Describing the Relationship Between Cooperative Learning Techniques Used and Student Cognitive Processing Capability During College Class Sessions

Thesis

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By

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ABSTRACT

The purpose of this study was to describe the frequency use of cooperative learning techniques by students enrolled in a university, methods of teaching in non-formal environments course. In addition, the researcher sought to describe student cognitive processing capability when answering higher or lower cognitive level questions during a ten-week university course.

Students (N=14) enrolled in a ten-week university, methods of teaching in non-formal environments, course were the convenient population for the study. The researchers randomly assigned each student into one of two groups prior to the first class session; the groups were labeled lower cognitive and higher cognitive. Each group received a closing reflection at the end of each class session. A bonus question was added to each closing reflection; the lower cognitive group received a closing reflection with a lower cognitive level bonus question, while the higher cognitive group received a higher cognitive level bonus question. The researchers also demonstrated the use of cooperative learning techniques in three lectures during the course. Four instruments were used to describe student use of cooperative learning techniques, and student cognitive processing capabilities on the assignments.

Results were that five of the students used cooperative learning techniques in their microteaching lessons, using a total of three techniques (timed-pair share, jot-thoughts,
and window-paning), 12 times throughout their lessons. The majority (n=4) of the students who implemented cooperative learning techniques scored in the top 50% on the cognitively weighted final examination.

Student answers in the lower cognitive group were assessed as right or wrong; on average, students answered ten questions correctly, three questions wrong, and had one missing closing reflection. The higher cognitive questions were assessed using a critical thinking rubric. None of the students scored higher than the lowest level of critical thinking as assessed by the rubric. Students in the higher cognitive group had a mean score of 18.9 on the critical thinking rubric, with a total range of 18 to 28.

On the final examination, each student was given a weighted score based on the level of cognition for each question asked. The cognitively weighted score of the final examination was 57.8; student scores ranged from 47.1 to 55.6 with a mean of 52.72.

No significant relationship was found between the students’ cognitive level of competency on the final examination and their processing capabilities when responding to lower and higher cognitive questions. A negligible relationship was found between observed student use of cooperative learning techniques and their cognitive processing capability on the final examination.
Dedicated to my parents, Dean and Beth Jagger and my Grandparents. Without your love and support I could never have accomplished so much in life.
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CHAPTER 1
INTRODUCTION

In March 2010, the unemployment rate was at 9.7%, as reported by the U.S. Bureau of Labor Statistics. Those without a job for 27 weeks or more increased to 6.5 million during that month. Teenagers were reported as the most unemployed working group at 26.1% (U.S. Bureau of Labor Statistics, 2010). During these uncertain economic conditions, educators must equip students with the skills they need for entering a changing workforce.

Cooperative learning gives students the opportunity to work in small groups, which is a skill that most employers expect from new employees (Ravenscroft, 1997). Ravenscroft (1997) pointed out that due to the nature of cooperative learning activities, students are teaching and coaching each other, which improves their learning. Through the coaching and teaching of their peers, students are able to “articulate their cognition and are able to observe and adopt the learning and study strategies of other students” (p. 187).

According to Johnson and Johnson (1999), structuring learning situations cooperatively promotes students to work together to achieve group success. Consequently, when students work together toward a common goal, it typically results in higher achievement and greater productivity than if students work alone (Johnson &
Johnson). Additionally, Johnson, Johnson, and Smith (2007) wrote that cooperative learning results in a greater transfer of the content learned from one situation to another, higher-level reasoning, and meta-cognition.

**Purpose and Objectives of the Study**

The purpose of this study was to describe the frequency use of cooperative learning techniques by students enrolled in a university, methods of teaching in non-formal environments, course. In addition, the researchers sought to describe student cognitive processing capability given higher or lower cognitive level processing opportunities during a ten-week university course.

The following research objectives guided this descriptive study:

1. Describe observed student use of cooperative learning techniques during microteaching.

2. Describe student cognitive processing capabilities when responding to lower and higher cognitive level questions.

3. Describe student cognitive level of competency on the final examination.

4. Describe the relationship between student cognitive level of competency on the final examination between those who received lower cognitive level closing reflection questions and those who received higher cognitive level closing reflection questions.

