MULTIPLE LITERACIES, MULTIMEDIA, AND MULTIMODALITY

IN THE CLASSROOM

By

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ABSTRACT

This paper examines the relationship between literacy and culture, including the way multiple literacies, multimedia, and multimodality can impact our students and classrooms. An examination of the history of literacies contrasts the philosophical and real goals. The role of multimedia technology in society identifies the trends of media multitasking. A critical review of the literature revealed that multiple literacies and multimedia use in classrooms has beneficial results in student motivation and achievement. The conclusion of this paper suggests that, with teacher professional development and awareness of new literacy skills, pedagogical changes can help all students succeed.

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CHAPTER ONE: INTRODUCTION

Rationale

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fortn r 2 tAk armz agnst a C f trblz, & by oposn nd em?

If you did not understand the previous statement, fear not. If you did,

however, you are one of a growing number of people with a new literacy. You enjoyed

one of Shakespeare's most eloquent soliloquies in text speak, also known as IM Lingo. It

is a vivid example of how new technologies create new literacies. We are in a global

world of multiple literacies and ways to interpret the world around us. Increasingly, the

clear division between subjects is dissolved, and there is a growing need to stress an

education that encompasses these multimodal transformations.

Even in the example above, it is still a modified form of print literacy, though

reinterpreted through the context of Information and Communications Technologies

(ICT). With more technologies becoming a part of our culture and society, we have

opportunity and ability to come to a broader understanding of what literacy means, the

potential of alternative forms of media to convey it, and how it can benefit our

educational system.

Nonetheless, it serves as a reminder that literacy is "socially situated and

ideologically formed" (Siegel, 2006, p. 65). Gestures, symbols, speech, and interaction

are all parts of emergent literacy. Identifying these interactions with the world around

them as part of literacy has put increasingly greater significance on sign-making and

semiotics as part of literacy. Literacy is not defined by the media it takes, but by the

scope and extent we allow it to make meaning in.

New media is shaping our youth's understanding and literacy patterns at home and in leisure. Once, we would have described this as private reading, yet the media itself is forcing us to rethink the borders of private and public spaces. As more youth turn towards screen literacy instead of traditional print literacy, it becomes an increasingly social activity.

However, for it to truly be literacy there must be the abilities to access, analyze, and evaluate the messages that are being exchanged. Thus, like traditional literacy, media literacies must be taught as a skill set and habits of effective inquiry. These forms of literacy must be evaluated in the same mindset as traditional print literacy while combating the perils of declining literacy in our society (Project Look Sharp, 2008).

Declining literacy rates have social, civic, and economic implications. These implications are the very real factors of having less critically thinking society, a more docile and apathetic citizenry, reduced global economic competitiveness. This can avoided if we are willing to address the complexities of literacy. If we commit to the movement toward a broader understanding of literacy. To do this, we have to be able and willing to explore the diversity of how to foster achievement, and explore the relationships we have with the media around us.

Most arguments for Media Studies begin with two significant assertions. The first concerns the amount of time children spend with the media. Statistics on television viewing, for example, suggest that children today spend more time watching television than they spend in school. The second assertion appears to follow inexorably from the first. If the media are such a major element in

children's lives, it seems self-evident that they must exert a very powerful

influence on their ways of thinking about the world—and as such, [we]

simply cannot afford to ignore them (Buckingham, 1991, p. 12).

As this quote suggests, and this paper identifies, the relationship that exists

with media convincingly sells us on the importance of multimedia and multimodal

literacy skills. Our fears and philosophical beliefs are often at the root of our stance with

media intake. However, the role of multimedia literacies should not exist within a

reactive ideological standpoint. Indeed, Davis (1992) states that media literacy should

focus on a creative exploration of the intricate relationships between the communication

and the participants. This more complex understanding and approach should be the main

drive of the classroom and educational practitioners.

Engagement is a crucial part of learning and literacy. In the classroom,

engagement is a sought after commodity. Gee (2003) argues that we should attempt to

examine video games and multimedia for clues towards successful engagement in

literacy and learning. Commercial multimedia thrives on attaining engagement, and has

become very good at obtaining it. Again, this can be seen by the sheer volume of media

that is consumed in our society. Identifying the role of the readers in these activities as

participants and active learners in the resolution of the problem, they are able to gain a

higher level of contextualized understanding.

Statement of Purpose

Multimodal literacy can bring a sense of agency, control, and meaningfulness

to the disenfranchised, but only if we are willing and able to provide the scaffolding and

support necessary to ensure their success. Therefore, the purpose of this paper is to

examine how literacy is being reformed and modified in our changing society. The paper will review the recent studies performed on multiple literacies, multimodality, and multimedia in the classrooms to discover the best facilitation of this emerging movement toward competent and successful reading skills.

<div align="center">Limitations</div>

This paper attempts to explore the validity of alternative texts and multimedia technologies as a pedagogical tool. It does not attempt to argue that they are a respectable format as art and the humanities. The argument of respectability and literary merit are highly subjective fields that turn attention away from the real issues and instead focus them on supposed highbrow versus lowbrow conflicts of utilitarian or canonical value. This dichotomy is unnecessary and derisive. It attaches a biased judgment on the role of pedagogy from a culturally encapsulated vantage point of those who have been deemed successful and view the public schools in the same light.

Also, many studies on multimedia in the classroom approach them as alternative measures for the less literary members of learning communities, instead of acknowledging their unique ability to represent a multimodal and culturally diverse form of expression and associating of literacies. The very point to be made is in opposition to this idea. What we have defined to be literary by which students are shoehorned into is unacceptable. By no means do I claim that alternate literacies are somehow easier and less academically challenging. Rather, they have a specific and complex form that can promote a non-traditional skill set to acquire a similar end goal.

Furthermore, it is not my intent to delve into the debate focused on the belief that video games, music videos, and other types of multimedia perpetuate violence and

anti-social behaviors. Violence exists and is just as prevalent in classical texts (rape, incest, patricide, and plain old murder are all in Shakespeare). Instead, this paper attempts to highlight the usefulness of adapting non-standard curriculum to encourage and promote multiple literacies and the acquirement of empowerment through understanding and making meaning.

Definitions

The concept of the Digital Divide became prominent in the mid 1990's and made mainstream by President Bill Clinton's election campaign of 1996. It is the gap between those with effective digital and information technologies, and those without it. It attempts to identify and acknowledge the unequal spread of technological skill and availability of citizens, normally seen in socioeconomic, racial, and geographical exclusions.

Multiple literacies and multiliteracies describe theability to encode or decode meaning in any of the forms of representation used in the culture to convey or express meaning.

Multimodality is the collection of sensations in finding meaning and communication in semiotics. Multimodality is represented through combinations and interactions between music, spoken word, sound effects, language usages, pictures, videos, etc (Duncum, 2004).

New Literacies Studies is a field of study and theory of literacy that focuses on the interactional sociolinguistics, and its importances as a learned trait with sociohistorical implications. This is primarily an ethnographic and anthropological field of research.

Information and Communications Technology (ICT) is an umbrella term used by the Information Technology Association of America (ITAA). It is also field of study in education focusing specifically on technology literacy. The term is an official part of the United Kingdom's National Curriculum and used as a criteria in pedagogical research.

Instant Messaging (IM) is the mode of written communication via electronic technologies. It was made popular with the Internet, but has become even more relevant in schools through cell phones and other forms technology, such as Personal Digital Assistants (PDA) that are becoming more accessible.

Transmediation is the translation of content from one sign system into another. In this process connections are made and new meanings can be constructed from the dissonance between content and expression until a link is created to bridge the two (Siegel, 2006).

Multitasking in the context of media is less about engaging two simultaneous and non-complementary activities, but rather a constant and sporadic shift between activities, where each one has an undivided attention, albeit for only a few minutes at most (Media Multitasking).

Convergence Culture is the belief that new technologies and digital information will not replace existing media, but rather will bond in complex relations with the old media forms. Therefore, it is not a technological revolution but a cultural and social shift of expectations and participatory interactions (Jenkins, 2006).

Critical pedagogy is the approach to education that teachers and learners should facilitate questioning and challenging of beliefs and practices that are dominate trends. It is the belief that educators and classrooms should be aware of the complex

decisions concerning justice, democracy, and competing ethical claims that exist in every moment of teaching and learning, and the hidden biases that might exist within the experience (Kincheloe, 2008).

Summary

In summary, we are in a global world of multiple literacies and ways to interpret the world around us. With more technologies becoming a part of our culture and society, we have opportunity and ability to come to a broader understanding of what literacy means, the potential of alternative forms of media to convey it, and how it can benefit our educational system. Literacy is not defined by the media it takes, but by the scope and extent we allow it to make meaning in. Declining literacy rates have social, civic, and economic implications. As more youth turn toward screen literacy instead of traditional print literacy, it becomes an increasingly social activity. Identifying the role of the readers in these activities as participants and active learners in the resolution of the problem, they are able to gain a higher level of contextualized understanding. In chapter 2 I will analyze the relevant history of multimedia and multimodality literacy, followed by an examination of research presented in recent years on multiple literacies, multimodality, and multimedia in the classrooms. In chapter 3, I attempt to discover the best facilitation of this emerging movement towards competent and successful reading skills and suggest further areas of study and applications.

CHAPTER TWO: HISTORY

Literacy and Meaning

The importance and definitions of literacy have long been debated. Plato critiqued the literate man in his dialogue *Phaedrus*, written in about 370 BCE. In it, Plato cites that reading and writing lead to a deterioration of memory and a view of knowledge that was both lackadaisical and falsified by perception. He further argued that the alternative of memorized oral traditions through classical poets was also served only as mediators to the words. In both cases, there lacked an ability to hold a constructive, critical conversation with the messages (Gee, 1996). There was no way to verify a complete, correct understanding of them.

The Russian philosopher and semiotician, Mikhail Bakhtin, thought that no word, spoken or written, was final. There always remained an ability to add a qualifier or clause. Bakhtin stressed the importance of open, flowing dialogue. Both philosophers emphasized the importance of communication, a constant flow and modification of thought that went both ways in interpretation and application, something that traditional writing can not contain (Gee, 1996). Modern technologies and forms of media make it increasingly able to have literature that responds, adapts, and transforms to all possibilities, representing a more organic dialogue process.

For most of history, print literacy did not focus on trying to engage in a dialogue with the text, but as a way to convey a specific set of principles. The first country in the West to achieve near universal literacy was Sweden, with The Church Law of 1686. This law stated all citizens had to be able to read what God's commandments were. Just as in Plato's time, literacy was commonly used as a tool to promote specific

ideals and ideologies (Gee, 1996). Similar laws existed in the United States, such as 1647's Old Deluder Satan Law in Massachusetts, making it a law that communities over fifty households had to provide education and literacy teaching (Spring, 2008).

When Walter Benjamin, a sociological and cultural critic, forewarned of a time when word and image would be interdependent, and the need for a citizenship with the critical skills to identify their parts and powers, he was witnessing the full might of a Nazi propaganda machine which masterfully blended both (Duncum, 2004). Multimodal messages proliferated in the twentieth century, and the twenty-first century shows no sign of abandoning this trend. Political messages are often replaced with corporate ones, but the power for both conquest and profit are undeniable in the union of words and imagery.

In many ways, the history of literacy is one of indoctrination and moral prescription. However, literacy is also a means of freedom and liberation. Plato stressed this dual nature of the written word, and later emphasized on both sides. For example, the educational theorist Paulo Freire constructed his philosophy of literacy around critical pedagogy, and the relationship of teachers as learners, and learners as teachers (Freire, 1998). Even more than that, he examined the role of literacy as a way to interpret the world around us.

It is that interpretation which was warned about by Plato, contemplated by Bakhtin, and encouraged by Freire that becomes the crux of the issue as our society progresses down its growing technological trend. We are increasingly part of a world that forces us to constantly evaluate and interpret everything around us. Through advertisements and all forms and types of media, we are processing gross amounts of

information. Increasingly, our society is trying to adapt, and our youth are the ones where this is the most evident.

<div align="center">Information Age On-line</div>

Therefore, it comes as no surprise that we, as adapting humans, are proficient at information foraging. This term was coined by Dr. Jakob Nielsen (2003), the premier Internet usability expert. On the Internet, most of the information available is non-fictional, and casual reading is not the norm. A typical user is expected to be hunting for facts, being an "informavore," and the user has a very short attention span. If a quick skim of the text turns up nothing, users quickly move on.

With any creature that wants a certain diet, the proper environment is necessary to have their support and involvement. With the vast amount of competitive information, and the power and freedom to travel, reading habits have changed. On-line reading is slower (Nielsen, 2006) than print-based reading, by up to 25%. Due to this, and other circumstances, skimming is almost a necessary trait for on-line reading. The end result is an average reader that is ruthlessly efficient, selfish in their goals, and a more active participant than their print-based peers.

As such, it is not just the readers that change, but the writers who must adapt to a changing audience (Aggers, 2008). Embedded links, bolded phrases to prevent skimming, short paragraphs, sentence fragments, and bulleted lists are all ways that web-based writers can lure and retain readers. Furthermore, promotional, flavorful language is often cut out. Figurative language, hyperbole, and aesthetics of writing all create a cognitive burden that slows the brain's capability to sort and process the desired information. This can lead to ego depletion, which is a psychological capacity for self-

regulation and the concept of a limited amount of willpower. Cognitive usage, through reading, skimming, or having choices are all forms of ego depletion (Baumeister, 1998).

We live in a society where choice is abundant. Yet, there exists a paradox of choice. The more choices we have, the more cognitive effort goes into making each choice. The more options are available, the more we doubt the choice we made was correct and that there were missed opportunities. Schwartz (2004) wrote:

Autonomy and Freedom of choice are critical to our well-being, and choice is critical to freedom and autonomy. Nonetheless, though modern Americans have more choice than any group of people ever has before, and thus, presumably, more freedom and autonomy, we don't seem to be benefiting from it psychologically (p. 5).

This can also be described as creating a cognitive dissonance, which is the psychological state of a mind in which two perceived truths are in conflict and contradictory. Often times, a deeply ingrained schema of thought cannot be modified without significant impact on the self. Such a state is threatening, and thus the mind attempts to remove the conflict by creating choice-supporting and confirmation biases (Aronson & Tavris, 2007).

Ultimately, this could be seen as a way to prevent ego depletion. We are constantly bombarded with choice. However, we need not always make a choice. We possess the ability to do multiple things simultaneously. And, in an effort to stem off choice, counter-intuitively try to take on more and more tasks and options simultaneously.

Multitasking

In a recent study, 58% of 7th graders multitask while reading with video games, instant messaging, and Internet browsing dominating most of the alternative tasks (National Endowment of Arts, 2007). These children are growing up in a culture saturated with information and multimedia. Lifestyle norms continue to shift as more and more emphasis is put onto Information and Communications Technology at an earlier age.

To say the impact technology has had on us during our lifetime is large is an understatement. The changes in our culture's literacy has not undergone such a radical shift that we have seen in our life time since the change from visual and oral literacies to print literacies centuries ago. As our youth are subjected to a larger array of technologies and avenues of learning, our educational systems attempt to look into the implications for schooling.

The great economic age-based diaspora is expected to achieve full stride by 2012. So long, Baby Boomers (L'Allier and Kolosh, 2005). In your wake, Generation X, Y, MTV, and I are all stepping up to the plate. Generation I is the generation of the Internet. A group grown and bred on Google and social networking sites like MySpace or FaceBook. Though students enrolled or entering school in the next ten years could also be called Generation M, which stands for Multitasking in Media (Foeher & Roberts, 2005).

The fact that multitasking has negative implications, such as an overall drop in productivity, retention, and information capacity, is constantly studied and critiqued by neurology and psychology, but the fact remains that it exists and is more popular than

ever. However, media multitasking has uniquely positive aspects that our youth are learning to deal with. These aspects can be seen through critical analysis of content and information, advanced ability to filter out information, and an increased comfortability with multimedia. If we accept this, we have an option to identify the positive effects of multimedia and adapt them to promote educational success.

In fact, young people are least likely to engage in multitasking activities when involved with visual media such as television and video games (Foehr, 2006). This implies there is something in their nature that attracts engagement and attention. Identifying what these are has been a goal for researchers to help bring the same level of participatory engagement into classrooms.

Building upon this, researchers have begun to put more emphasis on the many roles of ICT and how to bring it more into the classroom. Consider this; adults that are proficient in reading and writing make better citizens. Higher levels of literacy are congruent with higher voting rates and participation in community and government activities. An example: 77% of adults described as having below basic level of literacy do not use the Internet for information gathering. "Internet usage for information on current events, public affairs, and government rises in relation to reading skills" (To Read, 90). Therefore, there is an organized movement and an effort to create competent users of ICT in future generations through the multimodal learning in hopes it directly correlates to creating competent citizens.

<p style="text-align:center">Summary</p>

In conclusion, Plato argued for an alternative of the memorized oral traditions that classical poets possessed and used as tools of power. In contrast to these

mediators of knowledge, modern technologies and forms of media make it increasingly able to have literature that responds, adapts, and transforms. This helps establish the possibility of a more organic dialogue process. For most of history print literacy did not focus on trying to engage in a dialogue with the text, but as a way to convey a specific set of principles. In recent times, others have explored the role of literacy as a way to interpret the world around us.

A typical on-line reader is expected to be hunting for facts, being an "informavore," and the user has a very short attention span. With the vast amount of competitive information, and the power and freedom to travel, reading habits have changed. Cognitive useage, through reading, skimming, or having choices are all forms of ego depletion. The more options that are available, the more we doubt the choice we made was correct and that there were missed opportunities. This can also be described as creating a cognitive dissonance, which is the psychological state of a mind in which two perceived truths are in conflict and contradictory. Thus, in an effort to stem off choice, we counter-intuitively try to take on more and more tasks and options simultaneously.

Increasingly, our society is trying to adapt and our youth are the ones where this is the most evident. Lifestyle norms continue to shift as more and more emphasis is put onto Information and Communications Technology at an earlier age. These changes in our culture's are such a radical shift that we have not seen one so extreme since the shift from visual and oral literacies to print literacies centuries ago. By acknowledging multitasking we have an option to identify the positive effects of multimedia and adapt them to promote educational success.

