answer. Students in the E-1 group were also taught to initiate the problem-solving.

The overall conclusions of the authors were that children in middle-grades who could independently solve new science problems both mastered content knowledge relevant to the problem, plus learned thinking skills that allowed them to define the problem and plan a strategy.

The researchers did not discuss or draw conclusions surrounding the non-significant difference in planning scores for the E-1 and E-2 groups for the motion problem, nor did they discuss why they only included the scores of eight of the students on the quality of answer measure. This is problematic because this omission, for whatever reason, may have effected the interpretation of scores on quality of answer. For example, the students that were not included in the calculations may have scored significantly lower or higher. Overall though, the conclusions drawn by the

researchers were consistent with their methods of analysis, the instructional methods used and the data presented.

Duren and Cherrington (1992) also researched cooperative group work versus another teaching model. The researchers examined the relative effects of cooperative groups versus independent work after problem-solving strategy instruction.

Participants were 126 7th and 8th graders in four different pre-algebra classes at a Northern California urban middle school. The students were randomly assigned to two different groups: one using the problem-solving strategies in cooperative groups and the other solving problems independently. In the cooperative group class, students were randomly assigned to groups of four. Researchers gave the cooperative group students group work instruction on the following elements: roles, helpful feedback giving, rules/procedures and positive interdependence.

Both groups were given identical problem-solving instruction prior to solving the math problems. Students learned four problem solving strategies: 1. making a table and setting up an organized table to solve a problem 2. drawing a picture or diagram 3. making the problem simpler and 4. working backwards. The study did not mention the specific ways the instruction was given prior to solving the problems.

Students worked for 4 weeks total, 1 week per strategy. One strategy was taught on Monday and students then practiced the method on Tuesday, Wednesday and Thursday with a test on Friday. Then the process was repeated for the other three strategies. Each practice day the students received new problems to work on.

Duren and Cherrington (1992) gave a final test 3 months later to measure long-term retention of problem-solving strategies. Students took this test

independently and did not practice the skills during the 3 month interim. The test consisted of two problems to solve and students could use any of the learned strategies. Researchers used a holistic approach to grade the test where each step was given partial credit.

Duren and Cherrington's (1992) findings were that students who used the cooperative group approach used and applied problem-solving strategies better than the students who worked independently, on the final test. The mean difference in the test scores was 1.7 points more for three of the strategies and significant ( $p < .05$ ) in two of the strategies (picture and working backwards). Half the students in the cooperative groups attempted to use one of the strategies, while 43% of the independent learners did. Only 107 students took the post test out of 126 original students.

In addition, researchers found that the work backwards strategy resulted in the most dialogue, with students having differences in opinion as to the best strategy and defending their viewpoint.

Duren and Cherrington (1992) concluded that significant differences were found in long-term retention of problem-solving strategies between the two groups. Higher results may be contributed to students verbalizing steps to solutions and making justifications. The authors further theorized that because the students could share responsibilities while in groups, they persevered more. Also because in groups there was less competition and stress, this led to higher scores. The author stated that cooperative groups were a good way to practice problem-solving techniques and to place information in long-term memory.

Table 1

*Pre-Algebra Classes: Analysis of Strategies by Treatment*

<u>Strategy</u>	<u>N</u>	<u>Mean</u>	<u>Score</u>
<u>Make a table</u>			
Individual	62	4.63	0.27
Cooperative	45	6.4	
<u>Draw a Picture or Diagram</u>			
Individual	62	10.6	.05*
Cooperative	45	12.45	
<u>Make it Simple</u>			
Individual	62	9.8	.95
Cooperative	45	9.85	
<u>Work Backwards</u>			
Individual	62	8.73	.00*
Cooperative	45	12.02	

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\*p<.05      Maximum 20 points per strategy (Duren & Cherrington, 1992, p.82)

Overall, the numbers seem to support the conclusion that cooperative work was more effective for problem-solving than independent work. More studies like this would help to lend support for these conclusions. The conclusion that because the students in the cooperative group had less stress and were less competitive, this led to higher scores, was not verified by tests using measures of stress and competition.

Almost all of the studies reviewed in this section found cooperative work helped students learn reasoning strategies or other methods of critical thinking, such as evaluation. The studies also found that cooperative work resulted in higher performance of critical thinking skills than independent or direct instruction methods.

#### Computer-based inquiry/Research

In today's technologically-savvy culture, computer-based instruction exists with websites containing many lesson plans or websites for students to explore and learn. This next section reviews several studies of computer-based instruction geared toward developing critical thinking. Are these methods effective? The answer to this question is important because school districts might pay a lot of money for a program that is not very effective.

Kuhn, Black, Keselman, and Kaplan (2000) found mixed results from using a computer program designed to teach students how to analyze science concepts. Specifically, the researchers measured the effectiveness of a computer program to teach students a correct mental model of multivariable causality as well as metacognitive understanding of inquiry goals. The study also assessed students for generalizability of the metastrategies to a different problem.

Kuhn et al. (2000) hypothesized that students at the middle school level may have an incorrect mental model of multivariable causality that will impede their analysis of causal factors that are involved in most forms of inquiry learning related to science.

The study included 42 middle school students, from mixed grade classes, 6th-8th, in an urban school. Kuhn et al. (2000) studied one experimental class and one

control group over several months. The control group had 12 boys and nine girls. The experimental group had 11 girls and 10 boys. The intervention group and the control group were arbitrarily chosen. The classes had a majority of students who were African American or Hispanic.

The study involved repeated practice in both pairs and individually, using a Macromedia Director program, which allowed self-directed investigation of multivariables. Students investigated five different variables and the outcomes of changing levels and types of the variables. Students took on the role of builders, trying to discover the best height to build the support of various buildings.

The intervention involved 9-10 sessions in 6 weeks, with an average of two sessions per week. The dyads were switched around so students worked with new students. The dyads were random except were changed if students ended up with a student they had already worked with.

The computer prompted students to choose various levels/types of independent variables in order to study multiple variable influences on an outcome to see which variables make a difference or not. They needed to analyze components rather than just be concerned with getting the “correct” outcomes. To promote students analysis of the various levels of the variables, the computer awarded students points if they made correct predictions and took points away if they made incorrect predictions.

Before students began the computer instruction, teachers gave an introduction to the program, in which they assessed students’ initial beliefs about how the variables would effect flooding. Then, the students investigated the variables. They

did five trials per session then drew conclusions of either causal or noncausality. Students collaboratively discussed in their pairs ideas and had to reach an agreement before manipulating the various variables.