5. Describe the relationship between observed student use of cooperative learning techniques in microteaching and student cognitive level of competency on the final examination.

**Constitutive Definition of Terms**

*Closing reflection:* Assessment given to students at the end of each class session that reinforces retention of the content taught during the class session.
Cooperative Learning Techniques: Incorporation of students working in groups to accomplish the same goal (Gillies, 2007; Johnson & Johnson, 1999). Techniques used by the researchers in this study include: inside-outside circle, jot-thoughts, paraphrase passport, Q-approach, send a star, timed-pair share, and window-paning.

Final examination: A 204-point examination testing student content retention of the ten-week university course. Questions were asked at various levels of Bloom’s Taxonomy. Students received the exam during the final class session.

High cognitive competency: Students’ ability to process final examination questions at the application, analysis, synthesis and evaluation levels of Bloom’s Taxonomy (1956).

Higher cognitive group: Students who received higher cognitive bonus questions on each class session’s closing reflection.

Higher cognitive level closing reflection questions: Questions asked to the students in the higher cognitive group. These questions were asked at the application analysis, synthesis or evaluation levels of cognition.

Higher cognitive levels: The upper four levels in Bloom’s Taxonomy of educational objectives in the cognitive domain (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). The levels are labeled application, analysis, synthesis and evaluation.

Inside-Outside Circle: Cooperative-learning technique that consists of splitting the class in half. This activity can be done with students working individually or as a group. Half of the students/groups form a circle facing the outside; the other half then forms a circle around the first. Both circles should be facing each other. In a specified amount of time one of the two circles shares their idea, answer, etc., to the person/group they are facing. After their time has expired the member(s) in the other circle then share(s) in the same
amount of time. Finally, one of the circles rotates to face a new person/group, followed by each of the groups sharing once more. The process can be repeated as often as the instructor wishes (Kagan, 1994).

*Jot thoughts:* Cooperative-learning technique that consists of splitting the class into groups of any size. Once the groups are formed, the instructor provides each group with slips of paper for them to jot their ideas. Once the groups are given a task/question they put only one idea on each slip of paper, but they should also try to fill the surface of their desk with as many ideas as possible. No slip of paper should overlap another (Kagan, 1994).

*Lower cognitive group:* Students who received lower cognitive bonus questions on each class session’s closing reflection.

*Lower cognitive level closing reflection questions:* Questions asked to the students in the lower cognitive group. These questions were asked at the knowledge or comprehension levels of cognition.

*Lower cognitive levels:* The lower two levels in Bloom’s Taxonomy of educational objectives in the cognitive domain (Bloom et al., 1956). The levels are labeled knowledge and comprehension.

*Microteaching lab:* Weekly sessions in which students teach their daily plans to their classmates and the lab instructor. All of the lessons taught were digitally recorded. Each lab consists of four to seven students.

*Paraphrase passport:* Cooperative-learning technique that consists of students sharing their answers with one another in a structured format. Students move around the classroom asking each student to share their answer, but before the student listening can
write down the answer, the student must first paraphrase the answer and receive confirmation from the student who gave the answer that the answer was understood. Paraphrasing starters were provided to the students during this technique (for example: ‘To summarize what you said…’ ‘In other words…’ and ‘To reword your idea…’). Every student should obtain answers from the entire class, or obtain the number of answers specified amount by the instructor (Kagan, 1994).

*Q-approach:* Cooperative-learning technique that requires students to create questions using two stems of a question. The first stem is one of the following words: what, where/when, which, who, why, or how. The second stem is one of the following words: would, can, will, might, is, or did. Given both stem words, the students create a question that pertains to the content being taught (Kagan, 1994).

*Send a star:* Cooperative-learning technique that can be used any time a class is split into groups. The instructor asks each group to choose one person that will move to another group and share and the information/answer their group has created. This activity can be done as many times as the instructor sees fit (Kagan, 1994).

*Timed-pair share:* Cooperative-learning technique that allows students a specified amount of time to share their thoughts about a given topic. Once the time has expired, they spend the same amount time listening to their partner’s idea, giving both students an equal amount of time to share and voice their opinions (Kagan, 1994).