Identifying what attracts and engages youth in the media has been a goal for

researchers to help bring the same level of participatory engagement into classrooms. Therefore, there is an organized movement and an effort to create competent users of ICTs in future generations through the multimodal learning in hopes it directly correlates to creating competent citizens.

Next, chapter three will review the literature and recent scientific studies on multiple literacies, multimedia, and multimodality. The research is organized into five seperate sections of study: cognition formation, the role of technology, impact of multiple literacies, alternative forms of text, and their effect in the learning process. Each of the studies will be summarized and critiqued based on the conclusions provided. The reviews attempt to determine their significance in relationship to student achievement and learning productivity. Lastly, Chapter four will represent the summary of the findings based on the sections from chapter three, implications of classroom practice, and suggestions for future research.

CHAPTER THREE: CRITICAL REVIEW OF LITERATURE

Introduction

Chapter one discussed the way culture and literacies are intertwined, and how technology is a part of our culture's network of meaning making. We should look in the future toward the implications of multimedia and multiple literacies, and how their synergy in growth can positively impact our students. Chapter two explored the emergence of literacies that evolve, adapt, and represent multimodality for the readers. Further examination of our society and youth attempt to identify the trends in media and lifestyles and inquire how literacy is being reformed and modified in our changing society.

The intent of this paper is to review the literature on multiple literacies, multimodality, and multimedia in the classrooms to discover the best facilitation of this emerging movement toward competent and successful reading skills. Chapter three is a critical review of recent literature in the fields of study set forth in chapters one and two. This meta-analysis of research is divided into five sections: cognitive formation in multiple literacies, multimedia, and multitasking, the role of technology, the impact of multiple literacies, alternative forms of text, and the effect on the learning process. Each section is divided into two subsections representative of three research studies a piece.

Cognitive Formation in Multiple Literacies, Multimedia, and Multitasking

This section focuses on the process in which information is retrieved and internalized. The initial set of studies focuses on the role of multimedia and multi-literacy in relation to cognitive development. These researchers focus on the process in which information is retrieved and internalized. First, the comprehension process is analyzed by

Mayer, Dow, and Mayer (2003), who explored how different graphical interfaces and screen prints influence comprehension. Next, Riding and Grimley (1999) compared different types of cognitive styles with the use of various multimedia formats, and Thomas and Hofmeister (2002) wondered if the comprehension process was modified by using on-line bulletin boards and Virtual Learning Circles in literacy development.

The second subsection, which involves physiological processes and brain studies, begins with Just, Carpenter, Keller, Emery, Zajac, and Thulborn (2001) who sought to identify interconnectivity between apparently unrelated neurological systems. This is followed by Bergen, Grimes, and Potter (2005), where the effectiveness of simultaneous messages in multimedia are researched.

Comprehension Process

Mayer, Dow, and Mayer (2003) performed a series of five separate post-test two group case studies with a total of 223 self-selected college students at the University of California, Santa Barbara in an effort to determine how pedagogy can help foster constructivist learning in Web-based multimedia environments, and what works in designing agent-based multimedia.

In this research, Mayer, Dow, and Mayer recruited college students who were eligible to receive credits for a class on constructing electric motors. Participant questionnaires gathered information on the subjects, including previous knowledge and experience in the subject area of electronics. The researchers designed the series of experiments to attempt to create and evaluate self-explaining environments for scientific, interactive laboratory work. An important aspect to the theoretical foundation of the study was to test the generality of a cognitive theory of multimedia learning which

asserted that there exists a limited capacity for visual and a verbal processing, and that both are required to coordinate for active multimedia learning.

The first experiment examined the role of the interactive multimedia's voice as a modality effect through an analysis of learning results from a group that had responses verbalized, or were given back through on-screen text. They hypothesized that the graphics with narration would ease cognitive load by distributing data into both verbal and visual channels. After working with the interactive program on electric motors, the subjects were given a series of problem-solving questions, each with a list of possible correct answers based on the data that could be obtained in the experiment.

The second experiment was conducted twice, exploring the role of interactivity in cognitive processing. They hypothesized that when information was given at a subject's own pace, and when learner control was established with the flow of data, that the learner better prevented an overload and allowed for more connections to be made before continuing. One group was given an unbroken on-screen presentation of information, while the other group had the ability to push a button to stop or continue the presentation. There was an immediate post-test conducted with one group, and the second group had a delayed post-test a week later, to determine if the effect of interactivity persisted.

The third aspect of the study examined whether or not cognitively demanding questions orientated learners in a multimedia environment toward deeper concepts and self-explanation. The hypothesis was that students who are given challenging conceptual prequestions perform at a higher level than those without. The prequestions given were selected to ensure a conceptual level of understanding and an integration of the principles

learned, as opposed to factual-level of information, and the subjects were informed that the follow-up multimedia activity (experiment one) would answer the question.

The fourth and final experiment in the study centered on the use of visual imagery representative of the interactive multimedia's presence as an agent. The researchers hypothesized that including a life-like, detailed, and engaging image of the narrator (Dr. Phyz) would not increase learning, as it would be a seductive detail that would distract, rather than facilitate learning.

The findings for the experiments were as follows: in experiment one, the group with narrated information had significantly more answers to the problem-based questions (M 8.43, SD 2.56) than did students in the text group (M 6.54, SD 2.22), t(54) 2.96, p .0046. The effect size was 0.85. This result supported the modality effect people understand a multimedia explanation better when the words are presented as speech rather than as on-screen text.

Experiment two's immediate post-test had subjects with interactive controls performing significantly better (M 7.95, SD 2.27) than did students in the non-interactive group (M 5.72, SD 3.18), t(35) 2.46, p .0189. The effect size was 0.70. In the delayed post-test group, interactive control performed better (M 6.41, SD 2.92) than the non-interactive group (M 3.68, SD 2.65), t(39) 3.109, p .0035. The effect size was 1.03. Mayer, Dow, and Mayer used this as additional evidence that interactivity and learner control increased cognitive retention and transfer of information.

Experiment three's subjects in the prequestion group generated significantly more answers on the problem-solving transfer test (M 8.90, SD 2.50) than did students in

the no-prequestion group (M 6.24, SD 3.20), t(52) 3.45, p .0011. The effect size was 0.83. Mayer, Dow, and Mayer stated that priming cognitive activity encouraged a transfer of knowledge during the learning.

In experiment four, students who learned with the visual representation present did not generate significantly more answers on the problem-solving transfer test (M 6.60, SD 3.28) than students who learned with no visual representation on the screen (M 5.95, SD 3.52), t(37) .55, p .5835. Mayer, Dow, and Mayer suggested that while it is important for the computer persona's voice to be heard, allowing for the verbal channel of cognition to be activated, a physical representation of the computer persona, via an on-screen figure, has no significant impact, possibly due to the fact that the visual channel is already working at a high level of capacity.

As a result of these experiments, Mayer, Dow, and Mayer concluded that interactive multimedia follows expected cognitive processing trends of limited attention and delineations of importances placed upon the information. They generalized that designers of multimedia learning applications and tools should follow the theories of modality, interactivity, and self-explanation principles. These principles focus on the ability of the subject to clarify to oneself the solution, based on the ability to control the influx of information, for example by directing the pace of presented information.

In examining the validity of these experiments, each experiment had different subjects and a different amount of subjects. Internal and external validity appear within the norms based on the statistics they provided, and information is available to repeat the study for reliability and to determine if expected hypothesis in any way interfered with the objectivity of Mayer, Dow, and Mayer's findings.

Riding and Grimley (1999) performed an exploratory pre-test/post-test one group case study on cognitive styles and gender with multimedia materials with 80 11-year old subjects, to determine how different modes of multimedia presentation affected content recall.

The subjects were selected from an urban primary school based on the results of a Cognitive Styles Analysis. Forty male and 40 female students were selected based on their results to have a distribution of different styles across the two dimensions of cognition. These were defined as the Wholist-Analytic spectrum, and the Verbal-Imagery spectrum, thus identifying subjects as Wholist-Imagers, Analytic-Verbalizers, etc. These identified the likelihood that the subjects would organize information in wholes or parts, in the case of the Wholistic-Analytic spectrum, and how they were inclined represent information during thinking, verbally or in mental pictures in the Verbal-Imagery spectrum.

The sample used three CD-ROMs containing information in the subject area of science at an appropriate grade level. They were evaluated and identified if they possessed multimedia presentation of knowledge through picture-plus-sound (PS), picture-plus-text (PT), and picture-plus-sound-text (PTS). A set of 57 test questions were designed to draw from each of the CD-ROM', as well as the three forms of presentation. The questions were then further categorized as having a verbal label, a definition, a reason, or visual recognition. Each question possessed four possible choices.

Three computers were set up in the subjects' classroom, and they were tested three at a time during normal classroom activities. The pre-assessment, interactivity with the multimedia, and the follow-up test was conducted over six sessions. The order of CD-

ROMs and test questions administered were varied to control for order effects.

   Riding and Grimley found that the mean Wholist-Analytic ratio was 1.11 (SD 0.31), and the Verbal-Imagery ratio was 1.09 (SD 0.20). The correlation between the ratios was nonsignificant (r = 0.03). Analyses of the variance performed in a one-way comparison with gender as the variable identified no significant gender differences among either dimension ($p > 0.40$). In constructing an analysis of variance amongst the Wholist-Analytic by Verbal-Imagery by gender, with repeating measures on their performances between traditional and multimedia tests, two significant finds were noted. First, an interaction between Wholist-Analytic style and the Verbal-Imagery style overall in both measures using F-distribution for their probability theory (F = 5.22, df 1,65, $p = 0.026$). Second was the interaction between the Wholist-Analytic style and the type of work, traditional or multimedia, with content recall (F = 5.67, df 1,65, $p = 0.020$), compared to the type of work and the Verbal-Imagery spectrum, which had little significance ($p = 0.082$)

   Next, overall performance based on cognitive style was addressed. In order of worst to best performance they were Analytic-Imagers, Wholist-Verbalisers, Analytic-Verbalisers, and Wholist-Imagers. The study identified that while Wholist learners faired better with the multimedia formatted information, the Analytic subjects had the reverse effect. Riding and Grimley hypothesized this might be due to the fact that the multimedia, without external information and supplements, created a smaller "viewing window" of the information. While the difference was not significant, they warned that it could be magnified with lower-ability students, who tend to be Wholist-Verbalizers, and show an increase of interest in multimedia.

When examining the modes of presentation (PS, PT, and PTS), along with the content given (Verbal-Label, Definition, and Reason), there was a main effect on the mode of presentation (F = 38.79, df 2,144, $p < 0.001$), and also an interaction of mode of presentation by the form of content (F = 5.41, df 4,288, $p < 0.001$). Thus, the overall performance in content type was similar for PS and PT, but higher for PTS, especially with Verbal-Label and Definition content. There was also a significant interaction of gender by mode of presentation (F = 3.41, df 2,144, p = 0.036), and gender by Wholist-Analytic style by Verbal-Imagery style by mode of presentation, (F = 3.57, df 2,144, p = 0.031).

Riding and Grimley noted that further investigation was needed into which cognitive styles have the best science performance, as their data contradicted a previous study. They noted that either the content area of science has changed, or the variance in the subjects' ages had significant impact. The conclusion reached was that Wholists learn better from multimedia than from traditional methods, and the control of choice that the multimedia puts in the student's hands that would predictably lead toward more self-explored learning. Finally, they added that more research into the differences of gender in information processing and the relationship to the specific content areas should be explored, as science is a male-dominated subject area, and cognitive style may have an impact on this.

As a critique, subject area science (and using computers) favors males not due to cognitive styles of learning, but due to possible socio-cultural outside influences that influence the general perception of the field. Males are encouraged to engage with technology, to build and destroy, experiment, identify how things work, play video

games, and express themselves in ways that function well with computers. This exploratory study offered no form of control for regression, maturation or history of the students. The instrumentation and testing was a positive strength in the study. Overall application may have less influence than other studies, due to the fact that it was not conducted in American schools, but rather in the United Kingdom.

Thomas and Hofmeister (2002) implemented a multi-phase research project to examine the relationship between the use of message boards as Virtual Literature Circles and the cognitive complexity of 125 third and fourth graders' responses and feedback.

This two-week study was performed using subjects in five rural schools of central Missouri, with the same text used for reading. In the first phase of the study, a random sampling of the subjects were taken to examine the quantity and quality of their posts to the message board. The posts were evaluated in chronological order to determine if the use of the Virtual Literature Circle influenced the cognitive complexity of the questions through growth and continued depth.

The cognitive complexity was evaluated on a scale of 1-very simplistic text-dependent responses, to 4-text-independent responses with complexity, that was based on the theoretical hierarchy of the Read-Encode-Annotate-Ponder reading, writing, and thinking strategy. The traditional psychometric inter-rater reliability in this pilot study was 0.37, and as noted by the researches this is considerably lower than would be desired. However, they noted that the information yielded is still useful for exploratory and probative research. The inter-rater agreement within one point on the scale was 88%, a significant increase in overall reliability. Each subject was given two cognitive

complexity scores, a mean of the first half of their posts, and a mean of their second half.

Scores were determined by averaging the score of all raters. A paired-samples T-test was

calculated between the group means of the first half and the second half of the student

responses and did not show statistical significance ($p < 0.05$). Additionally, using the

effect size measure of Cohen's <u>d</u>, the difference between the means was relatively small

($d = 0.27$).

In the second phase, responses were categorized into three types:

reconstructive, constructive, or non-directive, with the mean cognitive complexity score

of each category given. They found that differences between the means of the three

different types of prompts appeared significant (Reconstructive = 1.88; Constructive =

2.93; Non-directive = 2.45). Paired samples T-tests were calculated between each pair of

means and identified statistical significance ($p < 0.05$) between constructive and

reconstructive ($n = 10$) and between constructive and non-directive ($n=17$). In the case of

the means between reconstructive and non-directive, there was almost statistical

significance ($p < 0.06$; $n=10$). Additionally, using the effect size measure of Cohen's *d*,

the difference between these two means was high ($d = 0.82$).

Thomas and Hofmeister concluded that in phase one, continued use with a

Virtual Literature Circle did not enhance cognitive complexity. In phase two, they found

enough statistical significance to conclude that the prompt type and formation of the

questions used impacted cognitive complexity. Thus, while message boards may serve as

Virtual Literature Circles for study collaboration and work, there is no data to suggest

that it has more efficacy as a teaching tool, or that higher-order levels of cognitive

processing occur more than otherwise, but that finely-tuned questions, in conjunction

with these forms of alternative teaching methods, could have positive pedagogical implications for future study.

There are numerous faults with the study, many of which were self-identified by the researchers. With a low inter-rater reliability, many of their other statistics were skewed by a lack of precise answers and evaluation of them. In this one-shot case study, there was nothing to monitor previous knowledge, regression, or matriculation of the subjects. Furthermore, no information on the subjects were provided that might have been beneficial to the study, such as socio-economic status, gender, or familiarity with computers.

In this subsection of cognitive formation in multiple literacies, multimedia, and multitasking which explores the comprehension process, Mayer, Dow, and Meyer (2003) found that multimedia design should reflect constructivist ideas through modality, interactivity, and self-explanation principles. Next, Riding and Grimley (1999) concluded that students identified as Wholists learn better from multimedia, and that the ability to have control of their learning in an interactive way influenced their comprehension process, and Thomas and Hofmeister (2002) found that bulletin boards did not directly affect cognitive processes, but rather it was the question types along with new teaching methods that provided the cognitive benefit to students.

Physiological Processes

These next studies attempted to explore the notion that the brain processes these new forms and presentations of information in innately different ways, through brain structure, and neural connections. The interdependence of non-overlapping cortical systems in dual cognitive tasks was studied by Just, Carpenter, Keller, Emery, Zajac, and

Thulborn (2001) with different sensory modalities to identify the relationship between apparently dissociable neural systems in eighteen subjects.

This study used functional magnetic resonance imaging (fMRI) measured in voxels (a value in a three-dimensional grid) to identify and analyze the activation of cortex areas during cognitively demanding tasks. Two of the most separated and distinct neural systems are the language comprehension system, and the visuo-spatial neural system. These were the areas focused on during the study.

The subjects consisted of eighteen right-handed English-speakers, ages 18-32. There were six females and twelve males in the study. Data from ten other participants was removed due to technical problems with the fMRI.

The subjects either performed a sentence comprehension task alone, a mental rotation task alone, or performed both at once. The sentence comprehension task was to judge general-knowledge sentences heard auditorily, while the rotation task presented them visually with pairs of drawings of abstract 3-D figures had to be mentally rotated to judge their identity. Two-thirds of the sentences in the comprehension task were true, and one-third were false. In the language comprehension, failure to answer within three seconds was an error, and in the mental rotation exercise, failure to answer in five and a half seconds was an error.

The behavioral measures found that dual activity did not compromise the accuracy of either task. The response accuracies in the dual task was 85.9% for the sentence task and 87.7% for the rotation task, indicating that both tasks were being performed with a high degree of awareness and effort. There was not a significant change in the percentage of answers correct with sentence comprehension, but there was a

significant increase in the time it took to answer, from 532 to 740 milliseconds, ($F(1,17)$ = 24.8, $p < 0.01$). For the mental rotation condition, the performance decline were reliable from single to dual task in terms of both error rates, from 7.8 to 12.3% ($F(1,17)$ = 10.69 $p < 0.01$) and total response times, from 2440 to 2792 milliseconds ($F(1,17)$ = 23.72, $p < 0.01$).

Based on the fMRI scans, the dual tasks produced only 56% as much activation volume in the temporal and parietal lobes as the sum of the two single task conditions ($F(1,17) = 24.0$, $p < 0.01$). The decrease was larger in the language comprehension cortical areas with the activated voxels here decreasing from 34.1 in the language comprehension condition to 16.6 in the dual conditions ($F(1,17) = 43.17$, $p < 0.01$). In the visuo-spatial cortical areas, the voxels decreased significantly, but by not as much, from 35.1 to 25.0 voxels ($F(1,17) = 4.49$, $p < 0.05$). The cerebellum was one of the only areas to show even a small amount of, though still statistically insignificant, more activation in the dual tasks (10.7 voxels) than in the whole of the single tasks (6.7 voxels).

