A Comparison of Higher Order Thinking Skills Demonstrated in Synchronous and Asynchronous Online College Discussion Posts

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Abstract

Developing higher order thinking skills in students is an important task for higher education. Students who are competent analyzers, synthesizers, and evaluators become workers who are better prepared for the work challenges they will face. Class discussion, a long-standing and well-regarded instructional method, in online classes is either synchronous or asynchronous. Synchronous discussion is in real-time, often using chat or messaging applications. Asynchronous discussion typically uses online discussion boards where students respond to comments and questions from class-members. The intention of this study was to explore what higher order thinking skills develop naturally via student social constructivism. This exploratory study measured instances of higher order thinking skills in synchronous and asynchronous online discussion using the Florida Taxonomy of Cognitive Behavior. In this study, overall synchronous discussion was found to be at the knowledge level and overall asynchronous discussion was at the comprehension level. An experiment was conducted comparing overall cognitive levels of synchronous and asynchronous online discussion and a statistically significant difference in the overall cognitive level of comments between the two groups was found.

Introduction/Theoretical Framework

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 not only able 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.

The National Research Agenda for the American Association of Agricultural Educators has outlined key areas for research focus; a "*Sufficient Scientific and Professional Workforce that Addresses the Challenges of the 21st Century*" is among those goals that address this issue (Priority #3, Doerfert, 2011). 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. "*The need to provide a highly educated, skilled workforce capable of providing solutions to 21st century challenges and issues has never been greater*" (Doerfert, 2011, p. 19). In this new century and its information era higher order thinking 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 (Fellenz and Conti, 1989).

Jones and Safrit suggested that distance education may be uniquely able to develop student's higher order thinking skills because of the interactive and collaborative nature of distance education (Jones and Safrit, 1994). 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 and Goodyear, 2010). Online distance education (through both synchronous and asynchronous discussions) could be poised as a useful tool in building critical thinking abilities (Ellis and Goodyear, 2010). These thinking abilities are identified as no less than a requirement for survival in the complex technology age.

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Discussion is one of the best ways of demonstrating and sharing one's thoughts; Arends calls it the "externalization of thinking" (Arends, 2004, p. 428). Discussions involve students in their own learning (Davis, 1993) and serves as a way to practice thinking through problems, sorting concepts, and creating arguments and rebuttals. 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). When students work together to decipher meaning or construct ideas through communication it is called social constructivism (Scardamalia and Bereiter, 1996; Vrasidas, 2000). Arends (2004) noted that many instructors found online discussions work the same as face to face and sometimes even better. Purposeful dialogue about course content allows students 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.

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 in greater detail (Wilen, 2004), allowing for more social constructivism. Students do not feel pressured to respond as soon as a question is posed, allowing time to think about how they wish to respond. Asynchronous online discussions may provide a greater opportunity, for students to develop together a more complete answer, specifically one that exhibits higher order thinking skills.

The theoretical framework for this study was built upon Piaget's concept of constructivism, the basis for social constructivism as described by Vygotsky and Bruner (Bruner, 1996) and Scardamalia and Bereiter (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). 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 including other learners. For distance education Vrasidas (2000) used both constructivist and social constructivist lenses arguing knowledge has both individual and shared components.

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 et al., 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.

The overarching goal of Social Constructivism is to empower students in the task of "meaning making," in the "co-construction of knowledge" (Palinscar, 1998). Meaning making requires communication and contemplation of what we know and to what we are being exposed. Communication and contemplation occur in both external (social) and internal (reflective) settings. For Piaget reflection helped create higher order knowledge by allowing the resolution of components of lower level knowledge (Bruner, 1996). Social constructivism paves the way for this resolution to be found in the dialectic of online discussion. Learners must deliberate, ruminate, and consider many possibilities in order to determine what they think is correct. Then learners must perform those same actions and decide together what the meanings are and what the ideas or events represent.

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. 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 may be crucial in accessing higher order thinking skills.

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. 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).

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. Black et al. (2008) 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 ($r = 0.774$, $p < 0.01$) and community and learning community ($r = 0.597$, $p < 0.01$) (Black et al., 2008, p. 68). 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).

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 et al., 2006). Ellis and Goodyear purposefully chose online discussion as a means to provide possibilities for discussion, interaction, and social meaning making to their online class (Ellis and Goodyear, 2010). If, as Palinscar claimed, "Explaining one's thinking to another leads to deeper cognitive processing" (Palinscar, 1998, p. 349), then online discussion should be a successful arena for students to work together and grow their higher order thinking abilities.

Purpose

This exploratory study compared the higher order thinking skills in synchronous and asynchronous online discussion in a graduate level course by comparing the weighted mean cognitive level scores.

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

- What is the weighted cognitive level score of student comments made in each synchronous and asynchronous online class discussion?
- 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 0.10 level of significance: HO1: There is no significant difference in the overall mean cognitive level between synchronous and asynchronous online discussion.

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.

Materials and Methods

This study was exempted by the North Carolina State University Institutional Review Board. The questions of this study utilize an experimental research design. The independent variable (synchronous or asynchronous) was manipulated and the dependent variable (overall mean weighted cognitive level score of synchronous and asynchronous online discussion) was observed, the constant is that the same discussion questions were used. This scenario is experimental research as described by Fraenkel and Wallen (2009).

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. 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 are naturally developed by student social constructivism given the situation, population, and questions.

Participants of this study were the entire enrollment of a 2010 University's Agricultural and Extension Education (AEE 505) 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 fields, 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 (East Coast 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 stu-

dents 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.