*Window-paning:* Cooperative-learning technique that allow students to conceptualize an idea visually. Instructors discuss and breakdown a situation, process, story line, etc. into smaller bits of information. The students have in front of them a sheet of paper split up in the number of sections needed for the content being delivered. As the instructor presents
the information the students draw a picture that will help them remember that part of the process. Once the content has been delivered students should break into groups and verbally explain the content material they drew in their windowpanes (Kagan, 1994).

**Operational Definition of Terms**

*Student use of higher cognitive teaching techniques:* Frequency count of how often students incorporated higher cognitive teaching techniques in their daily lessons during the microteaching.

*Student cognitive level of competency:* Weighted score given to students on the final examination, using Pickford’s (1988) cognitive weighting scale. This score was based on the cognitive weighting on each question the student answered correctly. For example, question one on the examination was asked at the knowledge level of cognition, which was weighted at .10, the question was worth four points. To find the student’s weighted score, the points the student answered correctly were multiplied by the cognitive weighting of the question. For the example given, if the student answered all four points correctly, the weighted score was 4 multiplied by .10, which is .40. In order to get the complete weighted score, the score for each question was calculated and then summed for all individual scores. Cognitive weighting is explained in chapter three.

*Student cognitive processing capability:* Score given to students, using a critical thinking rubric (see chapter three) for the answers on each closing reflection.

**Limitations of the Study**

The researcher chose to describe one university course, which was a convenient population (N=14). The findings cannot be generalized outside of the convenient population. In addition to the size of the population, maximum time was not provided to
introduce the higher cognitive teaching techniques to the students. Because students were only given the opportunity to see the higher cognitive techniques three times, they may not have felt comfortable using them in their microteaching labs. Finally, researchers chose to make the higher/lower cognitive questions (the questions used in the research) *bonus questions*; thus, students were not required to answer the questions Consequently, there is a possibility of missing data.
CHAPTER 2
REVIEW OF RELATED LITERATURE

Chapter two contains a review of related literature pertinent to the study. The researcher examined literature related to the theoretical framework, as well as concepts related to cooperative learning, critical thinking, and higher cognitive questioning. The Conceptual Framework is also described in this chapter.

Theoretical Framework

Three theories were used to build the theoretical framework; one was Piaget’s theory of cognitive development. Woolfolk (2007) explained, Piaget’s theory as a model for describing how humans think about a problem and their surroundings. Piaget’s theory consists of four stages including sensorimotor, preoperational, concrete operational, and formal operational (Woolfolk, 2007).

The second theory was Bloom’s Taxonomy; Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) established a hierarchy of cognition comprising six levels. As one works through the hierarchy, each level demands the use of the lower level skills. The six levels include: knowledge, comprehension, application, analysis, synthesis, and evaluation. The third theory was the social interdependence theory, supporting that the achievement of each individual’s goal in a group is affected by the other member’s actions (Johnson & Johnson, 2007).
Piaget’s theory of cognitive development.

Jean Piaget’s theory of cognitive development is comprised of four stages including sensorimotor, preoperational, concrete operational, and formal operational (Woolfolk, 2007). According to Woolfolk (2007), Piaget’s theory is a “model describing how humans go about making sense of their world by gathering and organizing information” (p. 26). As humans develop and grow, thought processes change; certain thought processes are simple for adults, but are not simple for children (Woolfolk, 2007).

The first stage an individual goes through is sensorimotor, which is the period from birth until approximately two years of age (Woolfolk, 2007). During this stage, an infant is said to make use of imitation; memory and thought begin to develop and one begins to recognize objects (Woolfolk, 2007). Preoperational occurs between two and seven years of age, during which the child develops language (Woolfolk, 2007). In the preoperational stage one usually has trouble seeing others’ point of view, and can think logically in one direction (Woolfolk, 2007).

Concrete operational is the third stage an individual reaches, which typically occurs between seven and eleven years of age (Woolfolk, 2007). An individual starts to solve hands-on problems in a logical fashion, as well as understand laws of conversation and reversibility (Woolfolk, 2007). The final stage an individual reaches is formal operational, which occurs between the ages of eleven and adulthood (Woolfolk, 2007). During this stage of development, one can solve abstract problems logically, can conduct scientific thinking, and develops concerns about social issues and identity (Woolfolk, 2007).
Bloom’s Taxonomy.

Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) established a hierarchy of cognition comprising six levels. As one works through the hierarchy, each level demands the use of the skills in the lower areas. The six levels include: knowledge, comprehension, application, analysis, synthesis, and evaluation. According to Bloom et al. (1956), knowledge, identified as the lowest level of cognition, emphasizes remembering and more specifically, recognition or recall of content material. Sample objectives for the knowledge level of cognition found in Webb’s (1970) Florida Taxonomy of Cognitive Behavior (FTCB) include: define meaning of a term; cite a trend or rule; gives steps of a process or describes methods; and states a general concept or idea.

Comprehension, the second level of Bloom’s Taxonomy (1956) involves the student’s ability to know given content material and be able to use the ideas presented. Bloom et al. (1956) explained three types of comprehension, which are: translation, putting material in other terms; interpretation, propose relative importance and develop interrelationships; and extrapolation, make estimates or predictions based on trends. Example objectives for comprehension include: restate a problem in one’s own words; verbalize a graphic representation, show similarities or differences; and show cause and effect relationship (Webb, 1970).

The third level of the hierarchy is application (Bloom et al., 1956). When presented with a problem, students are using the cognitive level of application if they can apply an appropriate solution. Students are able to work through real-life situations, when
presented with an application-based objective in the classroom. According to Bloom et al. (1956), “the fact that most of what we learn is intended for application to problem situations in real life, is indicative of the importance of application objectives in general curriculum” (p. 122). Example objectives for application include: identifies, selects and carries out a process; applies previous learning to new situations; and applies abstract knowledge in a practical situation (Webb, 1970).

Analysis, the forth level of Bloom’s Taxonomy, places an emphasis on the student’s ability to breakdown the material and detect relationships between the parts (Bloom et al., 1956). As an objective, analysis can be divided into three levels: first, identify the elements; second, draw relationships between the elements; and third, understand organizational principles and the structure of the elements (Bloom et al., 1956). Example objectives for analysis include: distinguish fact from opinion; point out unstated assumption; infer purpose or point of view; and detect bias or propaganda (Webb, 1970).

The fifth level of the hierarchy is synthesis, which includes putting parts and elements of the content together to form a whole (Bloom et al., 1956). The synthesis level requires students to work with elements of a problem and create a structure or pattern that was not there before, whereas, during comprehension, application, and analysis, students are given the material to solve the problem. In synthesis, students must draw upon elements from many sources to form a solution (Bloom et al., 1956). Example objectives for synthesis include: produce a plan or proposed set of operations; design a structure; and draw inductive generalization from specifics (Webb, 1970).
Evaluation is not placed last because it is the last step in the thinking process. Rather, it requires, to some extent, all the other cognitive behaviors of the hierarchy (Bloom et al., 1956). According to Bloom et al. (1956), evaluation is the process in which students make judgments about the content material. Example objectives for evaluation include: evaluate something from evidence or from criteria (Webb, 1970).

**Social interdependence theory.**

Social interdependence is the idea that the achievement of each individual’s goal in a group is affected by the other member’s actions (Johnson and Johnson, 2007). Prior to the creation of the social interdependence theory, Lewin suggested that an individual’s behavior is driven by the tension that arises when working toward a goal, and that interdependence among members is the essence of any group (Johnson, Johnson, & Smith, 2007). Deutsch “extended Lewin’s notion to the relationship among the goals of two or more individuals. In doing so, he developed social interdependence theory” (Johnson, et al., 2007, p. 16).

Social interdependence can be defined as positive or negative. Positive interdependence encourages cooperation, while negative interdependence encourages competition (Johnson and Johnson, 2007). Positive interdependence is when members of a group perceive they can only reach their individual goals when the other group members reach their goals. Negative interdependence exists when members of a group perceive they will only reach their individual goal when the other members fail to reach their goals (Johnson and Johnson, 2007). According to Johnson and Johnson (2007), “in creating cooperative learning lessons, the teacher has to structure positive
interdependence, individual accountability, promote interaction, and the appropriate use of social skills, and group processing” (p. 19).