In addition to the computer investigation, students did a paper and pencil exercise that involved reflecting and thinking on the strategies used, including comparing variable levels. Students were asked to discuss in dyads answers to the questions before writing them down. Another teaching method researchers used was having students think about the various available strategies in the experiment and hypothesizing on which ones would work better. Students did a 'metalevel' exercise with the goal of having students match strategies with the goals of the task. The students also needed to analyze, draw conclusions and justify them during this process.

A pre-test consisted of an introduction to the program and five trials in which students manipulated variables, made predictions and inferences then justified them. Another pretest was done to measure the generalizability of the metastrategies (the controlled comparison) as well as the comprehension of the goal of the investigation. These tests were taken individually. Researchers conducted the post tests also individually, in the 2 weeks following intervention. The authors compared teaching strategies as well – one in which students engaged in only the performance-level exercise (control) and the other in which students used the metacognitive exercise (experimental group).

Findings by Kuhn et al. (2000) were that students made less prediction errors (inferences) in the post-test compared to the pre-tests. The mean errors decreased

from 1.23 to .96. This decrease was significant:  $F(1,40) = 4.54, p = .039$ . On the transfer (generalizability) tests, the students decreased their errors, from a mean of 1.05 to .74 on the post-test. This was also significant:  $F(1,40) = 7.87, p = .008$ . From these results, the authors found students learned about the causal system in the investigation.

Students improved their use of the analysis strategy. To measure the change in the use of the controlled analysis strategy, Kuhn, Black, Keselman, and Kaplan (2000) measured the amount of valid inferences in proportion to overall number of inferences. The students on both tests increased their use of valid inferences. These results were subjected to the arcsine transformation and an ANOVA and for the main task time and were found to be significant,  $F(1,41)$ . Students improved more in the experimental group in number of valid inferences made compared to the control group.

In a post-test of the generalization measure, which used a different domain, all students in the experimental group chose correct strategies and all but two in the control group did. Approximately 55% of the experimental group could also justify their choice by explaining why they chose that setup of the experiment. This was more than the 38% of the control group. This was found to be significant,  $(1, N = 36) = 7.60, p, .01$ .

Kuhn et al. (2000) stated they couldn't conclude empirically if mental models changed during the "why" of a strategy as well as whether the "how" could help students learn metalevel understanding more. Metalevel exercises using the computers were effective in change, but this change was gradual. The authors

recommend further research in various methods to help facilitate the cognitive skills necessary for inquiry learning.

The method of awarding points for correct answers and taking away points for incorrect answers may have implications for the development of intrinsic science inquiry. However, the scores reported seemed valid given the research method used and the way in which scores were analyzed. The study used a control group, which allowed for the experimental group to be compared to a group that did not receive the same intervention. It was interesting that for the generalization measure all but two of the students in the control group chose correct strategies compared to all the students in the experimental group. This seems like not that much of a difference.

While students in this study used computers to help them learn analytical skills surrounding variables in experiments, in this next study, students learn argumentative analysis skills surrounding larger-scale science issues.

Seethaler (2004) designed a study to find out how successful 8th grade students were at learning to weigh the tradeoffs in using one method of agriculture over another, forming a judgment, then supporting their position with appropriate evidence. Students used a computer program to scaffold them through these reasoning skills, in combination with other teacher-led presentations and discussions.

Participants included 173 students, who were from a moderately diverse, suburban, middle-class neighborhood. Teachers had strong scientific backgrounds, one with a Ph.D. in biology. The intervention lasted 10 class periods of 45 minutes each.

For this project, educational researchers, teachers and scientists designed the curriculum. The resulting technology was a Web-based Inquiry Science Environment (WISE) using certain principles of scaffolding. These principles were called Scaffolded Knowledge Integration (SKI) framework and were originally developed by Linn (1995 and 2000). The SKI framework had four principles: 1. to make science accessible 2. to make thinking visible 3. to help students learn from others and 4. to promote autonomous lifelong science learning.

Students used a website to guide them through the project, which contained an inquiry map for the steps. This gave students prompts and hints, links, online discussions and other tools. Students then chose and defended their positions. Teachers sought to have students develop connected ideas about the controversy among multiple themes. These themes were human health, environment and economics. In addition, students compared genetically modified foods (GMFs) with other types of agricultural methods such as organic foods and foods grown with pesticides. Students learned of the tradeoffs involved in the latter two as well. Another goal was to give students a balanced view of GMF.

Other methods included brainstorming, comparing and sampling GMF food, analyzing food package labels, readings, a jigsaw teaching method in which students learned the pros and cons of the issue, poster making in pairs or groups, presenting posters, synthesizing information from multiple disciplines, and taking positions on what method of agriculture should be used in certain geographic areas and defending these positions with evidence.

Data sources analyzed were students' written work, pre-tests and post-tests consisting of short-answer questions, online notes and offline notes, and the position paper. Other sources of data were observation notes, audiotapes of interviews with students and teacher and whole class discussions.

Seethaler (2004) analyzed pre-test and post-tests for changes in learning, especially concerning analyzing risks and benefits of GMF. The short answers were given scores for unique and correct (normative) responses. Part of the definition of correct was scientifically recognized. Specific real life examples were expected. Students did not get points if they just said organic farming was better because it was 'natural.' They had to elaborate with specific techniques. The researchers looked for examples and arguments. Students also received partial points for examples that were not explained very well. For reliability of scoring, a second coder graded a subset of the tests, with greater than 85% inter-rater reliability.

Seethaler (2004) also analyzed the papers to see how students used evidence in arguments and made sense of the tradeoffs. The following criteria were used to grade these papers: 1. number of pieces of evidence used 2. themes of evidence used 3. scientific normatively 4. degree of elaboration of evidence students presented in favor of their position 5. degree of elaboration of evidence used by the students against their argument and 6. quality of students' conclusions. A 10-point knowledge integration (KI) scale was used for criteria 3-6. A 3-point scale was used for evidence in favor and against their position.

Researchers used a 4-point scale to assess conclusions in the papers. A second scorer graded a subset of the position papers, with a 70% rate of agreeing with the

primary scorer. After a discussion with the primary scorer about non-normative information, the rating was 90% agreeable.

Results showed that, in general, students' short answer responses contained more scientific explanations to back up their answers. In addition, students overall were in favor of GMF both before and after, although 62% wrote papers in favor of growing it while 80% said they would eat it initially.

