ABSTRACT

BRIERTON, SARA BETH. Higher Order Thinking Skills as Demonstrated in Synchronous and Asynchronous Online College Discussion Posts. (Under the direction of Dr. Elizabeth Wilson.)

Developing higher order thinking skills in students is an important task for higher education. Rapid rates of technological advancements have developed a need for workers who are able to repeatedly learn and adapt (National Research Center for CTE, 2010); students who are competent analyzers, synthesizers, and evaluators become workers who are better prepared for the work challenges they will face. Companies report difficulty finding employees who possess these higher order thinking skills (Kreitzberg & Kreitzberg, 2009). The Association of American Colleges and Universities (2010) surveyed employers and found a majority thought analytical reasoning skills should receive more academic emphasis. Higher order thinking skills - analysis, synthesis and evaluation, prepare students to be learners, workers, and contributors to society.

An increasing number of students are taking courses through distance education and are using distance education technologies in their classes (Black, Dawson and Priem, 2008). Class discussion, a long-standing and well-regarded instructional method, can be replicated in online classes. Two types of online discussion are synchronous and asynchronous. Synchronous discussion takes place in real-time, often using chat or messaging applications. Asynchronous discussion is most often accomplished through

online discussion boards where students respond to comments and questions from other students and the instructor.

Purposeful dialogue allows students to delve deeper, and to wrestle with the ideas and meanings presented in class (Arends, 2004). Discussion engages students in idea investigation and problem exploration; it also builds group decision making abilities and advances higher order thinking skills (Wilen, 2004). When students work together to decipher meaning or construct ideas through communication it is called social constructivism (Scardamalia & Bereiter, 1996; Vrasidas, 2000). Providing students with real-world content, prompts for open discussion, social interaction opportunities, and chances for reflection results in productive discussion via social constructivism. An examination of student discussion comments and the resulting meaning making should indicate the cognitive levels demonstrated in that discussion.

This exploratory study compared the instances of higher order thinking skills in synchronous and asynchronous online discussion. An experiment was conducted that compared the weighted cognitive level scores in synchronous and asynchronous online discussion. Students in a graduate level online class were randomly assigned to either a synchronous or asynchronous delivery of their required class discussion. Transcripts, generated by the Learning Management System, were reviewed and student comments were ascribed to the corresponding level of Bloom's Taxonomy using the Florida Taxonomy of Cognitive Behavior. Overall, asynchronous online discussion resulted in a higher weighted cognitive level score. The format of asynchronous online discussion provides more opportunities for reflection, which could have resulted in higher cognitive

scores. This study also described the distribution of comments in online discussions according to Bloom's Taxonomy level. Most discussions, regardless of delivery mode were at lower cognitive levels. Replication of this and other studies about cognitive levels as demonstrated in online discussions is needed. Specifically needed is research exploring the role social constructivism could play in eliciting higher order thinking skills.

Higher Order Thinking Skills as Demonstrated in Synchronous and Asynchronous Online College Discussion Posts

by
Sara Beth Brierton

A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements of the Degree of
Doctor of Education

Agricultural and Extension Education

Raleigh, North Carolina

2011

APPROVED BY:

_____	_____
Dr. Elizabeth Wilson Committee Chair	Dr. Mark J. Kistler Committee Co-Chair
_____	_____
Dr. Jim Flowers	Dr. David W. W. Jones

DEDICATION

I can do all things through Christ who strengthens me. I must confess I often doubted that a dissertation was really included in that list of 'all things.' Apparently it was, Praise God.

I would like to dedicate this work to my grandparents, Hank and Carol Parker. Though they passed before I completed my bachelor's degree, they instilled within me a supreme value of education *and* thinking. I believe that they are pleased with this accomplishment. They continue to mean the world to me.

My entire family has provided unending care and support throughout my life and has always been encouraging and excited about my educational adventures. My grandparents, Pops and Grams as I called them, were both wonderful people, and wonderful 'unofficial' teachers. As I was lucky enough to live only a block away, I spent many hours in his workshop, his office, her kitchen, her yard, and their car learning. They provided me with a world of experiences, encouraged me to explore them, and asked me questions about what I learned. Pops enabled my curiosity; if I had a question he rarely gave me the answer, but together we would discover it. Grams gave me responsibilities and the tools to handle them. It is from them that I probably first learned the very higher order thinking skills this dissertation seeks to explore. They also bought me my first computer (a Macintosh in the early 1980s); my grandmother encouraging me to "do something in the computer field." At that point no one was practicing online education, but I still feel like they were preparing me for this path.

Thank you Pops and Grams, thank you for everything. I love you and miss you.

BIOGRAPHY

Sara Beth Brierton was born near Chicago and grew up on the beautiful flat prairiescapes of Urbana, Illinois where she attended Urbana District 116 schools for K-12. She enrolled at the University of Illinois and after a detour studying architecture received a B.A. in political science. One snowy January morning Sara packed all her stuff into a Ryder truck and drove halfway across the country to Winston-Salem, North Carolina. In Winston great friends were made and good times were had, but Sara knew there was more school in her future (she had no idea just how much!). She moved to the Raleigh area where she had the good fortune to work for a technology intensive sports company during the dot com craze, and the bad fortune for that company to be one of the many that didn't 'quite' make its IPO. Having access to advanced technology and seeing the many innovative uses for it rekindled Sara's love of technology. Her next step was more online technology, but also classes – administered as *snail mail correspondence courses*. One thing led to another and Sara began in earnest her graduate studies at NC State in Extension and Adult Education. She received her Masters of Extension in 2007 and stayed for the doctoral program and teaching assistantship. Providence smiled and previous work experiences paid off when Sara found what was being done in modern DE; it was online and just beginning to tap the potential of the Internet. It became the focus of her research and chosen career path. Sara hopes to improve the quality, usability, and enjoyment of online distance education. To that end she believes a quality education at any level and in any location must advance student thinking abilities. Her goal is to find ways to help develop those thinking abilities in online students.

ACKNOWLEDGEMENTS

There are many wonderful people whose help made this project possible.

Dr. Beth Wilson – Thank you for pushing, pulling, cajoling and almost bribing me into finishing. I appreciate all of your work and guidance. You have gone from temporary advisor and teacher, to mentor and friend.

Dr. Mark J. Kistler – Thank you for always being solid and steady on this bumpy path.

Dr. Jim Flowers – Thank you for your vision and viewpoint, not only on statistics, but on the entire research process.

Dr. David W.W. Jones – Thank you for your encouraging dialogue and our discussions that raised my own analysis, synthesis and evaluation.

Dr. Grant Holley & Dr. Susan Osborne, Graduate School Representatives, and Dr. Roger Woodard from the Statistics Department – Thank you for your input and insight.

The entire AEE Department faculty and staff – Thank you for teaching and researching opportunities, helpful instruction, great conversations, advice, and support.

Several iterations of grad students in Ricks rooms 10, 205, 207, & 213 – Thank you.

My efficient and efficacious editor Erica – Thank you.

Thank you to my family for love and support.

Thank you to my mother for her never-ending belief that I could do this.

Thank you to my father for being the other half of my inter-rater reliability.

Thank you to my friends for allowing me to disappear for the better part of several years and always welcoming me back when I needed a study break; and hopefully welcoming me back again now that I'm finished.

Thank you to Julie – cheerleader, editor, sounding board, encourager, and dog-walker, thanks for helping me see who I can be.

Additionally I would like to thank my elementary and secondary classroom teachers. I have been very fortunate to have been in many interesting classes, some easy, some difficult, but most of them have been lead by gifted educators. Thanks especially to:

Lynn Morrow	Carol McGehe	Carolyn Conrad
Marcia Applebee	Ann Helm	Ray Stoia
Lynn Mickunas	Janice Presley	Christine Cox
Carmen Reid	Henry Mears	Carol LeSeure

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I: Introduction

Overview Of The Study

A primary goal for education is to develop students who are prepared for the work and life challenges they may face (Association of American Colleges and Universities, 2010). Formal elementary through post-graduate education seeks to produce analytical, problem-solving, critical thinking students. It seeks to cultivate students who are able not only to acquire knowledge and comprehend ideas, but also to synthesize thoughts and evaluate concepts. These skills, which include the higher order thinking skills of analysis, synthesis and evaluation, are paramount to preparing students to become learners, workers, and contributors to society. For decades class discussion has been a significant component of teaching and learning. Purposeful dialogue about course content allows students and instructors to delve deeper, and to wrestle with the ideas and meanings presented in class (Wilen, 2004). If discussion in brick and mortar classrooms is the vehicle through which these skills are exercised and taught, it should also serve that purpose in distance education courses.

The terms higher order thinking and critical thinking are not synonymous; however, there is a relationship and connection between them. The variety and overlap of these many descriptions results in researchers using Higher Order Thinking as an 'umbrella' term, including concepts such as creative, systemic and critical thinking encompassing various forms of thinking such as critical, systemic, and creative thinking (Resnick, 1987). As both critical thinking and higher order thinking refer in some way to

the cognitive processes that this research paper seeks to explore a joint term of **HOTS/CT** will be used to indicate the overarching concept of thinking skills.

Analytical Thinking Is An Important Skill For Employment

In order to best prepare students for employment and potential employment changes it is important to identify the skills that employers desire in prospective employees. The qualities and skills that rank on employers' most-wanted lists for their employees are transportable "soft" skills. The American Management Association (AMA) surveyed executives and found that 80% believe combining traditional competencies with newly defined 'soft' skills could develop better prepared students who are ready to enter the workforce. The AMA (2010) noted it is not enough for employees to be proficient in reading, writing and arithmetic if they are lacking in critical thinking, problem-solving, collaboration and communication skills. Workers in practically any position, in all industries and on nearly every job, need to have these skills to be hired and to remain employed.

The National Association of Colleges and Employers has conducted surveys of employers regarding the desired skills for almost 10 years, and their list of skills and qualities has remained virtually the same. Employment agencies note that analytical skills continue to be at or near the top of lists of qualities sought by potential employers, and are important in a busy global economy (AMA, 2010). Additionally Briggerman and Norwood (2011), in a study about which aspect of the job acquisition process carries the most weight (interviews, CVs, transcripts, etc.), found problem-solving skills to be one of

the top five skills employers are seeking. Human Relations professionals and employers expressed HOTS/CT and employee adaptability as primary competencies sought, and that these abilities were becoming more sought-after (SHRM, 2008).

Other agencies that focus on employees and employability also find analytical, critical, and higher order thinking skills among the most desired by employers. Hansen and Hansen's (2007) list of top ten qualities employers were looking for included:

- Analytical and research skills – "ability to assess a situation, seek multiple perspectives, gather more information if necessary, and identify key issues that need to be addressed" (paragraph 7).
- Problem-solving, reasoning, and creativity – "involves the ability to find solutions to problems using your creativity, reasoning, and past experiences along with the available information and resources" (paragraph 14).

Additionally, a consortium of agencies including: The Conference Board, Corporate Voices for Working Families, the Partnership for 21st Century Skills, and the Society for Human Resource Management collaborated to investigate what employers define as 'workforce readiness' in order to meet the challenges of the 21st century. They concluded that employers thought the critical thinking skills of those new to the workforce were in need of improvement and will grow in importance for the next five years (Kreitzberg and Kreitzberg, 2009). Critical Thinking/Problem Solving was considered the most needed skill over the next five years by 78% of employers

questioned. Those same skills were viewed as deficient in new high school graduates by 70% of those surveyed. Companies lamented that it was difficult to discover, entice, hire, and keep workers with HOTS/CT skills and they feared that the situation would not improve in the near future (Kreitzberg and Kreitzberg, 2009).

Higher Education Should Be Teaching The Skills Employers Want

Research indicates employers in the U.S. are complaining that current young adults do not possess the necessary skills for success in the 21st century workforce. Some of these employers, who are members of The Partnership for the 21st Century Skills and include Microsoft, Cisco, Pearson, and Apple, have also decried what is seen as obsolete and outdated educational approaches. These companies are requesting stronger focus on HOTS/CT, communication, and creativity (Harvard Graduate School of Education, 2011). On behalf of the Association of American Colleges and Universities, Hart Research Associates surveyed 300 employers of 25 or more people and discovered similar findings: Employers believe colleges should place a greater emphasis on intellectual and practical skills. Specifically, 81% of the employers surveyed thought critical thinking and analytical reasoning skills should receive more academic emphasis (Association of American Colleges and Universities, 2010).

Multiple surveys conducted by The National Association of Colleges and Employers (NACE) demonstrate that the skills hiring managers are looking for are communication and critical thinking (Gelhouse, 2007). Experts say, and a 2007 NACE survey confirms, that the most important skill employers seek in job candidates is the

ability to communicate effectively. Employers seek also the ability to collaborate, be a self-starter, demonstrate effective interpersonal skills, and possess analytical, synthesist, and evaluative abilities. Coursework in social sciences, like education, can sharpen these abilities (Gelhouse, 2007). Adjunct to this, NACE conducts a yearly skills survey of businesses to determine what skills are in demand for new and recent graduates. The *Job Outlook 2011 Survey* lists communication, work ethic, collaboration, and analytical proficiency as the most sought after skills; skills "employers see as critical in today's workplace," says NACE Executive Director Mackes (J. Bandini, 2011, para. 4).

Society has switched from an industrial/manufacturing basis to a service/innovation base, and factory jobs have been reduced and replaced by innovation; rapid rates of technological advancements have developed a need for workers who are able to repeatedly learn and adapt (National Research Center for Career and Technical Education, 2010). Workers require a strong foundation in what are now called *21st Century Skills* which stress the need for a strong academic foundation and employer-desired skills. Today's workplace "…places a premium on flexibility, critical thinking, problem-solving, teamwork, and the use of information. A consensus has emerged, as reflected in Perkins IV and *Reinventing the American High School for the 21st Century* (ACTE, 2006) that secondary Career and Technical Education (CTE) must assume part of the responsibility for providing such a foundation" (NRC CTE, 2010, pp. 4-5).

Ultimately the business community is looking to hire new workers who are proficient in analytical and higher order thinking skills, and colleges and universities are looking to instill those skills in their graduates. The National Center for Continuing

Education (NCCE) speculated that future workers will need to be sufficiently prepared in these thinking skills. The future will require competency in core curricular areas such as reading, communication, math and science, history, and arts and literature. The report of the New Commission on the Skills of the American Workforce suggested that the future will require proficiency with ideas and abstract concepts in order to get a good job, and creativity and innovation will be the key to the good life. Achieving high levels of education, most likely a new and different kind of education, will be the only security there is (National Center on Education and the Economy, 2007).

Facione, Sanchez, Facione, and Gainen (1995) suggested that our (North America's) enthusiasm to elevate HOTS/CT to a central outcome of formal education is shown in the goal statements, school and government policies, and accreditation criteria of higher education. Edwards (2004) added that developing, in students, an ability to think critically is a primary goal of liberal and professional educations.

Newcomb (1995, p.4 cited in Edwards, 2004, p. 228) posited that, "The need to have students graduate with the demonstrated capacity to think at the higher levels of Bloom's Taxonomy is more urgent than ever. The nature of the world we live in depends on it." This capacity is developed by teaching and learning higher order thinking skills. To prepare for the complexities and challenges of a technologically advanced society, agriculture faculty need to push their students to develop the HOTS/CT for problem solving and decision making (Torres & Cano, 1995; Miller & Pilcher, 2001). So, Edwards (2004) concluded, developing this intellectual capacity should be a priority for all teachers, including those in secondary agricultural education.

In *Transforming Agriculture: Education for a Changing World*, a section titled *The Desired Qualities of Graduates*, offers that graduates should be able to demonstrate HOTS/CT, follow a reasoned argument, employ and critique evidence-based arguments, and discern between scientific and non-scientific arguments. Graduates should also be able to formulate (in speech or writing) sequentially structured, logically determined, cogent, intricate ideas (National Academy of Sciences, 2009).

It seems clear that HOTS/CT skills are required in students for future success. Employers are looking for these attributes in potential new hires, and surely preference will be given to those individuals who demonstrate higher order thinking skills. Because employers are looking for these skills, colleges and universities are looking to develop these attributes in their graduates. It appears that the desire for these skills is widespread and represents most available employment opportunities. Students/future workers who are able to analyze, critique, assess and solve problems require less training from employers and are better able to adapt and thrive in changing workplace environments. If students do not possess these skills, their opportunities for future employment and success are hindered. "A focus on teaching critical thinking has been a unifying objective of Western education since Plato" (Gent, Johnston, Prosser, 1999, p. 517).

HOTS/CT Is A Goal Of All Higher Education Regardless of Delivery Method

Many suggest that the ability to think critically and perform higher level thinking skills is better preparation against change than any specific knowledge or skill set. Paul advised that as the world demonstrates an increasing pace of change and degree of

complexity, as it becomes more interdependent, HOTS/CT rises as a necessity for both economic and social success (Paul, 2009). HOTS/CT is a requirement. It is considered by Huitt (1998) as an attribute of utmost importance to attain success in the new (21st) century.

In this new century and its information era HOTS/CT is a necessary competency for processing through the abundance of new and often contradictory information. It is especially important in adult education which seeks to develop independence of thought, sound judgment, and autonomy of action for people as they navigate an increasingly complex social environment (Fellez and Conti, 1989 cited in Jones and Safrit, 1994). Kaasboll (1998), in a study identifying difficulties master's students had with their theses, found issues in defining research problems, examining methods, and evaluating literature and data; these are issues which require creativity and HOTS/CT for resolution. The information era has also provided the fertile ground from which online distance education has grown.

Jones and Safrit also suggested that distance education may be uniquely able to develop and grow HOTS/CT because of the interactive and collaborative nature of distance education (Jones & Safrit as cited in Miller & Pilcher, 2001). Well designed distance education creates opportunities for students to process course content in a variety of ways; asynchronous activities also allow students to access course content when they are most ready. Often the pacing of distance education discussions (asynchronous, at least) allows time for reflection which may lead to deeper understanding (Ellis & Goodyear, 2010). Online distance education (through both synchronous and

asynchronous discussions) could be poised as a useful tool in building critical thinking abilities (Ellis & Goodyear, 2010). These critical thinking abilities are identified as no less than a *requirement for survival* in the complex technology age.

Development Of Distance Education

Online education allows schedule flexibility, granting access to courses for students who are not necessarily full-time pupils including those with jobs and families (Allen & Seaman, 2007; Moore & Wilson, 2005). It also provides freedom from location constraints as many areas, especially small and/or rural locations, may not have the facilities or funds to offer the variety of classes needed by students today. Another benefit of online education is greater subject availability (Allen & Seaman, 2007). This is an advantage not only for non-traditional students, but even full-time, onsite students. When proximity is no longer paramount to learning, a student is free to pursue almost any of their interests, as well as their individual goals. Catering to the student's individual interests keeps their interest in learning active, creating life-long learners. If, however, students do not learn the higher order thinking skills necessary for job success, the advantages of online education are negated. Distance education must provide the same (or better) opportunities to develop and use these cognitive levels.

Distance education is generally defined by the fact that the instructor and the student are not in the same place. It is "planned learning that normally occurs in a different place from teaching and, as a result, requires special course design, special instructional techniques, special methods of communication by electronic and other

technology, as well as special organizational and administrational arrangements" (Moore & Kearsley, 2005, p. 2). Distance education (DE) began with the correspondence courses of the past. In the mid-1800s the postal systems in Europe and the United States were the 'new technology' being used to provide learning opportunities to those who could not participate in traditional schooling (California Distance Learning Project, n.d.). Then, as now, two groups that took advantage of correspondence courses were those who worked during the day and those who did not live near a school. By 1874 Illinois Wesleyan University was offering degree programs for off-campus students. The Chautauqua Movement and the Jessup Wagons of the later 1800s also provided educational opportunities to those who could not otherwise access them by traveling to the participants instead of making them travel to schools. The National University Extension Association in 1915 began accrediting higher education distance programs (California Distance Learning Project, n.d.).

Technology has changed the ways in which distance education is offered; what started with the penny post, and then utilized radio, television, and telephony systems now uses networked computers, video conferencing, the Internet and virtual reality to reach students regardless of constraints of time or location (California Distance Learning Project, n.d.).

Distance Education Is Growing

Distance education is growing; 25% of all students in higher education are taking at least one online course (Allen and Seaman, 2007, p.1). "The 17 percent growth rate

for online enrollments far exceeds the 1.2 percent growth of overall higher education student population" (Allen & Seaman, 2007, p.1). This growth was described as 'phenomenal' and 'unprecedented' by Black, Dawson and Priem (2008) and is demonstrated by these numbers: 3.2 million college/university level students taking at least one online course with 96% of the biggest institutions offering online courses (Allen & Seaman, 2007).