Thus, Just, et al. (2001) concluded that concurrent activation identified significantly less than the sum of each condition individually. Thus, while they appeared to be unrelated neural systems, there was a relative interdependence of the cortical system which demonstrated a drop in overall activation. The researchers suggested that there may exist a biological mechanism that limits the upper level of cortical tissue activation at any one given time, or there may exist a maximum capacity of attention to distribute to each process. Attention thus could be seen as a limited cognitive commodity. One significant question that arose was how the subjects were able to achieve a high level of

accuracy with their answers despite overall lower amounts of cortex activation.

With such a small sample size (only eighteen subjects) this study's numbers could easily be impacted by a few significant, askewed factors. However, the overall internal reliability of this study appears solid as an empirical, scientific study on brain activation. Generalization of this test appears to have validity.

Bergen, Grimes, and Potter (2005) conducted research out of the Kansas State University (KSU) on how attention partitions itself during simultaneous message presentations in multimedia and if it can be efficiently devoted to parallel sets of information.

Recent years have shown various news broadcasts and companies deviant from the traditional norms of established information processing. Traditional norms exist as a narration of information provided along a narrative visual in a very no-frills format. Previous empirical data and theoretical frameworks suggest that these new formats are increasingly hard to glean information from. However, they are becoming ubiquitous. These new formating changes create the headlines crawls, weather forecasts, stock tickers, scrolling sports scores, school closures, and traffic tips all piled atop sound bites and short visual cues in time with an audio feed for separate information.

These techniques appear to attract increasingly large numbers of young viewers, which is why the study attempted to re-evaluate traditional communication theory to explore how the information processing took place. These so-called "TV babies" may have adapted different ways to dealing with multiple message transmissions that previous generations have not. Bergens, Grimes, and Potter cited reports from MTV that stated information which demands parallel processing holds attention better than

serially presented information.

Previous studies have determined that humans have poor parallel processing skills. They are finite and fairly inflexible. Increased difficulty occurs as the two processes become increasingly different through the channels (ie visual and auditory). However, if these separate processes have the possibility of being part of a coherent whole, it is possible to reduce the effort due to what is called *perceptual grouping*.

Pretests were conducted to determine visual and auditory preloads using established criteria from previous studies. The methodology set forth was that when a subject was watching an attentionally draining television news story, there should not be as much attentional resource available to devote concurrently to the rehearsal of the preload. Thus, where there was a greater number of errors in recollection, the television story was inferred to replace a proportionally greater amount of cognitive demand.

Each news story that was shown was to have five questions that would be asked afterwards to determine retention of information. Subtle differences in fact and language were emphasized in the formulated questions.

The first experiment consisted of 60 KSU students. The participants were randomly assigned to conditions. Four news stories edited down to 12 seconds were used. These four stories were either presented as visually simple (no additional information), or complex conditions. After each news story and visual preload, the subjects were asked to open their booklets and fill in what the visual preload was, and then the multiple choice questions about the story they just witnessed. Two of the questions were foils, meant to make the subjects feel like they had not paid attention. Then they were told to repeat this process four more times, and that the multiple choice questions regarding the story were

the most important aspect, and that if they received a certain amount wrong, they would have to come back and participate at a later date. This was to ensure that the news segment would be the subjects' primary task.

There were five subjects per randomly assigned group, with 24 tapes representing all the possible story combinations and sequencing. The visual preload scores were given a 1 for a correct placement and a 0 for an incorrect placement. Participants' scores therefore could range from 0 to 3 on each of the four prompts. The subjects in the visually complex condition expended less visual attentional ($M = .939$, max score = 3) than subjects that watched the simple format ($M = .844$ max score = 3; $t(58) = -2.962, p < .00$). The visually complex condition left the subjects with more processing capacity to devote to remembering the visual preload, but they remembered fewer facts about the story ($M = 4.597$, max = 5) compared to the visually simple condition ($M = 4.900$, max = 5; $t(58) = 2.621, p < .01$)

The second experiment functioned similarly to the first except with the preload designed to probe for residual auditory working memory as opposed to visual. A different data pattern emerged. Participants in the visually simple condition scored better on the recall test ($M = 5.195$, max score = 6) than did the ones in the complex condition ($M = 4.874$, max score = 6; $t(56) = 2.063, p < .04$). In this experiment, the subjects in the visually complex condition recognized an average of fewer auditory story facts ($M = 4.500$, max = 5) than did the subjects in the simple condition ($M = 4.786$, max = 5; $t(56) = 2.021, p < .05$).

Based on the data patterns, the visually complex format drove the subjects' attention away from the visual channel and toward the auditory channel where there was

message coherency. The visually simple condition allowed the subjects to devote more attention to the visual channel where there was less semantic conflict. There was no direct evidence that the visually simple condition promoted perceptual grouping, but the researchers believed this is what created the data patterns; a semantic whole that was obtained.

Experiments three and four were the same as one and two but without edited clips. Each clip was at its full length of approximately 2:30 minutes. Experiments three had 174 subjects with 88 in the complex condition and 86 in the simple condition. In experiment three, subjects in the complex condition recognized fewer story facts ($M =$ 6.443, max $= 10$) than participants in the simple condition ($M = 7.047$, max $= 10$; $t(172) =$ -1.999, $p < .05$). Experiment four had 160 subjects with 80 in each condition. In experiment four, subjects in the complex condition recognized fewer story facts ($M =$ 6.400, max $= 10$) than participants in the simple condition ($M = 7.213$, max $= 10$; $t(158) =$ -2.709, $p < .01$).

In conclusion, there is nothing in the data that supports young people allocating attention differently than in previous studies. This data replicated previous empirical data in communication research. Thus, this format may be popular despite this formatting, not due to it. Marketing and focus on entertainment, rather than information, appeared to be the trend in the news stories observed.

This study has remarkably detailed information on the test methodology and theoretical support for the study. It provided reliable generalization on the use of parallel processing and the way in which we attempt to utilize and manufacture multitasking activities.

In this subsection of cognitive formation in multiple literacies, multimedia, and multitasking, physiological processes and brain studies were researched. Just, Carpenter, Keller, Emery, Zajac, and Thulborn (2001) found that while some neural systems appear unrelated, there was a relative interdependence which revealed a drop in overall activation, and that attention is a limited cognitive commodity. This is followed by Bergen, Grimes, and Potter (2005), who found that simultaneous message formatting was not effective, and that the prevalence of it in multimedia was associated with marketing and entertainment trends, not information attainment and changes to physiological neural processing.

Thus, this section found that it was not multimedia or multiple literacies that were directly beneficial, but the pedagogical framework and theoretical methods used in designing and implementing them in classrooms which has the most effect on student learning. The multitasking mentality of multimedia is not supported by research and the formatting is generally attributed to aesthetic and entertainment values.

The Role of Technologies

Other researchers have focused on the question of how the various forms of media are being used - both in the classroom and in daily life. These studies search for changes and insight into the way multimedia is impacting teaching and learning. The first section assesses research done on the integration of information and communication technologies into classrooms and its effect on learning in the classroom. Bussiere and Gluszynski (2004) specifically looked at how technology influenced reading skills while Kramarski and Feldman (2000) investigated how reading comprehension, metacognition, and motivation are affected by Internet use. Wenglinsky (1998) then examined the

relationship between education technologies and student achievement.

The second section investigated the multimedia use of students in and out of school. Willms and Corbet (2002) also examined what role ICT use played during and outside of the classroom. Foeher (2006) studied the prevalence of multimedia use and multitasking in students' daily lives, while Marcoulides, Stocker, and Marcoulides (2004) monitored the levels of computer anxiety and contrasted this to the growing reliance on computers in society.

Incorporating ICTs into the Classroom

Information and Communication Technologies are being integrated into classrooms across the United States. What effect is this having on the learning? To answer this, Bussiere and Gluszynski (2004) conducted a study that analyzed the information obtained from over 250,000 students aged 15 and up to answer the questions; does the information and communication technology influence certain aspects of the reading skills as measured by Programme for International Student Assessment (PISA) (i.e. retrieving information, interpreting text and reflecting on text), and when individual and family variables are controlled for using the PISA survey, how does computer usage and computer familiarity influence reading achievements.

PISA's study that Bussiere and Gluszynski used for their analysis used a complex sampling design (stratified, two-stages, PPS sampling), along with balanced repeated replication methodology (BRR) of 80 units. The PISA test was a criterion-based assessment of reading, along with a self-reported survey of lifestyle practices and ICT uses. The test examined reading literacy, scientific literacy, and mathematic literacy. Each domain is sub-divided into tasks and then into proficiency levels 1-5

Bussiere and Gluszynki examined the correlation of the use of ICTs with the reading scores. They conducted both single-variable correlations, as well as multivariate models of correlation on all applicable lifestyle, family, and individual information that was in the survey.

The information interpreted by the analysis concluded that access to ICT is not as important as the quality of its use. Findings from this study identified that a vast majority of 15-year-old Canadians had access to computers at their homes, schools, and libraries. Canada compared well internationally with other countries, with 88% of 15-year olds having access to a computer at home, which was above the OECD average (73%). Most of the youth used computers on a daily basis. Access to the Internet was also reported by a majority of respondents and the frequency of its usage was also very high. Some significant gender and provincial differences were discovered in terms of access and usage of both computers and the Internet.

The internal validity of this test can not be ascertained without more information on how the statistics were calculated, and what multi-factor analysis was used. Furthermore, correlations for the affect on reading and/or learning needs to be provided so as to allow for generalizations to be made. However, the findings are are in line with other studies. Though not focused on American students, the ability to generalize it to American youth could be rationalized, with the similarities in media and academic habits of Canadian and American youths, and a similar trend of computer use between urbanized locations and rural locations would be expected.

Kramarski and Feldman (2000) studied how ICT's in the classroom affected reading comprehension, motivation, and metacognition with 52 eighth-grade participants

using a pre-test/post-test control group design.

The objective was to investigate the reading comprehension of English as a foreign language with students who were exposed to metacognitive instructions embedded in Internet activities, as opposed to traditional classrooms. The hypothesis set forth by the researchers was that the metacognitive instruction from the Internet would show more gain, due to previous studies which linked the Internet as creating a more contextualized authentic learning, which thus has higher motivation for students.

The small sampling of students was from a single junior high school, randomly selected from different classes with a distribution of 25 males and 27 females. All subjects were Israeli students who were learning English as a foreign language. All students, in both the control group and experimental group, studied in pairs with the same teacher. Both groups used metacognitive learning, based on four stages: identifying the task, planning, performing, and evaluating. The experiment group used hypertexts and websites recommended by the teacher in a school computer laboratory, while the control group used similar passages from their classroom textbooks.

Three questionnaires were designed to be measures in the study, given pre- and post-test, along with observational data collected during in-class studying. A reading comprehension questionnaire was given to the subjects, comprised of a 12 item open test which assessed participants' reading comprehension.. The test was based on the use of reading strategies that the students acquired during the metacognitive instruction. Scores ranged from 0 to 100. The Kuder-Richardson reliability coefficient for this measure was identified at a 0.81 level. A motivation questionnaire of 15 items assessed student motivation to study English, constructed using a Likert scale of 1-strongly disagree, to 5-

strongly agree. Possible scores ranged from 1 to 75. The Kuder-Richardson reliability coefficient for this measure was identified at a 0.77 level. Lastly, the metacognitive awareness questionnaire had seven forced-choice items, each with five possible answers. This assessed students' abilities to self-identify learning strategies they used for reading comprehension. Scores ranged from 0 to 100. The Kuder-Richardson reliability coefficient for this measure was identified at a 0.77 level.

The study itself lasted for eight lessons, spanning two weeks of school. After the reading comprehension pre-test, no significant differences were found between the Internet group and the control group ($t(50) = 0.25$, $p > 0.05$), nor in the post-test ($t(50) = 0.94$, $p > 0.05$). In identifying the author's opinions, the control group significantly outperformed the Internet group ($M = 14.85$; $S = 4.48$; $M = 12.27$; $S = 4.64$).

With the second objective of the study, comparing the motivational and metacognitive effects of the Internet, there were significant differences between the two groups. In comparing the total motivational scores, the Internet group outperformed the control group ($t(50) = 2.58$, $p < 0.01$). There were also significant differences between the two groups' metacognitive awareness, with the control group outperforming the Internet group ($t(50) = 3.87$, $p < 0.001$). The qualitative observational data included that while the Internet students identified more enthusiasm and interest in using the ICT's, technical problems and difficulty integrating the metacognitive strategies hindered their success.

Kramarski and Feldman concluded that based on observational data, the Internet group failed to use the metacognitive strategies correctly for reading comprehension in part due to the requirement of also having to master the use of the ICT

itself, and that technical difficulties interfered with concentration and allotted time. They concluded that while ICT use drastically increased motivation for student participation and learning, a full and immersed early childhood with Internet usage may alleviate the problems faced in their study, as the subjects would already have fluency in the skill. Finally, they stated that while academic achievement did not increase, the Internet could be a valuable tool for students who face motivational barriers, especially in regards to reading comprehension.

Further research is recommended in identifying and creating metacognitive strategies unique to Internet activities and experiences, which may greatly differ from traditional classroom environments. As a critique, the study was conducted in Israel, with a very different mix of ICT use, media prevalence, and general socioeconomic makeup. The statistical information provided appeared repeatable with internal validity, but given the specific variables and small sample size, future studies may yield different results. Still, the research remains valid, and could be useful for helping English Language Learners in American schools.

Wenglinsky (1998) examined the relationship between educational technologies and student achievement in mathematics through analysis of a national survey of thousands of public students. The foundation of this study was the 1996 National Assessment on Educational Progress (NAEP) in mathematics, and was conducted through collaboration with the ETS Policy Information Center. From the NAEP's collected national sampling, the subjects consisted of 6,227 fourth-graders and 7,146 eighth-graders. All statistics given have $p < 0.05$ unless otherwise noted. A multivariate analysis was used with Structural Equation Modeling, through the use of two

statistics software programs: STREAMS and AMOS.

Based on the student self-sampling through the NAEP questionnaire, Wenglinsky found that 33.2% of fourth-graders reported reported using computers at school weekly. In comparison of various socioeconomic markers, it was noted that African-American students reported using them far more often (42%), a statistically significant number. Meanwhile, 28% of eighth-graders reported using ICT's weekly. Male eighth-graders used them statistically significantly more (31% compared to 26%), and urban schools drastically used them more than rural schools (31% to 25%), with suburban schools in the middle (28%). Furthermore, Asian-American and European-American students had statistically significant more access to computers at home compared to African-American and Hispanic-American students, with the predominate amount all reporting to be from suburban schools.

In determining how in-class computer use was utilized, teachers selected simulation/applications or drilling/practice programs. Significantly more teachers with African-American students used drilling/practice programs (52%), while teachers of predominately Asian-American and European-American students used simulations (43%). Professional development in computer use further suggested an inequity in computer availability, and more important than availability was proper use and pedagogical significance in the classroom.

Statistical comparisons of professional development, school and home computer use, class size, level of thinking, and mathematic scores found that in general professional development and higher-order uses of computers seem positively related to academic achievement in mathematics. Meanwhile, frequency of use is unrelated or even

negatively related to them. Furthermore, while the size of the positive relationships are substantial for eighth-graders, they are statistically insignificant for fourth-graders, and outweighed by the negative relationships of technology usage.

Thus, Wenglinsky found computer use can certainly be a beneficial factor in student achievement, how it is used is far more important than its mere presence. When ICT use promotes higher-order thinking and the teachers are proficient enough to foster the ICT experience, the most direct connection to student achievement in mathematics is realized. Thus, while minorities might see a higher frequency of ICT use in their classrooms, it has less impact due to the role it plays in the curriculum and daily classroom experiences.

Style of teaching was not taken into consideration in this test. Thus, it might not be ICT's with higher-order thinking that fosters achievement, but teaching philosophy that overall lends itself toward higher-order thinking, ICT or not. Only the subject area of mathematics was analyzed, which was a limitation. The methodology of the statistical analysis was taken from a government study, so the internal validity can not be addressed without the chance of research bias. Finally, the age of this study is a concern. Computer use and integration of technology in public schools is drastically different, as the last ten years have had unparalleled growth in the field of ICT use.

In this subsection on the role of technology and how Information and Communication Technologies were incorporated into classrooms, Bussiere and Gluszynski (2004) found that ICT is not as important as the quality of its use. Kramarski and Feldman (2000) determined that ICT use did not improve student achievement, but should be recommended as a tool for students who face motivational barriers, especially

in regard to reading comprehension and seen as an additional supplement to educational practices. Wenglinsky (1998) found similar support that ICT use is not significant unless it is accompanied by higher-order thinking strategies and teachers that have professional development in the use of ICT.

Role in Culture and Society

With iPods, cellphones, video games, and computers proliferating our society, researchers explored what impact and changes this is having on our youth. With that in mind, Willms and Corbet (2002) continued with the theme of ICT use when they surveyed Canadian youth to determine its role in education and outside of the class in daily culture and lifestyle, with a heavy emphasis on research implications and areas for future study.

Focusing on high levels of academic achievement, and equity in public education, Canadian schools have an increasingly high desire to see ICT's in every classroom. A nation-wide survey of 29,687 students was conducted from 1,117 schools across the country to conduct inter-provincial comparisons. Based on this study of demographics, socio-economic standings, and responses to lifestyle questions, the results were analyzed.

A logistic regression was used to study multiple factors, and a statistical regression was then used when the answers "computer at home" and "linked to the Internet" were considered. All these have a $p < 0.05$. The findings presented that 88% of the sample size had computers at home, which compares to 83% in the United States. Only 69% have Internet access at home-- the same as the United States.

The information on how ICT's are used in schools show that only 33% of

computers exist in individuals' classrooms, and from that, only 5% of the computers are used for inquiry-based learning. Ontario and British Columbia had statistically significant more access to ICT's both in home and at school than the other provinces, especially the Atlantic provinces. Female students were 15% less likely than male students to have Internet access at home ($p < 0.05$). Parental education was also significant, which each additional year of education increasing the likelihood of Internet access at home by 18% ($p < 0.05$). Interestingly, students that were designated as recent immigrants to Canada were 77% more likely to possess Internet access at home than their native peers. The conclusion made by Willms and Corbet was that increased use of technologies is still heavily connected to overall socio-economic status, seen through household income and parental education levels.

This study provided very little information on the exact forms of factor-analysis and regressions models used in their statistics, so internal validity was hard to measure. The study itself was conducted in Canada, and its generalization to American schools an socioeconomics is somewhat dubious.