Students gave much more elaborate rationales in their papers than in their initial responses. The majority of students used the jigsaw information correctly and accurately in their papers. Students presented just a little bit more evidence in favor of GMF than against. Students used on average three to four pieces of evidence in their papers from the curriculum and three from other sources. One-third of students had non-normative pieces of evidence. These ideas, such as, GMF gives you cancer, were not in the curriculum and came from students' prior ideas or from over generalizing other pieces of evidence in the interventions. Mostly though, students used these ideas as additional pieces of evidence for or against a position.

Seethaler (2004) found a trend that students only used evidence for and against their chosen method, while not mentioning evidence learned about other methods to compare to. Students evaluated risks and benefits (tradeoffs), as well as evaluated various methods in relation to each other. However, none of the students received a score of 3 on their conclusions. The authors stated that students tended not to explain why they thought a particular method was better and tended to list evidence learned during the intervention, suggesting students had difficulties integrating the information in order to evaluate it.

Seethaler (2004) concluded that students could present counter-arguments when given rich content and scaffolding. Still, students had difficulties using evidence from one context in the context of another method. Overall, students gained a more integrated understanding of the controversy of GMF but would also need more experience to better connect ideas. The authors explained that students would need more explicit instruction on how to write a conclusion that weighed the evidence.

It appeared student didn't jigsaw for or against positions for regular, pesticide agriculture production yet were given that option to choose from. Without having learned about the tradeoffs in non-GMF farming, students would have difficulties giving examples and evidence for or against this method. The study gave students much scaffolding and multiple ways to learn the information. This seemed to help contribute to the critical thinking students evidenced in their papers.

Another study that used computers as a teaching tool, Goldenberg (2005), involved students' analysis of primary digital sources. One-hundred fifty-nine middle school and high school students from four schools, both private and public, were included in the study. Students were from history, language arts and geography classes. Two of the classes were middle school and three were high school. Three levels of classes were in the study: AP, average and low-achieving.

Goldenberg (2005) chose humanities teachers from a professional development program on primary sources and technology in the classroom. Seven teachers were chosen from a survey of 358 teachers. Teachers who reported "high" use of primary sources were chosen, so students had already been exposed to primary

sources in their classrooms. The teachers were instructed on how to administer the teaching task.

The study used an online historical interpretation task, using parts of the *Picturing Modern America* website. For this task, students looked closely at an historical image, took notes on details they observed, then drew conclusions based on their observations and prior knowledge. Students chose from three images from the turn of the 20th Century: a photo, a panoramic map or a political cartoon. Thirty-two students chose the political cartoon, 33 chose the panoramic map and 94 chose the photograph. The task showed students a step-by-step process for reading the primary document. First students wrote down a question they had or selected one given to them. Then they tried to gather data to answer their question. The task was completed in one class period and some sessions were in computer labs.

Researchers compiled data in a spreadsheet and analyzed it for trends. Categories for analysis were used on how students developed as historical thinkers, using the following criteria:

1. Observation: scanning and parsing the document, observing details
2. Sourcing: considering who made the document and what their motives were
3. Inferencing: making inferences, speculating, guessing about meaning
4. Evidence: citing evidence when making inferences or drawing conclusions
5. Question posing: cultivating puzzlements, keeping track of one's questions
6. Corroboration: comparing what is found to what one already knows, other documents, etc...

Results showed that the students in the AP classes exhibited the historical thinking skills detailed above more than students in the other classes. But, students from the regular or remedial classes also displayed these behaviors. What was different was their answers had less background knowledge and less sophisticated language. Yet, these students still approached the documents actively, noted details, drew inferences and used evidence.

Students made observations and inferences and posed questions for the photograph and cited sources and corroboration with the panoramic map. High school students scanned the photographs more completely than middle school students and brought more background knowledge to their responses. For the panoramic photo, students from all levels made good corroboration (compared findings of new document to prior knowledge) and made good evidence to draw conclusions.

Survey data showed that nine out of 10 students said they learned more than in their previous social studies/English classes. Seventy-two percent said they liked history more now. Students said they understood more by focusing in-depth on the sources.

The authors excluded from the results what students did with the political cartoon, citing the reason as space issues. This was unfortunate, as the results from this data would have given an idea of how students approached such cartoons. In addition, the authors didn't define what 'good' meant when reporting that students gave good evidence and corroboration when discussing their evaluations. If this was measured with specific coding as to quality, then the reader would have a better idea of the students' use of evidence and corroboration. Also, self reporting as to whether

they felt they learned more is not as reliable as a control group, which was not fully described. In addition, results from self-reports might have several confounding variables, including the wording of the questionnaire as well as potential student ideas of what teachers expect them to fill out.

The authors also concluded that in classrooms where teachers use primary sources to actively engage students, students learn important skills of historical interpretation and document analysis. Since the study included a large amount of students from various schools, this generalization seems valid. Goldenberg (2005) further stated that their study added to a growing body of research on the skills necessary to get meaning from direct sources.

Another study researched online primary sources and students' ability to think critically about them. Harris (2002) researched whether students were able to make the necessary inferences when selecting online primary sources in order to weave the evidence together to understand historical social context. The study also used story writing to help students create meaning.

Participants included 53 academically gifted 8th grade students in a Midwestern farm town. Students researched primary source materials online, analyzed historical photos then wrote fictionalized multigenerational family stories based on images. This was the first part to a unit on the oral history of family farming. The students had no or little farming experience themselves.

A teacher first lectured on the recent history of farming in the U.S., the Dust Bowl era to present day. Then students independently read a variety of sources about modern farm life: newspapers, magazines and books, tables of statistics, short fiction

and trade publications and completed a questionnaire after each reading. The school librarian media specialist (the author) introduced students to an online archive of Dust Bowl-era photos from the Library of Congress American Collections ([memory.loc.gov/ammem/fsahtml/fahome.html](http://memory.loc.gov/ammem/fsahtml/fahome.html)) and also taught students searching methods and visual literacy skills. Students then wrote short stories based on a photo, connecting the photo to present life (Harris, 2002).

The online research took several days, during which the author taught lessons and helped students. One lesson was how to search using subject and keyword and how to analyze photos. Students viewed all photos on a strip (while analyzing one) to gain more context clues. The author modeled the search and selection process and led the class in group analysis of photos. Students first were asked to describe the photo then to offer inferences and interpretations.

The specific questions students answered: 1. What is happening in this picture? 2. What are the circumstances this photo represents? 3. How are the people dressed (be specific in your descriptions)? 4. What can you observe from the expressions on their faces, posture, or position in the photo? 5. Describe the setting. What do you notice about the room (furniture, walls, etc.)? 6. Is there anything interesting or surprising about the situation in the photo? Given what you know about the era, how might you explain it (Harris, 2002)?