Online education is becoming increasingly popular in adult, higher, and secondary education programs. For many learners online education provides schedule flexibility, freedom from location constraints, and greater subject availability. For formal and informal educational institutions online education also provides a potentially substantial saving in tuition cost (Allen and Seaman, 2007).

Discussion As An Instructional Method

When humans gather, there are almost always communication exchanges; it is a normal and natural way for people to interact, to learn, to share and to understand one another and themselves. Arends (2004) noted that strong support of discussion methodology comes from the studies of linguistics, communication, patterns of exchange, and other language fields. This familiarity with the process is one reason discussion can be successful in classroom settings (Bender, 2003). Common, informal discussions are a natural and intuitive way to exchange ideas, express oneself, and process the world and its people. Appropriate planning, design and execution of this common exchange can serve as a gateway to sharing and developing more complex or abstract ideas,

demonstrating understanding and displaying cognitive processes (Lang, 2005). When students work together to decipher meaning or construct ideas through communication it is called social constructivism (Scardamalia & Bereiter, 1996; Vrasidas, 2000). Discussion is one of the best ways of demonstrating and sharing one's thoughts; Arends calls it the "externalization of thinking" (2004, p. 428).

Discussion "is an educative, reflective, and structured group conversation with [and among] students" (Wilen, 1991, p. 25), and is a popular teaching method/strategy used at one time or another in most classrooms with any subject and every age student. It is important to understand what discussion is, and what it is not. Discussion is ongoing, a back-and-forth exchange between student and teacher or among students. In discussions, thoughts, ideas and sometimes even feelings are shared; in quality discussions, there is space for working out a problem or developing a thought together. Discussions are usually less strict about absolute right and wrong answers and allow students to present ideas that are not yet fully formed. Discussion is not recitation. Recitation is a direct instruction method wherein the teacher asks a question and a student or two respond; it works best with fact-checking, assignment checking, and low-level understanding of ideas. Discussion is not solely a standalone method. Often there is a discussion element paired with other teaching methods (post-lecture demonstrations, role-playing, group work, etc.) that allows students to share and develop the ideas they or other students acquired during the previous lesson segment. Discussion is touted by many researchers as a way to engage students in investigating ideas and exploring problems and their

solutions; it also builds group decision making abilities and advance HOTS/CT (Wilen, 2004).

Arends (2004) stated that classroom discussion has three main purposes: improving student thinking/self-develop student understanding, encouraging student engagement and involvement, and growing communication abilities/developing thinking processes. Discussion can improve student thinking by allowing students to stretch their content knowledge by increasing and focusing the time spent talking about the content (Arends, 2004). Discussion also "gives students public opportunities to talk about and play with their own ideas and provides motivation to engage in discourse beyond the classroom" (pp. 425-426), which heightens student engagement. According to Arends, discussions can create a congenial setting wherein teachers, and other students, can help students clarify their thinking and interaction skills.

One purpose of discussion is review, to check that students are mastering content. The next step with review is to extend learning; use what students know as a foundation upon which to build additional knowledge and develop more complex ideas (Cruickshank, Bainer, & Metcalf, 1999). Well directed discussion may reach cognitive levels higher than processing. According to Cruickshank, Bainer, & Metcalf (1999), encouraging students to talk about the message and its effects may engage students in HOTS/CT; additional purposes for discussion include: opportunities for students to examine their ideas, scenarios to enable problem-solving, and time to work on communication skills.

Discussions involve students in their own learning (Davis, 1993). It serves as a way to practice thinking through problems, sorting concepts, and creating arguments and rebuttals. Students can use discussion as a public forum in which to test their thoughts and positions, assess others' arguments, and evaluate supporting and opposing evidence. Often discussions also expose students to a variety of viewpoints and responses. Davis goes on to note, "a good give-and-take-discussion can produce unmatched learning experiences as students articulate their ideas, respond to their classmates' points, and develop skills in evaluating the evidence for their own and others' positions" (1993, p. 63).

Discussion is considered a means of authentic assessment (Wilen, 2004). The idea of authentic assessment (or alternative assessment) comes from a growing constructivist movement and increasing interest in what are known as 'best practices.' The constructivist perspective proposes students are able to learn best when they themselves are actively building or constructing knowledge. They do this by forming connections between their existing knowledge and the new information. They are then able to process and apply the new knowledge in real-life situations where it becomes part of their repertoire.

Discussion is the means through which most people interact and communicate in their daily lives at work, at school at home; this familiarity means discussion meets the criteria for authentic assessment (Wilen, 2004). Students ask questions of each other in 'real-life,' so having them ask questions of each other in discussion is a valid and authentic approach. It also tends to reach higher levels of thinking as students respond to

each other's questions more completely, and in more complex ways, than they respond to instructor questions. (Hunkins, 1995, as cited in Wilen, 2004).

Questioning As A Key Component Of Discussion

A key component of quality discussion is questioning. Instructor questions should guide and focus the discussion, but be flexible enough to allow for appropriate tangents. Instructors need to take care that questions are not the type that allow for rapid-fire responses that devolve into class recitation. Questions are like fire-starters - the purpose is to entice and engage students into a thoughtful discussion, one that allows them to ask questions of each other and the class as a whole. Questions that can do this create the setting of social constructivism where students are able to share in meaning-making and more complex thinking (Wilen, 2004). In general, low level questions elicit low level responses and higher level questions are more likely to elicit higher level responses, however, the level of the question does not guarantee the level of response (Mills, Rice, Berliner, & Rousseau, 1980). Instructor's questions should not be exclusively rote memory/learning questions. However, not all questions need to be at higher cognitive levels to receive higher order thinking answers. Students can and will provide higher cognitive answers to lower cognitive questions and vice-versa. In general, varying the question levels is good for discussion and it is important to examine the specific audience and the purpose or intention of the lesson. Often, questions begin at a lower level and advance as the discussion progresses (Wilen, 2004). If the purpose is to achieve higher order thinking skills then questions of higher levels need to be asked,

though it should be noted that, even higher level questions are not a guarantee of high level responses. Mills, Rice, Berliner, and Rousseau (1980) found instructor questions and the student responses were of the same cognitive level only 51.3% of the time (p. 196). The percentage was a little greater when only examining lower order thinking questions and less at higher order questions.

Rowe (1974) has done much research on wait time and classroom discussion. In general, she found instructors did not give students enough time to answer, or fully answer, the questions posed. This is attributed to the fact that an instructor's fear/discomfort of silence causes him/her to provide answers or new questions too quickly. A common critique of in-class discussions is that the pace is often too rapid. Additionally if students learn that the teacher will provide the answer after only a few seconds of silence they are less motivated to answer themselves. Sufficient wait time is just as important in online synchronous discussion as it is in brick-and-mortar classrooms. Developing an appropriate answer, particularly one that involves HOTS/CT takes time. "Teachers cannot conduct a discussion at a quick pace because, with cognitive level questions, more time is necessary for students to understand the question, connect the content to past knowledge and experience, formulate a response and express it" (Wilen, 2004, p. 35).

Brualdi (1998) adds, "high-level-cognitive questions can be defined as questions that require students to use higher order thinking or reasoning skills. By using these skills, students do not remember only factual knowledge, they use their knowledge to problem solve, to analyze, and to evaluate" (p. 3). It is thought that these high-level

cognition questions are good indicators of whether a student truly comprehends a concept. This is because a deep understanding of the concept is required in order to appropriately answer questions at these higher-levels.

In lectures, students are listening to the content being delivered by the instructor, whereas in recitation students are repeating that content back to the instructor. Listening and repeating are a part of education, and have their place; however science shows these actions do not help students obtain that content for long-term retention or in a form that can be later built upon. Cognitive psychology research indicates that the depth to which content is processed affects our ability to remember that content. If listening and repeating are the techniques used the information is successfully stored, however, it is difficult to find or recall later (McKeachie & Svinicki, 2006). Instead, if the relationships between the new information and the familiar/previously stored information are identified or if the new information is discussed (explained, synthesized, evaluated), it is more likely to be remembered when needed (McKeachie & Svinicki, 2006). "Classic studies over the last five decades have repeatedly shown that, in discussion, students pay attention and think more actively" (McKeachie & Svinicki, 2006, p. 36). McKeachie, in advising college teachers, suggested that discussions often start best if started with a question. He argued that sometimes a *Factual Question* might be best; it allows a knowledge check and breaks the ice. More often, however, questions that elicit more complex answers fuel quality discussion and develop thinking skills. *Application and Interpretation Questions*, McKeachie and Svinicki (2006) offered, elicit comments about connections, relevance, and analysis. *Problem Questions* can start problem-solving

discussions, and appeal to students (especially adult learners) if the problem is 'real.' Questions that ask about connections, comparisons, evaluations, and critiques enable discussants to wrestle with more involved and deeper thinking (McKeachie & Svinicki, 2006).

The Socratic Method

The Socratic Method is recommended as a successful discussion technique (McKeachie & Svinicki, 2006; Polite & Adams, 1996; and Wilen, 2004). As with any instructional strategy implementation strongly affects success. The Socratic Method exemplified in many law school classes (and what the public identifies as this method) is an extreme interpretation that does not encourage deeper thinking and explorations of ideas and concepts (Wilen, 2004). McKeachie and Svinicki (2006) noted that strict adherence to the Socratic Method is not necessary to achieve the benefits of this technique in soliciting HOTS/CT. Polite and Adams (1996) described this methodology as instruction-through-questioning and suggested that it can be used for many different disciplines to enhance critical thinking. In their study involving middle school students, interviews of these students found that seminars which were conducted using Socratic Methods effectively enhanced at least two areas of student development, namely conflict resolution and higher order thinking. Students in middle school are, for the most part, just beginning to develop the intellectual capacity for HOTS/CT. Polite and Adams (1996) suggested that Socratic seminars are a straightforward way through which to feed and grow that capacity.

Discussion In Distance Education

Often online discussion is available within a learning management system or LMS. Systems such as WebCT, Blackboard, eCollege, Sakai, and others usually include sub-systems with a two-fold purpose of content presentation and facilitation of discussion (student-student and student-instructor) through interactive technologies Rovai (2006). Computer conferencing provides options for synchronous (chat), asynchronous (discussion boards), and other (e-mail, blogs, comments, etc.) formats through which online discussion and learner interactions may be conducted. Telecommunications technologies that enable this discourse are often referred to as Computer Mediated Communication (CMC). Just as brick and mortar classes create an environment for learners to combine content, social interaction and discussion, CMC provides opportunities for the same in online classes. As such, the identifying characteristic of constructivist learning environments online is social interaction; most often this interaction is manifested via online discussions (Rovai, 2006).

Arends (2004) noted that many instructors found discussions online work the same as face to face and sometimes even better. Both synchronous and asynchronous online discussions create interactions that may motivate students to talk about important topics after the class or to revisit the topic in the next class. This extends learning time beyond when class is in session and provides more opportunities for reflection and application to student-life situations. Teachers suggest that, overall, their students like online exchanges. Enjoyment of online discussion fosters engagement and increases in participation are often realized (Arends, 2004).

Synchronous online discussion provides an opportunity for students to interact with one another. Since participants are discussing topics and content in real time, each student is able to respond immediately which creates opportunities for comments that might change the direction or thoughts of another student (Arends, 2004). Synchronous discussions are dynamic and multi-faceted; their direction may vary with each new comment.

In asynchronous online discussions students are free to discuss topics more or in greater detail (Wilen, 2004). They can do so and instructors are not pressured to cut off a student who is monopolizing class time by wanting to talk more on; a particular topic or at a particular time. In asynchronous exchanges students do not feel pressured to respond as soon as a question is posed, allowing them time to think about how they wish to respond. Asynchronous online communication gives students considerable time to think about, formulate, draft, and even review their response. This eliminates the common complaint of class discussion (that it moves too quickly for higher-level thinking to have time to develop) (Arends, 1996). It could be that asynchronous online discussions allow more time, and therefore a greater opportunity, for students to develop a complete answer, specifically one that exhibits HOTS/CT.

The format that discussion takes often affects the difference in the total number of comments between synchronous and asynchronous discussion. Due to the nature of the two formats and the way students post comments; synchronous chats have more postings than asynchronous forums. In synchronous, or real-time, discussion the students were engaged in a more conversational style discussion with shorter comments, but more total

comments made. In the asynchronous discussion each instance of a comment is either the complete student response to the posed question or a section of the response in some instances.

Conceptual Framework

Critical And Higher Order Thinking Skills

Research about what critical thinking is, how it can be developed, and why it is important contributes to research posing the same questions about higher order thinking. Critical thinking has been a long held goal of formal public higher education; however, there are a myriad of definitions, contradictory research findings, and debate on how best to develop this very important quality.

Critical thinking research and debate is increasing in educational fields. As schools (at all levels) attempt to ready their students for life and work in an increasingly complex, and unknown future, skills such as critical thinking appear to best prepare graduates for change (Edwards, 2004). Increased study of critical thinking has expanded and multiplied the definitions and attempts to focus what critical thinking is and how it can be recognized (Whittington, 1995). Pascarella and Terenzini (1991) used an aggregate of other definitions and found critical thinking most often suggested ability in a variety of exercises including recognizing core components of an argument, identifying relationships, and then interpreting those elements correctly to realize appropriate conclusions from arguments. The abilities of evaluation and analysis are inherent in this definition.

Rudd (2007), in an article evaluating definitions of critical thinking and synthesizing many such definitions, offered, “Critical thinking is reasoned, purposive and reflective thinking used to make decisions, solve problems and master concepts” (p. 47). Inherent in that definition are the ideas of analysis (of reasons and of problems), synthesis (again in reflection and also concept mastery), and evaluation (in decision-making). Further, a teaching textbook explains critical thinking as a group of cognitive skills performing a higher order thinking activity (Burden and Byrd, 1994 as cited in Rudd, 2007).

Norris & Ennis (1989) explained critical thinking as reasonable and reflective thinking that informs decisions about beliefs or actions; although defining ‘reasonable thinking’ and ‘reflective thinking’ might just create more questions.

Critical thinking can be demonstrated in nearly every discipline and is also seen across disciplines. However, many researchers suggested that critical thinking is particularly needed within disciplines. Because critical thinking relies on analysis and evaluation of one’s own experiences Glaser suggested critical thinkers possess “an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences” (1941, p. 5-6).

A Delphi consensus definition provided by Facione (1990) suggested that critical thinking involves many considerations upon which to base a judgment (evidence, concepts, methods, criteria, and context) and identifies critical thinking as a key component of inquiry. This involved definition claims critical thinking is a powerful resource in life and an emancipating force for education. This description covers a lot of

territory, and may be too convoluted to be used to identify instances of critical thinking. However, Facione (1990) determined the foundational critical thinking skills are interpretation, analysis, evaluation, inference, explanation, and self-regulation. The overlap between critical thinking and higher order thinking is demonstrated in the breakdown of these critical thinking skills. Facione (1990) posited that for critical thinking skills to be successfully exercised in a variety of subjects or disciplines content specific knowledge is required. Dunne and Morgan (1995) agreed, suggesting that critical thinking should be cultivated through engagement with different knowledge areas; and that it is not merely a skill to be taught in isolation. Real-world issues, topics, and problems situated in a variety of settings can elicit thinking that has shades of meaning and relevance that truly meet the definition of critical thinking.

Rudd, Baker, & Hoover (2000) reviewed the Facione (1990) studies and generated this definition: "Critical thinking is a reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information and for which an incontrovertible solution is unlikely" (p. 5).

Teachers are starting to think about their subject matter content not as the focus, but rather as important information that can also serve to channel critical and creative thinking. The content gives learners something to think about, but cognitive instruction provides the how and offers opportunities for thoughtful engagement (Fogarty & McTighe, 1993).

A successful education should be more than solely information transfer. That information is more powerful when students can take (remember) previously learned

information and combine it with new, “that is interrelate or rearrange the information- to achieve a purpose such as to solve a problem, analyze an argument, negotiate issues, or make a prediction. This is higher-order thinking” (Underbakke, Borg, Peterson, 1993, p. 138). To do this, it is not necessary to separate the content from the teaching of higher order thinking skills, rather these skills become the processes or operations that make content meaningful and useful. Higher order thinking offers ways of dealing with content; effective thinking is learning more ways to deal with information (Underbakke, Borg, Peterson, 1993).

The movement and growth of a ‘thinking curriculum’ has been ongoing for several decades, and in that time many attempts have been made to delineate and quantify what promotes students’ thinking skills. There have also been many attempts to define thinking, Miri, David, and Uri (2007) say, “Some use the phrase ‘cognitive skills’ (Leou et al., 2006; Zoller, 2001) and others refer to ‘thinking skills’ (Resnick, 1987; Zohar & Dori, 2003), but they all distinguish between higher- and lower-order skills” (p. 355). There are still many differing views, definitions, and approaches to teaching HOTS/CT, and because there are so many differing interpretations it is clear there is not a ‘unified field theory’ of cognition and thinking (Fogarty & McTighe, 1993). In 1956, Bloom, Engelhart, Furst, Hill and Krathwohl developed a categorization for levels of cognition known as Bloom’s Taxonomy. Higher order thinking refers to the upper three levels (analysis, synthesis, and evaluation) of Bloom’s Taxonomy (Edwards, 2004). Berge and Muilenburg (2000) referred to a thought hierarchy which has constructivist thinking as its peak. The thought stages leading to the final stage include critical thinking, higher-level

thinking and distributive thinking. Resnick (1987) suggested as a working definition of Higher Order Thinking Skills: non-algorithmic, systemic, complex, and possessing a degree of uncertainty. However, Bloom's levels of analysis, synthesis, and evaluation are regarded as higher order.

The interrelatedness of critical thinking and higher order thinking suggests that teaching, learning, and research about one can shed light on teaching, learning, and research of the other.

Bloom's Taxonomy

Bloom's Taxonomy of Cognitive Objectives is considered a foundational work in the categorization and description for levels of cognition. Bloom, Engleheart, Furst, and Krathwohl (1956) developed the Taxonomy of Education Objectives: The Cognitive Domain as the first of three (intended) works describing the educational behaviors of students. Each was intended to help categorize the behaviors and assist in the writing of educational objectives. McKeachie and Svinicki (2006) described the taxonomy as a "popular framework to improve an instructor's ability to teach thinking, regardless of the discipline" (p. 320). *The Cognitive Domain* sought to divide and arrange thinking skills by the level of erudition. Based on complexity, some skills were considered lower order and others (also requiring more effort) higher order (McKeachie & Svinicki, 2006).

Bloom and his colleagues suggested the taxonomy be used as a guide in course design. Objectives and instruction based on the taxonomy would be more consistent and students would better understand assignments and course goals, all of which would boost

student performance (McKeachie & Svinicki, 2006). Ewing and Whittington (2009) interpreted (from Bloom) that the taxonomy is appropriate for cognitive behaviors in a myriad of classes and at varying levels of educational instruction.

"Teachers are beginning to realize that their subject matter content is not the focus but the vehicle that carries the skills of critical and creative thinking" (Fogarty & McTighe, 1993, p. 161). The content provides something to think about, but the cognitive instruction provides the ways to engage students in dealing with that content in a thoughtful manner (or to meaningfully use content knowledge). Fogarty and McTighe (1993) suggested frameworks (like Bloom's and others) could assist teachers in increasing their confidence and competence in teaching thinking. Utilizing such taxonomy throughout course design and implementation is important. Although Fogarty and McTinghe name Bloom as one of the available frameworks, they conclude – "Nevertheless, a theoretical base is important since it provides a conceptual foundation for grounding such practices (p.167).

Purpose Of Research

This exploratory study compared the instances of higher order thinking skills in synchronous and asynchronous online discussion in a graduate level course. It also described the distribution of comments in online discussion according to Bloom's Taxonomy level.

Research Questions

These research questions were used to address the problem and guide the study:

1. How often is each of the cognitive levels of Bloom's Taxonomy demonstrated in synchronous and asynchronous online class discussion?
2. What is the weighted cognitive level score of student comments made in each synchronous and asynchronous online class discussion?
3. What is the overall weighted cognitive level score of discussion demonstrated in synchronous and asynchronous online class discussion?

Research Hypothesis

Stated in the null form for statistical analysis, the following hypothesis was tested at the .10 level of significance: HO_1: There is no significant difference in the overall mean cognitive level between synchronous and asynchronous online discussion.