Foeher (2006) issued a report for the Kaiser Family Foundation on media multitasking by American youth using 2032 students, in grades 3rd to 12th, to determine its impact and prevalence in our society.

This research paper used multiple studies and analyzed data collected during the 2003-2004 school year. The 2032 subjects responded to a written questionnaire, and a self-selected sub-sample of 694 respondents. These respondents also completed a seven-day diary of media use.

The original sampling of the subjects began with randomly selecting the

schools from over 80,000 public, private, and parochial schools in the United States. The second stage was then to randomly select grades and classes within each school individually. This methodology of sampling permitted oversampling of certain grade levels. Furthermore, an oversampling of African-American and Hispanic students was achieved to allow for more racial group comparisons. Overall sampling was weighted based on information provided from the National Center for Education Statistics. The second stage of the study represented by the diary, was self-selected and thus not weighted.

The survey used a set of Likert scales with its four principle questions regarding multitasking as dependent variables and 18 separate values, having a Cronbach's Alpha of .74 for the factor analysis. Factor analysis is a statistical technique used to explain most of the covariability among a number of observable random variables in terms of a smaller number of unobservable latent variables called factors. Factors with eigenvalues greater than 1.00 are considered significant, explaining an important amount of the variability in the data, while eigenvalues less than 1.00 are considered too weak, not explaining a significant portion of the data variability. Only the fourth question, "When you use a computer how often do you do any of the following activities at the same time:read, watch TV or listen to music?" had an eigenvalue of 1.00 or higher. A linear regression analysis was then conducted using Stata, a data analysis and statistical software program, which identified a variance of .228 and an F statistic of 26.39, with $p <$ .001. Coefficients and their significance levels closely resembled one another.

Foeher (2006) concluded that television and music do not foster media multitasking, but computers and video games do (while a television and a computer may

be on at the same time, the computer is the interacted "culprit"). The younger one was, the more likely they were to media multitask. Self-identified females more than boys were media multitaskers. Foeher recommended further study into the development of pre-frontal cortex growth with media multitasking. "Sensation seekers" and those likely to engage in risky behavior are more likely to media multitask, based on self-identified habits and activities which were then designated to constitute as sensation seeker.

Overall, Foeher's research appeared to be weighted appropriately and noted its weakness in having self-selected subjects for sampling. The use of statistical analysis was not transparent, and relied heavily on information produced from analysis programs, with no apparent effort made to determine the appropriateness of validity of the data.

Marcoulides, Stocker, and Marcoulides (2004) examined the cross-cultural impact of computer use in the psychology of 218 subjects by monitoring them on a Computer Anxiety Scale (CAS) to compare the anxiety to the wide-scale integration of computers into our global society and world cultures.

The subjects were all volunteers selected from the international University of Hamburg, with 106 identified as male, and 112 identified as female. To ensure a cross-sectional representation of students across the university, participants were selected from the following four different departments: (a) 57 students from the educational sciences, (b) 54 students from psychology department, (c) 56 students studying law, and (d) 51 students studying economics. The average age of the sample was 24.25 (SD = 4.86).

The CAS itself was an instrument available in both English and German, using a 5-point Likert scale, from "Not At All" to "Very Much"). It consisted of 20 questions that subjects were to rate if they caused anxiety or apprehension. This resulted

in a score that ranged from 20 to 100, with higher scores identifying higher levels of self-identified anxiety. The CAS was used in previous studies conducted by Marcoulides, Stocker, and Marcoulides and was compared to previous results from the 1980s and 90s. Furthermore, previous testing identified a high test-retest reliability coefficient supporting a marked degree of stability of the CAS across various time spans, from ten weeks to five months.

All nonzero parameter estimates identified as pattern coefficients were found to be statistically significant ($p < .01$). The mean German CAS was 31.7 (SD = 6.9), and the American mean was 38.5 (SD = 21.2). Thus, Americans in previous studies identified as having a slightly higher level of anxiety with computers than their international peers. Marcoulides, Stocker, and Marcoulides identified that although rapid technological saturation exists, the level of anxiety appears to be invariant, and thus at a constant level. They concluded that since technology and ICT's are a necessity in most spaces of life, such as work and schooling, further investment and research should be devoted to training and scaffolding in these areas, as computer anxiety has been previously shown to be directly related to computer achievement, and that structured training and workshops are still necessary for students even though their cultural environments are technologically rich.

This one-shot study consisted of self-identified anxiety in a single instrument. While the statistics themselves appear to be accurate, the ability to generalize from this test has many flaws, such as a failure to identify the history of computer use, the way the subjects were selected to ensure appropriate sampling of demographic variances, and pool from which the subjects were selected. While there is little doubt the conclusions

made in the research were accurate, there appears to be little information in the study that sheds insight on how the relationship between ICT's and culture are impacting students at a psychological and cultural level.

In this subsection, on the role of technology and the role technology plays in society and culture, Willms and Corbet (2002) found that academic quality is related to increased technology use, which in turn is directly related to socio-economic status markers. Foeher (2006) found that media multitasking was identified more in younger students and that more traditional media use such as music and television do not increase media multitasking, but computer use and video games do. Lastly, Marcoulides, Stocker, and Marcoulides (2004) found that with rapid technological saturation, a consistent level of anxiety exists, and that for the role of technology to change and impact classrooms, an appropriate amount of training and scaffolding for both teachers and students should exist.

Like the previous studies, this section found that it was not the technology that directly influenced the results, but that role it played as a motivational factor and as a facilitation of higher-order conceptual thinking. This, along with its representation as a socioeconomic signifier outside of the school setting, helps establish the proper role of technologies in the classroom.

The Impacts of Multiple Literacies

With the fluidity of literacy's definition, the way multiple literacies are seen has yet to fully solidify. Yet, it is indubitable that their role has had, and will continue to have, significant impact on education. In this section, Chandler-Olcott and Donna (2003) start the first subsection examining how adolescent girls use technology in their literacy

practices outside of school, then Sanford and Madill (2007) contrast the role of technology in girls' literacies with a study on how it influences boys' leisure activities and the formulation of multiple literacies. Ranker (2006) follows this with a similar longitudinal study of young males' multiple literacies and video games.

       The second subsection details the comparisons and contrasts the theoretical understanding of multiple literacies with the singular, traditional print literacy in which Newman (2002) attempts to identify whether or not multiliteracy traits are related to academic achievement entering college. Blair and Sanford (2004) monitored the back-and-forth shift between life literacies and traditional literacy in middle-school boys, and Kobrin and Young (2003) conclude the section with a quantitative study between screen-based literacies and traditional print literacy.

Multiple Literacies and Technology

    Where multiple literacies and technology intersects, Chandler-Olcott and Donna (2003) conducted a longitudinal qualitative study on twelve suburban seventh and eighth graders in upstate New York in an attempt to determine what ways and for what purposes adolescent girls use digital technologies in their literacy practices beyond formal academic settings, and what constructs of gender are formed through their technology-mediated literacy usage.

    From the twelve students two specific subjects were focused on over the 18-month literacy research at their school. The form of qualitative instrumentation was a hybrid blending of traditional qualitative and teacher-research approaches. Observations, interviews, home visits, and data analysis were used. Chandler-Olcott and Donna put emphasis on what they call a Multiliteracies Pedagogy Framework.

This pedagogical theory emphasizes the "how," as opposed to the traditionally sought-after "what" of literacy instruction. Through this case study they try to focus on the four aspects of the multiliteracies framework as laid out by them: Situated Practice, Overt Instruction, Critical Framing, and Transformed Practice.

Data collection was obtained through face-to-face interviews and field notes from informal and formal activities, home visits, and collected artifacts. Information from face-to-face interviews and group interactions both in person and through on-line communities were collected and analyzed both inductively and recursively. Through these, the researchers identified how and where different modes of meaning were being activated and utilized.

This categorization was done by coding specific events and actions into various modes such as visual, gestural, audible, spatial, and linguistic modes. Furthermore, they relied on the previously mentioned frameworks of Situated Practice, Overt Instruction, Critical Framing, and Transformed Practice to contextualize the case studies in determining the impact on multiple literacies with on-going, extensive charting.

Chandler-Olcott and Donna concluded that ICL activities were used for social activities and identification was based on communities formed through the technology. The activities on-line contradicted some gender assumptions about on-line activities, while the students reinforced their own gender roles. Socio-economics was a more significant role in community structure and identification than gender, based on which technologies they used to access the Internet. Identification to access to the Internet was not indicative of ability to fully use and access all materials, and thus communities and social capital.

Much of the paper was dedicated to the pedagogical framework and background leading up to the case study and the reasons and rationale for it being conducted. Furthermore, instead of providing explicit examples of transcripts, field notes, and how the information was interpreted by the researchers, much of the study instead discussed through what theoretical lenses the data was critiqued. Without providing explicit examples of what questions were asked and how the researchers framed the discussions, it would be difficult to replicate this study. The researchers admitted that it would be dangerous to generalize this case study away from the themes they attempted to analyze, and warned against drawing conclusions based on these two specific girls which they identified as European-American, fluent in English, and possessing enough economic privilege to have access to technology. Instead, they recommended that future research be done in the areas of multimodal technology and literacy use, going so far as to suggest a long-term study of mixed qualitative and quantitative instruments conducted on a large scale with adequate sample sizes.

Sanford and Madill (2007) examined how multiliteracy was engaged in boys' leisure time and activities through a qualitative study of video game play and design that called into question the supposed failure of boys' literacy skills.

This study examined the role and usage of literacy out of school that deviates from the traditional way literacy is expressed and utilized in an academic setting. The study attempted analyze deeper the way gender as a social construction has impacted literacy development and identification, along with the perceived way masculinity and masculine expectations of society effect young males.

The study took place across one summer where nine week-long video game

construction summer camps were held. The instructors at this camp were adolescents from 12-16, and predominately male, and volunteered to be participants. Most of the students were between the ages of 8 and 12 and male. All self-identified as being interested in video games. The research obtained by Sanford and Madill was from observations during the camp activities and focus group interviews. The data analysis was supplemented by digital images of the games and audio recordings of conducted interviews.

Sanford and Madill identified many cases of operational literacy, which is reading and writing in a range of contexts in every subject. The researchers also identified that many subjects took the operational literacy for granted, due to the extensive time devoted to learning and understanding the symbols and language use in video game construction. Such a devotion of time and energy to gain competence might make it harder for outsides to identify the literacy traits being implemented.

In the actual exchange between instructors and students, observations noted a lack of precise oral language. Rather, much of the exchange was through demonstration and other signals, such as body language and gestures. Reading instructions, and adapting to the specific semiotics and language of the specific program they were using were crucial for successful instruction, and yet almost all students identified an ease of integrating and learning, even with an apparent lack of communication between instructors and students.

Traditional types of learning activities used in a school setting were also observed. Journals, free writings, and brainstorming activities, all used by the instructors, were also successful means of showing literacy skills in a contextualized fashion. Both

the instructors' and students' confidence and competence in the subject area created a more engaging learning environment.

This competence is based in part on their cultural literacy, and is related to the meaning and semiotics of a specific social practice or institution. This shared cultural capital was most evident in the direct conversations between instructor and student, and student to student. Abbreviated sentences and fragmented dialog existed, while the subjects were observed interacting with the ICT and their individual projects. In interviews, the subjects were aware of society's opinions on video games, as well as what they personally gained and learned from video games, and the potential positive and negative impacts in the students'. The subjects also identified the way various motivations to play video games (such as: a pastime, as a social activity, as a mental challenge, or as a way to battle loneliness) interacted, differed, and yet ultimately shared similar bonds within their selected social community. Positive reinforcement, encouragement from the instructors, as well as identifying expertise and knowledge as a hierarchical structure of the community are all significant and unnoticed within the community itself.

Also, in designing their video games the students identified an awareness of literature techniques, such as symbolism of objects and the representation of colors in creating mood and tone. Characters also identified varying levels of depth, juxtaposing ambitions, goals, and archetypes.

Critical literacy skills were not directly observed during video game construction. The greater social and cultural implications were not noticed unless first made explicit. Without being taught how to identify and critique the values within the games, critical literacy skills will not develop. Indeed, video game design puts an

emphasis on accepting the games' rules and structure as absolutes. Otherwise, winning (and the victory conditions are also set by the rules) is impossible. Sanford and Madill suggested the average video game focuses on the idealization of masculine and the Western hegemony of competition, strength, aggression, and domination.

However, the difference between consumption and production were also noted. In constructing and designing video games, the ability to empower students and create critical thinking opportunities were identified.

In conclusion, outside of school, boys are exposed to a plethora of non-linear, multi-layered, and intertextual texts that may or may not be linked to pictures and images in semiotic sign systems. These are utilized in their recreational activities and games that are embedded into the current cultural and mass media of our youth. Video game design and structure, and computer programming in general, stress repetition, which is a natural type of learning technique.

Instead of parents and teachers showing an aversion to unfamiliar modes of literacy, such as video games, Sandford and Madill suggested that guiding students toward practicing more critical dimensions of literacy and metacognitive awareness of their actions in these games can lead to beneficial learning results. Thus, the difference from engaging in violence to understanding violence could be fostered and promoted, which opens the door to the conversation of social responsibility.

This study focused on a narrow group of subjects, which makes it difficult to measure its validity. The subjects were all willing and had a vested interest in video games and multimedia. Further research should be done with both male and female genders, as well as subjects who are less invested in video games. However, given the

context of the study, and the conclusions they reached based on their analysis and observations, this quantitative study does have merit in understanding and reflecting multimodal forms of literacy and metacognition in boys.

Ranker (2006) conducted another study involving video game use and composition in the use of multiple literacies through a longitudinal qualitative case study to examine how new mediums and contexts are impacting language and meaning-making. Ranker's subject was an eight-year-old European-American boy under the pseudonym of Adrian.

Adrian was observed in school during the researchers' one hour writing groups, twice a week. Ranker identified the style of research as inquiring and observational. The writing group was informal, with no explicit curriculum, only the object of writing. Adrian was observed with a much stronger desire to create art and draw, rather than write in traditional formats.

In conversations with other students and the researcher, evidence suggested that Adrian had developed a highly specific set of expectations and knowledge, described by Ranker as a semiotic domain. From Adrian's texts and writings during the workshops, Ranker identified multimodal experiences connected to Adrian's video game experiences and interactions with technology.

As with literary texts, Ranker identified several specific genres, each with its own emphasis on cueing systems, meaning-making, and use of multiple literacies. Thus, like any other form of media the writer must attend to the specific textual and multimodal features of the genre and medium. Character roles, depicted through Adrian's writings and drawings, identified a clear difference from traditional literary characters. The ability

for the player to interact with the character, thus making it an extension of their own self, are seen as tools for narrative progression.

Ranker identified several ways that plot also differed from traditional literature in working with Adrian. The written narrative by Adrian, in contrast to traditional narrative expectations in children's literature, had quick resolutions to conflicts, but without extended build up. Instead, the resolution was temporary, and thus identified as having a resistance to closure. Game structure is explicitly structured to resist narrative closure, so repeated playability and continued interest can be achieved. Perpetuation of the narrative exists only in that the main character prevents their own demise.

The interactivity of the video game's text, focusing decision-making and action upon the reader/player, put focus on non-linear story-telling, which differs dramatically from traditional print-based literacies. Ranker noted that Adrian identified a level of foresight and critical application to the design and functionality of the video game, seeing them as interrelated properties that parallel the narrative.

Ranker concluded that within a different media and contextual framework, special attention should be paid to identifying specialized knowledge of students, such as Adrian's multimodal processing of new literacies. In this specific case study, Ranker also stressed the importance of drawing as a meaning-making activity and the many forms that writing can take when teaching it. There were many more questions left for future research, as what weight should be given to new forms of media in comparison to the emphases of traditional literacy in curriculum building. The best conclusion to be made is that students write within a genre informed by their participation in popular media and

extracurricular activities, and identifying and using the structures and conventions of those media can be valuable resources.

Ranker offered many critiques of the case study, such as possible alternative questions and writing styles using the notebook and workshop time to explore more in-depth the significance of Adrian's multimodal and non-linear narratives had on his writing. Gender bias in video games was also noted, but not explored in any depth.

In this subsection on the impact of multiple literacies, Chandler-Olcott and Donna (2003) found that online multiple literacies often challenged gender assumptions and allowed for the subjects to explore their gender identity uniquely. Furthermore, access to the Internet was not indicative of ability to gain all the social and cultural benefits from it. Sanford and Madill (2007) discovered critical literacy skills were not developed in the multimodal video game context unless made explicit, and that production of video games identified a large amount of critical thinking and use of multiple literacies, while the consumption of video games is a socio-cultural experience that often focuses on the themes of Western hegemony; competition, strength, aggression, and domination. Ranker (2006) concluded that more emphasis should be placed on discovering students' specialized literacy traits that exist in mediums, such as multimedia, outside of traditional print literacy, and that the multimodal experience of art creation is one of the most powerful forms of meaning making.

Comparisons Between Multiple Literacies and Traditional Literacy

These studies attempted to draw further comparisons between a holistic multiple literacies approach to reading against the traditional, narrow-viewed definition of literacy. They evaluated the merits of multiple literacies with achievement rates,

comprehension, and retention. Newman (2002) established a qualitative, longitudinal multi-case study of four subjects that had just graduated from high school to determine how academic achievement does or does not correlate with multi-literacy skills.

Newman originated with 28 volunteer subjects that were recruited during freshmen orientation at Michigan State University. Out of these, he selected two female and two male subjects (Greg, Carmin, Sophie, and Will) to assure similarities and differences in background and educational experiences. These four case studies were conducted over an eleven-week process during their first quarter in college, while Newman conducted research primarily through observational logs, subject self-reflections, and face-to-face interviews on a weekly schedule.

Through this information, Newman created a taxonomy of facts, connections, concepts, procedures, and meta-information. Primarily, this centered on what the subjects used to move content from source to target. Newman identified four cardinal processes used to achieve these goals. These included exposure (making themselves conscious of the information), extraction (a process of selecting information), manipulation (changing or synthesizing information), and display (showing the information).