Questions 2, 4 and 6 were designed to prompt analyzing and interpretation. The teacher modeled viewing the photo carefully. Students then chose their own photos to analyze, then worked in pairs to analyze them.

Specific criteria for creative writing were that it had to contain plausible and causal relations taking place in photo to present (to give present-day meaning to old photos), and they had to be 2 pages long. Students had two class days to write the stories and out-of-class time if they chose to. The writing task was also done in pairs, with the hopes that students would bring multiple perspectives to the task and engage in argumentation to gather alternative theories and inferences about the photos' circumstances.

This inquiry-based informal action research was the result of a collective effort of students, teachers and the school library media specialist. This study used theory building, interpretation and grounded theory methodology in order to interpret results.

Researchers analyzed 27 stories and the answers to the analysis questions. They first identified themes then re-read to verify. Approximately 91% of the interpretive questions were answered appropriately. Students struggled with separating observations from inference and interpretation. Students tended to transpose their own frame-of-references onto the historical photos. At times students went beyond interpretation into conclusions (Harris, 2002).

The author also noted that when students did not collaborate on the stories, the qualitative nature decreased. Also, without sufficient background knowledge and directed feedback, students had gaps in understanding and inserted unrelated information into the stories or used inappropriate writing devices. The authors stated that next time they would give students more structure to write the stories – more prompts and information to incorporate to make the stories more believable.

This study seemed a good way of getting students to interpret history. The percentage of students who were able to use interpretation speaks to the success in this area of the study. The use of the online website might have to be accompanied with additional online support or more teacher support in order to get better results with the story writing piece. Having students use online background information could have given the stories more realistic scenes or allowed more informed analysis and interpretation of the historical photographs. The lack of this background information was evidenced when students tended to insert their own frame of reference onto the photographs.

In this next article, Oliver and Hannafin (2000) designed a lesson using web-based hypermedia and open-ended problem solving. This qualitative article studied the classroom as a whole, student dyads and individual students. The authors studied students as they solved complex science problems.

Participants included 12 middle school students from a rural middle school in the Southern United States. All 12 students were 8th graders.

The researchers used constructivist ideas for open-ended learning so students could collect, organize, annotate and evaluate complex information using the Internet. The study lasted 5 weeks. The students were paired by ability level – with a low ability student paired with a high ability student. The students were asked to find, frame and solve open-ended problems of a building collapsing during an earthquake. Students were asked to choose one problem and design inquiry questions surrounding this. Students had some scaffolding, including finding and reading 13 websites, using advanced organizers, and learning key search words. Then students collected

information and organized it. They were encouraged to critically reason through more than one solution. Students had access to 65 additional websites and 46 books. Other methods used were brainstorming and evaluation of solutions, drawing designs, as well as making web pages of their solutions.

The data the authors collected included tests, observations, and project artifacts at three stages of the project. They also collected interviews and a follow-up transfer test.

Results showed that students used lower-end thinking skills such as information gathering. The students were able to resolve the problems but did so without using computer tools to show evidence for their arguments. Some pairs did not use the time wisely, read unrelated websites, and did not discuss with each other solutions. Another pair of students did discuss solutions with each other but did not ask very many questions or display much higher-level thinking. Another pair worked well but did not generate premises or solutions. One pair did evaluate solutions and came up with viable solutions.

Lastly, researchers found the students rarely used the computer tools designed to help them think critically. They did not use them to organize information, see relationships and patterns, justify ideas or defend solutions. The authors concluded that using web-based hypermedia and open-ended problem solving did not lead to much critical thinking. They also concluded that the tools alone were not sufficient to help students solve the problems (Oliver & Hannafin, 2000).

This study might have had poor computer methods that led to these results. Another possibility is the students did not receive enough scaffolding from teachers to

help them engage in critical thinking. The conclusion by the authors that the problem was related to lack of outside support does not really analyze the computer tools themselves to see if they were designed to scaffold students sufficiently or not.

Overall, the studies in this section did not produce great results. The use of computers, while in some studies helped students think with some critical thinking skills, needed to be used in combination with other methods in order to scaffold students to their highest potential in critical thought. Some of the studies relied only on the computers and those were the studies in which students did not develop as much critical thought as researchers might have expected.

#### Artistic creations

Several of the studies reviewed for this chapter used artistic means to foster student thinking. These included visual art, music, poetry, photography and more. Such diverse means for students to express their thinking meant that students who might have had difficulties with written expression could have the chance to voice their ideas in other modes.

Kroeger, Burton, Comarata, Combs, Hamm, Hopkins and Kouche (2004) studied seven teachers who conducted a project geared at helping at-risk youth stay in school. The project included six at-risk adolescents from a suburban middle school. The students, three boys and three girls, had low grades, poor social relations and behavioral problems. In this study, students took photographs, teachers conducted interviews with the students and used classroom methods such as discussion and small group. Students and teachers in Kroeger et al. (2004) came together for short 30 minute sessions.

The idea for the project arose when the teachers in the article grew concerned that their teaching methods were not reaching the students. The project included an on-going dialogue between teachers and the students about their experiences in school. The overall goal of the study was to deepen students' bonds with school. The development of some critical thinking skills was a sub goal of the intervention.

This participatory study included three parts and the process evolved as the study progressed and teachers' reflection on their own practice deepened. Teachers listened to students, observed the environment as well as reflected, simultaneously. Students took photographs of their lives, shared them with other students and learned from them. The teachers then engaged students in dialogue about individual change, quality of life and changes within the school system (Kroeger et al., 2004).

The students used disposable cameras to take pictures they believed depicted their lives as learners. They placed the photos in journals, gave each one a title and caption and reflected on how each one showed their reality. When students shared their photos, they spoke so much that they had to compete for air time. Teachers found students eager to share with each other their work. Teachers asked: 'What do you see? What is happening here? How does the problem relate to our lives? Why is there a problem? And, what can you do to solve the problem?'

When teachers met with students for interviews, they asked them questions about how they saw themselves and school. The questions asked them to describe good days and bad days at school and to compare a good day with a bad day (analysis). The authors attempted to create bonds with students to gain empathy for them, in an attempt to help prevent them from dropping out.

All the sessions were recorded then transcribed. All the teachers involved analyzed the transcripts and themes emerged.

The photography taking and discussion resulted in literal level statements to statements about elements of a trusting community and friendship as well as comparison of two separate things. Students analyzed their social network and society in general. The students developed, together, criteria, for building a community with each other. Students interpreted, explained and re-explained the meaning in the photos as well as the context in which they were taken.