Assumptions Of The Study

The introduction of new educational delivery methods assumes a degree of willingness on the part of the learner to cooperate. It is also assumed that the instructor appropriately and willingly executed the technologies, experiments and demonstrations to the best of his/her ability and that the students also willingly participated to the best of their ability. Furthermore it is assumed that students who are enrolled in graduate level classes have the experience and requisite cognitive ability to be capable of the core skills at each level of Bloom's Taxonomy.

Limitations Of The Study

The primary limitation of the study is that it is only generalizable to this specific subject and for this population. Technical problems are not uncommon in distance education; some students reported Internet connection difficulties. There were no reports of ongoing or long term inability to maintain an Internet connection; however any interruption in service connection may have limited the discussion comments from students. Another limitation is that the structure of the discussion events may not accurately reflect typical online education. While an advantage to online education is schedule flexibility, there are often specific dates and time-required participations like exams, discussions, conference calls, etc. The effect of this restriction should be minimal.

Definitions of Terms

Asynchronous Online Discussion: Discussants are not participating simultaneously. Most often learners submit discussion posts to an online learning management system where other class members can view and comment on one another's posts.

Brick and Mortar: Classes held at a physical location, NOT online or distance classes.

Computer-Based Instruction or Computer-Mediated Instruction (CMI): Instruction that utilizes a computer to deliver teaching and training, usually through the Internet. Materials including tutorials, simulations, and exercises are accessible via the computer.

Computer-Mediated Communication (CMC): Learner communication via two or more networked computers. Synchronous, asynchronous, and static communication are all

types of CMC.

Learning Management System (LMS): is an online framework and information system that provides the structure and logistics for most instructor-led online learning. LMS provide a centralized access to content, instruction, feedback, grading, and student interaction.

Moodle: Is a popular LMS utilized by NC State and many other universities, community colleges, high schools, etc.. Moodle is characterized as progressive because it is open-source and modifiable and can provide active learning opportunities.

(Moodle) Chat: The chat module within Moodle is used to enable synchronous discussion. Moodle chat is similar to messaging, but can accommodate multiple people. Moodle chat can create a record (transcript) of all postings made during the chat session.

(Moodle) Forum: The module in Moodle that serves as a discussion board and allows students to respond to questions and offer comments and postings from the instructor and other students. Posts usually are submitted within a window of time, but are then visible to others for days, weeks, or longer. The Moodle forum allows comments to follow a subject (used most often) or chronological or personnel thread.

Synchronous Online Discussion: Discussion that occurs in real-time. Most often synchronous discussion uses a chat or instant messaging format.

Threads: The layout of discussion posts as viewable on the screen. Threads may be sorted chronologically, topically, or by author.

WebCT / Blackboard / Moodle / Sakai / eCollege: An online classroom management system that provides an accessible online location for class content, discussion and grading.

Summary

Employers and educators are looking for students to gain and advance HOTS/CT skills and competencies in higher education. Within the environment of higher education distance education is growing both in numbers of participants and advancements in delivery. Discussion is a successful method of building HOTS/CT. Online discussion presents questioning and dialogue opportunities to develop analytical skills.

Wilen (2004) advised using discussion (whole-class, small-group, dyads, etc.) as a way to encourage the social construction of knowledge. Discussions facilitate learning in natural settings by realistic tasks. It is important to note that for students who have enrolled in online classes, discussion online *is* the natural setting, whether through learning management software sites, conferencing technology, or computer mediated communication. Additionally class discussions that are appropriate for graduate students (adult learners) should focus on topics important to those learners. Problem-solving, case studies, and current events that impact adult learners should all resonate as authentic tasks via class discussion.

Critical thinking and higher order thinking both define complex cognitive thought. The interrelatedness of critical thinking and higher order thinking suggests that teaching, learning, and research about one can shed light on teaching, learning, and

research of the other. Course content provides something to think about, but the cognitive instruction provides the ways to engage students in dealing with that content in a thoughtful manner. HOTS/CT skills allow students to use previously and newly learned information "to achieve a purpose such as to solve a problem, analyze an argument, negotiate issues, or make a prediction" (Underbakke, Borg, Peterson, 2004, p. 138).

Chapter II: Review of the Literature

Theoretical Framework - Social Constructivism

The theoretical framework for this study is built upon Piaget's concept of constructivism, which forms the basis for social constructivism as described by Vygotsky and Bruner (Bruner 1996). "Constructivists, such as Dewey (1916), Vygotsky (1978), and Bruner (1996), view knowledge as constructed by learners through social interaction with others" (Huang, 2002, p. 28). These frameworks are further focused when Kolb (1984) discussed social constructivism for learning, and finally a specific framework of social constructivism for teaching and learning as demonstrated by Scardamalia & Bereiter (1996). The connections between constructivism and social constructivism are close and strong. For many, these ideas are two sides of the same coin. Cobb (1994) suggested the ideas are inseparable. Using mathematics as an example, a constructivist approach teaches the individual content while the social constructivist identifies the acceptable practices within the mathematical society or context. For distance education Vrasidas (2000) used both constructivist and social constructivist lenses and argues knowledge has both an individual and a shared component. For even shared knowledge to have meaning it must be processed in each individual's mind and must be relatable to each individual's experiences.

Constructivist thinking is "constructing knowledge from personal experiences" (Bender, 2003, p.17). Using personal experiences as a link for learning is a hallmark of Andragogy (Knowles, Holton, & Swanson, 2005). Knowles, et al. (2005) identified the life experiences of adult learners as a touchstone that must be included and used as a

reference for all subsequent adult learning. Good discussion provides opportunities for learners to share their experiences and connect them to their current learning. This concept of cognitive scaffolding supports the development of more complex (higher order) thinking through interaction.

Using constructivism, educators attempt to develop environments which enable learners to study the processes and steps of thinking and learning. Successful meaning construction requires an individual to gather and notate the appropriate knowledge and information; they must then analyze the data and from it, deduce a reasonable hypothesis, and then test it. After all this, the results must be analyzed, incorporated with previous results and knowledge and then applied to a real situation (Crotty, 1995). The constructivist idea is that learning is not listening and then repeating the stated view of the situation, but instead joining in and interfacing with the surrounding environmental components. Participation helps create an individualized view of the situation. Constructivists involve participants in order to establish knowledge that is not static, but usable and adaptable in various situations.

The intent of constructivism is not necessarily focused on predicting learning from specific instructional events, but rather "to discover and to describe formally the meanings that human beings create out of their encounters with the world, and then to propose hypotheses about what meaning-making processes were implicated" (Bruner 1996, p.2).

The overarching goal is to empower students in the task of ‘meaning making.’ Meaning making requires communication and contemplation of what we know and what

we are being exposed to. Communication and contemplation occur in both external (social) and internal (reflective) settings. Learners must deliberate, ruminate, and consider many possibilities in order to determine what they think is correct. Then learners must also perform those same actions and decide *together* what the correct meanings are and what the ideas or events represent. They work together to solve problems. Experiential knowledge is the use or application of that meaning within a real-world scenario. Our interactions with the world serve to form both our experiential and reflective knowledge. Because of this constructivism strongly supports using learning activities in real-world situations.

The key perspective of social constructivism is a focus on combining the role of the individual and the role of the group in meaning making, in the 'co-construction of knowledge' (Palinscar, 1998). Social constructivism moves knowledge construction from the exclusive realm of the individual and places it in a societal context. What happens when this is done is anything but straightforward. The opportunities for developing additional and higher thinking skills grows exponentially. If knowledge construction is an idea bouncing around in someone's head that is enriched every time it comes into contact with another idea or evaluation in that person's head, then the socio-construction of knowledge is enriched and magnified by the multiple contacts with many ideas, evaluations, and criterion references encountered by multiple people. It has been suggested by many that there is a great increase in the opportunity and therefore the role of social interaction in meaning making. Technological advancements have enabled social connections to be available whenever and nearly wherever. Distance education

classes provide opportunities for learning focused social interaction to be available to almost every student when and where it is convenient for that student, this may be a 'socio-cultural revolution' (Palinscar, 1998).

Palinscar explores this phenomenon further by examining the relationship between the quality of interaction and nature of learning. Traditionally formal education has been rooted in direct instruction; the teacher gives the knowledge to the student who receives it as is. While direct instruction is well-suited to delivering factual content, there is little to indicate that this method provides a conduit for developing HOTS/CT (Palinscar, 1998). So to develop higher order thinking skills interaction is necessary. Integral to conceptual development is incorporation of the social dynamic and of the activities of culture such as language, symbols, and recognized and shared elements (Palinscar, 1998). It is important to note that what is required is co-collaboration; the individual cannot absorb the knowledge offered in social constructs ignorantly with any more success than absorbing direct instruction of advanced ideas and critical thinking. The individual must be invested, ideally constantly referencing their thoughts against the thoughts of others. "Explaining one's thinking to another leads to deeper cognitive processing" (Palinscar, 1998, p.349).

Social constructivism adds the important layer of meaning-making taking place in real situations. Real situations almost always include other people. Interaction with those other people plays an important role in meaning-making and therefore in teaching and learning. For many, including Dewey and Vygotsky, interaction is a crucial component within the learning experience (Vrasidas, 2000). For Dewey, that interaction

was between the individual and his experience, his environment (which in most learning scenarios is an environment with a social component). The connection between knowledge and experience is a fertile ground for HOTS/CT; judgment (decision-making) is the result of knowledge and experience combined and applied in practical settings (Lipman, 1991). Lipman took the connections a step further by identifying wisdom as a component of good judgment which is in turn a component of HOTS/CT. The application to practice is in the experience and judgments within practice develop criteria and there is a connection between criteria and HOTS/CT. This leads to the conclusion that HOTS/CT is grounded, ordered, supported and reinforced thinking (Lipman, 1991).

For Vygotsky social interaction was integral to learning (and psychological development) within constructivism. The ability to develop and maintain multiple viewpoints in a variety of settings is a key factor in HOTS/CT (Vrasidas 2000). Beyer, after a meta-analysis of the literature identifying and defining critical thinking, developed a list of 10 crucial skills. Contained in that list are the skills of: "Distinguishing relevant from irrelevant information, claims, and reasons (#2): "Identifying unstated assumptions (#6); and "Determining the strength of an argument or claim" (#10) (Beyer, 1987, p. 187).

In 1978 Vygotsky introduced a concept he labeled the Zone of Proximal Development (ZPD). The ZPD stressed the important relationship between social interaction and psychological development. Cole (1985) described the ZPD as the intersection of culture and cognition. This zone is the gap between individual learning and social learning. Vrasidas (2000) offered Vygotsky's explanation of this gap zone as

the difference between isolated reasoning and learning and the reason and learning produced cooperatively with more capable peers. A class of students provides a multitude of experiences and expertise for supplying and sharing the role of more capable peer. According to Vrasidas a student moves to a higher developmental level when interacting with students of that level.

Therefore social learning situations that enable interactions from students on many levels, regarding a variety of topics in multiple points of view should provide the necessary elements for higher order and critical thinking to blossom. Online discussion groups students of different abilities with different experiences together to discuss and examine topics and issues from multiple perspectives using multiple criteria. If these discussions are synchronous, students are able to interact with one another in real-time, which may heighten the interaction and fortify cooperative meaning making. If these online discussions are asynchronous, a crucial time element is added that provides opportunity to think about, process, and reflect on the discussion. This time for reflection is also paramount to accessing higher order thinking skills. For Piaget reflection helped create higher order knowledge by allowing the resolution of components of lower-level knowledge. This process is often worked out through discourse between student and teacher. Social constructivism paves the way for this resolution to be found in the dialectic of online discussion.

Literature Review

This review of literature begins with a broad look at instructional methods that have shown success at developing HOTS/CT. The review explores specifically the use of discussion to engage students in HOTS/CT. The current literature for both synchronous and asynchronous delivery modes includes studies of strategies and relevant elements of distance education. The theoretical framework for this study emphasizes the role of interaction and social aspects in HOTS/CT creation. This is a growing field and applicable studies of this element of online discussion are included in this literature review. Exploring the cognitive levels of teaching and instruction can play a role in improving student learning. Consequently, most of the literature regarding assessment of cognitive levels presented in learning situations focus on the instructors' output (discourse, expectations, testing, etc.). Several of these studies are included to demonstrate the accepted process of coding cognitive behavior, to show the expressed levels of cognitive behavior by instructors, and to reveal the primary focus of educational cognitive behavior research to date. Research regarding student's cognitive behavior is sparse, but a few key studies provide some foundation upon which to build.

Instructional Methods used to Develop HOTS/CT

Case studies are an effective means to introduce 'real-world' situations in courses. Case studies can be explored individually or collaboratively. Lee (2007) compared asynchronous computer-mediated collaborative case study with individual case study and found both deliveries were successful. Using a non-equivalent control groups research

design and a pretest posttest method, significant increases in HOTS/CT was shown by both groups (a total of 83 participants). There was, however, no difference reported between the two deliveries (the methodology indicates that both groups may have actually utilized collaboration). Case study appears to be a worthwhile method of developing HOTS/CT. The researchers offered that one reason case studies were successful was, "relevant and interesting case studies motivated the students and initiated the analytical cognitive processes" (Lee, 2007, p.90). Williams and Williams (2000) examined the use of web-based case study presentations for pre-service teachers. Opportunities for and increases in HOTS/CT were found. Additionally, "Students were very positive about the instructional value and aid to retention…Through the web, they could spend as much time as needed in thinking through the scenario and their recommended solutions to the case" (Williams & Williams, 2000, p. 163-4).

Zinsser described writing as "thinking on paper," (1998, p. 147). Regardless of delivery mode, writing improves HOTS/CT (Marzano, 1993; Resnick, 1987). Quitadamo and Kurtz (2007) explained that historically writing has been thought to improve thinking because the writer must analyze and evaluate to determine what arguments to make, and s/he must often synthesize counter arguments, contributing research, or past experiences. When comparing a writing component to a quiz component in a biology lab, the researchers found that students who completed the writing assignments had statistically significant higher scores on a standardized thinking skills post-test (Quitadamo and Kurtz, 2007).

When transferring a brick and mortar course to the online environment the interaction between and among students that took place verbally now takes place through writing. The reliance upon writing as a means of processing and growing HOTS/CT means students need to be able to write, and write well. One advantage of this transition is that as writing becomes a significant component of the class; it provides students with opportunities and incentive (grades, communication, expectations, etc.) to practice and improve their writing (Breach, 2005). Unfortunately good writing may not be the norm; even at the graduate student level, comfort and proficiency at writing is not a mastered skill. A writing proficiency test, designed by The Writing Programs office at Texas A&M and distributed to 44 graduate students (both on campus and online at three cooperating universities) was used to explore writing competency. Students were instructed in advance that they would be writing essays and were given two content articles and APA information the week before testing. Students were also provided with detailed instructions, APA guidelines, and copies of the articles (if needed) at the time of testing. The Writing Programs office evaluated the essays using the writing criteria of; argument, coherence, grammar, summary, audience awareness, and sources (Murphy, Lindner, Kellsey, & Wingenbach, 2005). In this study evaluating writing of agricultural education graduate students, the researchers found that over 90% of sampled graduate students did not demonstrate writing proficiency. The National Commission on Writing found that large, successful corporations were fairly dissatisfied with the writing skills of recent graduates. "Since up to one-third of the employees in these blue-chip corporations do not possess adequate writing skills, writing deficiencies may be even more

pronounced elsewhere in the broader private sector, particularly among employees of small- and medium sized businesses" (National Commission on Writing, 2004, p.14).

Academic opportunities to practice and apply theories are heavy contributors to developing higher order thinking skills, and more are needed. Boyd and Murphrey (2002) thought choosing better instructional methods may address the lack of options. They suggested that multimedia can offer models that utilize video, sound and animation (appealing to a variety of learning modalities) and convey complex concepts. Animation (according to Dooley, Stuessy & Magill, 2000 cited in Boyd & Murphrey, 2002) provided linkages between concrete and abstract elements and metacognitive scaffolding. Those provisions helped students explore and reach higher levels of cognition. Examining for the effect of learning modality preference revealed no statistically significant difference, so the computer simulation appeared to have an effect on all types of students. Results showed that students who did participate in the computer simulation activity scored higher on examination questions than those who did not participate (85% to 76%, significant at the $p<.05$ level). The questions from that exam were then divided into the levels of Bloom's Taxonomy and student responses were tallied. Those in the treatment group (receiving the computer simulation) scored higher on questions at the knowledge, comprehension, and analysis level (Boyd & Murphrey, 2002). The researchers concluded, "Instructors who seek to improve students' understanding of abstract concepts [a key component of higher order thinking] should consider using computer-based simulations that emulate the working environment" (Boyd & Murphrey, 2002, p. 43).

Miller and Pilcher (2001) also examined the cognitive levels expressed by instructors using the Florida Taxonomy of Cognitive Behavior (FTCB). Their research design involved courses using a two-way audio video system versus brick and mortar classes versus videotaped classes. Evaluation of the FTCB results showed overall both instructor's *desired* cognitive level of discourse and their *demonstrated* level of discourse was equivalent for on-campus versus off-campus sections. The researchers concluded that, "instructors teach to the same levels of cognition in on- and off-campus courses" (Miller & Pilcher, 2001, p.26). The overall assessed levels were found to focus heavily at the knowledge stage (45.1%) and another 51.6% of instruction focused on what the researchers labeled 'Processing,' a combination of Bloom's comprehension, application and analysis levels. Less than five percent of instruction was at the highest two levels (3.1% at analysis and 0.1% at evaluation). Professors expressed their desired levels for on-campus sections as 33.1% remembering, 30.0% processing, 19.2% creating and 17.7% evaluating; desired levels for off-campus sections were 31.2% remembering, 30.8% processing, 20.0% creating, and 18.1% evaluating (Miller & Pilcher, 2001).

Research on the interplay of teaching methods and learning styles is abundant. Since certain teaching methods or strategies may work best with various learning styles, modalities or preferences, it is wise to explore also what role these styles may have on the development and learning of certain skills and qualities such as HOTS/CT. While research on the influence of learning preferences is interesting, it is important to note that classes contain a variety or learners with a variety of preferences and those instructors cannot select students based on learning pre-disposition. Instead, research in the area of

the impact of learning styles is helpful as a guide for instructional design and teaching. Using the Gregorc Style Delineator, Myers and Dyer (2006) found that students who were strongly associated with the Abstract Sequential learning style performed significantly better on tests of higher critical thinking skills, while the other three styles performed similarly to each other. They found that only about one-third of their population identified with the abstract sequential learning style, but a majority identified as concrete sequential. This matched findings in other studies (Cano & Garton, 1994; Rudd et al., 2000; Witkin, et al., 1971 as cited in Myers & Dyer 2006). Knowing that certain students may more 'naturally' engage in HOTS/CT should encourage teachers to focus class time on tactics that assist those who might not find HOTS/CT development as comfortable. As Myers and Dyer suggested, teachers need not spend as much time using the techniques most favored by abstract sequential learners when teaching HOTS/CT. They did not find, nor do they suggest, that students with other learning style preferences cannot acquire and cultivate HOTS/CT.

Higher order thinking skills can be incorporated into almost any lesson or curriculum. The research reported here demonstrates that there is no consensus as to which teaching methodologies or strategies are best suited to foster the growth of HOTS/CT.

Discussion as a Means of Developing HOTS/CT

Discussion and questioning are repeatedly cited as providing opportunities for students to develop and refine HOTS/CT. Explorations of questioning tactics begin with

a discussion of the Socratic Method, which has demonstrated much success in helping students to think in a questioning and analytical manner (Polite & Adams, 1996; Parkinson & Ekachai, 2002; Paraskevas & Wickens, 2003). In teacher interviews, Polite and Adams (1996) found that teachers concentrating on cognition and metacognition thought Socratic Seminars was a useful tool for building HOTS/CT. In the same study, student interviews showed that students thought the seminars aided HOTS/CT and conflict resolution and half of the students felt more compelled to significantly participate in discussion (Polite & Adams, 1996). In a mixed-methods designed study of students in an introductory public relations class Parkinson and Ekachi (2002) found students reported more occasions to use and practice HOTS/CT in Socratic type seminars. A comparison of pretest and posttest scores found both groups (Socratic vs. lecture) equally retained factual course knowledge. The students involved in the Socratic group reported more occasions to exercise critical thinking skills and more opportunities to develop problem-solving abilities. The Socratic group participated in follow up focus groups and overall expressed enjoyment of the Socratic Method (Parkinson & Ekachi 2002).