As a result, Newman concluded that pedagogical implications of this model included establishing a more realistic curricula for academic literacy programs and educating professors to better match grading criteria with learning goals. He identified a disconnect between the multiple literacies available and used by the subjects in processing concepts, and the tendency of the University faculty to focus on only one form of literacy. The subjects that were more aware of the design, which Newman used to express the set of rules in the academic system and thus traditional literacy skills, were

more successful participants.

Extensive notes and dialogue were provided from the interviews and logs. Newman opted to live with the subjects in the University's dormitories while conducting the study. He made no generalizations, but expressed an interest in further study in the area of the academic game and students' awareness, as players in the system, of the rules.

A two-year ethnographic case study was established by Blair (2004) as an attempt to identify how the literacies of middle school boys' differs from traditional literacy. Further emphasis is placed on the way literacy can morph between learned academic literacy and applied life literacies.

The subjects were identified as six pre-adolescent and adolescent boys from urban and rural schools, no further information was given. The methodology consisted of observational data, collections of writings and artifacts, as well as interviews with the subjects. Between the first and second years, responses were studied using an *Nviro* data-analysis program to identify themes and commonalities. Five themes in life literacies were established that helped engage the boys: personal interest, success, fun, action, and puprose.

Based on the collected ethnographic research in interviews and observations, Blair established that boys transform time to work on aspects of literacy that appeal to them. They also morphed the purpose of assignments to suit their individual needs. Finally they modified literacy events to become socio-cultural capital.

The observed need and want to restructure the flow of time and class preparations was seen to hinder the students' academic success. The strict management of time was seen only in their academic life, and was compared in contrast to their use of

media and technology at home, which was described as existing in a flow, a state playfulness and control in which time gets distorted.

Their out of school literacy, which often took the forms of multimedia, comics and graphic texts, textually rich card games, and magazines were often not identified or encouraged in the academic setting. This complexity was often not seen by the teachers, and when students attempted to adapt academic literacy tasks to better fit their personal experiences, the result was often one of poor academic achievement.

When the boys were allowed to select their own reading choices in school, they focused their selections on readings that either promised action and excitement, or reinforced their personal hobbies and identified them how to succeed. This success was seen in creating stronger social ties with family, friends, and gaining increased socio-cultural capital and attention.

Thus, Blair found that most of the literacy engaged by the boys was driven by social purposes. Even when the literature was to benefit the boys, this benefit existed as a member inside a larger community. Like their use of multimedia and textualized card games, their literacy selections were tools for creating camaraderie and collaboration. This was described as a construction of affinity-identity formation consistent with Gee's theoretical background. Even expository writings were focused around social actions, where the memorization of statistical information, rehearsal of arguments, and comparisons of rankings all played a role in future conversations.

However, this conversation often tends to follow and enforce gender trends and expectations. Literacy use is thus part of a gender regime that the boys are enacting and identifying through, academic failures and all. In the end, the connection between in-

school and out-of-school literacies need to be strengthened. Identifying these alternative texts can help create scaffolding. The real issue remains the need of our schools to embrace multiple literacies and reconsider the expectations and role that literacy should have in the academic setting.

Blair provided many insightful connections in the ethnographic study that are credible and dependable, but left out some important details. More information on the standing of the subjects, such as socio-economics, should have been included. The report should have also included more artifacts and authentic samples of the literacies observed to make it a more transferable qualitative study with confirmability.

The cognitive equivalence of traditional print-based pencil-and-paper tests compared to newer screen-based literacy and computerized tests was quantitatively investigated by Kobrin and Young (2003) through a verbal protocol analysis with forty-eight subjects.

Kobrin and Young examined the comparison between the two formats of testing based on a plethora of previous studies conducted in the area. They hypothesized that using a different form of validity, as opposed to the traditionally used measurements of content, criterion, and construct that there may be a difference in results. They instead focused on a more holistic form of validity that required multiple types of evidence to support inferences. Another focus was identifying construct-irrelevant variances which can make the test unnecessarily difficult by putting undue burden on the cognitive processes of the subjects.

The test itself uses reading comprehension questions, which previous studies have shown are more susceptible to the modal transition of information. The verbal

protocol method was determined to be appropriate since the subject's verbal response activates the same psychological processes that are used in the test-taking along with other behavioral measures such as response speed and sequences of eye fixations. Only the thoughts were verbalized, not any rationale or explanations.

Kobrin and Young hypothesized that test-taking on computer-screens introduced new levels of complexity, from eye strain to the inability to interact with the passage (underlining, circling, crossing out answers, etc.). Also, some previous research identified that screen-based literacy may require more attention and mental resources dedicated to decoding, which reduces the resources available for comprehension. The inability to see an entire passage at one time on a screen and the requirement to scroll may weaken a reader's visual memory, which is also taken into consideration during the test construction. These three extraneous cognitive loads may impact the results of subjects using screen-based tests.

The participants in the study were undergraduates from a large northeastern public university. They consisted of thirty-five females and thirteen males. The participants were taken and divided into four equal groups of twelve subjects. Groups 1 and 3 took the computerized test first, followed by the paper-and-pencil test. Groups 2 and 4 took the pencil-and-paper test first, followed by the computerized test. Groups 1 and 2 were asked to think aloud as they answered the reading comprehension items, whereas Groups 3 and 4 completed the items silently.

The four groups did not differ significantly in their mean self-reported SAT Verbal score ($F(3, 40) = 1.191$, $p = .325$) in their experience taking any type of computerized test ($p = .785$), or in their experience taking the GRE ($p = .965$). Compared

to national averages of test results, the subjects did not differ substantially in item performance.

The reading comprehension test was two passages, each 55 lines long and having seven corresponding questions in the field of the humanities. The computerized test to emulate the layout and design of the ETS's GRE web-based test that displayed 25 lines of text at any given time. All subjects were first instructed in a think-aloud exercise to prepare them for the verbalization of their thought process.

During the actual test, the verbalization was transcribed verbatim and then classified into three levels: utterance level, passage/question level, and the test level based on previous research on the cognitive processes used. The utterance level was further broken down into the categories of reading, paraphrasing, recalling, monitoring, inferences, integrating, and identifying important information. A navigation code was used to note when the subjects moved from one question to another. Intercoder reliability was established for coding at the utterance level and was based on six randomly selected participants from each

group. About 2,000 of the 8,000 recorded utterances were coded a second time by an independent researcher. The utterances from the computerized test were recoded for three participants per group, and the utterances from the paper-and-pencil test were recoded for the other 3 participants per group. Intercoder agreement was 86%, and Cohen's kappa was .80. The utterances which were coded differently were discussed among the two coders until full agreement was reached.

The results of the test using a three-way analysis of variance between the order of test type and the grouping types identified no significant main effects, nor were

interactions between the variables significant. The subjects using the paper-and-pencil had utterances with a significantly greater frequency. The pattern of results using the verbal protocols were not consistent using chi-squared testing.

Student's *t*-test was used to evaluate the difference of the mean from the subjects who read all the possible answers aloud on computerized tests versus traditional paper testing. On the first and second tests, the subjects using the computerized test did read the answers more frequently. The first *t*-test was slightly significant (t(165.05) = 2.07, *p* = .04), and the mean difference for the second test was statistically significant (t(160.28) = 2.297, *p* = .024).

To identify the amount of searches for ideas in the passage, and the duration of each search from the subjects, independent *t*-tests were used. The items were divided into four types of idea searchers: main idea, supporting idea, inference, and other. None of the differences were statistically significant at an alpha level of .01. The magnitude of difference between computer-based testing and pencil-and-paper testing were negligible.

There was no statistical significance in the difference between subjects who navigated back to previous questions for review and rechecking based on the medium of the test. Thus, no evidence suggests that those with a paper test took advantage of the availability and ease of scanning and predicting in the reading passage.

Kobrin and Young surprisingly found that the ability to underline and circle passages and words might create a false sense of security and confirmation of previously held beliefs, substituted for a more meaningful and deep reading. The lack of physical aids in computer-aided testing may, in fact, promote deeper reading comprehension due to the lack of these traditional aids. Almost all the subjects used the same general test-

taking strategies regardless of the medium presented. In this study they concluded that the difference in tests may be more similar than originally thought, and in fact computer-based testing may promote a more construct-relevant set of behavioral principles and cognitive functioning.

Kobrin and Young effective utilized a four-group design to address possible variables and impacts of the testing circumstances. There was detailed information included in tables on the chi-squared and *t*-test results. The subjects appeared to be self-selected volunteers of a college level education, which is difficult in generalizing the content of the study to all students and classroom applications. Due to the fact that their conclusions went against their hypothesized expectations that traditional the print literacy skills would be superior, this test appears valid and lacking in any researcher bias.

In this subsection on the impact of multiple literacies, Newman (2002) found a disconnect between the multiple literacies available and used by students in conceptual, critical thinking, and the tendency of faculty to focus on only the traditional form of literacy, thus by preventing the best possible education to occur and relegating students to simply play the grade game. Blair's (2004) research suggested that the many literacies used by boys are primarily to create camaraderie and collaboration. Their failures in traditional literacy is due in part to the inability to see how their literacies are being utilized as a member of a community in a social, organic process. Kobrin and Young (2003) found that, contrary to their expectations, screen-based literacy in test use promoted deeper reading comprehension, and was surprisingly similar to traditional print literacy.

These studies demonstrated the impact of multiple literacies. When multiple

literacies are at work and being utilized, individuals' socio-cultural and critical thinking skills both benefit. The final set of studies show a significant power in the multiple literacies students use in their daily lives, and that an awareness of these literacies by teachers and school administrators is necessary for their full potential to be realized.

Alternative Forms of Text

The previous research focusing on the ability to read and decode text is being forced into new realms of understanding. As multimedia continues to expand the role of traditional print is being modified. The first subsection in this area involves electronic books, CD-ROMs, and general screen print, starting with Gulek and Demitras (2005), who looked at the role of laptop use and screen print in student achievement. Similarly, Demetriadis and Pombortsis (1999) explored how technology rich environments influenced multiliteracy education. Reinking and Watkins (2000) examined what specific interventions and implementations of electronic media affected student achievements in middle school students.

The second subsection specifically analyzes the use of hypertext as an alternate to traditional print media. Its role as a non-linear transferral of information was studied by Wenger and Payne (1996) to determine its relationship to comprehension and retention. Balcytiene (1999) sought to know how knowledge acquisition through reading methods differed between hypertext and traditional texts. Smith (2001) concludes the section with an examination of emergent readers' use of hypertexts, and how reading differs based on the contextualization of experience.

Electronic books and screen print are not that different from traditional print, yet studies are being conducted to compare and contrast their effectiveness and to see if the mode in which print is transferred is important. Gulek and Demirtas (2005) analyzed 259 middle school subjects in determining the impact of laptop use on student achievement through grade point average, essay writing skills, end-of-term grades, and standardized testing scores in a multi-year quantitative study.

With rapid technological growth at the center of our society, this study explored the previous research on computer use as a beneficial learning tool that promotes self-reliance, cooperative interactions, and active learning. Many school districts through grants and sponsorships have explored laptop immersion programs in the hopes of more interdisciplinary learning and constructivist teaching. This study focused on the laptop immersion program of Harvest Park Middle School in the Pleasanton Unified School District.

The subjects were all students at Harvest Park Middle school, situated approximately 40 miles southeast of San Fransisco, California. The 259 students in the immersion program were selected from the larger school population of 1085. The program started with the 2001-2002 school year sixth graders, and followed them with their matriculation through seventh and eighth grade along with future classes, so that in the 2003-2004 school year all three grade levels were involved in the laptop immersion program, thus defined as cohort 1, cohort 2, and cohort 3.

Demographic data was collected in the following areas: ethnic background, gender, Gifted and Talented (GATE) program enrollment, special education status,

enrollment in the National School Lunch Program (NSLP; economically disadvantaged status), English Learner status, and parent education level. Each demographic was within 5% of the larger school demographic, with some noticeable results. There were no African-American students in the program, while the school's population was 1% African-American. There was a higher male-to-female ratio in the program compared to the school, and increased favoring of parents with higher education levels.

Data collection used a variety of sources. Students' grade point average (GPA), end-of-course grades on a 5 point scale (A =5, F =1), the District Writing Assessment (unless the student had an IEP), which is reported in four proficiency levels of minimal proficiency, limited proficiency, solid proficiency, and advanced proficiency, standardized norm-referenced test scores, and criterion-based test scores. Further comparison to prior achievement of the various cohorts was conducted after the study.

Data analysis using students' t-tests identified no statistical significance in the difference of achievement between laptop and non-laptop students prior to the enrollment. However, the comparison between the two groups after one year indicated that laptop students identified significantly higher achievement in language arts (F =9.84, $p < 0.005$) and mathematics (F =13.89, $p < 0.001$). The difference between the two groups in writing achievement at the end of Year 1 was not significant. However, the Year 3 results significantly favored the laptop students ($F = 5.53, p < 0.05$).

When comparing laptop and non-laptop students, the difference in mean scores indicated that laptop students consistently scored higher than non-laptop students in English-language arts at the end of Year 1 (F =10.68, $p < 0.005$), Year 2 ($F = 6.87$, p < 0.01), and Year 3 ($F = 6.88, p < 0.01$). The difference between laptop and non-laptop

students in CST math performance was significant in Year 1 ($F = 8.57$, $p < 0.005$), but non-significant in Year 2 and Year 3.

For Cohort 2, Year 1 results identified that laptop students demonstrated significantly higher achievement in English-language arts ($F = 10.12$, $p < 0.005$) and mathematics ($F = 9.22$, $p < 0.005$). While the prior writing skills was not statistically significant between the two groups, the laptop students demonstrated significantly higher achievement at the end of Year 1 ($F = 7.73$, $p < 0.01$). Cross-sectional comparison between laptop and non-laptop students identified that laptop students obtained significantly higher overall GPAs in both Year 1 ($F = 19.97$, $p < 0.001$) and in Year 2 ($F = 12.06$, $p < .005$).

Finally, Cohort 3 identified higher achievement in writing using laptops after the first year of enrollment ($F = 4.02$, $p < 0.05$). English-language arts scores did not show any statistical differences after enrolling one year, but laptop students demonstrated significantly higher math achievement ($F = 5.09$, $p < 0.05$). Laptop students also obtained significantly higher overall GPAs during their first year ($F=17.29$, $p< .001$).

In conclusion, Gulek and Demirtas found that students that participated in the study were more likely to score higher in writing, mathematics, and overall GPA. They noted that the students were not randomly assigned to the laptop immersion program and that teacher participation in the program was also voluntary. The quality and interest in the teachers that volunteered in the program may have influenced the results. Due to a very small sample size, the impact on special education students was not addressed, but that they assume the visual cues provided by laptops would aid special education learners with its multimodal approach. Finally, they made note that this raises serious concerns

about equity in education, and the fiscal responsibility involved in making sure every student had access to ICTs.

This study identified many of its sources of internal invalidity. The researchers were aware of the limitations of the study based on its location, demographics, and the socioeconomic factors. Other influences were taken into account by the researchers, but the effects of laptop-formulated education as a benefit to student achievement appears clear.

Demetriadis and Pombortsis (1999) conducted a small-scale two-group study on 39 subjects transitioning into college at Aristotle University to answer the question of whether or not a theoretical framework in which multiliteracy education is presented affects the way it is used by the students.

Two groups of students studied the same content material in a computer networking domain using hypermedia environments. An experimental group studied in a case-based environment following mainly the instructional prescriptions of Cognitive Flexibility Theory, while the control group used an electronic book environment and followed a more linear way of study. The subjects were domain novices and they had never before used systematically computer based instructional environments to learn something. A stratified distribution was used to allocate them in either of the two groups: experimental (20 students: 10 in the first year of studies, 12 female, 8 male) and control (19 students: 10 in the first year, 13 female, 7 male).

The study attempted to test six specific null hypothesizes proposed by Demetriadis and Pombortsis. They used a variety of instruments, including a series of unpaired two-tailed t-tests with the mean scores of the various scoring items as dependent

measures and treatment (experimental, control treatment) as independent variables. Differences were only significant for the first two items in their instrument. The first item difference reached the significance level of .01 (t[35]=2.973, p=.005), and for the 2nd Flexibility item, the level of .05 (t[24]=2.07, p=.049). Two-factor analysis of variance (ANOVA) was used throughout in an effort to determine possible significant main and interaction effects, with a *p* of less than .05 in all cases. Meanwhile, the post-test questionnaire for recording learning of introductory knowledge had a Cronbach Alpha of .723.

Where introductory learning characteristics were concerned (such as understanding basic domain concepts and describing simple procedures) both treatments led to the same performance, but when characteristics of a more flexible learning were concerned (handling of more complex problems and discerning between case specific and domain deeper structural characteristics) then students in the experimental group performed significantly better. In general, the study indicated that carefully structured case-based instruction for novice students enhanced flexibility in learning while not hindering acquisition of introductory domain knowledge and recommended further research into the exact impact.

However, the subjects were not of appropriate age level to use these findings, as they were not K-12 grade level, but rather high school graduates. Using the group comparison they adequately addressed issues internal validity of maturation, regression, and the instrumentation to document the measures of analysis.

Investigating the use of multimedia book reviews to increase independent reading, Reinking and Watkins (2000) used a formative experiment with fourth and fifth

graders to answer what interventions and implementations may enhance or inhibit achievement in pedagogical goals.

The instructional intervention set forth in the research was the use and incorporation of multimedia book reviews related to their independent reading by the students on in-class computers. The researchers were also interested in observing the intentional and unintentional effects of the technology, noting previous studies which demonstrated that new ICTs, multimedia, and computers are often not fully integrated into the classrooms, and instead exist outside of the holistic pedagogical structure. Thus, school settings often inadvertently subvert the transformative abilities that the technology can offer.

The methodology used for formative experiments is similar to a traditional pilot study program, except that there is a focus on achieving the desired outcome, rather than observing all outcomes that arise. Thus, the goal is clearly established, and the researchers attempted to discover what combination of resources, materials, situations, and conditions must be implemented for the desired result to be achieved.

As such, the pedagogical goal was simply to increase the amount and diversity of students' independent reading. The instructional intervention of the multimedia book reviews along with its screen print attempted to restructure many of the elements in traditional book reviews, while making it more personally engaging and circumventing potential limitations of the conventional format.