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 (Miller (1989); Whitington and Newcomb (1993), Cano and Metzger (1995); Miller and Pilcher (2001); and Ewing and Whitington (2009)). 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 (Brown et al. 1966). 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).

Whitington and Newcomb (1993), Ewing and Whitington (2009), and Cano and 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 (Fraenkel and Wallen, 2009) coefficient of reliability of 0.93 (rater #1) and 0.94 (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 (Fraenkel and Wallen, 2009) coefficient of reliability of 0.88 was calculated.

The course utilized 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. Asynchronous students were required to post a specific number of times; synchronous students had to participate in discussion chat sessions. A rubric for assessing all discussion comments was provided to the students at the beginning of the semester. Online class discussion participation 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 provided. 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 (Moodle) Learning Management System software specifically the Forum or Chat function they used.

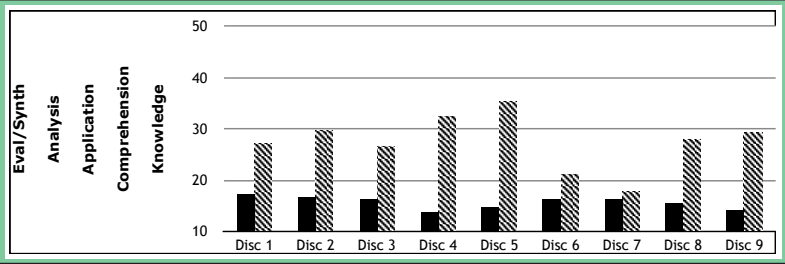
Once all the discussions concluded, two observers were given the discussion transcripts and used the FTCB's 55 descriptor statements to rate each comment. Once coding began the observers did not consult with each other regarding coding. The observers completed all of the synchronous discussion transcripts before they began the asynchronous transcripts. Within each delivery mode the nine discussions were not coded consecutively. This controlled for changes in expectations of the comment level as the semester progressed.

For this study, the FTCB was used to categorize students' cognitive behaviors via a written transcript of the discussion postings. The descriptor statements help the observer match comments to categories. As per the instructions for use of the FTCB (Whittington 1991, 1995; Whittington et al., 1997; Whittington and Newcomb, 1993; and Miller, 1989) 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. 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 0.1 for each comment made at the knowledge level (0.2 at the comprehension level, 0.3 at the application level, 0.4 at the analysis level, and 0.5 at both the synthesis and evaluation level) (Miller, 1989 and Cano and 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; Brown et al., 1966). So an analysis comment demonstrates that knowledge, comprehension, and application cognitive processes have already occurred in the discussant's mind.

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 <0.10. According to Agresti and Finlay (1997) an alpha level of 0.10 is acceptable for exploratory studies.

Figure 1. 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.

Results and Discussion

Question #1 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, knowledge = 0.10, comprehension = 0.20, application = 0.30, analysis = 0.40, and synthesis /evaluation = 0.50 (Miller, 1989). The sum of each level's scores equals the weighted cognitive level score for that discussion. Weighted cognitive level scores could range from 10 to 50 (the total percent possible is 100 with a minimum weight of 0.10 which equals 10 and a maximum weight of 0.50 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 higher order thinking 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 1 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).

Question #2 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 higher order and critical thinking skills, 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 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 (Bloom, 1956). The knowledge level is the first level and is considered a lower order thinking level. Results for the asynchronous discussion are grand mean 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: HO1: 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 1 details the t-test calculation. The p-value reported was 0.0002, which is less than the alpha of 0.10. The hypothesis was rejected; there is a difference in mean overall weighted cognitive level scores for synchronous and asynchronous groups.

Table 1. 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	0.0002
Asynchronous	9	27.46	5.38		-	-

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

[a] $p < 0.10$

Summary

Question 1 - 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. 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 the individual discussion weighted cognitive level scores was indicative of a higher order thinking taxonomic level.

Question 2 - 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 (Bloom, 1956). 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).

Research Hypothesis: HO1: There is no significant difference in the overall mean cognitive level between synchronous and asynchronous online discussion.

The hypothesis was rejected; there is a significant difference in mean overall weighted cognitive level scores for synchronous and asynchronous groups.

If online distance educators must choose between asynchronous and synchronous discussion, then asynchronous should be chosen because it elicited higher weighted cognitive level scores in this study. Asynchronous discussion may also be better because it provides online students with the temporal flexibility they often desire and the time they need for reflection.

Another 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. Using synchronous discussion occasionally throughout the semester may strengthen the social presence quotient and encourage students to challenge, help, and develop together. 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.

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 higher order and critical thinking skills in online classes will benefit online education greatly.

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 higher order thinking skills, especially those conducted in online scenarios should be undertaken. 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.

This research indicates that these discussions were primarily at lower cognitive levels, which is similar to results regarding cognitive levels of instruction found in the Whittington studies (Whittington, (1991); Whittington, and Newcomb, (1993); Whittington, (1995); Whittington et al.,1997); Ewing, Whittington, (2009). A desired level of higher order thinking skills 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 or unprepared to utilize analytical thinking skills they may be insufficiently prepared for future jobs or job changes (AMA, 2010). Research indicates (Hansen and 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 do not indicate a higher order thinking skills crisis, but if they are part of a trend, future employers may have to spend more training dollars in developing missing skills (Kreitzberg and Kreitzberg, 2009). Educational programs that are able to establish and build higher order and critical thinking skills in students will graduate learners who are highly sought by employers (NCR CTE, 2010).

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 higher order and critical thinking skills were not demonstrated in these discussions, 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.

While neither group demonstrated anything but small forays into higher order and critical thinking skills, 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.

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