An important insight from the Kroeger et al., (2004) study was learning about the whole child in order to help them succeed academically. “Truly, you can’t reach the students’ academics until the social and emotional is taken care of. That is exactly what we are doing here. We get that in place and later the academic piece is going to come,” one teacher stated (p. 55).

This is an example of how thinking and academics cannot be separated from the emotional and social aspects of a child. The project also helped the teachers see what the students valued. One thing that would have helped readers of the article understand more about the learning that transpired is listing the way in which the conversations were coded or analyzed. There didn’t seem to be any structured way so it is difficult to see how much critical thinking transpired compared to lower-level thinking skills. But since this was not the main focus of the study, this is understandable.

In another study using artistic expression with at-risk youth, teachers taught higher-level thinking during a unit on literature (Ciancio, 2003). The authors

observed teachers facilitating critical literacy skills for “at-risk youth” through artistic responses and other methods.

The case study involved a small group of five “at-risk” male students in 9th grade. Four were White and one African American. They were participants in an Occupational Work Adjustment (OWA) program. Ciancio (2003) defined “at-risk” as excessive absences, truancy, low grades and test scores, extreme personal or home problems, family financial difficulty, or substance abuse or “dislike of school in general.” Several of the students had learning disabilities and were on Individualized Educational Plans (IEPs).

The teachers in Ciancio (2003) taught students a unit for 6 weeks on Julius Lester’s *Othello*. This young adult book, which put an African American protagonist at the center, was a modern adaptation to a Shakespeare novel. Teachers encouraged students to ask questions and make hypotheses, and to argue interpretations. Students responded through music, visual art and poetry writing. The teachers wanted to teach about power relationships in society to have students critique the basic assumptions of society. Teachers addressed racial stereotypes in literature and social and historical contexts were also questioned.

Additional instructional methods included the following pre-reading strategies: learning background knowledge, interpreting the cover art of the book, and predicting. Both teachers and students read the book aloud. Teaching models included discussion format as well as whole class instruction. Students also watched film clips from the documentary *Ethnic Notions*, a critique of negative stereotypes of African Americans in media. Students represented their thoughts on the novel by

drawing or creating a collage. Teachers gave several prompts for this project: What did the novel make you think of? Did it connect to anything you've ever experienced? Or students had the option of exploring one of their own questions. Students wrote a few sentences explaining their art. Students both read and wrote poetry that related to social issues. Students wrote songs and presented their lyrics (Ciancio, 2003).

Results showed the students' interest in the book increased as they progressed through the novel as did their reading skills. By discussing their lyrics of the songs they wrote, students helped each other define their own views; they also debated and questioned those of their classmates. The students also interpreted. The music motivated the students to engage more deeply in the book. The teachers reported that the students saw how the book related to their lives, through the music connection. In addition, students critiqued the negative racial views of the white characters in the book and connected this to discrimination in media (Ciancio, 2003).

Ciancio (2003) recorded teacher-student dialogues. Examination of the recorded sessions showed students examined the plot and motives of characters in relation to stereotyping. Students sharpened their critical literacy skills by empathizing with characters, exploring moral issues and debating their interpretations. The teachers also helped students pose questions and explore ideas through artistic experiences.

Ciancio (2003) also took an initial survey of the students' attitudes about literature. The results showed the students had negative ideas about Shakespeare. A scale was used from 1 to 5 with 1 being a low opinion and 5 being a high one. Most

students put 1 or 2. One student put a high point that was not specified as to the exact number. The wording of the scale was not mentioned.

The teachers made conclusions that seemed to match their goal. While no formal question or hypothesis was posed, it was evident they were trying to teach critical literacy skills and described this through their accounts, example dialogues and descriptions of how the unit unfolded in this case study. The survey was a weak measure of whether students grew to like literature because of several reasons. First, no post-survey was reported as having taken place in which to compare to the initial survey. Second, students might just put down what they think teachers want them to.

The studies in this section gave students a chance to express their thinking in artistic mediums. As the researchers found, this engagement, used in conjunction with discussion and other teaching models, helped students think critically. The importance of this is that students who might not learn very well through reading and writing can have an alternative way to express their learning.

#### Critical Thinking Skills Taught as a Separate Skill

Most of the studies in this chapter used methods of teaching critical thinking that were integrated into domains. Some methods were specific to certain domains, such as analyzing scientific variables or discussion as a way to talk about social problems. Not very many of the studies reviewed for this paper used methods to teach critical thinking that were separate from the domain. The few studies that did were reviewed for this section. While some of the studies in this section taught skills while using some kind of domain content, the critical thinking skills were meant to be general so that they might be applied to multiple contexts.

In this first study, researchers used intensive training courses in cognitive skills (Matthews, 1989). Matthews hypothesized that students taking a cognitive abilities test after an instructional course in critical thinking skills would tend to score higher than similar students who took the test prior to instruction.

Sixty-seven students participated in the study, 34 7th grade students and 33 8th grade students from a predominantly African American school. The study included 33 males and 34 females of low to high ability levels, although most were average to above average ability. The study took place at a college.

Researchers randomly assigned the participants to two groups: one took the test prior to instruction and one took the test after instruction. The experimental group took the test after the instruction for post-instruction measures. Students were not told that the test was part of the instruction program in order to avoid the placebo effect. Then students received instruction Monday, Tuesday and Wednesday mornings for 6 weeks. The lessons were 60 minutes total each day and were taught by the same teachers. The instruction was divided into two sessions each day. Seventh and 8th graders were divided into separate sessions. The students received this in place of their normal language arts classes.

Teachers taught reasoning strategies in non-domain-specific exercises. They taught the following specific skills:

- 1 Classification (sorting of things into groups according to common qualities)
- 2 Qualification (recognizing unique attributes - sensory, logical or emotional)

- 3 Operation analysis (thought sequencing necessary to be able to recognize the relationship between an event, operation, or transformation and the stages and sub stages that constitute it)
- 4 Seeing analogies (series of mental operations to recognize the similarities between relationships)
- 5 Structure analysis (the highest skill of the program – process of gaining an awareness of the relationship between a whole structure and its parts)
- 6 Thing-making (vocabulary building – becoming aware of a thing and naming it)

Researchers taught one thinking skill per week with pictorial handouts to supplement verbal instruction. The teacher explained each item on the handouts and gave detailed explanations for correct responses (Matthews, 1989).

Matthews (1989) used The Cognitive Abilities Test first developed by Thorndike and Hagan to measure the effectiveness of the teaching. This standardized test measured mental aptitude. The test had three sections: verbal, quantitative and nonverbal. Verbal included three subtests – verbal classifications, sentence completion and verbal analogies. Quantitative contained quantitative relations and number series subtests. Nonverbal had three parts: figure classification, figure analogies and figure analysis.