The research sites and subjects were selected based on location, commitment, and student demographics. In the first year of the student two elementary schools were selected, and in the second year of the study a third was chosen. The first school was in a

small town within commuting distance of a large metropolitan with mostly European-American students. The second school was in a rural/agricultural area with predominately blue-collar and professional families in which 15% of the students were identified as African-American. The third school was in the same district as the second, and possessed similar characteristics.

Two differences in computer accessibility were observed in the chosen schools and noted for pedagogical research. Schools either had a designated computer lab where students could work for 1-2 hours a day, or a single computer in the class that could be accessed throughout the day.

During the first six weeks of the academic year, qualitative data was collected to fully understand the students, teachers, and environment of the research sites. Observations, field notes, and interviews were collected to establish information on independent reading levels. This, along with a quantitative survey on reading attitudes was given to the students and parents. On this survey, the mean values for each class ranging from 2.73 to 3.15 on a 5-point Likert scale ($p < 0.05$).

Students were shown multimedia book reviews and gained familiarity with them by January, at which time students began creating their own multimedia book reviews. In the last weeks of the school year, qualitative and quantitative feedback was collected in the same manner as the pre-test information.

From their qualitative information, the researchers found that observable peer interaction was higher when accessing the multimedia and screen print in comparison to the conventional book reviews. Furthermore, the peer interactions promoted the pedagogical goal through incidental sharing of information and mediated the use of book

reviews and independent readings.

The computer lab differed from the classroom setup in that qualitative evidence suggests that technical difficulties and more capable peers facilitated a heightened level of camaraderie and helpfulness. Moreover, lower achieving students were seen in interacting with the screen print and multimedia functions of the book interviews to be more confident and willing to share and seek help, or give advice. In conclusion, many students seemed to acquire a different, more active, persona when involved with project activities, often becoming less inhibited, more verbal, and more cooperative.

Other noted effects came from the school sites. Classrooms which volunteered for the study based on its implications for test scores, rather than for its potential to enhance curricular goals or to promote students' and teachers' development identified a significant fall off and lack of motivation to see it through.

The quantitative post-experiment data suggested students' attitudes toward academic and recreational reading tended to increase, or not to decrease at expected levels based on previous studies, in the classes involved in the multimedia book reviews. Selected control classrooms using alternative computer activities aimed at improving independent reading identified decreases in at least one or more of the scales. Statistically significant gains ($p < 0.05$) on variables included on the parent questionnaire were as follows: free time reading (one class); ratio of time spent watching TV and reading (three classes); range of reading materials (one class); number of trips to the library (one class); and reading for enjoyment at home (two classes). None of the decreases in means were statistically significant. There was no statistically significant changes to the diversity of

the books selected by students.

While the pedagogical goal was realized during the study, evidences suggested that is was not the electronic print and book reviews which created this, but rather the socio-cultural conditions that existed around the computers and technology. Troubleshooting, debugging, and adapting to the challenges of novel technology in a collaborative manner is likely more significant, and more research is required.

The qualitative aspects of this study are more valid than the quantitative parts. Detailed transcripts were provided and qualitative examples given, but the quantitative measures did not take into account regression, maturation, and internal validity. The statistical data was not included in the narrative of the research, but instead attached as tables which limited the relationship of it to the conclusions that were being drawn.

In this subsection of alternative forms of text Gulek and Demirtas (2005) found that electronic media, specifically laptop immersion programs, fostered higher achievement in writing, mathematics, and overall GPA. Demetriadis and Pombortsis (1999) found that highly organized technological rich environments enhanced flexibility in learning while not hindering acquisition of introductory domain knowledge. Reinking and Watkins (2000) found that it was not electronic print itself that increased student achievement, but rather the socio-cultural conditions that existed around the computers and technology in the students' lives.

Hypertext

Hypertext has created a print that challenges traditional, chronological, sequenced reading. Hypertext allows readers to have very different avenues of reading from a singular origin. Discovering the considerations of comprehension and retention

when working with non-linear texts, Wenger and Payne (1996) worked with students from Binghamton University around the way hypertexts influenced cognition.

Theoretical support of cognitive processing and working assumptions suggested that reading hypertexts would be more cognitively demanding and require more cognitive overhead. If this were true, then pairing linear and hypertexts with concurrence cognitive tasks would have different levels of performance in the multiple tasks. Furthermore, previous research suggested that hypertexts would be more cognitively taxing with texts that emphasized relational processing as opposed to item-specific processing.

Thus, four experiments were devised to test the issues set forth. Two presented passages that favored one form of processing or the other in hypertext and linear text for comparison, with readings paired to various concurrent memory-load for analysis. Experiments three and four were used to critique and examine the theoretical validity to the underlying processes used in the first two experiments.

The variables in experiment one were causation or descriptive formatting, linear or hypertext formatting, the pairing of a secondary task, and type of recall task by the subjects. This resulted in a 2 x 2 x 3 mixed-factorial design. The information gathered was compared to a pre-test baseline reading rate to provide a control for individuals' reading speed. Fourty-eight subjects were selected for the experiment, with a mortality of eight subjects.

The subjects were tested individually for 110 minutes, in which six reading tests were performed on unfamiliar subject matter. Wenger and Payne found that, using Tukey's post-hoc analysis with a $p < 0.05$ and a mixed-factor ANOVA, that the load

analysis identified no differences among the conditions ($F < 1.0$), with the mean reading rates for the digital, spatial, and control conditions at 189, 184, and 178 words per minute. **T**he main effect for type of load was statistically significant, with hypertext requiring longer decision times, 15.0 seconds, than linear text, 6.8 seconds, all other factors were statistically insignificant. Thus, while hypertext reading was slower, due to interactivity and decision-making, it was not seen to be more cognitively demanding.

Experiment two followed experiment one's design, but replaced the unfamiliar reading material with subject matter that was more recognizable to the participants. Thus, this was to determine if increased familiarity produced different patterns of performance. Fifty-seven subjects were recruited, with a mortality of nine subjects. The candidate texts for experiment two were rated as more familiar (4.3 for description, 3.6 for causation) than the texts used in experiment 1 (8.8 for description, 8.0 for causation) on a scale of 1 (high familiarity) to 12 (complete unfamiliarity).

The comparisons and analyses revealed no interactions involving load and no other main effects or interactions that were statistically significant, with the means for the digital, spatial, and control conditions being 190, 187, and 189 words per minute, as with experiment one. The data collected suggested that processing hypertext did not require more cognitive resources than linear text, even when the level of topic familiarity is increased. Type did not interact with load on any of the measures taken while reading, and the load manipulations reliably induced greater processing demands than did the control condition.

Experiment three and four did not directly relate to the role and significance of hypertext. In short, they determined if the roles of description and causation texts

matched the patterns in previous studies of text forms and their impact on spatial loads. In conclusion, Wenger and Payne found that overall cognitive load did not increase when using hypertext, and that the reading processes was not hindered, which it would have been if hypertext required greater levels of processing.

The generalization of this study has its merits. All the data analysis appeared authentic and the researchers had no issues with determining statistically irrelevant material that did not match the hypothesis. Measures were tested and controls modified to suit the data collected. The sample size was small, however. An increase in subjects with more variety would be recommended for this research to be considered as having strong internal validity.

Balcytiene (1999) conducted a significant study on the cognitive activities of readers who utilized hypertext through a hybrid study of both qualitative and quantitative measures with 38 subjects to explore how knowledge acquisition through reading methods, the patterns of hypertext reading strategies, and the role of individual differences in these methods.

The focus of the study was how hypertext influences the complex knowledge structures, problem-solving skills, and metacognition seen in learning. The knowledge that was to be measured was on Gothic art, which was selected as being something many of the subjects had little or no familiarity with, and represented a knowledge base that would be representative of hypertexts' capabilities in visual and print fashion. Style recognition is thus an interdisciplinary field that incorporates a variety of academic domains; history, geography, architecture, art, etc.

The subjects were 38 university students with the average age of 24.6 years.

They were randomly assigned to one of two treatment groups with 23 using conventional print documents and 15 using the hypertext formating. Seven of these 15 subjects were selected for detailed qualitative video recording and interviewing. They were part of a three session study which included a pre-test questionnaire, a reading and learning session, and a post-test questionnaire. Also included was a follow-up session in which interviews were conducted to judge qualitative factors.

The pre-test questionnaire involved describing the style of 12 example artifacts by specifying views and stylistic traits that represented Gothic, Renaissance, or Baroque styles. The post-test questionnaire they were asked to do the same with 17 artifacts. Qualitatively more difficult pictures were selected for and included in the post-test.

The two questionnaires used a multiple choice answer of A) Gothic, B) Not Gothic, and C) Maybe, Unsure. Based on their pre-test, the subjects in each group were then designated as High with prior knowledge, or Low with little prior knowledge. The effects of the treatments were determined by using a analysis of variance (MANOVA). The difference between the measurements was significant ($F(1, 25) = 5.02$, $p < 0.034$), but the difference between treatments and interaction was not significant. Thus, there was a significant increase in the ability to recognize the pictures among all the students.

In comparison of the High and Low students, a MANOVA analysis revealed that the low-prior-knowledge students benefited significantly more than the High subjects ($F(1, 23) = 19.417$, $p < 0.0002$), while the difference in Low hypertext subjects compared to conventional print was not significant ($F(1, 23) = 3.09$, $p < 0.092$). However, the Low-prior-knowledge subjects in the hypertext group had the highest

improvement in recognition scores, though not significantly so ($F(1, 23) = 1.82$, $p <$ 0.189).

Balcytiene concluded from the quantitative study that the hypertext, with its interconnectivity and embedded, nested structure, provided tools to recognize large conceptual ideas in the text that encouraged meaningful exploratory activities. However, the fact the hypertext was still fairly hierarchical and structured could be a reason for the lack of significant differences, and identified this as a place of future study.

The qualitative interviews and methodology attempted to analyze six critical dimensions which were comprehension of context, usage of guiding questions, understanding of overall organization within the hypertexts, reporting on respective reading, comprehension of the text, and finishing the reading. Through the interviews, Balcytiene identified three typical patterns in using hypertext: 1) systematic reading followed by nonlinear testing and reflection, 2) systematic versus exploration reading, and 3) exploration due to respective preferences followed by systematic reading. Based on their patterns and answers in the interviews, the subjects were identified as self-regulated learners or cue-dependent learners.

The means of correct recognition in the tests and the self-regulation or cue-dependent variables identified no statistical significance ($F(1, 5) = 1.56$, $p < 0.26$). Thus, the strategic differences in the way information was accessed, and the role of learning as a problem-solving and self-regulated activities had no distinctions in this study on hypertext use in the classroom even though self-regulated learners performed better on the questionnaires. This is identified as a fault of the small sample size of the subjects in the interviews.

Balcytiene provided detailed information of the construction of the hypertext and the mode of information exchange, along with the quantitative and qualitative information to support the findings. The study itself was strong in internal validity and ability to be generalized. However, the ethnicity, gender, and socioeconomic backgrounds of the subjects were not provided in this study. The study itself offered a strong critique of its qualitative information based on the video taping selection and the subjects' self-judgment in the interviews.

Smith (2001) researched the way emergent readers interacted with various types of literacies through hypertext and print in a qualitative, year-long case study with a male toddler in order to analyze the similarities and connections between the contextual formats.

This study examined how a mother and child's lap reading differs from traditional print story books, CD-ROM story books, and Language Exchange Approach (LEA). Several theoretical perspectives were taken into account, including Vygotsky's socio-constructivist scaffolding, Bakhtinian perspectives, and multiple literacies.

The CD-ROM story books were either derived from or included with traditional story books. During the multimedia reading as much independence was given as possible. The subject, James, was supplied with an oversized mouse for young children and encouraged as much autonomy as functionally possible. The traditional and LEA formats of reading had him sitting in his mothers' lap during the reading sessions. This year-long case study, from 2½ to 3½ years of age follows James from his first experiences with CD-ROM books to his independent use of the multimedia.

During the first five weeks James was introduced to two CD-ROM books

along with their accompanying traditional print format until all CD-ROM books were introduced. After this introductory time, the selection of which CD-ROM book to select was chosen by the subject. Overall there were 57 CD-ROM book experiences, 53 traditional book experiences, and 56 LEA storybook experiences during the case study. The CD-ROM story books had narration which read the text on the screen aloud while highlighting the progress of words before the interactive and hypertext functions on each page became accessible.

Four hours of video tape was recorded each week over the course of a year. Through the recorded dialog, James and his mother conversed about the letters, sounds, and punctuation he was discovering as a way of formative assessments and to create literacy scaffolding. Both the traditional and CD-ROM story book sessions were surrounded by dialog, questions and answers, and verbal exchanges. Thus, both represented socially created, interactive events of co-created meaning.

Data collection was from prompted summaries, memos, and video tapes. Most data was divided into the categories of setting, location, talk, and interpretation. The data analysis was conducted in five phases. First was the memoing, coding, and categorization of data. A comparative method examined the subjects' learning of technolgy, interaction with hypertexts, and negotiating the routine. There was a committee review by peer reading researchers. Secondly, there was a comparative analysis of talk between CD-ROM, LEA, and traditional reading sessions. Codification of the dialog was provided along with a glossary of code definitions.

The third phase involved the identification of code clusters, wherein episodes of specific contexts created natural boundaries on specific literacy aspects. During this

phase seven integrated and emergent categories of episodes were identified: (1) episodes involving artifacts, (2) episodes involving interaction with print, (3) episodes involving reading strategies, (4) episodes involving word meaning, (5) episodes involving story text, (6) episodes involving illustrations and hypertext, and (7) episodes involving sharing and negotiating the routine.

Phase four of the data analysis involved the review of daily summaries and comparison to the episode categories for outliers. The final fifth stage resulted in the composition of total number and type of the episodes to compare across each type of shared reading activity.

In review of the collected data, the focus on specific aspects on the story books differed based on the medium, examined by each type of episode in order. With regard to episodes about artifacts, they were 26% of all episodes for CD-ROM storybooks, 1% for traditional storybooks, and 0% for LEA storybooks. The sociocultural context of a computer-mediated interaction is the reasoning supplied by the researcher.

Episodes involving print also differed significantly based on the type of experience. The proportion of engagement with print for LEA storybooks was 33%, 5% for traditional storybooks, 1% for CD-ROM story- books. These results with LEA were expected, based on the connection it makes between spoken and written words.

Episodes involving reading strategies, such as identifying known words, following with his index finger, and other emergent-level skills broke down with LEA storybooks being the most prominent, with 30% proportion of engagement, followed by 13% in traditional books, and 2% with CD-ROM books. The size of print, and the location, such as being on a computer screen or not, were seen as variables that

contributed to this.

In episodes involving word meaning, the occurrence of identifying new words' meaning happened the most during traditional texts at 4% of the time, followed by 2% with CD-ROM books, and 0% of LEA episodes. The low percentage is due to the fact that the same books were repeated, and the LEA's co-construction was made with known words.

Episodes involving story text, such as when meaning is co-constructed and shared, which dominated the traditional sharing episodes at 50%, followed by LEA with 18%. and CD-ROMs with 14%. However, these differ based on the format of the literacy, such as the subject speaking directly to the multimedia with CD-ROMs.

The next category of episodes were those involving illustrations and hypertexts, such as supplementary information, animations, and the construction of their meaning. Their frequency was fairly consistent with 28% for CD- ROM storybooks, 20% for traditional storybooks, and 15% for LEA storybooks. While these fluctuated over time with LEA and traditional readings, it was fairly consistent with the interactive CD-ROM books.

The final type of episode was the sharing and negotiating of the routine. These episodes were about the parameters of the reading activities, such as dialog convincing James to read passages on his own, or what and where to click with the CD-ROM books. The breakdown between sharing types is 28% for CD-ROM storybooks, 8% for traditional storybooks, and 3% for LEA storybooks. This is in part due to CD-ROM books being a new activity, while the other two had already been conducted with pre-established norms.

In conclusion, the focus on various parts of literacy with each format allowed James to create a unique and whole understanding of multiple literacies in which each format, comprised of its own strengths and weaknesses, facilitated his greater ability to function independently as an emergent reader. The researcher concluded that CD-ROMs and hypertext formats are a positive addition and supplement to learning and literacy, but should not replace other formats of literacy, due to the differences that the multimedia constructed on sociocultural expectations and the shift in the formulation of dialog during the electronic reading.

Each episode provided examples, where applicable, for each type of reading it was identified in. Detailed appendixes of qualitative measures and coding were also provided. It should be noted that Smith was also the participant in this study, as the mother of the child involved in the case study. However, many previous reading research was cited that was also using the researcher's children, so this is not an uncommon event. Overall, this is a very in depth and elaborate qualitative study.

In this subsection of alternative forms of text, Wenger and Payne (1996) found that overall cognitive load did not increase when using hypertext, and that the reading processes was not hindered by using it. Balcytiene (1999) determined that hypertext provided tools to recognize large conceptual ideas in the text through its connectivity and embedded nature, which encouraged meaningful exploratory activities. Smith (2001) found that hypertext in emergent readers were a positive addition and supplement to learning and literacy, but should not replace other formats of literacy due to the changes of sociocultural interactions.

In this section, the influence of alternative forms of text thus appears to be

one that electronic print and technology is at least superficially beneficial to student achievement, and that hypertext is not disadvantagous to learners, and indeed allows larger, conceptual ideas to be cued as scaffolding. Most importantly, however, is the fact that the significance of their use is overshadowed by the fact that sociocultural interactions and the shift of thinking that occurs when accessing them is most likely the cause of student achievement and emergent reading growth.

The Effect In the Learning Process

The next studies explore the usefulness, or lack thereof, of multimedia and multiple literacies application in the classroom at various levels of literacy. Labbo and Kuhn (2000) begin with comprehension of multimodal media in the emergent level literacies in kindergartens. Meanwhile, de Jong and Bus (2002) conducted another study in kindergartens on the impact of multiple literacies and technology application. Alfassi (2000) attempted to identify if inquiry-based fostering learning communities benefited technology in classrooms.

The second subsection focuses on the way critical thinking skills are influenced by multimedia and multiple literacies, such as Pear and Crone-Todd's (2002) investigation of a computer-aided social-constructivist classroom. Zydney (2005) researched whether or not multimedia environments helped students define complex issues and create hypothesizes for ill-defined problems. Damico and Riddle (2006) studied whether or not digital texts helped students explore complicated social issues based on previous research implemented into the classroom.