**Cooperative Learning**

Cooperative learning is the incorporation of students working in groups to accomplish the same goal (Gillies, 2007). However, not all group work is effective cooperative learning. Instead, the instructor using various techniques should guide cooperative learning; if done properly, cooperative learning can be very successful (Gillies, 2007). In cooperative learning groups, students should work towards accomplishing a shared goal (Johnson & Johnson, 1999). Also, to ensure effective cooperative learning is taking place, individual performance, not just group performance, should be checked frequently to make sure all students are contributing to the group (Johnson & Johnson, 1999).

Kagan (1989) defines a structural approach to cooperative learning as being “based on the creation, analysis, and systematic application of structures” (p. 12). Unlike cooperative activities, structures can be used repeatedly over a variety of subjects and grade levels (Kagan, 1989). Ravenscroft (1997) identifies three purposes of cooperative learning. These include: “improved individual learning; more positive attitudes towards school, study, and other students; and an opportunity for students to work in small groups” (p. 187).

According to Johnson and Johnson (2007), three types of cooperative learning exist. The first is formal cooperative learning which occurs when students work together over the period of a single class session or multiple sessions, to achieve shared goals and assignments (Johnson and Johnson, 2007). Informal cooperative learning happens when
students work together temporarily that lasts from a few minutes to a whole class session, to accomplish shared goals. Finally, the third type is a cooperative base group; these groups are long-term and have stable membership.

Responsibilities of cooperative base group members includes: ensuring positive academic progress is taking place; holding each other accountable for the learning; and providing each member with support and assistance to accomplish the goals (Johnson and Johnson, 2007). The three responsibilities listed here, along with social skills and group processing, are identified by Johnson and Johnson (1999) as the five essential elements of cooperative learning. The first essential element is positive interdependence, which is the perception one has that the only way for them to succeed is if everyone else in the group succeeds (Johnson and Johnson, 1999). Individual accountability is the second essential element; each member of the group must be assessed to ensure that each student is contributing to the whole (Johnson and Johnson, 1999). The third essential element Johnson and Johnson (1999) lay out is face-to-face promotive interaction; individuals in the group provide the other members with praise and support for the work they do.

Possessing social skills is the forth-essential element; Johnson and Johnson (1999) felt that in order to have a successful cooperative learning experience, members of the group must possess interpersonal skills. According to Johnson and Johnson (1999), “persons must be taught the leadership, decision-making, trust-building, communication, and conflict-management skills just as purposefully and precisely as academic skills” (p. 71). The final essential element for successful cooperative learning is group processing; which exists when discussion takes place about how well the group is achieving their goals (Johnson and Johnson, 1999).
In a study, Gillies and Boyle (2010) examined perceptions of 10-middle school teachers when implementing cooperative learning in their classrooms. Gillies and Boyle (2010) interviewed the participating teachers, after each had embedded cooperative learning techniques in two units of instruction, both lasting 4-6 weeks. During the interviews, the teachers reported they had a positive experience incorporating cooperative learning. Comments mentioned included that students not only learned to interact with one another, but also were willing to take risks with their own learning (Gillies et al., 2010). Teachers also saw benefits of cooperative learning, which included better management and structure of their lessons. Some issues reported in the implementation of cooperative learning were: student socializing, time management, and the organization required on the teacher’s part. Most of the teachers suggested cooperative learning be used more widely, while a few indicated it was a “challenge and required commitment on the part of the teacher if it (cooperative learning) was to be implemented effectively” (Gillies et al., 2010, p. 938).

**Cooperative learning techniques.**

One of the techniques used in this study was paraphrase passport, as defined in chapter one. Costa (1984) stated that, students become better listeners of their peers’ thoughts as well as their own when engaging in paraphrasing activities.

Q-Approach is based on Bloom’s Taxonomy and helps ensure that an equal distribution of cognition is taking place across the levels of the Taxonomy (Wiederhold and Kagan, 1992). Wiederhold and Kagan pointed out four factors to consider when implementing Q-Approach. These include: teacher attitude, cooperative learning, critical
thinking, and student question generation, all of which have the ability to empower students to be flexible, autonomous learners (Wiederhold and Kagan, 1992).