Researchers examined scores on the eight subtests to determine differences between pretest and posttest scores. The researcher decided to analyze the eight separate tests as eight different hypotheses. The researcher used independent t-tests in the analysis because the group of students that took the pretest was different than the

group taking the posttest. The researcher said because the two groups were chosen in a random fashion, differences in scores would mean that the instruction caused higher scores (Matthews, 1989).

Results showed the means on the posttest scores were higher than those of the pre-test students in all tests except one, figure classification. A significant difference was found on three of the subtests ( $p < .05$ ). The results support the hypothesis that teaching thinking skills would raise scores on the verbal analogies, number series, and figure analysis. But the hypothesis was not supported for the verbal classification, sentence completion, quantitative relations and figure classification and figure analogies. This might be because the difference was found to be non-significant for these subtests.

The researcher drew the conclusion that cognitive aptitude can be increased by instruction. Previous research that higher-order thinking skills raised scores on tests was stated to be supported by this study. Scores would have been higher if instruction were longer, the author concluded. The abilities that increased the most were ones that required abstract thinking.

The conclusions drawn were consistent with results, except that longer instruction would have resulted in higher scores. This might have been an over-generalization because without a separate test showing longer instruction does raise the test scores even more, there is no way of telling whether they would or not. The goal, sample, design and findings were congruent. The randomness of the samples helped support the claim that higher scores were a result of instruction. But without a full control group, this cannot be determined, because students had other educational

experiences over the 6 weeks that could have been confounding variables. To retest with different answers for the group who did the pretest might have given some more information, although another confounding variable would be that students would be more familiar with the test and this could cause higher scores. Additionally, researchers found certain subtests to have a non-significant difference in scores, so teaching these skills may not be desirable, given the limited time teachers generally have on their hands.

This study measured what standardized tests might measure and so would have value for students planning on taking the SATs in high school or other tests like this. But, the methods in this study may not directly apply to teachers wanting to teach students non-logical thinking skills such as forming judgments or making evaluations.

Finally, the students were from one school only and included a lot of mid- to above average-achieving students. Because of this, generalizing to below average populations might not be warranted, even if there were some students who fell within this range in the study.

Another study, Sternberg (1998), used the *triarchic theory of human intelligence*, which states that human intelligence has three main aspects: analytic, creative and practical. The researcher's hypothesis was triarchic instruction would increase performance on assessments: multiple choice and measurements of creative, analytic and practical performance. Sternberg gave two reasons for the hypothesis: 1. triarchic instruction would help students encode information in three ways: creative, analytic and practical as well as for memorizing. These multiple ways of encoding

would enhance learning. This approach would allow students to think to learn as well as to learn to think. 2. Triarchic instruction would allow students to use their strengths and compensate for their weaknesses, which was a key component of triarchic instruction as well as of *aptitude-treatment interaction*.

Participants included 213 3rd grade students and 141 8th grade students. The 141 students consisted of 68 boys and 73 girls. For the purposes of this paper, only the results for the 8th grade students were included here. The 8th grade students took a summer course in introductory psychology at the Center for Academic Advancement (CAA), a program in gifted education at Johns Hopkins University. The goal of CAA was to identify gifted students and give them specialized education. Scores from the Scholastic Assessment Test (SAT) were how gifted students were identified. They had to have a score of 420 or higher on the verbal test. The students' mean score was 471. The students were selected from across the United States, with mostly white middle-class to upper-middle class backgrounds.

The instruction took place in two 3-week sessions. The weeks consisted of 5 days with 7 hours of instruction each. Teachers used an introductory psychology text. The research was done at two different sites. One site had 120 students. Of the eight sections, four received triarchic, two critical-thinking and two traditional methods. At another site, 21 students received critical thinking instruction.

The experimental condition consisted of teaching the triarchic method of thinking. Two control conditions existed: one group received exactly the instruction they would have received without intervention. The second control group received the same instruction but with critical thinking (analytic skills) instruction. To assess pre-

intervention skills, Sternberg (1998) gave students a multiple choice test as well as an additional performance-based assessment measuring analytic, creative and practical skills. Researchers divided students into three groups based on standardized ability measures so that there were mixed ability groupings.

Five experienced teachers in secondary psychology taught the 8th graders. The teachers also received an intensive training program prior to the intervention. The training involved techniques in including strategies in instruction in all aspects: lecture, discussion, collaborative-learning groups, and individual assignments. For the teachers employing the triarchic intervention, they learned techniques in creative, analytic and practical instruction.

The specific instructional strategies for the three different types of instruction were: 1. traditional: students participated in discussions, writing tasks that emphasized memorization skills 2. critical thinking: students worked on tasks that required analytical reasoning: analyzing the theories of various theorists, comparing and contrasting different theorists' ideas on a topic, stating the assumptions behind theories and then forming a judgment on which theory they most agreed with, explaining why. 3. triarchic instruction: a) analytic tasks: analyzing, judging, evaluating, comparing and contrasting and critiquing b) creative tasks: creating, inventing, discovering, imagining, and supposing c) practical tasks: implementing, using, applying and seeking relevance. For comparison purposes, Sternberg (1998) defined traditional education as memorizing, remembering, recalling, recognizing, and repeating.

Additional measures of effectiveness included a multiple choice test, a mid-term and short answer essays during a performance evaluation. Students also wrote three extended essays – one for analytic, one for creative and one for practical.

The performance evaluation was scored by three raters who did not know the research design or hypothesis. A 5-point Likert-type scale was used to rate the overall quality of each response. Correlations among the ratings given by pairs of raters for nine performance items ranged from .76 to .80. The authors stated that the overall correlation of .83 was sufficiently high to conclude that the raters were reliable in assessing students' responses.

A preliminary analysis studied two possible confounding variables, gender and SAT ability score, as they were considered important in the treatment-effect analyses. However, a MANOVA did not reveal differences in gender or SAT effects on outcome variables. Only a correlation between the analytic subtest and the final exam and the SAT scores were found to be significant ( $r = .189, p < .05$ ). There were no SAT related group differences across the groups.

Results showed the triarchic method was superior to critical-thinking and traditional methods of instruction on both the multiple test items and measures of analytical, creative elements of achievement. Three ways of evaluating effects were used: MANOVA, profile analysis and pair-wise least-squares means comparisons. Researchers examined the mean scores for differences among the three groups over the seven assessments. They found a significant difference between treatment groups on average performance:  $F(2, 138) = 50.04, p < .0001$ . There was a standard deviation of .30 in the triarchic group compared to the critical thinking group and a

standard deviation of .36 in the triarchic group compared to the traditional group. There were no differences between the critical thinking and traditional groups. Sternberg (1998) stated this meant the triarchic groups performed better than the traditional group and the critical thinking group.