<u>Emergent Level</u>

        Emergent level literacy is often seen as the most crucial in the growth of a student's literacy life. Knowing this, Labbo and Kuhn (2000) employed a qualitative case study to examine one kindergarten child's comprehension when reading multimodal multimedia CD-ROM talking books to determine the usefulness of this technology in emergent level processes and classrooms.

        Theoretical background supports that literacy understanding can be mediated by multimedia devices serving as electronic scaffolding. Labbo and Kuhn determined criteria for effective software as follows: it modeled fluent reading, fostered stimulation of cognitive processes, and is used for guidance.

        The study was conducted in three phases. The first phase consisted of the framework, methodology, and findings that were discovered. Phase two contained the case study itself involving one kindergarten child's interaction with two types of CD-ROM talking books: considerate and inconsiderate. Phase three was the examination of the subject's comprehension of story of each story book.

        Phase one largely consisted of determining the definitions of considerate and inconsiderate texts. Considerate text is a text that has an appropriate discourse structure suited for the content, is aware of audience appropriateness, coherence, and unity of purpose. Inconsiderate texts often are not written with audience in mind, and provide no supplemental aids such as summaries, definitions, marginalia, or other formatting techniques. This definition was modified to talking CD-ROM storybooks by the addition of the multimedia's role in contextualizing the socio-cognitive perspective of the learner and providing a zone of proximal development as an electronic peer in literacy

development. Through content analysis, two CD-ROMs were selected which were seen as representative as considerate and inconsiderate conventions. A codification of each condition was conducted. It consisted of the screen medium, media effect, and story relationship. These were then analyzed to determine if they were incongruent, incidental, or integral, and in what ways.

The second phase was drawn from a larger ethnography of the opportunities to construct literacy by young children with technology over the course of an academic year. Twice a week for this year, observations and field notes, along with informal interviews and recordings were conducted. The children were familiar with the format and concept of CD-ROM books in their classroom. The researchers attempted to select a kindergarten student that was representative of expected cultural norms. Assessment portfolios and review of each child's literacy development was discussed at length with their participating teacher. The final typical-case selection was a young boy who was from a bilingual household.

Based on the observations during the subject's use with the CD-ROM stories, he accessed incongruent material 59% of the time with the inconsiderate story, and 10% of the time with the considerate story. A review of his comments during the readings along with behavioral notes identified five large categories of the subject's responses, each with its own subcategories. They included attentive/perceptual responses, CD procedures, affective responses, cognitive responses, and metacognitive responses.

Higher levels of cognition and affective-cognition relationships were identified with the considerate text. After each interaction with the stories, the subject was invited to retell by composing an artistic response to determine the comprehension

level of each. The artistic examples provided identified that the subject was able to reconstruct a cohesive story including location, characters, problem, problem-solving, and resolution with the considerate CD-ROM. Meanwhile, the reconstruction of the inconsiderate story was fragmented and incomplete. It contained references to the incongruent animations and songs from the CD-ROM, along with supplemental characters and events which did not take place in the story.

In conclusion, while CD-ROMs are fun, engaging ways to encourage literacy, they should not all be seen as equals, and literary evaluation as pedagogical tools should be evaluated for each one individually. Modeling of comprehension and scaffolding of cognitive growth, as well as providing motivational support should be the focus of CD-ROM story books.

As a critique, Labbo and Kuhn did not differ between print and multimedia literacies as having unique sets of meaning-making processes. Further study in the area using larger cohorts from more heterogeneous socio-economic and cultural population was recommended. Thus, this case study may not be transferable on a large scale.

In an experimental four-group designed study to see whether or not using multiple literacies and technology has an impact on emergent-level reading, de Jong and Bus (2002) investigated 48 kindergarten children (4- to 6-year-olds) from four different classrooms in the same school. Most students came from low socioeconomic status households.

The sample size of the subjects was originally drawn from a pool of 120 students, which was reduced to 55 by scoring the subjects using Sulzby's levels of reading to ensure they were emergent readers. Seven subjects did not matriculate through

the study.

The methodology used by de Jong and Bus was to have an adult read to 12 children from a regular paper book. Meanwhile, 24 children explored an electronic book similar in illustrations and story content (also called CD-ROM storybook, talking book, interactive book, or computer book). For half of this group the electronic book was available with and for half without restrictions concerning the games. Twelve control children were only pre- and post-tested. After 6 sessions the examiner elicited an emergent reading of text and separate words to test to what extent children had internalized story meaning, phrasing, and features of written text.

Furthermore, the subjects were divided into low, middle, and high level reading groups, with ages averaging 4.8 for the low level, 5.6 for the middle level, and 5.11 for the high level readers before being assigned equally to one of the three experimental groups or control group. In inspecting the students' interactions with the computerized literature, examiners used Pearson's product-moment correlation coefficient to determine the linear correlation with a Pearon's r between .85 and 1.00 for all examples using word recognition with icons, word recognition without icons, letter knowledge, rhyming, name writing, and word writing.

When examining the relationship between electronic reading and the use of multimedia supplements, such as games and interactive options, the study determined that on average, the children played 4.85 games, (SD 1.98) per session. Overall time spent with games and the amount of different games was analyzed using multivariate analyses of variance (MANOVA).

The study found that during the book-reading sessions children's attention to

text and iconic modes differed as a function of book format and children's level of emergent literacy. When unrestricted games were available, children explored half as many pages as the restricted group ($p < .034$). Children explored more pages at the beginning of the session than at the end ($p < .013$). Scores on the first two sessions were worse than on the last four ($p < .003$). In the restricted environment, amount of reading increased ($p < .046$). For other information, such as reading level and reading amounts, univariate analysis of variance (ANOVA), with Level and Condition as between-subject factors was used. In other aspects of the study, de Jong and Bus used the Wilcoxon signed-rank test (similar in function to Student's t-test) and Kruskal-Wallis one-way analysis of variance with all p levels falling below .025.

In conclusion de Jong and bus determined that the regular book format was more supportive of learning about story content and phrasing; both formats supported the internalization of the written words' features. The electronic format was a less efficient means of supporting internalizations of story content. The many attractive options of electronic books seemed to divert children's attention from text and number of readings of the text in favor of iconic and pictorial explorations. These results are not in line with the hypothesis that electronic books stimulate dual processing and thus story understanding from previous studies, resulting in the need for further studies to be done on the subject.

The study itself was thorough and specific in its implementation, containing control groups and multiple experimental groups over an extended time with both pre- and post-assessments of student abilities. Multiple instruments were used to interpret and analyze various factors in the study.

Examining if computer-aided scientific inquiry-based Fostering Learning

Community (FLC) intervention increases reading and writing scores, Alfassi (2000)

conducted a prolonged quantitative study on 23 eighth grade social studies students in a

junior-high school and found support that literacy instructions should be obtained through

problem-based and Jigsaw-based techniques in multimedia rich environments. The study

was contextualized within a cooperative social science classroom.

This quasi-experimental longitudinal case study was a single group design

with assessments once a week over a 15-week period, culminating in a post-test result.

The study designed specific assessment tools for reading and writing that were used in

both the pre-assessment and post-assessment. These measures were designed to reflect

holistic socio-cultural evaluation procedures. It used the Ortar Reading Test, along with

reading accuracy and rate and writing samples. A criterion-referenced test of reading

comprehension was administered at the beginning and the end of the investigation.

Students read age-appropriate expository passages unrelated to the curriculum and

answered a set of questions from memory.

The criterion-referenced tests administered at the pre-teaching phase yielded

a mean score of 60.46%. After the investigation, the mean score on the criterion-

referenced tests identified a significant improvement, rising to 86.11%. To judge the

impact of the time spent reading and writing throughout the study's span, a MANOVA

analysis was conducted. It concluded that time was a significant factor ($p < 0.0001$) for

reading, and after dividing the students into two separate measures based on initial

reading comprehension, determined that the correlation to reading competence to time

was significant ($p < 0.05$). Due to the holistic style of some of the assessment tools,

inter-rater reliability was determined (0.78) for homogeneity of scoring between judges of written pieces. The rest of the assessments used Cronbach's alpha, with internal reliabilities between 0.71 and 0.80. However, the released study did not contain full details on the statistical formulas used to determine the reliability of various measurements.

Alfassi concluded that the students increased their writing performance and length of essays, both high and low functioning students identified growth. It supported claims that literacy instruction should be obtained through authentic and cooperative learning communities. However, no measures were adequately in place to judge the effectiveness of the computer use itself and its heavy involvement was an unevaluated variable.

The subjects in this study were not identified explicitly in age, gender, social standing, or other possible factors in the study's reliability. The geographical location of the
study was also not mentioned, and was likely not conducted in the United States. Alfassi took into account changes in reading and writing abilities due to maturation by using information from previous studies on expected growth of literacy skills. Overall, the study may have external validity but lacks sufficient information to re-implement.

In this subsection of the effect on the learning process, Labbo and Kuhn (2000) found that the designs of CD-ROMs were more important than their mere use. Higher levels of cognition and affective-cognition relationships were identified with the considerate text, while inconsiderate texts were significantly worse than traditional print literacy. Next, de Jong and Bus (2002) found that the electronic format is a less efficient

means of supporting internalizations of story content. The many attractive options of electronic books seemed to divert children's attention, as mentioned above as inconsiderate texts. Alfassi (2000) promoted the use of fostering learning communities in a socio-constructivist way, but did not adequately address the role of the multimedia's role in the classroom.

Critical Thinking Skills

Pear and Crone-Todd (2002) explored the way critical thinking skills could be effectively encouraged through a social-constructivist approach to computer-mediated instructions using a computer-aided personalized system of instruction (CAPSI) with 24 subjects.

Identifying evaluation as the highest level of cognitive thought and critical thinking, Pear and Crone-Todd constructed a study that would attempt to create a framework that would build on levels of cognition with decreasing scaffolding using the CAPSI in a series of manageable units while encouraging positive communication and thus peer support and the fostering of zone of proximal development. Thus, the test design is also the teaching design in which substantive feedback in an ICT environment will support the social-constructivist paradigm.

The subjects in the test were 24 undergraduates studying psychology who would be providing feedback and support to one another during the process. Instructions on how to provide feedback was in four criteria: use original examples, if the answer was clear or vague, if the relevant key concepts were explored enough, and if the answer was in the student's own words.

The course was divided into ten units, with each unit containing 20-30 essays

and short answer prompts. The intention behind using the CAPSI was multiple: generate and deliver tests at students' request, deliver to students' with written feedback and responses marked, advance the student one unit if peers and instructors signified a passing level of competence, automated appeal and eligibility processes, and provide a record and database of all transferred information including feedback.

Feedback was rated as being substantive or minimal. Examples of what constituted substantive or minimal feedback were induced. A total of 376 tests were analyzed, each containing three questions. Inter-rater reliability was measured on the basis of the first student's unit tests prior to examining the unit tests of the other students. Agreement about the form of the feedback (substantive or minimal) on these tests was 97%.

The median amount of substantive feedback was 36 instances, or 3.6 for each test taken. Each test was sent to two available peers and the instructor for feedback through the CAPSI.

The evaluation of peer's works and the freedom to modify and construct this form of social-constructivist setting with ease shows a significant value toward ICTs and critical thinking skills. Minimal instructor monitoring was required, and successful levels of student achievement were determined in the analysis of unit tests. In conclusion, the use of the CAPSI created an electronic milieu in which social interactions were allowed to grow and foster higher levels of cognition in the classroom.

Pear and Crone-Todd offered very little actual statistics on the success rate of their study. However, since pass/fail was determined by their peers, this might have little impact on the study itself. Still, more statistically significant measures to adjudicate the

effectiveness of the electronic medium would be necessary, such as possessing a control group who utilized traditional print and social meetings to compare their success and the mount of substantive feedback provided to one another.

Zydney (2005) structured a pilot study to investigate the effectiveness of a multimedia learning environment ability on sixty eight-graders to define complex issues and create hypothesizes for ill-defined problems. This study further focused on the learning cycle where problem-definition was created during problem-based instructional techniques.

The construction of the experiment's multimedia program, *Pollution Solution*, was designed to emphasize the cognitive flexibility theory of learning, as well as other constructivist methods as the scaffolded flexibility model. Formative assessments, modeling, and scaffolding were all incorporated into the multimedia program to support the development of complex problem-solving skills and higher-order thinking.

The subjects were from four separate earth science classes in New York public schools. 52.3% White, 15.8% Black, 17.4% Hispanic, and 14.6 % Asian and others including Pacific Islanders, Alaskan Natives, and Native Americans. Two-thirds of the students were female and 46% of the students were eligible for free lunch.

Each of the four classes randomly received a random treatment condition of the multimedia with modified scaffolding included within it. Treatment 1 was the control group and offered no additional tools. Treatment 2 included the organization scaffold, the research plan template, which provided the students with headings and focusing questions to organize their research. Treatment 3 included the higher-order thinking scaffold, a status report. The status report gave the students reflective, higher-order thinking

questions to help them integrate their new ideas with their prior knowledge. Treatment 4 was a combination of Treatment 2 and 3 and included the research plan template and the status report.

Student problem-solving skills were assessed through descriptions of legal, environmental, economic, and public relations factors with scores from 0-6. Hypothesis formulation was assessed through definition, relevancy, feasibility, originality, and consideration of multiple perspectives with a score from 0-6. Question generation was assessed on the question type (being inside or outside the problem domain), specificity, and perspectives. Each had is own form of coding and scale of significance.

The study itself was conducted over five 60-minute class periods in which the students worked with the *Pollution Solutions* multimedia to explore their problem. The first session was used for dividing into planning teams before students individually completed a 10-minute problem-solving test. The second session consisted of a whole-class discussion about the causes and effects of acid rain, then learned about it from the prospective of an energy company, and then time was spent in planning teams to find solutions to the problem before reporting out to the class. Session three had the students receive a demonstration on the multimedia interface before they were sent to research individually on the problem. In the fourth session, students began to construct their research plans which continued into the fifth and final session, along with a status report, if in the appropriate treatment group.

Using an ANOVA, the difference in the problem-solving test scores between the four treatments came close to significance ($F(3,56) = 2.36$, $p = .08$). ANCOVAs were run on the outcome measures with scaffolding type as a factor and problem-solving

ability as a covariate. When the ANCOVAs found statistically significant F-results, pairwise comparisons, with a Bonferonni adjustment, were run to determine which means were different from one another.

The findings from the study identified that the students' understanding of the problem varied significantly for different treatments ($F(3,55) = 5.60$, $p < .01$). The subjects who used the organization scaffold had significantly better problem understanding than the control group ($p < .01$). They also had significantly better problem understanding than the students who used the higher-order thinking scaffold ($p = .03$). And finally, those students who used the combination scaffold also had significantly better problem understanding than the control group ($p = .04$).

With the formulation of hypotheses, the study found that the scaffolding type had a significant effect ($F(3,55) = 3.69$, $p = .02$) on the quality of students' hypotheses, with the students who used the organization scaffold developed significantly better hypotheses than the control group ($p = .03$). As for the questions, scaffolding type did not have a significant effect on the type asked. Nonetheless, students who used the organization scaffold tended to ask more questions inside the problem domain than the other treatment conditions.

Thus, Zydney found in the pilot study that organization scaffolding was the most effective with the multimedia application. It helped orientate students to the problem, generate questions, and formulate accurate hypotheses. This matches with previous studies in the field of scaffolding techniques. That said, the higher-order scaffolding technique, which produced results slightly lower than the organization scaffolding, achieved much better at engaging students in multiple perspectives.

Detailed theoretical background was provided, along with consistent samples from the computer software that demonstrated its alignment with the established theoretical support. The study itself offered critique on the sampling size and limitations, noting it was a pilot study. Zydney also provided recommendations on changes that would have been made with the scaling and clarifying student answers for future studies as to improve the statistical results.

Damico and Riddle (2006) provided a qualitative longitudinal case study of digital texts incorporated into classroom usage in which 28 fifth-grade students explored complicated social issues using New Literacy Studies (NLS) and multimedia exploring if the implementation of previous research would have beneficial results.

The subjects were identified racially as being African-American, 10 as European-American, four as Latina/o, and four as multi-racial. Of the students, 14 participated in free or reduced lunch.

The project was inquiry-based in which the students were encouraged to generate their own questions and topics of learning in construction of a final project on the theme of freedom. The project was designed with the following principles for the guidelines: Review your own learning, select a topic, represent what you learned, and how to leave a legacy through action.

The students were observed during in-class group brainstorming activities and personal study time. Multimodal sign systems were encouraged as the final projects, such as plays, folk stories, songs, and surveying the student body on the issues of freedom. The creation of a compilation CD of these projects served as way to leave a legacy.

During the process, the reconfiguration of ideas and projects was observed as groups branched out or altogether tossed out existing frameworks of their final projects. Facilitated whole-group check-ins were observed where small groups and individuals presented progress reports and took in suggestions from other class members. During these times, the teacher critiqued literary sources and provided open-ended guiding questions to each group, such as "what information is not provided in this article?" and "What might be someone else's perspective on this issue?"

In the end, six students researched slavery, eight researched censorship, two researched racial profiling, five researched child slavery, three researched slavery and freedom, and two researched affirmative action. Amongst these issues, the approach and modalities varied from dances, dramas, simulated newscasts, and survey research.

In the application to teaching, Damico and Riddle (2006) identified several pedagogical challenges based on the observations in the case study. First, the teacher had difficulty in guiding the research process with such diverse selections and sources. A multimodal literacy and open-ended problem-solving strained the teacher's ability to analyze and support the various students' information. Another problem was the assessment of student work. How to effectively gauge student contributions to the creation of the digital text so they would be accountable for their own learning. While informal assessment strategies were utilized, the teacher still doubted her ability to appropriately assess some students' work.

Damico and Riddle (2006) made observations on the types of problems posed by the students in their presentations and the way each example represented a unique and multimodal literacy in the creation of the digital text. Spatial, auditory, visual, gestural,

and textual forms of information were utilized. Thus, by identifying new forms of texts and understanding their significance, as with NLS, they were able to facilitate new forms of textual practices. In conclusion, by moving away from solely using print-based text, multimodal literacy had deepened the students' understanding of the issues by encouraging them to explore problem-solving learning through situations, such as where to film with appropriate locations and backdrops, and how to convey the right emotional message through performance pieces.