One aspect of discussion is the interplay between student and facilitator. In some cases instructors primarily posed the opening question(s) and established the ground rules. This allows for students to work together to build dialogue and debate answers, challenges, and follow-up questions. Others, particularly with young students or more novice online discussants, tend to stay involved and attempt to steer the discussion. Instructors in one study (Gerber, Scott, Clements, & Sarama, 2005) challenged students' discussion comments and compelled responses. The sample was graduate students in an

educational standards class delivered online. These students participated in online discussion (40% of their grade) throughout the semester and those discussion transcripts were reviewed by the researchers. Each discussion consisted of two higher order topics and two lower order topics (Gerber, et al., 2005). The instructors responses to posts were either challenging (looking for evidence, disagreeing, contradicting, etc. but supportive) or non-challenging (supportive, informative, and encouraging). Exhibitions of challenging behavior appeared to increase some aspects of HOTS/CT in the student responses. It also increased demonstrations of reasoning, but only in low-level posts (Gerber, Scott, Clements, & Sarama, 2005).

Different levels of instructor facilitation may influence learner discussions. Often an instructor responds too much and through their positional authority all discussion becomes directed at them, reducing student interaction with one another even when students were required to respond to one another (An, Shin, & Lim, 2009). An, Shin, and Lim used social networking analysis, content analysis, and the quantitative statistic ANOVA to study if the amount of facilitator input impacted student interaction. When the instructor comments were minimal the student comments were directed to each other and expressed thoughts and comments more freely and heightened the level of social presence (An, Shin, & Lim, 2009). It seems a minimum amount (though not zero) of facilitator comments maximizes student comments and interaction with one another.

As higher order thinking skills and critical thinking skills are often seen as interwoven and connected, it follows that intentionally teaching one might increase abilities in the other. Miri, David, & Uri (2007) set out to determine if attempting to

purposely teach HOTS increased the critical thinking skills of students. Using an experimental design the researchers had a control group utilizing traditional teaching strategies and an experimental group that was purposefully exposed to strategies designed to develop higher order thinking. Miri, David, and Uri's analysis of pre, post, and post-post critical thinking assessments showed teaching for higher order thinking increased critical thinking. The strategies teachers found most helpful and used most successfully to elicit these skills were fostering discussions that were open-ended, utilizing 'real-world' examples and problems in class, and promoting inquiry learning experiments through group work (Miri, David, & Uri, 2007).

Fogarty and McTighe (1993) suggest three main approaches to developing HOTS/CT in students (and teachers); these are applying thinking skills and processes, utilizing cooperative learning strategies, and encouraging continuous reflection. They argue that applying thinking skills and processes when encountering content helps students extend and enhance their knowledge (Fogarty & McTighe, 1993). Miri, David, and Uri (2007) tested the success of overtly teaching higher order thinking skills to see if increases in critical thinking skills were seen. As expected, specifically teaching HOTS did increase CT post-test scores. Fogarty & McTighe (1993) contend that, "Research and experience show that cooperative learning enhances thinking processes" (p. 162). Johnson & Johnson (1985) offer that cooperative learning methods promote more learning and more thinking because collaboration engages learners in an interactive approach to processing information. Cooperative learning results in increased subject matter retention and a more positive attitude toward learning. It also, promotes group

member relations and additional chances for 'higher order' processing (Johnson, Johnson, Holubec, 1994). Lastly, Fogarty & McTighe (1993) stress that developing reflection skills in students should be a foundational goal for teachers of thinking. Farmer, Yue, and Brooks (2008) utilized blogs to increase incidences of HOTS/CT; they claim blogs provided opportunities for reflection.

Distance Education Instructional Strategies

Blogs often have reflection as their purpose and asynchronous delivery is the norm for this method of student writing. Farmer, Yue, and Brooks (2008) explored the role of Blogs in developing HOTS/CT. The blogs were evaluated quantitatively via frequencies of use and questionnaires (three occasions), and qualitatively through content analysis. Farmer, Yue, and Brooks offered that blogs provided opportunities for deeper continuous learning and reflection. "Student-student interaction was a goal of the blogging exercise. Commenting on other people's entries was a requirement for assessment" (p.128). However, it does not appear as though the opportunity for reflection necessarily results in demonstrated HOTS/CT. In a qualitative analysis of blogs from several educational levels, Ramos (2010) suggested that evidence of HOTS/CT, "can be found in two contexts: as a reaction to a direct challenge, proposed as a comment by a visitor; or as an answer to the tasks oriented to this type of thinking proposed by the teacher" (p. 20). It may be concluded that it is the interaction between student and responder that prompts the responses demonstrating HOTS/CT. Student's written assignments receive evaluation and feedback from instructors. Goodrich (2008)

sought to determine if increasing the feedback increased the success of those assignments. In this study students were instructed to generate written assignments regarding the effects of stress on disease; the assignments were supposed to contain analysis of the content information and criticism of results and conclusions. Goodrich (2008) found that using grading software (Waypoint) that increased his ability to provide rich feedback to asynchronous student writing assignments resulted in those students showing significant improvement (via assignment and exam scores) in the analysis and criticism aspects of writing, and those increases were seen throughout the semester.

Community and Social Presence in Online Discussion

The translation of a brick and mortar class to an online one is not just a matter of uploading content, assignments and assessments. It is important that online delivery be seen as its own environment, one that requires its own pedagogical (and andragogical) schema. As with traditional instructional design, the audience and the objectives should dictate online instructional design choices.

Curtis sought to explore the benefits of small group asynchronous online discussions in his education graduate class. Using a qualitative approach and a content analysis method with guiding questions for both latent and manifest content, Curtis explored these small group discussions (of 11 graduate students) to seek answers to guiding questions about levels of interaction, and its effect on meaningful learning and group problem solving. For many instructors, and arguably most students, the interaction provided by other class members is a vital element in the learning process. This interaction provides a social element with enjoyment, comfort, solidarity, competition,

and (as social constructivism touts) deep learning potential (Curtis, 2004). Many successful online instructors recognize the strong positive influence these social elements provide and specifically incorporate interaction opportunities. Curtis (2004) points out that the most pure interaction is provided by synchronous engagement as found in discussions, chat, and conferencing. Incorporating this social component as a supplement to content focused asynchronous discussions helped combat feelings of isolation and develops community (Curtis, 2004). Additionally chances to interact in real time encourage and enable cooperative and collaborative learning (whether specific group work was assigned or not). Analysis of actual comments made in synchronous chat showed many instances of students relying on each another to understand not only the logistics of the class, but also the content. Chats were intended and demonstrated "opportunities for students to better understand the material by hearing others' interpretations while sharing their own" (Curtis, 2004, p.143).

Brown examined how online community is formed in adult education classes. To do so a grounded theory analysis was performed that "incorporated archived class input as well as interviews with twenty-one students and three faculty members from three graduate-level distance education classes (2001, p.19). Community exists in asynchronous classes despite the isolation of students working online at different days and times. Brown (2001) suggested that isolation is overcome as students support each other as a community of learners. She specifies that, "The process of forming a community of learners is an important issue in distance learning because it can affect student satisfaction, retention and learning" (p. 18). Brown (2001) found community to

be defined by the participants as requiring that the members had something in common; it could be goals, hobbies, outlook, etc. The second theme was from their descriptions of 'learning community' participants felt ownership not only for their own learning, but some responsibility for the other group members' learning as well. She also found a development of community following stages of increasing familiarity and some interdependence; this grew with time and interactions.

Brown (2001) offered several propositions about the formation and development of community. First, community was not coincidence, but depended on students wanting it. Community was also not a guarantee for all students, but was tied to levels of engagement. Specifically, the more students interacted beyond class requirements the greater the feeling of community. Finally, the content of student posts, timeliness of postings, and positive and useful comments on student postings were all factors in building online community.

For many years, researchers of online learning and other educational professionals have supported the value of community in online learning environments. Community includes both student-student and student- instructor interactions. As online learning grows, both in number participating and in quality and degree of participation it is expected that establishing and nurturing a sense of community will increase in importance (Black, Dawson, & Priem, 2008). Black, Dawson, & Priem attempted to quantify this sense of community by using Learning Management Software (LMS) activity logs to explore if a student's sense of community was related to the number of posts and other data (time logged on, grades, attempts, elements accessed, etc.) generated

by that student. Significant strong positive correlations were found between the concepts of community and connectedness ($r = .774$, $p < .01$) and community and learning community ($r = .597$, $p < .01$) (Black, Dawson, & Priem, 2008, p. 68). The authors suggest LMS activity logs may be valuable tools especially for formative or 'just-in-time' assessments to establish whether students are developing a sense of community as the course progresses.

Dawson (2006) found similar results in his study of over 400 undergraduate and graduate students. Using activity logs to tally online behaviors and a sense of community assessment survey, Dawson states that, "the data demonstrates that students with greater frequencies of communication interactions possess stronger levels of sense of community" (p.153).

While social constructivism tells us that students build upon each others' ideas and, in so doing, create deeper and more complex levels of meaning, it doesn't really tell us how, nor does it examine the other impacts of this interaction. Garrison and others discuss the concept of interactivity in discussion. An examination of this idea includes explorations into the psychology of group work, or social interplay, and furthers the idea of community.

Garrison, Anderson, and Archer (2000) developed the Community of Inquiry model. A Community of Inquiry (CoI) is defined as a group that has, as its unifying agent, a common goal of study of a certain topic or set of topics. Where a Community of Practice tends to be more product driven and reliant upon shared long-range purpose among its members, Communities of Inquiry can be more loosely affiliated and convene

for shorter periods of time. It is fair (although not always accurate) to use CoI in reference to a class. The individuals are connected (if only for the semester) and linked by a common curriculum and course objectives (Garrison, Anderson, & Archer, 2000).

Garrison, Anderson, and Archer (2000) stated that learning occurs within this model of the Community of Inquiry through the interaction of three core elements, "cognitive presence, social presence, and teaching presence" (p. 88). These researchers used qualitative methods to examine events of online instruction and search for demonstrations of each of the three essential elements. Their content analysis of discussion transcripts indicated that each element is required for successful (fruitful) Community of Inquiry. The Community of Inquiry model describes one possible outcome of computer mediated communication. Within a Community of Inquiry cognitive, social, and teaching presences combine to enrich and strengthen discussion resulting in deeper and more complex discourse.

Thinking Skills in College Classrooms

Critical thinking remains the focus of many researchers (Brookfield, 1987), and the charge for the American higher education system to produce undergraduates capable of critical thinking necessary in adulthood remains steadfast (Sternberg, 1985). However, instructional discourse delivered in undergraduate classrooms typically reflects lower cognitive thinking levels (Miller, 1989; Fisher & Grant, 1983).

In multiple studies, Whittington (1991, 1995, 1998,; Ewing & Whittington, 2009) examined agricultural teaching in college to determine whether instruction was offered at

the desired cognitive level. In each instance most teaching (instructor's lecture, activities, and assignments) was of a low cognitive level despite the fact that most instructor's desired and favored levels of teaching were balanced across all levels or favored primarily higher cognitive levels. Whittington has suggested that researching the cognitive levels of teaching can play a role in improving student learning; and that these results may indicate a need for teacher training on effective means of developing higher level instruction. In each of the Whittington studies the FTCB was used to determine the Bloom's Taxonomy level of instructor comments in brick and mortar classrooms. Additionally professors were surveyed as to the desired distribution (by percentage) of their instruction which was compared to the assessed distributions.

While much research has examined the cognitive level of professor and instructor content delivery, less has examined student cognitive levels. Torres and Cano (1995) used The Developing Cognitive Abilities Test (DCAT) to assess the cognitive abilities of undergraduate seniors enrolled in the College of Agriculture at The Ohio State University. Student participation in the DCAT was voluntary. The DCAT is derived from Bloom's Taxonomy and identifies three cognitive levels. The DCAT level 'Basic Cognitive Abilities' is Bloom's level one and two (knowledge and comprehension), 'Application Abilities,' is Bloom's level three (application), and 'Critical Thinking Abilities' relates to Bloom's levels four and five (analysis and synthesis). The DCAT does not utilize the highest level of Bloom's Taxonomy, level six (evaluation). Raw scores from this test of critical thinking have a maximum score of 27. The researchers collected data from many different departments within the college. The overall average

score for Basic Cognitive Abilities was 19.9 (73.7%), for Application it was 20.2 (74.8%), and for Critical Thinking Abilities it was 16.8 (62.2%). Researchers agreed these scores indicated there was room for growth at each cognitive level, particularly level three. They state that, "The latitude for cognitive growth would imply that senior students enrolled in the College of Agriculture are graduating with less than adequate cognitive skills to allow them to solve problems, make decisions, and think critically" (Torres and Cano, 1995, p. 51). Torres and Cano surmise that the instructor's discourse should reflect all cognitive levels; and that often questioning occurs at lower levels initially and increases as the dialogue continues.

The 1993 Whittington study described the aspired cognitive level of instruction (as measured by the Newcomb-Trefz model) and the assessed cognitive level of instruction (as measured by the FTCB). It then determined the relationship between these variables and the attitude instructors had toward teaching at higher cognitive levels. Whittington and Newcomb (1993) found that instructors aspired to teach and test at higher cognitive levels and held favorable attitudes toward teaching at these levels, as well. However, they conducted classroom discourse at lower cognitive levels. The authors recommended a host of steps for instructors to raise the cognitive levels of their instructional discourse, including professional development and modeling desired behavior.

Further examination of agriculture professors' aspired and actual cognitive levels of classroom discourse reveal similar patterns as measured by the Florida Taxonomy Cognitive Behavior (Whittington, 1995; Whittington et al, 1997). In a study of fourteen

faculty members in the College of Agriculture at the University of Idaho, Whittington (1995) found that regardless of the cognitive level of instructional discourse to which the instructor aspired, between 25%-60% of the discourse occurred at a low cognitive level. No instructor was assessed as having greater that 6% of their instructional discourse at the highest instructional level. Additionally, in a study of sixteen faculty members in the College of Agriculture at the Pennsylvania State University (Whittington, 1997), 47%-80% of the instructional discourse occurred at lower cognitive levels as measured by the Florida Taxonomy of Cognitive Behavior. Less than 1% of instructional discourse was assessed at the highest cognitive level.

Finally, in a study of seven teacher educators teaching courses for secondary and middle school-level education majors at the University of Missouri-Columbia (Ball & Garton, 2005), 61% of classroom discourse occurred at lower cognitive levels and 39% of classroom discourse occurred at higher cognitive levels (as measured by the FTCB).

If students are to increase their critical thinking skills, they must have those same skills modeled for them, not only in classroom discourse but also in academic challenges presented to them. Academic challenges that are designed well can help students develop thinking skills (Terenzini, et al, 1995). McCormick and Whittington (2002) examined the cognitive level at which students were challenged to think in several courses in the College of Agricultural Sciences at Pennsylvania State University. Using Bloom's Taxonomy to measure the cognitive level of academic activities, they found that 28.4% of all academic challenges were written at lower cognitive levels, and 71.6% were written at higher cognitive levels. In a similar study, Ball and Garton (2005) examined the

cognitive level of assessments given by teacher educators in teacher preparation courses for secondary and middle school-level education majors at the University of Missouri-Columbia. Again using Bloom's Taxonomy to measure the cognitive level of assessment, 90% of assessments were written at higher cognitive levels while only 10% were written at lower cognitive levels.

In a study that analyzed the effects of cognitive level of instructor's statements, level of student's cognition, and classroom engagement, Ewing and Whittington (2009) developed a conceptual framework for describing cognitive levels in a classroom. Instructor statements were evaluated via the FTCB and Bloom's Taxonomy. A subset of the participating students viewed videotapes of classes in which they had participated and described their thought processes. These processes were divided into categories and the cognitive level was assessed. The researchers found an average cognitive 'score' for professor discourse to range from somewhere between the knowledge and comprehension levels to just reaching the application level. Additionally, over 60% of the professor's scores were at the lowest two levels of knowledge or comprehension: "No professor's total cognitive scores were above the analysis level of cognition (Ewing & Whittington, 2009, p. 43). The subset of students who conveyed their thought processes described thoughts that were off-topic (60% of the total recorded) were not evaluated. Of the remainder, the breakdown is fairly similar to professor discourse: 62.1% at knowledge and comprehension and 37.9% at the four higher levels. However, the mode cognitive level for 20 of the 21 students was at either the knowledge or comprehension level. It is interesting to note that although the assessed professor's comments merely reached the

application level, student processes showed 17% at the analysis level, 5.1% at the synthesis level, and 6.4% at the evaluation level.

In an exploration of the role learning style might play in affecting levels of cognitive instruction, Cano and Metzger (1995) determined whether horticulture teachers preferred a field dependent or independent learning style. The Group Embedded Figures Test (a cognitive style indicator which assesses degree of field-dependence) was used to determine teacher learning style. (It was delivered and scored by an experienced administrator.) Forty-four percent preferred the field-dependent style and 55% were field-independent. The FTCB was used to examine the cognitive level of instructor teaching. Results showed nearly half (47%) of instruction was at the knowledge level, 17% was at the translation/interpretation level, four percent at the application level, 12% at the analysis level, three percent at the synthesis level, and less than one percent at the evaluation level. Correlations between field independence and cognitive level were calculated at each stage of the taxonomy and most exhibited weak positive correlations; however, a moderate positive association existed with the application level and a strong negative association (r= -.53) with the knowledge level. The correlation with evaluation was also negative, but very weak. Overall a moderate association (r=.32) existed between learning style and cognitive level. This research examines an interesting connection. Cano and Metzger (1995) cite Clegg, Farley, and Curan (1967) and Dunn and Dunn (1979) with the claim that, "The flexibility for learners to learn at higher levels of cognition begins with the teacher's style of learning and the levels of cognition utilized in the classroom (p. 37).

Another study that examined the potential effect of learning preference evaluated the impact of "an asynchronously delivered simulation activity to teach leadership styles and ethics theory" (Boyd & Murphrey, 2002, p. 36). These researchers point out that one challenge to helping learners reach the higher levels of cognition may be class size; lecture halls filled with students are difficult settings for the more complex levels of the taxonomy. Ethics, leadership styles, and other abstract concepts are also difficult in that setting as "students lack the opportunity to practice the theory in real world applications" (p. 36).

There are a variety of studies which have attempted to assess an instructor's demonstrated classroom cognitive level. Many of these studies use the FTCB to codify the instructor's discourse to the matching Bloom Taxonomy level. Several also ask the instructors to identify the breakdown (percent time spent at each level) they desire and intend their instruction to achieve. Fewer studies seek to assess the *student*'s cognitive level demonstrated or expressed. This is an interesting deficiency in the literature because overall course objectives and educational goals focus on student, not instructor, output. Certainly much research indicates a strong relationship between the two; however, there is little indication of a direct causative link between high levels of instructor cognitive output and high level student output. Lectures at level two can result in exam answers at level three or four or higher. Instructors who teach the majority of the time at lower levels are still able to achieve higher student level output through expectations, effective content delivery, variable methods and other 'good teaching techniques and strategies.'

Online Discussion And HOTS/CT

Discussion, as the primary method or as a component of other methods and strategies does seem to promote the development of HOTS/CT. If these discussions and discussion elements are moved online is something 'lost in the translation?' With current technology, online exchanges and discussions can be divided into synchronous and asynchronous delivery options. Asynchronous discussion provides the schedule flexibility to allow all students to participate, and participate at their own pace (Lang, 2005). While this slower rate may be more equitable and allow students to post when they can provide their best answer, it might not be very realistic. Lang (2005) argues that the quick responses required from synchronous discussions are better preparation for real life and work situations, as bosses and clients usually don't allow workers to reply 'when it's convenient.'

Irrespective of delivery, it seems likely that the benefits of discussion to HOTS/CT promotion could be realized in online discussion. Students who are successful at 'deep' or analytical thinking in brick and mortar classrooms also demonstrate those thinking abilities in online discussion, whereas students who practice shallow discussion in a classroom do the same in the online environment. Ellis and Goodyear (2010) call this a "consistency of approach" across brick and mortar and online environments (p.62).

The learning that takes place through good discussion is specifically suitable in distance education settings. Online learning is considered very effective in uniting communities of learners (Ellis, Goodyear, Prosser, & O'Hara 2006). These researchers

purposefully chose online discussion as a means to provide possibilities for discussion, interaction, and social meaning making to their online class (Ellis & Goodyear, 2010).

Summary

Learners are better able to develop their thoughts, focus their ideas, and grow their problem solving and meaning making abilities when working together and sharing ideas with each other through dialogue. "When there is collaboration and a sharing of personal experience between all class members, these shared multiple perspectives can lead to socially constructed meaning;" this is social constructivism (Bender, 2003, p. 17).