In the analysis of analytic tasks on homework, the triarchic group and the critical thinking group scored better than the traditional group. For the homework assignments on creative thinking and practical thinking, there was no difference between triarchic or critical thinking groups but both groups scored higher than the traditional group.

For the examinations, the three groups did not perform differently for the analytic skills. But, the triarchic group scored highest on the creative tasks. The difference on the creative measure for the critical thinking group was marginally significant from the traditional group ( $p < .07$ ). The traditional group scored higher than the critical thinking group. On the practical tasks, the triarchic group scored highest and there was no difference between the critical thinking and traditional.

On the multiple choice test, the triarchic group scored highest. Comparing the triarchic with critical group, the difference was significant:  $t(88) = 3.91, p < .0001$ . And the triarchic compared to the traditional group was significant as well:  $t(88) = 6.02, p < .0001$ . The critical thinking group scored better than the traditional:  $t(58) = 2.61, p < .01$ .

Sternberg (1998) did not make generalizations to a broader population, stating that the test was done for the subject of psychology and would have to be further tested on other subjects. Unfortunately, the assignment of groups was not random. In

addition, since the specific methods for the triarchic method were not explained fully, teachers might have a difficult time replicating the results of this study.

These results had implications for the methods used to teach critical thinking compared to traditional. Traditional methods did not raise students' critical thinking ability as much as teaching critical thinking or the triarchic skills. However, the fact that students could take the intervention home for homework, outside a controlled setting, raised questions as to reliability of the data for this particular assignment.

The few studies in this section resulted in success in teaching students critical thinking skills. The studies had pre-determined measures of what the critical thinking skills were that were to be measured. The difference between teaching CT in context versus as separate skills is a philosophical debate still being played out in the CT field. Should teachers teach CT in context and allow students to guide their own thinking or should teachers have a formalized set of skills they are teaching across domains? The next section begins to explore this question.

## CHAPTER FOUR: CONCLUSION

This chapter summarizes the findings of chapter three, in which the literature on teaching CT skills to middle school students was critically examined. First, the connection between the historical context of critical thinking and the current research will be discussed. Then, key patterns from chapter three's critical review of the literature are examined. This includes a discussion of what strategies were found to be effective and which ones were unsuccessful. Next, this chapter suggests classroom implications of the research surrounding teaching critical thinking to middle school students. Lastly, areas for further research are discussed.

### Summary of Findings

The studies reviewed in this paper were the current studies of a vast field of knowledge related to CT. Historically, the earliest civilizations engaged in critical thought, from Socrates to Voltaire to Chinese philosophy such as the Mohist tradition (Hongladarom, S., 1998; Paul, 1990). We seem destined to seek out answers and to look beyond the surface of our environment. So, the current studies reviewed in this paper are part of a historical quest that is thousands of years old. Yet, the history of critical thinking in our schools is fairly recent. As mentioned in chapter two, our earliest schools focused more on memorization and religious studies. World history has shown many examples of barriers to critical thinking as well (Spring, 2005).

But times have changed and with it the necessity for research on effective critical thinking teaching strategies. The studies reviewed here can help teachers find effective methods for the current goals of education in the United States and

Washington State, which include critical thinking (NCHS website; Washington State EALRs, Social Studies, Benchmark 2).

Overall the studies in chapter three had many different and creative ways to teach students critical thinking skills, an important skill for students to have. The articles represented a range of disciplines: language arts, social studies, math, science, and art. While most dealt with language arts and social studies, disciplines other than the humanities were reviewed because domains are not naturally separated in the world outside school. Teachers can integrate math, science and art into language arts and social studies, so I reviewed articles with these domains. Researchers in the studies in chapter three found students could think critically using certain teaching methods in many different disciplines.

Many of the studies used writing to teach critical thinking skills. The process of writing helped students think through analyzing, arguing, evaluation and critiquing, with varying levels of success (Bowser, 1993; Brozo et al., 2002; Ciancio, 2003; De La Paz, 2005; Gillespie, 2005; Gruber & Boreen, 2003; Harris, 2002; Kerr, 1998; Oliver & Lalik, 2004; Pouit, 2002; Seethaler, 2004; Werle, 2004; Wolf, 2003). Teachers used writing in combination with other strategies in most of the studies cited above. In fact, not very many of the studies used just one strategy with students. Many used two, three, or more. For example, Brozo, Walter, and Placker (2002), used discussion, media images, and debate in addition to writing. One study had students write in groups in order to solve problems (Kerr, 1998).

The studies with discussion were perhaps the most successful models (Bowser, 1993; Brozo et al., 2002; Gruber & Boreen, 2003; Lynn et al., 1999; Polite

& Adams, 1997; Powell et al., 1994; Wilson & Clark, 2000). The groups allowed students to learn new ideas from each other and to challenge each others' thinking. This allowed students to see multiple views and to refine their arguments or opinions. Additionally, when teachers let the students' ideas guide the discussion, students could reach depth in their critical thinking as well as access their prior understandings of concepts (Brozo et al., 2002; Gruber & Boreen, 2003). In Gruber and Boreen (2003) students accessed their previous readings or experiences in order to bring meaning to their dialogue. Another benefit of allowing students to bring their ideas and experiences into the dialogue was the relevancy of the discussion increased and the discussions were personally meaningful for students. Brozo, Walter, and Placker (2002) allowed students to discuss the racism in their own neighborhood, which led to a fruitful discussion and a brainstorming session on actions the students could take to combat racism. If the teachers had had time or the willingness to extend this brainstorming session, the students might have been able to implement their ideas and see the results of their thinking play out as social justice in their own communities. But, the authors in Brozo et al. (2002) reverted back to their original lesson plan so this possibility didn't materialize.

What happened in the studies that included discussion was that if a teacher tried to control the conversation too much with their own beliefs and ideas, students did not originate critical thought as much. For example, another technique used in the articles reviewed in chapter three was questioning. This technique usually was used in combination with discussions. Studies found mixed results when using this technique. Usually this was because of the way in which the teacher or researcher used the

questioning. Oliver and Lalik (2004) found that using questioning during discussions in a manner that put girls on the defensive and that interjected too much adult judgment resulted in mostly resistance to critical thinking and perseverance in previous beliefs. The researcher in Oliver and Lalik had a predetermined belief that the beauty pageant at the school in the study was oppressive to girls and the girls in the study were not allowed to come to their own opinions or to originate other social critiques. The manner in which the researcher questioned the girls was confrontational.