In critiquing this study, it is clear the researchers utilized a rich array of theoretical background on building upon their examples. Due to this, a large portion of the paper was focused on the pedagogical framework and background leading up to the case study and the reasons and rationale for it being conducted. Thus, the longitudinal study provided only a cursory overview of the transcribing and data-collection, instead of providing explicit examples of transcripts, field notes, and how the information was interpreted by the researchers. Without providing explicit examples of what questions were asked and how the researchers framed the discussions, it would be difficult to replicate this study. This study does not have the necessary information to generalize it. That said, there is supportive evidence that furthers the belief that classrooms and schools have the ability to cultivate collaborative work through new literacies in an attempt to establish social justice and transforming injustices.

In this subsection of the effect on the learning process, Pear and Crone-Todd's (2002) study created an electronic milieu in which social interactions were allowed to grow and foster higher levels of cognition in the classroom. Zydney (2005) found that the organizational scaffolding was the most effective with the multimedia application,

reinforcing the significance of the technology's design and consideration to pedagogical goals. Damico and Riddle (2006) concluded that by moving away from solely using print-based text, multimodal literacy had deepened the students' learning and increased problem-solving.

In this section, the effect of multiple literacies and multimedia in the classroom appears to be that the design and focus on content is crucial in emergent levels to prevent it from becoming overwhelming and distracting. The critical thinking impact, however, shows that it most certainly is advantageous, and should be adopted into classrooms as a source of deepening student awareness, metacognitive growth, and strengthening of problem solving skills.

Summary

Chapter three was a review of literature on multiple literacies, multimedia, and multimodality. The findings of the studies set forth were summarized and analyzed based on qualitative and quantitative traits in the conclusions provided. The research in the cognitive formation in multiple literacies, multimedia, and multitasking section indicated that it was not multimedia or multiple literacies that were directly beneficial, but the pedagogical framework and theoretical methods used in designing and implementing them in classrooms which has the most effect on student learning,

Like the previous studies, the section on the role of technology found that it was not the technology that directly influenced the results, but the role it played as a motivational factor and as a facilitation of higher-order conceptual thinking. This, along with its representation as a socioeconomic signifier outside of the school setting, helped establish the proper role of technologies in the classroom.

The section on the impact of multiple literacies indicated that when multiple literacies are at work and being utilized, individuals' socio-cultural and critical thinking skills both benefit. The final set of studies identified a significant power in the multiple literacies students use in their daily lives, and that an awareness of these literacies by teachers and school administrators is necessary for their full potential to be realized.

In the influence of alternative forms of text section, the studies indicated that electronic print and technology is beneficial to student achievement, and that hypertext is not disadvantageous to learners, and indeed allows larger, conceptual ideas to be cued as scaffolding. Most importantly, however, is the fact that the significance of their use is overshadowed by the fact that sociocultural interactions and the shift of thinking that occurs when accessing them is most likely the cause of student achievement and emergent reading growth.

In the final section, the effect of multiple literacies and multimedia in the classroom appears to be that the design and focus on content is crucial in emergent levels to prevent it from becoming overwhelming and distracting. The critical thinking impact, however, shows that it most certainly is advantageous, and should be adopted into classrooms as a source of deepening student awareness, metacognitive growth, and strengthening of problem solving skills.

Chapter four outlines the summary of these findings with respect to cognition formation, the role of technology, impact of multiple literacies, alternative forms of text, and their effect in the learning process. Chapter four will then establish the classroom implications of these findings and consider future research in the fields of multiple literacies, multimedia, and multimodality.

CHAPTER FOUR: CONCLUSION

Introduction

Chapter one discussed the way culture and literacies are interconnected, and the way technology is a part of the sociocultural network of meaning making. It suggested we should look in the future towards the implications of multimedia and multiple literacies, and how their synergy in growth can positively impact our students. Given this, chapter one presented the readers with an understanding of the rational of the guiding question: how literacy is being reformed and modified in our changing society.

Chapter two explored the emergence of literacies that evolve, adapt, and represent multimodality for the readers. It studied literacy's philosophical and realistic roles through ideological power, propaganda, and its importances in shaping thought. The chapter noted the role that literacy has served throughout traditional civilization as a lense that prescribed norms were manifested. Further examination of our society and youth attempted to identify the trends in media and lifestyles and inquires how literacy is being reformed and modified in our changing society. Our youth increasingly use the multimedia that is ever present in their daily lives, and face the demands of a multitasking environment where quick decision and a need to constantly evaluate the flow of information is shaping our society in new and multimodal ways.

Chapter three reviewed the literature of multiple literacies, multimedia, and multimodality. The research was organized into five large sections of study: cognition formation, the role of technology, impact of multiple literacies, alternative forms of text, and their effect in the learning process. Each of the qualitative and quantitative studies were summarized and critiqued based on the conclusions provided. The reviews

attempted to determine their significance in relationship to student achievement and learning productivity.

Chapter four is the final chapter of this paper. This chapter will revisit the guiding question, how literacy is being reformed and modified in our changing society, based on the five sections from chapter three to answer the question of the study, the implications for classroom application, and suggestions for future research emphasis.

Summary of Findings

How is literacy being reformed and modified in our changing society with multiple literacies, multimedia, and multimodality? This was the guiding question which focused the review of literature. When you consider the implications of expanding the understanding and acceptance of these alternative forms of literacy that have begun to be so deeply ingrained in the daily lives of our youth through their media multitasking and multimodal functionality, the role of literacy is continuously undergoing a progressive rebirth and reinvention of meaning and meaning making capabilities.

The section on Cognitive Formation found that multimedia design should reflect constructivist ideas through modality, interactivity, and self-explanation principles, while the ability to have control of their learning in an interactive way influenced student comprehension process, and found that bulletin boards did not directly affect cognitive processes, but rather it was the question types along with new teaching methods that provided the cognitive benefit to students (Mayer, Dow, and Meyer, 2003; Riding and Grimley, 1999; Thomas and Hofmeister, 2002). Physiological and brain studies found that while some neural systems appeared unrelated, there was a relative interdependence which revealed a drop in overall activation, and that attention is

a limited cognitive commodity, and simultaneous message formatting was not effective due to this limitation. (Bergen, Grimes, and Potter, 2005; Just, Carpenter, Keller, Emery, Zajac, and Thulborn, 2001). This suggested that the pedagogical framework and theoretical methods used in designing and implementing multimedia and multiple literacies in classrooms which has the most effect on student learning.

The section on the Role of Technology found that ICT's are not as important as the quality of its use, and while not always a determinate in student achievement they should be recommended as a tool for students who face motivational barriers, especially in regards to reading comprehension and seen as an additional supplement to educational practices, and when accompanied by higher-order thinking strategies and teachers that have professional development in the use of ICT are very successful (Bussiere and Gluszynski, 2004; Kramarski and Feldman, 2000; Wenglinsky, 1998; Willms and Corbet, 2002). Media multitasking was identified more in younger students and that more traditional media use such as music and television do no increase media multitasking, but computer use and video games do, and when mixed with rapid technological saturation, an appropriate amount of training and scaffolding for both teachers and students should exist (Foeher, 2006; Marcoulides, Stocker, and Marcoulides, 2004). In short, this section found that it was not the technology that directly influenced the results, but the role it played as a motivational factor and as a facilitation of higher-order conceptual thinking.

The section of multiple literacies identified that online multiple literacies often challenged gender assumptions and allowed for the subjects to explore their gender identity uniquely, access to the Internet was not indicative of ability to gain all the social and cultural benefits from it, and that more emphasis should be placed on discovering

students' specialized literacy traits that exist in mediums, such as multimedia, outside of traditional print literacy (Chandler-Olcott and Donna, 2003; Ranker, 2006). A disconnect was found between the multiple literacies available which are used by students in conceptual critical thinking and the tendency of teachers to focus on only the traditional form of literacy. This disconnect prevents the best possible education to occur and relegates students to simply play the grade game, and the failures of boys in traditional literacy is due in part to this inability to see how their multiple literacies are being utilized as a member of a community in a social, organic process (Blair, 2004; Newman, 2002). Screen-based literacy in test use promoted deeper reading comprehension, and was surprisingly similar to traditional print literacy, while when used in video games they could reinforce the socio-cultural experience that often focuses on the themes of Western hegemony; competition, strength, aggression, and domination (Kobrin and Young, 2003; Sanford and Madill, 2007). Thus, this section found that when multiple literacies are at work and being utilized, individuals' socio-cultural and critical thinking skills both benefit.

The section on Alternative Forms of Text identified that electronic media, specifically laptop immersion programs, fostered higher achievement in writing, mathematics, and overall GPA, and that highly organized technological rich environments enhanced flexibility in learning while not hindering acquisition of introductory domain knowledge (Demetriadis and Pombortsis, 1999; Gulek and Demirtas, 2005). It was not electronic print itself that increased student achievement, but rather the socio-cultural conditions that existed around the computers and technology in the students' lives, and in regards to hypertext, overall cognitive load did not increase

when using hypertext, and that the reading processes was not hindered by using it, but rather hypertext provided tools to recognize large conceptual ideas in the text through its connectivity and embedded nature, which encouraged meaningful exploratory activities (Balcytiene, 1999; Smith, 2001; Wenger and Payne, 1996).The most significant find was that electronic media is useful due to its role in socio-cultural interactions and the shift of thinking that occurs when accessing them is most likely the cause of student achievement and emergent reading growth.

In the section of the Effect on the Learning Process, higher levels of cognition and affective-cognition relationships were identified with the considerate text, while inconsiderate texts were significantly worse than traditional print literacy, and that designers of software must be taken into consideration, since many texts in electronic format are less efficient in supporting internalizations of story content (de Jong and Bus, 2002; Labbo and Kuhn, 2000). Other studies created an electronic milieu in which social interactions were allowed to grow and foster higher levels of cognition in the classroom (Alfassi, 2000; Pear and Crone-Todd, 2002). Organizational scaffolding was most effective with the multimedia application, reinforcing the significance of the technology's design and consideration to pedagogical goals, so that by moving away from solely using print-based text, multimodal literacy had deepened the students' learning and increased problem-solving (Damico and Riddle, 2006; Zydney, 2005).

In conclusion, the findings which lead into the classroom implications suggest that the effect of multiple literacies and multimedia in the classroom appears to be that the design and focus on content is crucial in emergent levels to prevent it from becoming overwhelming and distracting. The critical thinking impact, however, shows

that it most certainly is advantageous, and should be adopted into classrooms as a source of deepening student awareness, metacognitive growth, and strengthening of problem solving skills.

<div align="center">Classroom Implications</div>

A complete understanding of new literacies that emerge from multimedia and multimodal representations needs to be from a foundation of understanding multiple literacies as social interactions and cultural practices that greatly influence the students (Tierney, Bond, & Bresler, 2006). Digital technologies can be a natural expansion of socio-constructivist pedagogy and collaborative classroom environments.

The classroom implications determined thus far appear to be that a proper and well-facilitated use of multimedia and multiple literacies integration will have a positive impact on student achievement, literacy development, and socialization. This is found to be true across all grade levels, from emergent literacies in kindergarten, to critical thinking in high school. This can only be achieved, however, through professional development by teachers and school administrators in the field of information and communication technologies use and application, as well as the understanding of socio-constructivist pedagogy by the software developers, themselves. Only by fostering a open discourse across the spectrum, from conception to application, will the multimodal practices of multimedia's new literacies have the significant impact we hope is possible.

Yet, teachers in American public schools are under constant pressure to teach to tests. Accountability has become a hallmark of our classrooms, not a learning environment rich in multimodal opportunities of inquiry-based research and problem-solving dilemmas. As many of the summaries of the research concluded, variables existed

on the ability of the teacher and the desire to incorporate the multimedia and multiple literacies into a coherent pedagogical structure. Individual teachers' philosophical and theoretical background in literacy and learning will have as much of an impact as the influx of information and communication technologies in their classrooms.

That said, there is a definitive and rationale place for multimodal media and incorporation of multiple literacies into the classroom. All that we think we know, and we think we understand that exists beyond our immediate life and past experience has come to us through media. To understand all that entails, from the subtleties of perception and the impact this has on our decisions. To be aware of its influence on our beliefs, views, opinions, values, and behaviors effective communication practices can be formed through the traditional print-medias, audiovisual medias, and ICTs.

Furthermore, media education is an extension of political awareness and democracy. Our politicians and domestic issues are packaged and sold, and increasingly through mediums such as FaceBook and MySpace. An in-depth and comprehensive understanding of multiple literacies and the multimodal nature of our society can lead to a citizenry capable of critical thinking, that can unpackage and deconstruct media messages and make informed decisions.

Thus, the classroom implications for multiple literacies, multimedia, and multimodality exist within a sociopolitical and sociocultural context. The merits of each without support and understanding will not significantly impact student development and achievement. Ultimately, it is the education, not of the students, but of the teachers, that is paramount to the success of information and communication technology based multiple literacies. In this fact, there are numerous resources available to aid and support the

professional development of educators. A few resources are the Association for Media Literacy (www.aml.ca), the Center for Media Literacy (www.medialit.org), the National Association for Media Literacy Education (www.namle.net), the National Council for Social Studies' Technology Community (ommunities.ncss.org/communities/technology), and other resources exist solely to aid classroom practitioners with materials and curriculum support, such as Project Look Sharp (www.ithaca.edu/looksharp/).

Suggestions for Further Research

Many of the studies in this paper were from international sources. The United States role in the development of multiple literacies and multiple literacies research appears to be well behind our international peers' advancements. From the studies found, I believe more emphasis needs to be placed on the choice of subjects, to analyze the differences of socioeconomic status, ethnic and cultural milieus, and the relationship our many students have with computers in their lives.

Other studies found difficulty in separating the impact of the technology, and the impact on the sociocultural expectations and atmosphere around the technologies. Indeed, one must wonder if the two things are even able to be separate factors, or if they are so interconnected that they must be examined as representing one unique variable. Further research into this dilemma could be insightful, especially given our culture's constant shifting, adapting view of technologies and multimedia.

Eliminating the variable of the teacher's quality, desire for success, and professional development should somehow be addressed in future research. Furthermore, research should be conducted on teacher quality itself in determining the effectiveness of instructional implementations and instruments, such as multimodal technologies or

otherwise. Research in the effectiveness of various methods of providing professional development, and its long term effects on student achievement and success should be monitored. Further information can be found in Cervetti, Damico, and Pearson (2006). Without this type of quantitative data to support a whole-hearted attempt at embraced multiple literacies and technological advances, I am pessimistic in seeing it adapted at anything other than a crawling, sluggish pace.

Conclusion

Chapter one discussed the rationale behind the paper, including the interconnected relationship of literacy and culture, and the way sociocultural process of meaning making. It found that we need to examine the implications of multimedia and multiple literacies, and how their synergy in growth can positively impact our children as students and citizens. Given this, chapter one presented the readers with an understanding of the rational of the guiding question: how literacy is being reformed and modified in our changing society.

Chapter two explored the emergence of literacies that evolve, adapt, and represent multimodality for the readers. It studied literacy's philosophical and realistic roles through ideological power, propaganda, and its importances in shaping thought. The chapter noted the role that literacy has served throughout traditional civilization as a lens that prescribed norms were manifested. Further examination of our society and youth attempted to identify the trends in media and lifestyles and inquires how literacy is being reformed and modified in our changing society.

Our youth increasingly use the multimedia that is ever present in their daily lives, and face the demands of a multitasking environment where quick decision and a

need to constantly evaluate the flow of information is shaping our society in new and multimodal ways. Thus, the relevant history involves the growth and adaptation of humans and literacy on a systematic level, and how as "informavores", we are adapting our literacy habits in this media saturated environment.

Chapter three reviewed the literature and recent scientific studies on multiple literacies, multimedia, and multimodality. The research was organized into five separate sections of study: cognition formation, the role of technology, impact of multiple literacies, alternative forms of text, and their effect in the learning process. Each of the studies were summarized and critiqued based on the conclusions provided.

These conclusions found that properly designed single-message multimedia which fosters constructivist ideals in an interactive way is beneficial to student achievement, and the theoretical foundations on multimedia has the most significant impact on its success. (Bergen, Grimes, and Potter, 2005; Just, Carpenter, Keller, Emery, Zajac, and Thulborn, 2001; Mayer, Dow, and Meyer, 2003; Riding and Grimley, 1999; Thomas and Hofmeister, 2002). Furthermore, the quality of increased ICT usage, such as in tandem with higher-order conceptual thinking, is directly related to is impact on student achievement, especially with those who face motivational barriers to academic success and that professional development (Bussiere and Gluszynski, 2004; Kramarski and Feldman, 2000; Marcoulides, Stocker, and Marcoulides, 2004; Wenglinsky, 1998; Willms and Corbet, 2002). Discovering students' specialized literacy traits should be the prime focus of teachers to incorporate multiple literacies into the classroom, but critical literacy skills were not developed in the multimodal video game context unless made explicit, nevertheless the creation of multimedia allows for much more critical thinking

and meaning making, and on-line multiple literacies can challenge gender assumptions, both of which are inherently socio-cultural experiences (Chandler-Olcott and Donna, 2003; Blair, 2004; Newman, 2002; Ranker, 2006; Sanford and Madill, 2007). Specific programs that create highly organized and technologically rich environments, such as laptop immersion, created higher achievement in students, and that part of their success was the socio-cultural conditions that technology builds in students' lives. However, these should supplement, no replace, traditional formats of literacy (Balcytiene, 1999; Demetriadis and Pombortsis, 1999; Gulek and Demirtas, 2005; Reinking and Watkins, 2000; Smith, 2001). Further evidence suggested critical analysis of pedagogical design be taken into consideration, as that considerate text benefits student achievement, as does an electronic milieu of social interactions. Electronic texts can distract emergent readers and lead to decreased internalization, but increased multimodal literacy can deep students' problem solving and cognitive skills (Damico and Riddle, 2006; de Jong and Bus, 2002; Labbo and Kuhn, 2000; Pear and Crone-Todd, 2002; Zydney, 2005).

Lastly, Chapter four represented the summary of the findings based on the sections from chapter three, implications of classroom practice, and suggestions for future research. It found that, based on the research provided, the author's statement is that professional development of teachers and teacher candidates is paramount to the success of information and communication technology based multiple literacies.

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