A variety of instructional methods (problem-solving, inquiry, and case study) have shown some success at developing HOTS/CT (Johnson & Johnson, 1985; Lee, 2007; Williams & Williams, 2000). No one method, however, has been indicated by research to be foolproof. Activities and good teaching strategies that engage and focus learners such as using mixed media, studying real-world scenarios, and pre-defining HOTS/CT have also shown success in developing analytical thinking (Boyd & Murphrey, 2002; Miller & Pilcher, 2001). Strategies which involve writing and opportunities for revisiting that writing (blogs, journaling, and online discussion) establish a good environment for higher order thinking practice (Marzano, 1993; Quitadamo & Kurtz, 2007; Breach, 2005; Farmer, Yue, & Brooks, 2008; Ramos, 2010).

A solid understanding of the variety of learning styles students possess and ways of teaching that connect with those styles may create opportunities for students who might otherwise have trouble developing HOTS/CT skills (Cano & Garton, 1994; Myers

& Dyer, 2006). While instructors who challenge student's discussion comments and encourage back and forth dialogue see some success, those instructors who become overly involved in discussion risk shifting the discussion focus from content to teacher appeasement (An, Shin, & Lim, 2009; Gerber, Scott, Clements, & Sarama, 2005; Miri, David, & Uri, 2007).

Class discussion allows opportunities for social interaction (Lang, 2005; Curtis, 2004; Brown, 2001; Black, Dawson, & Priem, 2008) and the development of social presence (Garrison, 2000; Garrison, Anderson, & Archer 2001, 2010). Use of the Socratic Method can refine discussion even further and engage learners in deeper and more analytical understanding of complex issues (Polite & Adams, 1996; Parkinson & Ekachi, 2002; Paraskevas & Wickens, 2003). Much of the literature that seeks to describe the cognitive level of class discussion focuses on instructor output; however, these studies still illuminate the process of categorizing and exploring cognitive behavior (Cano & Metzger, 1995; Torres & Cano, 1995, Whittington, 1991, 1995, 1998; Whittington et al., 1997; Whittington & Newcomb, 1993). These studies also found that the desired level of professor instruction, which was distributed fairly evenly across Bloom's Taxonomy, did not match the assessed cognitive levels demonstrated, which averaged nearly half at the knowledge level and less than 10% at the synthesis and evaluation levels (Whittington, 1991, 1995, 1998; Whittington et al., 1997; Whittington & Newcomb, 1993). Distance education strategies can mimic those of brick and mortar classes, and may even provide additional benefits such as encouraging class engagement

outside of class and time for reflection (Curtis, 2004; Dawson, 2006; Fogarty & McTigne, 1993; Lang, 2005).

Chapter III: Methodology

This chapter will discuss the methods used in addressing the research questions; the research design, instrumentation, data collection and analysis will be explained.

Purpose Of Research

This exploratory study compared the instances of higher order thinking skills in synchronous and asynchronous online discussion in a graduate level course. It also described the distribution of comments in online discussion according to Bloom's Taxonomy level.

Research Questions

These research questions were used to address the problem and guide the study:

1. How often is each of the cognitive levels of Bloom's Taxonomy demonstrated in synchronous and asynchronous online class discussion?
2. What is the weighted cognitive level score of student comments made in each synchronous and asynchronous online class discussion?
3. What is the overall weighted cognitive level score of discussion demonstrated in synchronous and asynchronous online class discussion?

Research Hypothesis

Stated in the null form for statistical analysis, the following hypothesis was tested at the .10 level of significance: HO_1: There is no significant difference in the overall mean cognitive level between synchronous and asynchronous online discussion.

Research Design

The first guiding question was addressed via descriptive research. Fraenkel and Wallen (2009) defined *descriptive research* or *a descriptive study* as "Research to describe existing conditions without analyzing relationships among variables" (Glossary G-2). McMillan (2004) said descriptive research includes those studies that give straightforward information about the amount or frequency of something. This study described the levels of Bloom's Taxonomy achieved in online discussion, and the mean level achieved by each group.

The remaining questions of this study utilize an experimental research design. Fraenkel and Wallen describe *experimental research* as "research where at least one independent variable is manipulated, other relevant variables are controlled and the effect on one or more independent variables is observed" (Glossary, G-3). Class participants were randomly assigned to either the synchronous or the asynchronous group. All participating students were from the same class, the same section, and the same enrollment period. McMillan (2004) also explained "comparative studies examine the differences between groups on a variable of interest" (p. 9). The difference between the overall mean weighted cognitive level scores achieved by the synchronous and

asynchronous groups were compared. The differences between the weighted cognitive level scores for each class were also compared.

All students in the course were provided weekly course content online. Discussion questions related to the weekly content were made available to the asynchronous group on the Moodle server. The discussion questions were not visible to the synchronous group until the time of the chat session. Unless a specific question was posted for the instructor or a specific need for clarification and further instructions were required the instructor did not post to the discussion thread. The intention of the study is to explore what higher order thinking skills and critical thinking (HOTS/CT) are naturally developed by social constructivism given the situation, population, and questions.

Variables of Interest

The dependent variables for this study are the overall mean weighted cognitive level score of synchronous online discussion and the overall mean weighted cognitive level score of asynchronous online discussion (measured using the Florida Taxonomy of Cognitive Behavior). Additionally mean weighted cognitive level scores for each class and both delivery methods are also dependent variables. The independent variable is the type of discussion (synchronous or asynchronous). The constant is the discussion questions used (see Appendix B).

Participants

Participants of this study were the entire enrollment of a 2010 North Carolina State University's (NCSU) Agricultural and Extension Education graduate class utilizing online discussion. The course is a Trends and Issues reading and discussion course with topics from multiple areas of interest within the department and field of agricultural and extension education. The intent of the class is to not only familiarize students with the current topics of importance in the Agricultural and Extension field, but also to help students develop ways of learning about new topics, analyzing and assessing the research regarding those topics, and to develop treatments (activities, curricula, programs) that could be used to address these and future topics.

This particular course was required for each master's degree offered through the Agricultural and Extension Education department. As this was a required course for the master's degrees, the students enrolled in the course are similar to the general graduate student AEE enrollment. The students represented a variety of ages (20s through 50s), locations (North Carolina to Colorado), and a fairly even mix of males and females. This course is offered online and on-campus and is part of the regular course offerings of the department.

Only students participating in the online section of the class were involved in the study (N=24). These students were randomly assigned to either the synchronous or the asynchronous group; there were 12 students in each group. Each group had the same rubric for assessing discussion posts, received the same type of open-ended discussion

question prompts, and was required to participate in the same number of discussion events. All other assignments and requirements were the same for the two groups.

Instrumentation – Florida Taxonomy of Cognitive Behavior

This study utilized an evaluation instrument that assessed the level of thinking exhibited in the online discussion. To examine the student's cognitive level score of comments made in both synchronous and asynchronous online discussion, discussion board comments were coded with the Florida Taxonomy of Cognitive Behavior (FTCB). The FTCB was designed by Brown, Ober, Soar, and Webb in 1966 and has been used many times in multiple disciplines. The FTCB is based on Bloom's Taxonomy and is used as a tool to ascribe Bloom's Taxonomy levels to statements from the target audience. Bloom's Taxonomy breaks thinking into six cognitive levels (knowledge, comprehension, application, analysis, synthesis, and evaluation), the FTCB uses seven (knowledge, translation, interpretation, application, analysis, synthesis, evaluation). For the frequency distribution, the FTCB levels of translation and interpretation were combined (forming comprehension) in order to more clearly align with the commonly used Bloom's Taxonomy. The difference is one of semantics and does not affect coding.

For this study the FTCB was used to categorize students' cognitive behaviors via a written transcript of the discussion postings. Each written student posting was assessed using the FTCB. As per the instructions for use of the FTCB (Whittington 1991, 1995; Whittington et al. 1997; Whittington & Newcomb, 1993, and Miller 1989 also used this same procedure) for each student's posting any identified level of cognitive behavior was

only recorded once per instance regardless of the number of occurrences at that level (Appendix D). If a student's discussion post lists multiple facts in one instance the knowledge cognitive level box was only checked once. If a posting had an additional component at a different cognitive level both levels were recorded.

Once each statement had been coded the scores were processed using a weighting system which assigns a multiplicative value of .1 for each comment made at the knowledge level (.2 at the comprehension level, .3 at the application level, .4 at the analysis level, and .5 at both the synthesis and evaluation level) (Miller, 1989 and Cano & Metzger, 1995). The weighting system accounts for the hierarchical nature of Bloom's Taxonomy. For example a level four (analysis) comment pre-supposes cognition at levels one through three (Miller, 1989; Bloom et al., 1956). So an analysis comment demonstrates that knowledge, comprehension, and application cognitive processes have already occurred in the discussant's mind.

The Florida Taxonomy of Cognitive Behavior (FTCB) was used to assess the comments of both synchronous and asynchronous discussion. The FTCB provided a framework so that each comment could be assigned to a category representing Bloom's Taxonomy levels. The Florida Taxonomy of Cognitive Behavior was originally developed to categorize the cognitive level of classroom dialogue. The FTCB is based on Bloom's Taxonomy with the 55 questions divided into the overarching levels of knowledge, comprehension, application, analysis, synthesis, and evaluation. Because the FTCB is a framework for coding comments, the knowledge level (which in Bloom's Taxonomy is very broad) is subcategorized into three sections and the comprehension

level is subcategorized into two sections. These subcategories are strictly formatting and do not affect the FTCB's alignment with Bloom's Taxonomy or its use in this study as the individual (55) statements are the guiding descriptors. The descriptor statements help the observer match comments to categories. For example if the discussant is stating the components of the futuring process in the first lesson then a checkmark was placed next to descriptor #10, 'Gives the steps of a process' (Appendix A). Descriptor #10 falls within the knowledge category. If a student correctly uses those futuring components for a subsequent lesson then a check would be placed next to #30, 'Applies previous learning to new situations' (Appendix A).

Validity and Reliability

Throughout the field of education Bloom's Taxonomy is accepted as a valid tool for cognitive behavior classification. Miller (1989) offers that the FTCB, based upon the support Bloom's receives can be viewed as a valid means of identifying cognitive level behaviors. Ball and Garton (2005), Cano & Metzger (1995) and Whittington (1991) also assert the validity of the FTCB.

Whitington and Newcomb (1993), Ewing and Whitington (2009), and Cano & Metzger (1995) each established intra-rater reliability of the FTCB by viewing video tapes of lectures, coding cognitive behaviors with the FTCB and then repeating the process some weeks later. Intra-rater reliability for this study was similarly established, the raters used the FTCB to code discussion transcripts from one of the discussions not used in the main study (first week, different section) and then repeated the process 2-3

weeks later. A Pearson-Product Moment coefficient of reliability of .93 (rater #1) and .94 (rater #2) was calculated. Inter-rater reliability was determined by using the same discussion transcript (first week, different section) from each rater. A Pearson-Product Moment coefficient of reliability of .88 was calculated.

Discussion Logistics

The course utilizes discussion as an integral component of its overall course makeup. In addition to other written assignments unique discussion questions were asked in nine lessons during the semester (see Appendix B). Students were required to post a specific number of times. A rubric for assessing discussion comments was provided to the students at the beginning of the semester (Appendix C). Participation in online class discussion was a requirement for successful completion of the class. Students were made aware that their postings were going to be reviewed for data collection; however they did not have access to the FTCB coding framework. The reviewer did not assess student discussion class grades, and the review was completed after all course grades had been submitted.

All discussion postings were made using the Moodle Learning Management System. All online class participants had access to a Moodle class site specifically for their course section. Information and guidance for using Moodle was made available through verbal instruction, slideshows, written instructions, and the helpdesk information was made available.

Synchronous discussion used Moodle's *Chat* tool. This tool was available only to those students in the synchronous discussion group. All participating students were logged on simultaneously. The instructor posted the same discussion question prompts (although usually divided up throughout the course of the chat) and students typed their answers and responses in real-time. These postings were visible to the all chat participants with the student's post time and name also visible.

Asynchronous discussion used Moodle's *Forum* tool. This tool was available to all members of the class (as introductions and other class information, not involved in this study, were distributed via Forum). The open-ended discussion question prompts were made available to the Forum participants. Students were instructed as to the quantity and deadline of their postings. Participating students then composed and uploaded their discussion postings and responses at their leisure within the timeframe allowed. Their postings were visible to the instructor and all Forum participants. Each post showed the time of the post and the identity of the participant.

Moodle maintains a written record of all online discussions (both Chat and Forum). Those written records were the transcripts that were reviewed and classified using the FTCB. Over the course of the semester discussion (either synchronous or asynchronous or both) occurred most weeks. Nine discussion events for each delivery type (synchronous or asynchronous) were reviewed. In addition no discussions from the first or last week of the semester was utilized. This allowed students time to become familiar with the class, each other, and the Learning Management System software specifically the F*orum* or C*hat* function they used.

Procedure

The FTCB in previous studies (Whittington, 1991 and 1995, Whittington & Newcomb, 1993, Whittington et al., 1997; Miller, 1989; Ball & Garton, 2005; Cano & Metzger, 1995) has been used by an observer in a classroom to codify either the instructor's discourse (lecture, explanations, questions, answers, etc.) or student comments and questions. At brief time intervals the observer noted what was being said at that moment and placed a check in the box coinciding with one of the 55 descriptors. In this study the process is similar except instead of listening to a class the observers were reading a transcript of the discussion. The transcripts are exact copies of the actual written posts made by both the synchronous and the asynchronous discussants. Instead of using a time delineator the individual posts indicate when to check the appropriate descriptor.

Once all the discussions concluded, two observers were given the discussion transcripts and used the FTCB's 55 descriptor statements to rate each comment (see Appendix A). Once coding began the observers did not consult with each other regarding coding. A third observer was prepared to offer coding for irreconcilable differences, but none existed.

The observers completed all of the synchronous discussion transcripts before they began the asynchronous transcripts. Within each delivery mode the nine discussions were not coded consecutively. This was to control for changes in expectations of the comment level as the semester progressed. All discussant names were changed (early US

President's names were used) and the thumbnail image that the LMS attaches to each comment was removed.

The observers coded 1739 synchronous comments and 435 asynchronous comments. The difference in the total number of comments between synchronous and asynchronous discussion is due to the nature of the two formats. In synchronous, or real-time, discussion the students were engaged in a more conversational style discussion with shorter comments, but more total comments made. In the asynchronous discussion each instance of a comment is either the complete student response to the posed question or a section of the response in some instances. In synchronous discussion a question would be entered into the chat log, students would reply by typing their comments into the chat box and hitting the enter key, which displayed their comment in the chat log. These student entries were most often one line of text for each reply. For example, three lines in synchronous discussion is most likely three separate comments from the discussant and equals three coding events whereas in asynchronous discussion three lines of text is probably one entry and would only receive one score. An exception would be if the entry contained a distinct comment of a different cognitive level, then the entry would receive two recorded scores.

Analysis of Data

This study compares the level of cognitive behavior for synchronous and asynchronous discussion. The data were collected from online discussion transcripts; coded using the FTCB, tallied and simple percentages were calculated using Microsoft

Excel. The individual weighted cognitive level scores for each discussion and the overall means for each group were also calculated through a weighting system and compared via *t*-tests. An *alpha* level for tests of significance was set *a priori* at $p < .10$. According to Agresti & Finlay (1997) an *alpha* level of .10 is acceptable for exploratory studies. Additionally a frequency distribution was calculated to see the percentage of discussion represented by each cognitive level of Bloom's Taxonomy.

Once all comments had been coded by cognitive level, the number of comments at each level was tallied. Percentages were determined by dividing the number of comments at each level by the total number of comments. For example there were 107 knowledge comments made in synchronous discussion #1 and there were 1739 total comments made in synchronous discussion #1, so $107 \div 1739 = 43\%$.

Summary

This experiment compared the weighted cognitive level scores of synchronous and asynchronous online discussion from one graduate trends and issues class. Students were randomly assigned to either the synchronous or asynchronous discussion delivery. Moodle, the LMS, automatically generates a transcript of all student comments; two observers then used the Florida Taxonomy of Cognitive Behavior as a framework to ascribe the Bloom's Taxonomic Level to the student comments. A tally of the comments at each cognitive level was generated and percentages of each level were calculated. Additionally a weighted cognitive level score was calculated based on a protocol

previously established. A *t*-test was calculated to determine if the difference in overall weighted cognitive level scores was significant.

Chapter IV: Findings

This chapter provides the findings of the research. Using the research questions as a guide results of statistical and hypothesis testing are presented.

The participants in this study were enrollees of a North Carolina State University Agricultural and Extension Education graduate level online trends and issues course. Students in the Spring 2010 course (n=24) were randomly assigned to either a synchronous or an asynchronous discussion group. All other assignments, rubrics, and requirements were the same for the two groups.

Purpose And Research Questions

This exploratory study compared the instances of higher order thinking skills in synchronous and asynchronous online discussion in a graduate level course. It also described the distribution of comments in online discussion according to Bloom's Taxonomy level.

Question #1- How often is each of the cognitive levels of Bloom's Taxonomy demonstrated in synchronous and asynchronous online class discussion?

Table 1 and Table 2 show the number of comments at each cognitive level for each synchronous and asynchronous discussion respectively. Table 1 and Table 2 also display percentage of comments in each discussion by cognitive level. Percentages at each cognitive level were later used to calculate weighted cognitive scores.

Table 1

Bloom's Taxonomy Cognitive Level Frequencies for the Synchronous Group Comments

Discussion	Knowledge		Comprehension		Application		Analysis		Synthesis		Evaluation	
no.	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
1	107	43	130	52	0	0	0	0	12	5	0	0
2	123	47	104	40	33	13	0	0	0	0	0	0
3	85	50	60	36	24	14	0	0	0	0	0	0
4	104	63	60	37	0	0	0	0	0	0	0	0
5	95	55	78	45	0	0	0	0	0	0	0	0
6	85	49	65	38	22	13	0	0	0	0	0	0
7	61	41	79	54	7	5	0	0	0	0	0	0
8	126	51	104	42	16	7	0	0	0	0	0	0
9	100	63	51	32	8	5	0	0	0	0	0	0
Total	886	-	731	-	110	-	0	-	12	-	0	-

Note. Total number of all comments = 1739.

Table 2

Bloom's Taxonomy Cognitive Level Frequencies for the Asynchronous Group Comments

Discussion	Knowledge		Comprehension		Application		Analysis		Synthesis		Evaluation	
no.	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
1	0	0	15	50	9	30	6	20	0	0	0	0
2	0	0	8	32	10	40	7	28	0	0	0	0
3	2	4	22	45	16	33	9	18	0	0	0	0
4	3	7	11	24	11	24	13	28	8	17	0	0
5	1	2	13	26	0	0	30	60	6	12	0	0
6	4	16	17	68	2	8	1	4	1	4	0	0
7	13	33	23	57	4	10	0	0	0	0	0	0
8	2	7	12	40	9	30	4	13	3	10	0	0
9	11	22	4	8	16	32	15	30	4	8	0	0
Total	36	-	125	-	77	-	85	-	22	-	0	-

Note. Total number of all comments = 345.

The difference in the total number of comments between synchronous (n = 345) and asynchronous (n = 1739) discussion is due to the nature of the two formats.

Synchronous discussion is in real-time and students tend to be engaged in a more conversational style discussion with shorter comments, but more total comments. Almost every line of text was a unique student comment each of approximately a sentence in length and represented a complete entry on the FTCB coding framework. In the asynchronous discussion each instance of a comment is either the complete student response to the posed question or, in some instances, a section of the response. Almost all asynchronous comments were more than one sentence in length as students submitted a completed response each time. If a post contained two distinct levels it received two codes. Most posts, however, warranted coding as one entry on the FTCB framework. It is also interesting to note that although the comment counts vary greatly with five times as many synchronous than asynchronous comments; the character counts do not. The total number of characters in synchronous comments averaged 7037 per discussion while the total number of characters in the asynchronous comments averaged 5464 per discussion. So synchronous discussants posted more times, but wrote about the same total amount as the asynchronous discussants.

Ninety-three percent of the synchronous comments were either from the knowledge (51%) or the comprehension (42%) level. The non-weighted scores for the asynchronous group do show a more even distribution of comments. In fact, while there were 22 synthesis comments (6%), there were only 36 knowledge comments (10%).

The data from Tables 1 and 2 were also used to generate Figure 1 and Figure 2. The number of comments for each discussion at each cognitive level was summed to give a total number of comments at each cognitive level for all synchronous discussion. The

same process was used to find the total number of comments at each cognitive level for all asynchronous discussion. These totals were used to calculate percentages of discussion at each cognitive level for the overall synchronous and asynchronous discussions respectively. Figure 1 and 2 provide an overview of the breakdown of cognitive behaviors for each delivery setup.