Another study with pre-determined questions was different from the Oliver and Lalik (2004) study in that it allowed students to form their own judgments, evaluations and analysis (Rickford, 2001). Rickford (2001) found that when students responded to questions that were pre-made that they responded without defensiveness and were able to come to conclusions of their own. The questions were not asked in a confrontational manner.

Another technique, that when used poorly did not result in much critical thinking, was computer-based programs. When teachers relied only on a computer-based program, students did not achieve their full potential (Harris, 2002). However, when the technology was used with other teaching methods, students were able to make meaningful critical connections (Goldenberg, 2005; Kuhn et al., 2000; Seethaler, 2004; Wolf, 2003.) For example, in Seethaler (2004), a teacher gave students background information, helped students brainstormed prior concepts, and facilitated discussion and paired work in addition to computer work to help students weigh the pros and cons of genetically modified food.

Teachers taught specific reasoning strategies as well in the articles reviewed (Daniel, 2005; De La Paz, 2005; Feuerstein, 1999; Leshowitz, 1993; Wolf, 2003). Some were heavily structured while in others the students may not have known they were being taught a specific strategy. The studies with highly structured methods achieved substantial results, but follow up studies would need to be done to show the degree of transfer (Daniel, 2005; De La Paz, 2005; Leshowitz, 1993).

Some teaching methods crossed through more than just language arts and into math and art as well as science. One of the most common teaching methods in these other disciplines was the use of discussion, or dialogue. For example, in Daniel (2005), teachers introduced discussions into a math class, which resulted in students growing their critical thinking. In another study, a teacher helped students critique art using the discussion model (Wilson & Clark, 2000).

Another common teaching strategy used across domains was cooperative groups. In Duren (1992), teachers studied the difference between students solving math problems in groups versus independently. The researcher found cooperative work in pairs helped students solve problems better than when they worked independently. Students also learned to justify their answers. Many of the studies reviewed in chapter three used the strategy of having students justify their answers with evidence. Another study using cooperative group work, Hudgins (1994), found that when students took on roles in which they practiced thinking skills, they learned science more than when they were working as a whole class.

These studies are connected to early educational philosophy on critical thinking, such as by Dewey, who stated in 1910 that reflective thinking should be

active and consider the positions from which beliefs come from (Feuerstein, 1999). Later, McPeck advised persons to approach any information in light of the perspective or motivations of the source (McPeck's papers, as cited by Feuerstein, 1999). Those studies in this paper that promoted students to engage in self-directed critical thinking led to more effective critical thinking skills.

In addition, these studies add to the body of research reviewed by Pithers (2000). Pithers reviewed research in this area and noted that authors agree that the teacher should act more as a facilitator rather than a lecturer of information to encourage critical thinking. The research reviewed also coincides with Pithers' analysis that most of the research now is studying CT skills used within a discipline rather than as a separate set of skills (Pithers, 2000).

#### Classroom Implications

It cannot be understated how important it is to allow students in discussions to voice their ideas and to take responsibility for their own discussion without too much interference by the teacher. Teachers who want to use such methods as discussion and higher-level questioning need to keep the results of the studies reviewed here in mind. The implications of these studies are that the manner in which teachers facilitate discussions will effect how much critical thinking students engage in. These studies also speak to the importance of being aware of our own beliefs and biases as teachers when encouraging critical thought among students. For example, do we want our students to believe what we do or do we want them to form their own judgments and conduct their own analyses. Both the Lynn, Johnson, and Hassan (1999) study and the

Oliver and Lalik (2004) study found at times that teacher bias negatively effected students' personal engagement in critical thinking.

The future ability of students to think critically is effected by these issues. This is because if students learn the important critical thinking skills of analysis, forming reasoned judgments and evaluation, then they can go on to use these in the future. But, if these skills are prevented because we are imposing our own beliefs on students, then they will not be able to critique things on their own in the future. So, allowing students to participate in a full discussion with each other rather than answering questions from the teacher is important.

Another implication of the research is that when teachers are using computers to help students develop critical thinking, they most likely will need additional support. Unless the computer program has sufficient scaffolding embedded in it, teachers will need to help students with such things as research skills and judging the validity of sources found on the Internet.

For teachers wanting specific reasoning strategies, these studies contained many ideas that resulted in critical thinking among students. Such ideas included advanced organizers that prompted students to evaluate sources, modeling of critical thinking, and structures to write argumentative essays (De La Paz, 2005).

The Daniel (2005) study was important because it showed that teaching students higher-level thinking in math can be done through non-traditional means. If teachers want to help students problem solve better in math, the techniques used by Daniel (2005) can be tried. These teachers encouraged students to think out loud and

discuss with each other strategies for solving problems. A closing reflection enabled students to evaluate the strategies they used that day in order to improve on them.

Several studies had poor results and so show what methods might not work for teaching critical thinking. Pouit (2003) found that when teachers used methods to help students retrieve ideas from memory, that this did not have a significant effect in their abilities to write argumentative text. These strategies included brainstorming and prompts. More structure in writing the persuasive text probably would result in more critical thinking among students. Another problem that this study had was the topic they chose did not seem very exciting or controversial for students. Teachers might have better results with the same strategies if the topic were of interest to students. Allowing students to choose their own topic might be even better. For example, in Brozo et al. (2002), when teachers allowed student ideas, the results were a list of ideas students could put into action in their communities.

An important factor to keep in mind is, what is the purpose of teaching critical thinking skills? Some studies showed teachers really caring about the purpose of teaching students critical thinking. The danger exists though, that critical thinking skills will be taught just to teach critical thinking skills. If districts require students to analyze, evaluate, form reasoned judgments, then teachers might teach them just to fulfill a requirement. In the Pouit (2003) study, students wrote persuasive essays on their summer vacation – not exactly the type of topic one might feel the need to argue about or form critical dialogue about. What might be very important for teachers is to have a purpose in mind that is meaningful and useful for students to learn critical thinking skills. This would serve students well in the future because they might learn

that critical thinking is vital to their lives and not just another remote fact to be memorized.

#### Implications for further research

More studies could be done comparing discipline-specific techniques with non-discipline specific critical thinking. In this way, which method is better could be discerned. Because technology plays an important role in the classroom, more studies on the effectiveness of computer-based learning on critical thinking need to be done. Another area of research could be the difference between teachers cultivating caring relationships with students compared to teachers not building rapport with students.

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