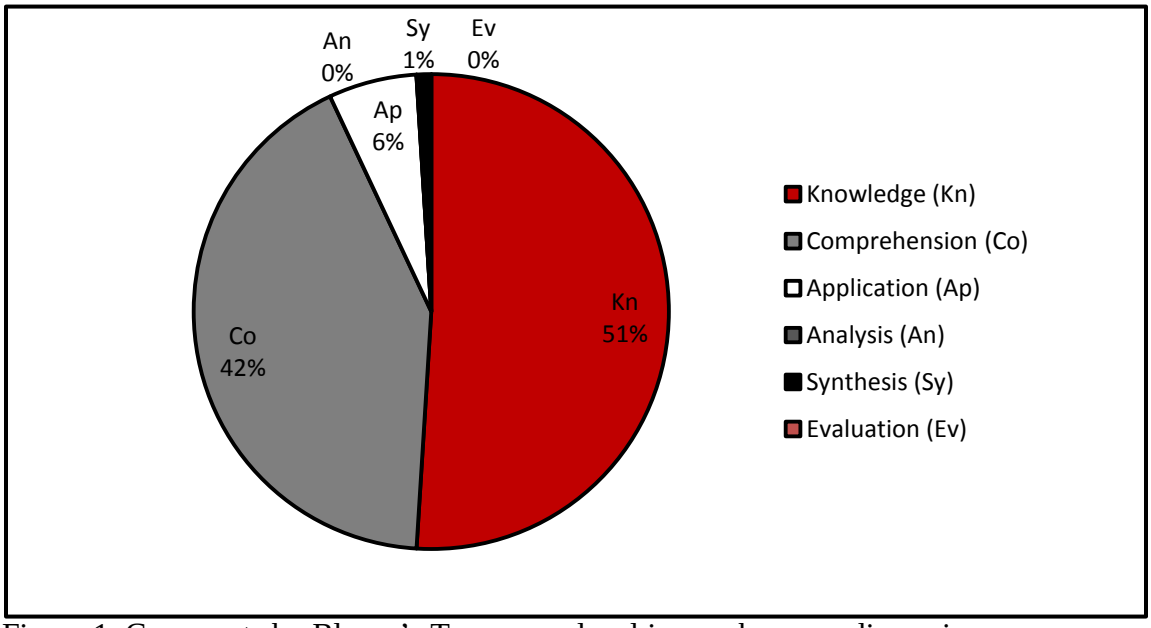


Figure 1. Comments by Bloom's Taxonomy level in synchronous discussion.

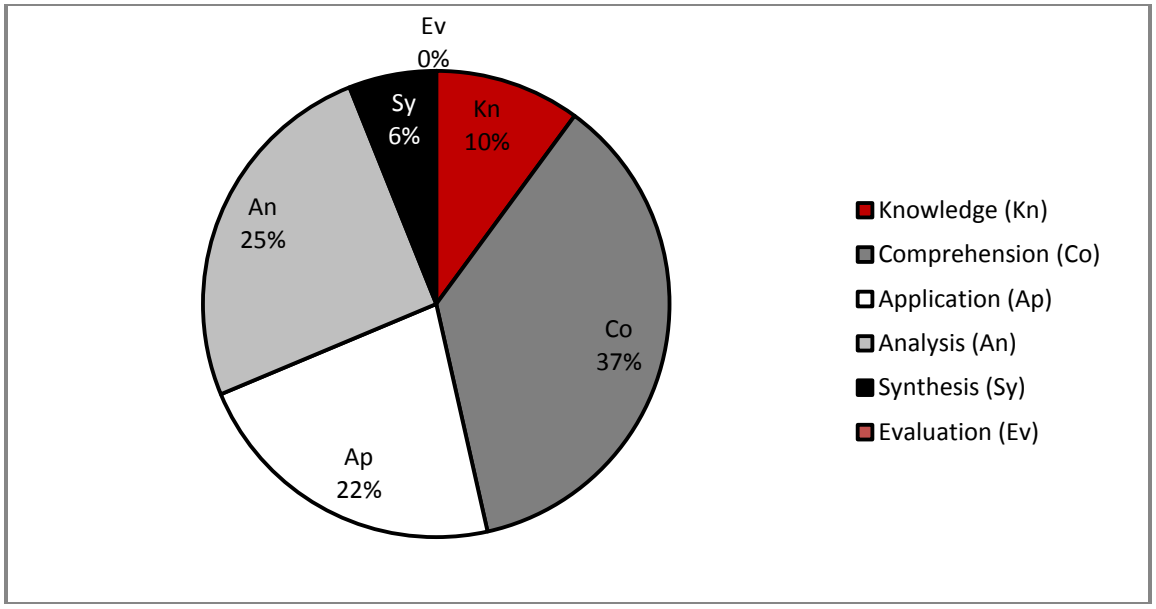


Figure 2. Comments by Bloom's Taxonomy level in asynchronous discussion.

Question #2 What is the weighted cognitive level score of student comments made in each synchronous and asynchronous online class discussion?

An overall weighted cognitive level score for each discussion was determined using the FTCB and weighted by multiplying the percentage of comments present at each level by (knowledge = .10, comprehension = .20, application = .30, analysis = .40, and synthesis /evaluation = .50 (Miller, 1989)). For example, from Table 1 the synchronous discussion #1 knowledge percentage is 47, so the weighted cognitive score is 47 x .10 = 4.7. The sum of each level's scores equals the weighted cognitive level score for that discussion. Table 3 and Table 4 show the total weighted cognitive level scores for each synchronous and asynchronous discussion respectively.

Table 3

Weighted Cognitive Level Scores for Synchronous Discussion Group

	Bloom's Taxonomy Level						
	% (.10) = Knowledge wt%	% (.20) = Comp. wt%	% (.30) = Application wt%	% (.40) = Analysis wt%	% (.50) = Synthesis wt%	% (.50) = Eval. wt%	Tot. Cog. Level
Disc1	4.3	10.4	0.0	0.0	2.5	0.0	17.2
Disc2	4.7	8.0	3.9	0.0	0.0	0.0	16.6
Disc3	5.0	7.2	4.2	0.0	0.0	0.0	16.4
Disc4	6.3	7.4	0.0	0.0	0.0	0.0	13.7
Disc5	5.5	9.0	0.0	0.0	0.0	0.0	14.5
Disc6	4.9	7.6	3.9	0.0	0.0	0.0	16.4
Disc7	4.1	10.8	1.5	0.0	0.0	0.0	16.4
Disc8	5.1	8.4	2.1	0.0	0.0	0.0	15.6
Disc9	6.3	6.4	1.5	0.0	0.0	0.0	14.2

Note. Total weighted cognitive level scores can range from 10-50; 10-19.9 knowledge, 20-29.9 comprehension, 30-39.9 application, 40-49.9 analysis, 50-synthesis/evaluation.

Table 4

Weighted Cognitive Level Scores for Asynchronous Discussion Group

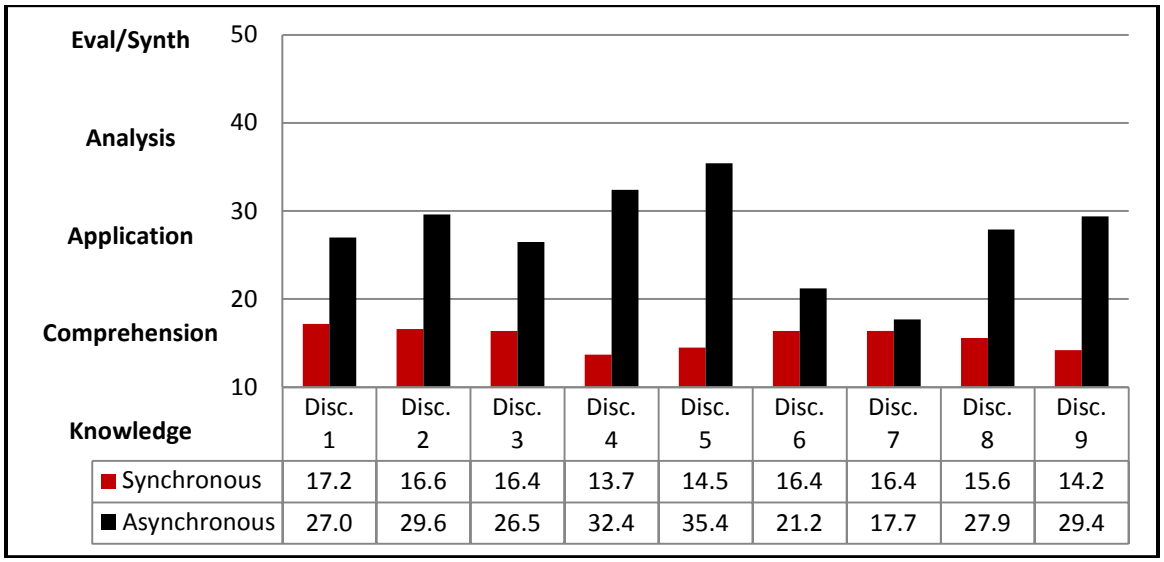
	Bloom's Taxonomy Level						
	% (.10) = Knowledge wt%	% (.20) = Comp. wt%	% (.30) = Application wt%	% (.40) = Analysis wt%	% (.50) = Synthesis wt%	% (.50) = Eval. wt%	Tot. Cog. Level
Disc1	0.0	10.0	9.0	8.0	0.0	0.0	27.0
Disc2	0.0	6.4	12.0	11.2	0.0	0.0	29.6
Disc3	0.4	9.0	9.9	7.2	0.0	0.0	26.5
Disc4	0.7	4.8	7.2	11.2	8.5	0.0	32.4
Disc5	0.2	5.2	0.0	24.0	6.0	0.0	35.4
Disc6	1.6	13.6	2.4	1.6	2.0	0.0	21.2
Disc7	3.3	11.4	3.0	0.0	0.0	0.0	17.7
Disc8	0.7	8.0	9.0	5.2	5.0	0.0	27.9
Disc9	2.2	1.6	9.6	12.0	4.0	0.0	29.4

Note. Total weighted cognitive level scores can range from 10-50; 10-19.9 knowledge, 20-29.9 comprehension, 30-39.9 application, 40-49.9 analysis, 50-synthesis/evaluation.

Weighted cognitive level scores could range from 10 to 50 (the total percent possible is 100 with a minimum weight of .10 which equals 10 and a maximum weight of .50 which equals 50). A score of 10.0 would correspond to the knowledge level of Bloom's Taxonomy, 20.0 to comprehension, 30.0 to application, 40.0 to analysis, and 50.0 to synthesis/evaluation (Miller, 1989). For synchronous discussion the weighted cognitive level scores ranged from 13.7 – 17.2. All scores from the synchronous discussion were within the knowledge level; therefore, each discussion was representative of lower order thinking. For asynchronous discussion the scores ranged from 17.7 – 35.4. These numbers indicate that there was an individual discussion at the knowledge level, others at the comprehension level, and still others at the application level. None of these individual weighted cognitive scores, however, is indicative of a higher order thinking score. Overall weighted cognitive scores do not mean every comment was at that level, or that there were no HOTS/CT comments. It is important to remember the weighted cognitive scores provide an overall number for each discussion in its entirety, which make comparisons easier.

Weighted cognitive levels scores do not follow any pattern; lowest scores are not the first or last discussion and the highest asynchronous score is not the first or last discussion either. The highest synchronous score was from the first discussion, but subsequent scores are uneven. For either delivery case the scores do not consistently increase or decrease as the semester progresses. The variety of scores across the semester is better seen graphically. Figure 3 is the graphical representation of each discussion's weighted cognitive level score for both synchronous and asynchronous delivery modes

along with the level of Bloom's Taxonomy for each (as described by Miller 1989).



	Disc. 1	Disc. 2	Disc. 3	Disc. 4	Disc. 5	Disc. 6	Disc. 7	Disc. 8	Disc. 9
Synchronous	17.2	16.6	16.4	13.7	14.5	16.4	16.4	15.6	14.2
Asynchronous	27.0	29.6	26.5	32.4	35.4	21.2	17.7	27.9	29.4

Figure 3. Weighted cognitive level score for each discussion by delivery mode.
Note. Total weighted cognitive level scores can range from 10-50; 10-19.9 knowledge, 20-29.9 comprehension, 30-39.9 application, 40-49.9 analysis, 50-synthesis/evaluation.

Question #3 What is the overall weighted cognitive level score of discussion demonstrated in synchronous and asynchronous online class discussion?

To examine synchronous and asynchronous discussions as methods for developing HOTS/CT, it is necessary to compare the weighted cognitive scores of the two delivery methods. To do this, an overall mean was calculated for each delivery mode. This was done by summing the weighted cognitive level scores for each type of discussion and dividing by nine (the number of discussions). Results for the synchronous discussion are grand mean $\bar{x}$ = 15.67, the SD = 1.24, the SE = 0.41, and the range = 10.0 – 50.0. This overall weighted cognitive score for synchronous discussion is representative of discussion primarily at the knowledge level. Weighted cognitive scores between 10

and 19 correspond to the knowledge level of Bloom's Taxonomy. The knowledge level is the first level and is considered a lower order thinking level. Results for the asynchronous discussion are grand mean $\bar{x}$ = 27.46, the SD = 5.38, and the SE = 1.79. A weighted cognitive score of 27.46 is within the range of the comprehension level of Bloom's Taxonomy. This score is on the high end of the comprehension level, but is still demonstrative of lower order thinking skills.

Research Hypothesis: HO_1: There is no significant difference in the overall mean cognitive level between synchronous and asynchronous online discussion.

A *t*-test was used to determine if the difference in overall mean weighted cognitive level scores of all synchronous and asynchronous discussions was statistically significant. The *t*-test used was a matched pair, one-tail t-test. Table 7 details the *t*-test calculation. The *p*-value reported was .0002, which is less than the *alpha* of .10. The hypothesis was rejected; there is a difference in mean overall weighted cognitive level scores for synchronous and asynchronous groups.

Table 5

Independent Sample *t*-test on the Overall Weighted Cognitive Level by Delivery Mode

Delivery Mode	n	Mean Weighted Cognitive Score	SD	*t*-value	*df*	*p*-value
Synchronous	9	15.67	1.24	5.811	8	.0002
Asynchronous	9	27.46	5.38		-	-

Note. Weighted cognitive scores can range from 10-50.

[a] $p < .10$

Chapter V: Summary, Conclusions, Implications, and Recommendations

Summary of Purpose and Research Questions

This exploratory study compared the instances of higher order thinking skills in synchronous and asynchronous online class discussion. It also described the distribution of comments in online discussion by Bloom's Taxonomy level.

Exploring the relationship between online discussion and higher order thinking skills is important in establishing whether distance education classes are succeeding in developing HOTS/CT within students. Distance education may be uniquely able to develop and grow HOTS/CT because of the interactive and collaborative nature of distance education (Miller and Pilcher, 2001). In order to best evaluate methods of developing HOTS/CT in students, research about current practices to promote HOTS/CT, and the success of those practices is necessary. This study sought to determine which of two online discussion delivery formats, synchronous or asynchronous, was more successful in eliciting student HOTS/CT using discussion. These thinking abilities are identified as no less than a requirement for survival in this complex and dynamic technology age.

These research questions were used to address the problem and guide the study:

1. How often is each of the cognitive levels of Bloom's Taxonomy demonstrated in synchronous and asynchronous online class discussion?
2. What is the weighted cognitive level score of student comments made in each synchronous and asynchronous online class discussion?

3. What is the overall weighted cognitive level score of discussion demonstrated in synchronous and asynchronous online class discussion?

Stated in the null form for statistical analysis, the following hypothesis was tested at the .10 level of significance: HO_1: There is no significant difference in the overall mean cognitive level between synchronous and asynchronous online discussion.

Summary of Methodology

The design for the first question of the study is descriptive, describing the frequency of comments occurring at each level of Bloom's Taxonomy in synchronous or asynchronous online discussion. The percentages of total synchronous and (separately) asynchronous comments at each level of Bloom's Taxonomy were identified and tallied using the Florida Taxonomy of Cognitive Behavior.

The remaining questions of this study utilize an experimental research design. The study involves the entire enrollment of a Trends and Issues online graduate class utilizing online discussion. Participants were randomly assigned to either the synchronous or the asynchronous online discussion group. As part of the regular course assignments students were expected to participate in online discussion guided by questions (the same for synchronous and asynchronous) relevant to each week's lesson content. Each group used the same discussion rubric, received the same question prompts, and was required to participate in the same number of discussions. All discussion postings were made using the Moodle Learning Management System. All questions, answers, and comments were transcribed automatically by the LMS software.

These transcripts were then analyzed and coded by two reviewers using the Florida Taxonomy of Cognitive Behavior to ascribe Bloom's Taxonomy levels to the student's entries. A weighting system used by Miller (1989) and Cano & Metzger (1995) took the percentages found with the FTCB and calculated a weighted cognitive level score. The differences between the weighted cognitive level scores for each class were compared. The difference between the overall mean weighted cognitive level scores achieved by the synchronous and asynchronous groups were also compared.

Summary of Findings

The overall total number of synchronous comments was 1739; of those 93% were either from the knowledge (51%) or the comprehension (42%) level. Very few comments (7%) were made at higher order thinking levels. The percentages for the asynchronous group do show a more even distribution of posts. In fact, while there were 22 synthesis posts (6%) there were only 36 knowledge posts (10%).

Weighted cognitive level scores (Miller 1989; Cano & Metzger, 1995) were determined using the FTCB and a weighting system which produces a score ranging from 10 to 50. A score of 10 indicates all entries were at the knowledge level and a score of 50 indicates all entries were at the synthesis/evaluation level. The weighted scores accommodate the likelihood that higher level comments will be less frequent than lower level comments. The scores for the nine synchronous online discussion classes ranged from 13.7 - 17.2, indicative of comments primarily at the knowledge level.

For the asynchronous online discussion group individual classes' weighted discussion scores ranged from 17.7 - 35.4. These scores demonstrated a greater range of scores among

the classes and higher scores for each class. Most of the asynchronous classes were in the comprehension range, while two were within the application range and only one was at the knowledge level. For the asynchronous discussion 31% of the total comments registered above the application level. Even so, the overall weighted cognitive level score for all discussion during the semester was still within the parameters of lower order thinking.

The overall mean weighted cognitive level score for all synchronous online discussion posts was 15.67, SD. = 1.24, this score also indicates comments were primarily within the knowledge range. Overall mean weighted cognitive scores for asynchronous discussion was 27.46, SD = 5.38. The overall mean score for the asynchronous group was statistically significantly higher than the overall mean score for the synchronous group.

Conclusions

Question 1 - How often is each of the cognitive levels of Bloom's Taxonomy demonstrated in synchronous and asynchronous online class discussion?

Within synchronous discussion nearly all of the comments registered in the first three levels of Bloom's Taxonomy, primarily within the knowledge and comprehension level. No comments were scored in either the analysis level or the evaluation level. Within asynchronous discussion only the evaluation level had no comments. The lower order thinking levels (knowledge, comprehension, and application) represented a majority of the total asynchronous comments. Most discussion regardless of whether the discussion occurs synchronously or asynchronously is at lower cognitive levels.

Question 2 - What is the weighted cognitive level score of student comments made in each synchronous and asynchronous online class discussion?

For the synchronous delivery mode each discussion was within the knowledge range and represented lower order thinking. While there was one asynchronous delivery class with a score within the knowledge level, and a few at the application level, most asynchronous discussions were at the comprehension level. None of these individual discussion weighted cognitive level scores, however, is indicative of a higher order thinking taxonomic level. Individual discussion sessions all were at the lower cognitive levels.

Question 3 - What is the overall weighted cognitive level score of discussion demonstrated in synchronous and asynchronous online class discussion?

The overall weighted cognitive level score for all synchronous discussions combined was in the knowledge level of Bloom's Taxonomy. The overall asynchronous weighted cognitive level score was in the comprehension level of the taxonomy. Neither the synchronous nor the asynchronous group produced online discussions which registered a weighted cognitive level score within the higher order thinking range (analysis, synthesis, evaluation).

Implications

Are HOTS/CT skills prevalent in online discussion? As the overall weighted cognitive score for synchronous discussion carried a value of 15.7 which registers between the knowledge and comprehension domains there was very little HOTS/CT demonstrated in the synchronous class overall. The overall weighted cognitive score for asynchronous discussion was 28, which is between the comprehension and application

domains, there was little HOTS/CT exhibited in the asynchronous class overall. There were individual comments coded within the HOTS/CT range; however, not enough of this type of comment was made to produce an overall cognitive score in the analysis or higher range (40-50). It should be noted; however, that a weighted cognitive level score of 40 or greater would be required to indicate that overall the entire discussion was at a higher order thinking level. It may be unrealistic to expect such a high score. A score of 40 indicates most of the comments were at least at the analysis level, or that the ratio was very heavily skewed to only analysis level and higher comments. Even if half (50%) of the comments were at the analysis level and the remaining 50% were evenly spread over the other cognitive levels the overall weighted cognitive score would be less than 40 (36.00). If 50% of the comments were at the knowledge level and the remaining 50% were at the highest levels of synthesis or evaluation the overall weighted cognitive score is still less than 40 (30.00). Using the percentages of cognitive behavior displayed (Tables 1 and 2) may be preferable to using the weighting system in describing the discussions. The percentages may be more easily compared to results of other studies.

The questions were designed to illuminate course content, and whenever possible, to allow students to use their own experiences as part of the discussion. The questions were meant to prompt discussion that would develop and evolve based on the students' interaction and discourse. The class discussions were guided by questions that were intended to push students to higher levels of cognition and deeper discussions, but to do so there were still points of fact, statements of comprehension, and experiences to share in order to build the discussion. The lower levels of thinking exhibited by these and

similar activities are necessary for a good discussion, and these appeared to be fairly frequent in the student's entries. Lower cognition levels are the base upon which students are able to progress through the hierarchy (Ewing & Whittington, 2009).

This research indicates that these discussions were primarily at lower cognitive levels, which is similar to results found in the cognitive levels of instruction found in the Whittington studies. A desired level of HOTS/CT was not pre-established, but comparisons to other cognitive level studies show these percentages to be below instructor's desired levels of cognition (as were the assessed cognitive levels in the studies). If, in fact, these students are unable to utilize analytical thinking skills they may be insufficiently prepared for future jobs or job changes (AMA, 2010). Research indicates (Hansen & Hansen, 2007; SHRM, 2008) that employers are seeking employees proficient in analysis, able to synthesize new and changing information and able to evaluate what needs to be done to accomplish tasks and solve problems. The results from this study in isolation may not indicate a HOTS/CT crisis, but if they are part of a trend, future employers may have to spend more training dollars in developing missing skills (Kreitzberg & Kreitzberg, 2009). Educational programs that are able to establish and build HOTS/CT in students will graduate learners who are highly sought by employers (NCR CTE, 2010).

Perhaps the thinking style (field-dependence, Gregorc, VAK, etc.) of the instructor or the students affects which format is preferred. Instructors and students who value concrete and linear handling of a topic would be most comfortable with an asynchronous discussion, while those who appreciate a more dynamic and free-flowing

discussion, that may change direction and tone often would be best suited to synchronous online discussion (Cano & Metzger, 1995; Myers & Dyer, 2006).

Given a weighted cognitive level score of 40 seems unlikely; what then is a reasonable and acceptable weighted cognitive level score? What score would indicate a *sufficient* amount of higher order thinking? Most likely the determination of a sufficient weighted cognitive level score would vary depending upon the class objectives, and to what extent those objectives include HOTS/CT. It might be appropriate as long as there are enough comments at each level for even a very small percentage. Another goal might be for the cognitive scores to increase as the semester progresses or for certain cognitive level percentages to show increases over time. For example, in this study there were no evaluative comments, so a reasonable mid-semester goal might be for evaluative comments to be present in the discussions from the latter half of the semester. There is a dearth of research on what constitutes sufficient HOTS/CT or even what mean weighted cognitive scores are at various grade levels, various subjects, or instruction types.

Social constructivism and Garrison's concept of Social Presence (2000, 2001, 2007, and 2010) suggested that when students work together meaning-making is more prevalent (Scardamalia & Bereiter, 1996); however, assessing weighted cognitive scores for individuals could prove very informative. Weighted cognitive level scores could become a component of graded work. Individual students could be evaluated based on gains over time and determining specific teaching methods that improve individual scores would be easier to isolate.

The low occurrence of HOTS/CT in both the synchronous and asynchronous groups seems to run counter to the idea of Social Constructivism. However, it is unknown what the weighted cognitive scores would have been had the students been tested individually or in smaller groups, or in a less interactive setting. There is enough research to suggest that cooperative and collaborative work does extend student success and thinking (Garrison, 2000; Garrison, Anderson & Archer 2001, 2010; Curtis, 2004; Brown, 2001). The finer points of logistics and specifics regarding strategy and method need to be further researched. It is also possible that distance education students do not generally get the same or enough sense of community (Bender, 2003) required to spur each other on and deepen and develop their arguments and comments. However, as the asynchronous group actually exhibited a higher overall weighted cognitive level in their comments it seems unlikely that Social Constructivism worked in the asynchronous group, but not the synchronous one.

Distance education classes provide opportunities for learning focused social interaction to be available to almost every student when and where it is convenient for that student (Lang, 2005). If HOTS/CT were not demonstrated in these discussion then the participating students may not have identified the discussions as socially interactive. It is possible that these students, many of whom take mostly distance classes, are not willing to engage and/or are not looking for a social component to their studies.

Current technology requires most online interaction to be of a written form. While writing itself is indicated as a boon to analytic thinking (Zinser, 1998) discomfort with writing could negate that advantage (Murphy, Lindner, Kelsey & Wingenbach,

2005, National Commission on Writing, 2004). Although data was not collected on the specific writing experience or writing enjoyment of these students, they may not find written discussion as engaging as in person discussion. Observing and calculating weighted cognitive scores for students while participating in verbal discussion might indicate higher overall scores.

While neither group demonstrated anything but small forays into HOTS/CT, the asynchronous group did have a higher weighted cognitive level score overall and in each discussion. Given these results it seems that allowing time for reflection, processing, and or editing and review of discussion comments before posting, as occurs in asynchronous discussion, results in higher weighted cognitive behavior for discussants.

This study was at the exploratory level, and as such provides but a glimpse into the cognitive behaviors of online discussion students. Only when it is combined with additional studies of the same and similar type can irrefutable conclusions be drawn.

Recommendations for Practice

The results of this study do inform and advise instructors (particularly online instructors) who wish to develop HOTS/CT in their students. Changes in methodology and practice should be considered, as should a variety of software and application changes.

One recommendation may be to utilize both synchronous and asynchronous delivery for the same group of students during the semester. While cognitive scores were higher for the asynchronous group there appeared to be more interaction and a greater

social presence in the synchronous group. If both techniques are used students may receive the benefits of both and cognitive scores may increase. Synchronous discussion lends itself to exchanges early in the semester to let students get to know one another. Using synchronous discussion occasionally throughout the semester may strengthen the social presence quotient and encourage students to challenge, help, and develop together. Using both delivery modes as components of a larger strategy for HOTS/CT skill development and content mastery might prove even more successful. It is unknown the contribution delivery modes make. An analysis of the role specific methodologies play in HOTS/CT growth would be valuable.

While this study indicates that neither synchronous nor asynchronous online discussion appears to effectively bring about HOTS/CT in students it does not mean these approaches are worthless, nor does it mean that online discussion is a poor method. Certainly both types of online discussion may serve students well as a means to learn and understand course content. While this was not specifically tested, the cognitive levels indicate much activity in the knowledge and comprehension arenas so online discussion may be well-suited for obtaining and comprehending subject-matter information and core ideas. Additionally there is research to indicate that contact and communication between and among students helps foster a sense of community and connection (Bender, 2003; Lang, 2005; Curtis, 2004; Brown, 2001). Students who feel isolated may be at a disadvantage when it comes to learning, processing, and retention. A sense of belonging has been demonstrated to positively affect persistence (willingness to stay in the class). Garrison (2000), Garrison, Anderson & Archer (2001, 2010), Garrison & Arbaugh (2007)

are researching how great this social component of online education is in terms of impact on learning. Research to date indicates this social component is important and online discussions (particularly synchronous) are a good way to get it. Using a variety of methods and strategies is considered good teaching. There is much to indicate synchronous and asynchronous online discussion are worthy of continuing to be used by teachers.

As discussion can play a strong role in cognition, and questioning is integral to discussion establishing stronger questioning techniques would likely benefit student learning. Learning effective and appropriate questioning techniques is crucial to good teaching and especially important if course objectives and overall goals involve acquiring and developing HOTS/CT. There is much research on questioning that could be reviewed; trainings or workshops on effective techniques and strategies could also be utilized. It is also important to pay attention to each class of students and what works for them.

Asynchronous discussion elicited higher weighted cognitive level scores; if only one delivery method can be used, then asynchronous should be chosen. This also maintains the temporal flexibility that online students desire. Good planning and curriculums are needed to create instruction and content that sparks interest and resonate with students so reflection occurs.

Recommendations for Research

Replication is the key to being able to make experimental results, such as these, broadly generalizable. To that end, studies that specifically utilize the FTCB and the

weighting system should be conducted to strengthen these results. Other studies regarding teaching methods that elicit HOTS/CT, especially those conducted in online scenarios should be undertaken.

Data regarding the frequency of cognitive levels displayed could inform practice more fully if acceptable or desired percentages of cognitive behavior could be pre-established. Research into acceptable percentages for cognitive levels needs to be done. This research could then inform practice and percentages of cognitive behavior displayed by class, by individual, or by method could used to track learning and provide a means for evaluation and assessment.

Although online and distance education is not a brand new field, there are still significant gaps in the literature. Researchers seem to be just beginning to explore specific techniques, methods, and strategies intended to generate deep, analytical thinking. Additionally, the technology changes so quickly and significantly that new options for content and instructional delivery are very dynamic. Changes in logistics may always allow for innovation, however, that should not prevent practitioners from researching current procedures. Finding andragogically sound practice for developing HOTS/CT in online classes will benefit online education greatly.

The primary recommendation is for the study to be replicated in other departments within the college, within other colleges at the university and also at other universities. Additionally replications of this study with greater numbers of participants would yield a greater effect size for the conclusions drawn. If there is an advantage to one delivery method or the other (synchronous or asynchronous) it would be beneficial

for improving the cognitive level (and therefore the quality, depending on objectives) of online discussion. Such an advantage can only be indicated based on empirical evidence. It would benefit the field of distance education to conduct research to try and ascertain this empirical evidence.

References

Agresti, A. & Finlay, B. (1997). *Stastical methods for the social sciences.* Upper Saddle River, NJ: Prentice Hall.

Allen, I. E. & Seaman, F. (2007). *Online nation: Five years of growth in online learning.* Needham, MA: Sloan Consortium.

American Management Association (AMA). (2010). *AMA 2010 Critical skills survey*. New York.

An, H., Shin, S., Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussions. *Computers and Education*. 53. (749-760).

Arends, R. I. (1996). *Classroom instruction and management*. New York: McGraw-Hill.

Arends, R. I. (2004). *Learning to teach.* New York: McGraw Hill.

Association of American Colleges and Universities. (2010). *Raising the bar: Employers' views on college learning in the wake of the economic downturn*. Washington, DC: Hart Research Associates.

Ball, A. L. and Garton, B. L. (2005). Modeling Higher Order Thinking: The Alignment Between Objectives, Classroom Discourse, and Assessments. *Journal of Agricultural Education, 46*(2), 58-69. doi:10.5032.jae.2005.02058

Bender, T. (2003). *Discussion-based online teaching to enhance student learning.* Sterling, VA: Stylus.

Berge, Z. L. & Muilenburg, L. (2000). Designing discussion questions for online, adult learning. *Educational Technology, 40*(5), 53-56.

Beyer, B. K. (1987). *Practical strategies for the teaching of thinking.* Newton, MA: Allyn and Bacon, Longwood Division.

Black, E. W., Dawson, K. & Priem, J. (2008). Data for free: Using LMS activity logs to measure community in online courses. *Internet and Higher Education,11*, 65-70. doi:10.1016/j.iheduc.2008.03.002

Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain.* New York: David McKay Company, Inc.

Boyd, B. L., Murphrey, T. P. (2002). Evaluation of a computer-based, asynchronous activity on student learning of leadership concepts. *Journal of Agricultural Education, 43*(1), 36-45. doi:10:5032/jae.2002.01036

Breach, L.K. (2005). Enhancing online collaboration: Virtual peer review in the writing classroom. In K. C. Cook & K. Grant-Davie (Eds.), *Online education: global questions, local answers* (pp. 141-156). Amityville, NY: Baywood.

Briggeman, B. C. and Norwood, F. B. (2011). Employer assessment of the college graduate: What advisors need to know. *Journal of Natural Resources and Life Science Education, 40,* 19-28. doi:10.4195/jnrlse.2009.0040

Brookfield, S.D. (1987). *Developing critical thinkers*. San Francisco: Jossey-Bass.

Brown, B. B., Ober, R. L., Soar, R. & Webb, J. N. (1966). *Florida taxonomy of cognitive behavior.* Gainesville, FL: University of Florida.

Brown, R. E. (2001). The process of community-building on distance learning classes. *Journal of Asynchronous Learning Networks, 5* (2), 18-35.

Bruner, J. S. (1996). *The culture of education*. Cambridge: Harvard University Press.

Brualdi, A. C. (1998). Classroom questions. ERIC/AE digest. *ERIC Clearinghouse on Assessment and Evaluation*. Washington, DC: Educational Resources Information Center. Retrieved from http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED422407.

Cano, J. & Garton, B. L. (1994). The relationship between agriculture preservice teachers' learning styles and performance in a methods of teaching agriculture course. *Journal of Agricultural Education, 35*(2), 6-10.

Cano, J. & Metzger, S. (1995). The relationship between learning style and levels of cognition of instruction of horticulture teachers. *Journal of Agricultural Education, 36*(2), 36-43.

Cobb, P. (1994). Constructivism in mathematics and science education. *Educational Researcher, 23*(7), 4.

Cole, M. (1985). The zone of proximal development-where culture and cognition create each other. In J. Wertsch (Ed.), *Culture, communication, and cognition: Vygotskian perspectives.* New York: Cambridge University Press.

California Distance Learning Project. (2011). What is distance learning? Retrieved from http://www.cdlponline.org/index.cfm?fuseaction=whatis&pg=3.

Crotty, T. (1995). Constructivist theory unites distance learning and teacher education. *Education at a Distance, 9*(4), J12-J16.

Cruickshank, D. R., Bainer, D. L., & Metcalf, K. K. (1999). *The act of teaching.* (2nd ed.). Boston: McGraw-Hill College.

Curtis, R. (2004). Analyzing students' conversation in chat room discussion groups. *College Teaching, 52* (4), pp.143-148.

Davis, B. G. (1993). *Tools for teaching. (*1st ed.). San Francisco: Jossey-Bass.

Dawson, S.D. (2006). A study of the relationship between student communication interaction and sense of community. *Internet and Higher Education, 9,* 153-162. doi: 10.1016/j.iheduc.1006.06.007

Dunne, J. and M. Morgan (1995). "Thinking Critically About Critical Thinking." *Irish Educational Studies*, Educational Studies Association of Ireland 14.

Edwards, M. C. (2004). Cognitive learning, student achievement, and instructional approach in secondary agricultural education: A review of literature with implications for future research. *Journal of Vocational Education Research*, *29*(3), 225-244.

Ellis, R. A., Goodyear, P. (2010) *Students' Experiences of e-learning in higher education.* Routledge: New York

Ellis, R. A., Goodyear, P., Prosser, M. & O'Hara, A. (2006). How and what university students learn through online and face-to-face discussion: conceptions, intentions and approaches. *Journal of Computer Assisted Learning,* 22(4), 244-256. DOI: 10.1111/j.1365-2729.2006.00173.

Ewing, J.C., Whittington, M.S. (2009). Describing the cognitive level of professor discourse and student cognition in college of agriculture class sessions. *Journal of Agricultural Education,* 50(4). pp. 36-49.

Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. Millbrae, CA, The California Academic Press**:** 19.

Facione, P.A., Sanchez, C. A., Facione, N. C. & Gainen, J. (1995). The disposition toward critical thinking. *The Journal of General Education, 44*(1), 1-25.

Farmer, B., Yue, A. & Brooks, C. (2008). Using blogging for higher order learning in large cohort univeristy teaching: A case study. *Australasian Journal of Educational Technology , 24* (2), 123-136.

Fisher, C.B. & Grant, G.E. (1983). Intellectual levels in college classrooms. In C.L. Ellner & C.P. Barnes (Eds.), Studies in college teaching, p. 47-60. Lexington, MA: D.C. Heath & Co.

Fogarty, R., McTighe, J. (1993). Educating teachers for higher order thinking: The three-story intellect, *Theory into Practice,* 32 (3).

Fraenkel, J. & Wallen, N. (2009). *How to design and evaluate research in education.* New York: McGraw Hill.

Garrison, D. R. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *Internet and Higher Education , 2* (2-3), 87-105.

Garrison, D.R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance*

Education, 15(1), 7-23.

Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the community inquiry framework: a retrospective. *Internet and Higher Education, 13,* 5-9. doi:10.1016/j.iheduc.2009.10.003

Garrison, D. R. & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *Internet and Higher Education, 10,* 157-172. doi:10.1016/j.iheduc.2007.04.001.

Gelhouse (Gelhaus), D, (2007-8). What can I do with my liberal arts degree? *Occupational Outlook Quarterly, 51(4)*

Gent, I., Johnston, B., & Prosser, P. (1999) Thinking on your feet in undergraduate computer science: A constructivist approach to developing and assessing critical thinking. *Teaching in Higher Education, (4)* 4.

Gerber, S., Scott, L., Clements, D. H., Sarama, J. (2005). Instructor influence on reasoned argument in discussion boards. *Education Technology Research and Development, 53*(2), 25-39.

Glaser, E. (1941). *An experiment in the development of critical thinking*. New York, J. J. Little and Ives Company.

Goodrich, C. (2008). Using web-based software to enhance student learning of analytical and critical skills. *Educational Technology Systems, 36*(3), 247-253. doi:10.2190/ET.36.3.b.

Hansen, R.S., and Hansen, K. (2007). Quintessential Careers: What Do Employers *Really* Want? Top Skills and Values Employers Seek from Job-Seekers. Available at

http://www.quintcareers.com/printable/job_skills_values.html (accessed March 20, 2011).

Harvard Graduate School of Education. (2011). *Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century.* Cambridge, MA: Author.

Huang, H. (2002). Toward constructivism for adult learners on online learning environments. *British Journal of Educational Technology, 33* (1), 27-37.

Huitt, W. (1998). Critical Thinking. [On-line.] Available: http://chiron.valdosta.edu/whuitt/col/cogsys/critthink.html.

J. Bandini. (2011, January 26). Top skills for job candidates – NACE [Web log post]. Retrieved from http://sbm.temple.edu/blogs/cspd/2011/01/26/top-skills-for-job-candidates-nace/.

Johnson, R.T., Johnson, D.W. (1985). Student-student interaction: Ignored but powerful *Journal of Teacher Education* 36 (4): 22-26. doi: 10.1177/002248718503600406.

Johnson, D.W., Johnson, R.T., Holubec, E. J. (1994). *Cooperative learning in the classroom.* Alexandria, VA: Association for Supervision and Curriculum Development.

Jones, J.M., & Safrit, R.D. (1994). *Developing critical thinking skills in adult learners through innovative distance learning.* Paper presented at the International Conference on the Practice of Adult Education and Social Development, Jinan, China, April 13-18.

Kaasboll, J. J. (1998). Teaching critical thinking and problem defining skills. *Education and Information Technologies, 3*, 101-117.

Kolb, D. A. (1984). *Experiential learning: experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice Hall.

Knowles, M.S., Holton III, E. F., & Swanson, R. A. (2005). *The adult learner: The definitive classic in adult education and human resource development*. (6th ed.). Amsterdam: Elsevier.

Kreitzberg, A.P. and Kreitzberg, C. B., 2009, Critical thinking: A business survival skill for the 21st century, www.cognetics.com, accessed March 20, 2011.

Lang, S. (2005). Replicating and extending dialogic aspects of the graduate seminar in distance education. In K. C. Cook & K. Grant-Davie (Eds.), *Online education: global questions, local answers* (pp. 157-176). Amityville, NY: Baywood.

Lee, K. (2007). Online collaborative case study learning. *Journal of College Reading and Learning, 37*(2), 82-100.

Lipman, M. (1991). Thinking in education. Cambridge: Cambridge University Press.

Marzano, R. J. (1993). How classroom teachers approach the teaching of thinking. *Theory Into Practice, 32,* 154-160.

McKeachie, W. J., & Svinicki, M. (2006). *Teaching tips: Strategies, research and theory for college and university teachers.* (Eds). New York: Houghton Mifflin Company.

McMillan, J. H. (2004). *Educational research: Fundamentals for the consumer*. Boston: Pearson/A and B.

Miller, C. (1989). *Cognitive levels of instruction and student performance in college of agriculture courses.* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 9014458)

Miller, G., & Pilcher, C.L. (2001). Levels of cognition reached in agricultural distance education courses in comparison to on-campous courses and to faculty perceptions concerning an appropriate level. *Journal of Agricultural Education* 42(1) pp. 21-28.

Mills, S. R., Rice, C. T., Berliner, D. C., & Rousseau, E. W. (1980). The correspondence between teacher questions and student answers in classroom discourse. *Journal of Experimental Education, 48,* 194-204.

Miri, B., David, B. & Uri, Z. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research in Science Education, 37,* 353-369. doi:10.1007/s11165-006-9029-2

Moore, G. & Wilson, E. B. (2005). Perceptions of graduate students taking on-line and on-campus courses. *Journal of Agricultural Education*. 46(4) pp.23-35.

Moore, M. G. & Kearsley, G. (2005). *Distance education: A systems view*. Belmont, CA: Thomson Wadsworth.

Murphy, T.H., Lindner, J.R., Kelsey, K.D., Wingenbach, G.J. (2005). Authenticated writing competencies of agricultural education graduate students: A comparison of distance and on-campus students. Journal *of Agricultural Education*. 46(4) pp. 13-22.

Myers, B.E., Dyer, J.E.. (2006). The influence of student learning style on critical thinking skill. *Journal of Agricultural Education.* 47 (1), pp. 43-52.

National Academy of Sciences. Committee on a Leadership Summit to Effect Change in Teaching and Learning, National Research Council. (2009*). Transforming agricultural education for a changing world: Breaking down silos in the university.* http://www.nap.edu/catalog/12602.html accessed February 15, 2011.

National Center on Education and the Economy. (2007). *Tough choices or tough times*. San Francisco: Jossey- Bass.

National Commission on Writing. (2004). *Writing: A ticket to work...or a ticket out*. Princeton, NJ: College Entrance Examination Board.

National Research Center for Career and Technical Education (NRC CTE). (2010). *Professional development for secondary career and technical education: Implications for change.* Louisville, KY: Author.

Newcomb, L. H., McCracken, J. D., Warmbrod, J. R. & Whittington, M. S. (2004). Methods *of teaching agriculture.* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Newcomb, L. H. & Trefz, M. K. (1987). Levels of cognition of student tests and assignments in the College of Agriculture at The Ohio State University. *Proceedings of the Fourteenth Annual National Agricultural Education Research Meeting,* Las Vegas, NV, 182-18.

Norris, S. P., Ennis, R. H. (1989). Evaluating critical thinking. *Teaching thinking*. R. J. S. D. N. Perkins. Pacific Grove, CA, Midwest Publications.

Palinscar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology , 49,* 345-375.

Paraskevas, A. & Wickens, E. (2003). Andragogy and the Socratic method: The adult learner perspective. *Journal of Hospitality, Leisure, Sport & Tourism Education, 2*(2), 4-14. doi:10.3794/johlste.22.20

Parkinson, M. G. & Ekachai, D. (2002). The Socratic method in the introductory PR course: An alternative pedagogy. *Public Relations Review, 28,* 167-174.

Partnership for 21st Century Skills. (2008). *21st century skills standards*. Tucson, AZ: Author.

Pascarella, E. & Terenzini, P. (1991). *How college affects students: Findings and insights from twenty years of research.* San Francisco: Jossey Bass.

Paul, R. W. (2009). The foundation for critical thinking. Retrieved from http://criticalthinking.org/print-page.cfm?pageID=9.

Polite, V. C. & Adams, A. H. (1996). Improving critical thinking through Socratic seminars. *Spotlight on Student Success, No. 110.* Philadelphia, PA: Mid-Atlantic Laboratory for Student Success.

Quitadamo, I. J. & Kurtz, M. J. (2007). Learning to improve: Using writing to increase critical thinking performance in general education biology. *CBE-Life Sciences Education, 6,* 140-154. doi:10.1187/cbe.06-11-0203.

Ramos, M. A. S. (2010). Blog and complex thinking: A case study? *US-China Education Review, 7*(8), 11-21.

Resnick, L.B. (1987). *Education and learning to think.* Washington, D.C. National Academy Press.

Rovai, A. P. (2006). Facilitating online discussions effectively. *Internet and Higher Education, 10,* 77-88.

Rowe, M. B. (1974a). Wait time and rewards as instructional variables, their influence on language, logic, and fate control. Part one: Wait-time. *Journal of Research in Science Teaching, 11,* 81-94.

Rudd, R., Baker, M, Hoover, T. (2000). "Undergraduate Agriculture Student Learning Styles and Critical Thinking Abilities: Is there a relationship?" *Journal of Agricultural Education* 41(3): 2-12.

Scardamalia, M. & Bereiter, C. (1996). Engaging students in a knowledge society. *Educational Leadership* (0013-1784), 54 (3), p. 6.

Simon, A. & Boyer, E. G. (1970). *Mirrors for behavior II* (Special Edition). Philadelphia: Classroom Interaction Newsletter.

Society for Human Resource Management. (2008, February). SHRM 2007 Symposium on the Workforce Readiness of the Future U.S. Labor Pool: Executive Summary, Alexandria, VA. {Critical skills needs and resources for the changing workforce: Keeping skills competitive. The Wall Street Journal, Career Journal.}

Sternberg, R.J. (1985). Teaching critical thinking, part 1: Are we making critical mistakes? *Phi Delta Kappan 67*(3). 194-198.

Terenzini, P.T., Springer, L., Pascarella, E.T., & Nora, A. (1995). Influences affecting the development of students' critical thinking skills. *Research in Higher Education (36)*1, 23-39.

Torres, R. M. & Cano, J. (1995). Critical thinking as influenced by learning style. *Journal of Agricultural Education, 36*(4), 55-62. doi:10.5032/jae.1995.04055.

Underbakke, M., Borg, J. M., & Peterson, D. (1993). Researching and developing the knowledge base for teaching higher-order thinking. *Theory Into Practice, 32*,138-146.

Vrasidas, C. (2000). Constructivism versus objectivism: Implications for interaction, course design, and evaluation in distance education. *International Journal of Educational Telecommunications , 6* (4), 339-362.

Warmbrod, J.R., Christensen, J., Copeland, E., Ferree, D., Gustafson, R., Ludwig, B., McDonals, M. & Swank, C.W. (1989). *The Ohio State University College of Agriculture Strategic Plan*. Columbus, OH: The Ohio State University.

Whittington, M. S. (1991). Aspired cognitive level of instruction, assessed, cognitive level of instruction and attitude toward teaching at higher cognitive levels (Doctoral dissertation, The Ohio State University, 1991). *Dissertation Abstracts International, 52,* 1615.

Whittington, M. S. (1995). Higher-order thinking opportunities provided by professors in college of agriculture classrooms. *Journal of Agricultural Education, 36*(4), 32-38.

Whittington, M. S. (1998). Improving the cognitive level of college teaching: A successful faculty intervention. *Journal of Agricultural Education, 39*(3), 31-40.

Whittington, M. S., Stup, R. E., Bish, L., & Allen, E. (1997). Assessment of cognitive discourse: A study of thinking opportunities provided by professors. *Journal of Agricultural Education, 38*(1), 46-53.

Whittington, M. S. & Newcomb, L. H. (1993). Aspired cognitive level of instruction, assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels. *Journal of Agricultural Education*, *33*(2), 55-62.

Wilen, W. W. (2004). Refuting misconceptions about classroom discussion. *The Social Studies, (95)*1, 33-39. doi:10.3200/TSSS.95.1.33-39.

Wilen, W. W. (1991). Questioning skills for teachers. What research says to the teacher. Third edition. Washington, DC: National Education Association. (ERIC Document Reproduction No. 332 983).

Williams, V. S. & Williams, B. O. (2000). Facilitating higher order thinking: New teacher's dilemma. *Annual Proceedings of Selected Research and Development Papers Presented at the National Convention of the Association for Educational communications and Technology.* Denver, CO., 161-166.

Zinnser, W. K. (1998). *On writing well: The classic guide to writing non-fiction.* New York: Harper Perennial

Appendices

Appendix A

Florida Taxonomy Of Cognitive Behavior

1.1 Knowledge of Specifics						
1. Reads						
2. Spells						
3. Identifies something by name						
4. Defines meaning of a term						
5. Gives a specific fact						
6. Tells about an event						
1.2 Knowledge of ways and means of dealing with specifics						
7. Recognizes symbol						
8. Cites a rule						
9. Gives chronological sequence						
10. Gives steps of process, describes method						
11. Cites trend						
12. Names classification system or standard						
13. Names what fits given class. system or standard						
1.3 Knowledge of universals and abstracts						
14. States generalized concept or idea						
15. States a principle, law, or theory						
16. Tells about organization or structure						
17. Recalls name of principle, law, or theory						
2.0 Translation						
18. Restates in own words or briefer terms						
19. Gives concrete examples of an abstract idea						
20. Verbalizes from a graphic representation						
21. Translates verbalization into graphic form						
22. Translates fig. statements into lit. statements						
23. Translates foreign lang. into Eng. or vice versa						
3.0 Interpretation						
24. Gives reason (tells why)						
25. Shows similarities and differences						
26. Summarizes or conc. from obs. of evidence						
27. Shows cause and effect relationship						
28. Gives analogy, simile, metaphor						
29. Performs a directed task or process						
4.0 Application						
30. Applies previous learning to new situations						
31. Applies principle to new situation						
32. Applies abstract know. in a practical situation						
33. Identifies, selects, and carries out a process						

5.0 Analysis						
34. Distinguishes fact from opinion						
35. Distinguishes fact from hypothesis						
36. Distinguishes conc. from supporting statements						
37. Points out unstated assumption						
38. Shows interaction or relation of elements						
39. Points out particulars to justify conclusions						
40. Checks hypotheses with given information						
41. Distinguishes relevant from irrelevant statements						
42. Detects error in thinking						
43. Infers purpose, point of view, thoughts, feelings						
44. Recognizes bias or propaganda						
6.0 Synthesis (Create)						
45. Reorganizes ideas, materials, processes						
46. Produces unique communication, divergent idea						
47. Produces a plan, proposed set of operations						
48. Designs an apparatus						
49. Designs a structure						
50. Devises a scheme for classifying information						
51. Formulates hypotheses, intelligent guesses						
52. Makes deductions from abstract symbols, prop.						
53. Draws inductive generalization from specifics						
7.0 Evaluation						
54. Evaluates something from evidence						
55. Evaluates something from criteria						

Appendix B

Discussion Questions

FORUM 1
By Sunday night please post a substantive comment on the following questions:
A) How does STEM impact Ag Ed (if you don't remember what STEM is, double check Bledsoe's presentation). What needs to be done in a programmatic way to incorporate STEM into Ag Ed. What about in a personnel way?
Also remember that Bledsoe's "Components of Vision" were
1-Ag Ed should be available to all NC students
2-Abundant supply of quality Ag Ed teachers
3-Quality Ag Ed programs
4-Quality FFA opportunities and experiences
5-Ag Ed is an important stakeholder in NC education & NC agriculture

B) Pick one of these 5 components, explain what it means, and then explain why you think it is the most important of the 5.

FORUM 2
Dr. Zublena gives us the equation: NEEDS + ASSETS = OPPORTUNITIES.
Pick one of the following Extension scenarios (from the Zublena .ppt) and explain what the NEEDS might be and what the ASSETS might be. Then explain WHY you chose those NEEDS and those ASSETS.

For example for the scenario of - *Having local officials see victories as theirs too*. I might suggest that the NEEDS are if local officials feel invested in community program successes that will help create 'buy-in' for local programming so that they will assist where possible (permits, approvals, PR, etc.). This helps fulfill the general NEED for successful local programming, and might also fulfill specific programmatic needs for local events. In the future those same officials probably can be relied upon as ASSETS who are willing to give of their time, energy, and position. The relationship between programming agents and those officials also becomes an ASSET. I chose those NEEDS and ASSETS because I think the main issue about involving people of power is about partnerships and linkages. Not only are the specific gifts and talents of the official added to you ASSET list, but the very relationship becomes an ASSET.

Scenarios:
Collaboration with other community orgs and non-profits
Involve local officials **Diversity at every chance**
Marketing of impacts **Advisory leaders**
Collaboration with businesses **Using mass media**

Please make a substantive post by Sunday night.

Forum 3
This week's lesson attempts to cover the very broad topic of agricultural economics. Let's concentrate on the tools and techniques used by Ag Econ professionals in anticipating changes in the economy.

First, weigh in on whether Risk Managers need to be futurists (and study Trends & Issues) to be successful; be sure to explain why or why not. Also be sure to comment on another student's post either agreeing or disagreeing with them and give reasons why. Your initial post is due Sunday night (Feb 14th) and your response is due by Wednesday, Feb. 17th.

Remember the You Decide articles from Ag Econ Specialist Mike Walden? Review his comments and then make your own substantive comments (by Sunday, Feb 14) regarding this question- **Is innovation the key to prosperity?** Then by Wed, Feb 17th be sure to reply to at least one other post explaining what AEE professionals can do to support and encourage innovation. Be specific, think about programs, activities, technologies, etc.

Forum 4
After reading the articles for the Legislation lesson and listening to the Elluminate recording of Jay Boyette please comment on the following discussion questions.

By Sunday, February 21st-
1.) **Why** is it important for farmers and anyone involved in AEE professions to follow "ag" legislation?What will they gain by being aware of the bills and laws of NC?Make sure you give reasons why and how it's important.

2.) Then offer suggestions for this question - What ways can individuals influence legislative changes?

By **Wednesday, February 24th-**
A.) Reply to at least one other person's #1 post with a substantive comment.

B.) Also, discuss and/or debate with at least one other classmate which ways (that individuals can influence legislative change) are best and WHY.

Forum7
If your first name begins with A-L your option is conservation easements.
If your first name begins with M-Z your option is Voluntary Ag Districts.

By Sunday night make a posting describing (in terms a non-ag person could understand) what your option is and how it works. Then generate and describe at least 3 specific advantages of your option as a method of farmland preservation. By Wednesday (3/10) night please reply to at least one person with the other option and offer at least 3 counters

to their advantages and/or generate your own disadvantages or concerns.

Additionally by Friday (3/12) night please offer at least one well-defined programmatic (Ag Ed or Ext Ed) option for addressing the issues raised in the Farm Transition Network Workbook. This was the document that discussed that older farmers fear no longer being the decision maker and younger farmers fear that they will not get to be the decision maker in family farmland transition situations.

Forum8
We never really had a discussion regarding the commodities lesson so:

By **Sunday March 14th** please reply to the following:
1a) What is the **relationship** between commodities and subsidies?
1b) What would happen if the subsidies were removed? (think short term and long term too).

By **Sunday March 21st** reply to at least one person's post by addressing:
2a) Given the relationship the poster described will the commodity market prices remain as volatile as they have been? Why or why not.
2b) How should Ag and/or AEE professionals respond to these long term results? How will it affect their programming?

You can reply to one person with both responses or two different people.

Forum9
After listening to the Elluminate recording from March 24th, 2010 please make a substantive post regarding the following.

By Sunday, March 28th discuss the results and ramifications of the situation when the demographic makeup of school-age children does NOT match the demographic makeup of voters. Be sure to describe the situation. What population changes (not racial) may make this discrepancy likely in many places over the next 20-30 years?

By Wednesday, April 2nd reply to at least one student with your estimation of how the population they mentioned (in the last part of the first question) would react to the idea and use of year-round schools? Why?

Forum10
By Sunday night choose one of the 10 Threats and describe at least one way either Extension or Ag Ed is attempting to address that threat. Explain the program well and provide your assessment as to the success of the program. It might help if you could find data that supports your assessment.

By Wednesday (4/7) reply to another's post with at least one criticism of the program they described and how you think that problem could be lessened. The point is not to tear down programs, but to evaluate and try to improve their effectiveness.

After completing the reading and listening to the Elluminate recording from April 14th please respond to the following questions.

By Sunday night: Dr. Jayaratne talked about the trends/issues cycle. One of the issues from economic trends is 'Serving local needs with a global perspective' please explain what that means to you and give an example that demonstrates your interpretation of that issue.
Also by Sunday night: Dr. Wilson talked about the money/policy/accountability cycle. Give an example (that wasn't discussed on Elluminate) of that cycle, and explains how that cycle works.

By Wednesday night reply to a Jayaratne post and a Wilson post and evaluate the student's comments. Did they clearly demonstrate their understanding of the terms and concepts. If you had only their example to go by would YOU be able to understand the terms and concepts?
The point of the second exercise is not to "grade" each other, but to demonstrate your ability to evaluate. Remember this lesson is about accountability; demonstrate that you are able to hold each other accountable.

Appendix C

Discussion Rubric

AEE 505 Spring 2010 ALL DISCUSSIONS

For this class we will rely heavily on discussion to provide a place for us to interact and communicate. Class discussions are an important part of learning, and can be fun and informative too. Participation on these boards accounts for 20% of your total course grade. Please review the following rubric and descriptions. If you have questions or concerns contact Dr. Wilson or Sara.

	Level of participation & comments					
	None	Weak	Good	Great		
Criterion	0	1	2	3	Comments	Score
Message mechanics						
Course knowledge displayed						
New knowledge added						
Contribution						

Message mechanics—Class discussion comments will be posted by the due date. Messages should be respectful to all. Messages should be threaded correctly, and with an appropriate subject line. Class discussion comments need to be clear and easy to read. Perfect grammar is not expected, but mistakes that make messages difficult to understand do not contribute to the discussion.

Course knowledge displayed— Being able to incorporate the class material, previous discussion, presentations, and etc. is an essential element to successful discussion postings. Class discussion comments will demonstrate that the contributor has read the class material. Complete APA references are not required; however, offering someone else's work or words as your own is plagiarism. Be sure to cite the author of readings from class material or author and location for outside sources. For example "From the Knowles reading we see adult learners have experiences…" Provide enough information for outside sources that the article can be found by classmates or instructors who wish to access it.

New knowledge added—Class discussion comments will, when appropriate, integrate information from outside the class. Comments, that are relevant, are welcomed and encouraged from other courses, outside sources, and individual experiences. Complete APA references are not required; however, offering someone else's work or words as your own is plagiarism. Be sure to cite the author of readings from the class material and author and location for additional sources.

Contribution—Class discussion comments will contribute to the overall richness of the discussion and your classmate's experience. Students are encouraged to ask

questions of each other and to respectfully disagree or offer alternative interpretations. Students should also encourage and support comments that they find especially interesting or relevant. If commenting as a reply to another make sure that the connection, comment or question has been explained so that all class members see the relevance.

- **Remember**—the ability to integrate and evaluate the readings and postings into the overall objectives should be demonstrated. Successful dialogue and comments will demonstrate connections among postings and information. Facts and knowledge are important so please share those when appropriate, but what is done with facts and knowledge is also important. Good group discussions will build on that information. You may also find applications for the information or references to personal experiences. Each of you has unique thoughts and previous experiences that can benefit the discussions, please participate enthusiastically.
- **Respect**- others and their opinions.
- **Reference**- course concepts and readings.
- **Relevance**-provide relevant questions and comments.
- **Reflect**-think and then write.
- **Participate**- in required course activities.
- **Disagree**-be comfortable offering different points of view.
- **Reason**-provide rational, critical and thoughtful responses.
- **Encourage**- support and help one another.

Learn- and have fun with the discussion

Appendix D

Florida Taxonomy of Cognitive Behavior Statements/	Instances of Statement Seen in Discussion/														Totals
2.0 Translation															
18. Restates in own words or briefer terms															
19. Gives concrete examples of an abstract idea															
20. Verbalizes from a graphic representation															
21. Translates verbalization into graphic form															
22. Translates fig. statements into lit. statements															
23. Translates foreign lang. into Eng. or vice versa															
3.0 Interpretation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
24. Gives reason (tells why)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	x	x	x	x	x	x	x								**37**
25. Shows similarities and differences															
26. Summarizes or conc. from obs. of evidence	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	x	x	x	x	x										**20**
27. Shows cause and effect relationship	x	x	x												
															3
28. Gives analogy, simile, metaphor															
29. Performs a directed task or process															