Another technique Costa (1984) mentioned is student generation of questions, which matches up with the Q-Approach used in this study. When generating questions, students must pause and think about whether they understand the concept, can relate it to other concepts, if they can predict future ideas, and possibly give other examples (Costa, 1984). All of the actions associated with generating questions fall in varying levels of cognition. Being able to give examples of an idea falls under translation as a level of cognition, which is subcategory of comprehension. Showing how one concept relates to another is part of the analysis level of cognition, and predicting or formulating a hypothesis occurs at the synthesis level of cognition (Webb, 1970).

**Critical Thinking**

Critical thinking is defined by Wiederhold and Kagan (1992) as “a set of abilities and behaviors that allow students to look beyond the information presented, make connections, develop cognitive organizers, and create personal meaning” (p. 201). When involved in critical thinking, one engages in metacognition, which is the ability to think-through a process and create a strategy to obtain the information needed to complete the problem-solving situation (Costa, 1984; Wiederhold and Kagan, 1992; and Woolfolk, 2007). Costa suggested that a major part of metacognition is the ability to develop a plan of action for solving a problem and maintaining that plan in mind over a period of time. Woolfolk (2007) stated, “this knowledge is higher order cognition used to monitor and regulate cognitive processes such as reasoning, comprehension, problem-solving, learning and so on” (p. 267). Bruning, Schraw, Norby, and Ronning (2004) indicated
that metacognition enables students to coordinate various facets of knowledge and strategies learned to accomplish learning goals. Three kinds of knowledge are involved with metacognition including: declarative knowledge, awareness of yourself as a learner, skills and strategies needed to perform a task; procedural knowledge, how to use the strategies; and conditional knowledge, ensuring the task is completed (Woolfolk, 2007).

**Higher Cognitive Questioning**

Higher cognitive questions are characterized by two factors; the first is that students are required to state predictions, solutions, explanations, evidence, interpretations, or opinions; and the answer should not be readily available to them from the curriculum taught (Gall et al., 1978). Newmann (1987) defined higher order thinking as a result of higher cognitive questioning or teaching, as the opportunity one is given to interpret, analyze, or manipulate information, because the solution cannot be found through the routine application of previously learned content. Newman stated that, lower order thinking involves repetitive behaviors, such as memorizing and inserting a solution. Questioning students at higher cognitive levels stimulates cognitive skills and moves them beyond memorizing content (Gall et al., 1978).

When developing a tool to help science teachers align their teaching to their assessments, Crowe, Dirks, and Wenderoth (2008), examined nearly 600 science questions from college level exams. Crowe et al. wrote that, “developing strong assessment methods is a challenging task, and limited resources have been allocated to support faculty in this endeavor” (2008, p. 379). In most cases, exams are created using multiple-choice questions, due to the lack of resources and manpower it takes to grade essay type questions, which typically force students to think critically (Crowe et al.,
2008). However, using tools such as the one Crowe et al. created, faculty and students can achieve deeper understanding of the concepts by reaching higher cognitive thinking.

**Conceptual Framework for This Study**

Two variables related to the instructor, and two variables related to the students were examined in this study to describe cooperative learning techniques used by the instructor, and cognitive processing capability of the student across a ten-week university course (see Figure 2.1). The two variables, related to the instructor, were cooperative learning techniques used during class sessions and the cognitive level of reflection questions written. Student variables included the cognitive level of reflection questions they received, and the cooperative learning techniques they used in their microteaching lessons. These variables were used to describe the student’s cognitive processing capability and overall achievement in a ten-week course of instruction.
Figure 2.1. Conceptual Framework of Factors Influencing Student Cognitive Processing Capability

Instructor Variables
- Cooperative learning techniques
- Cognitive level of reflection questions written

Student Variables
- Cognitive level of reflection questions received
- Techniques used in microteaching

Student Cognitive Processing Capability
- Student Retention
- Cognitive Achievement on Final Exam

Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

Note: Bloom et al., 1956
CHAPTER 3

METHODS

The purpose of this study was to describe the frequency use of cooperative learning techniques by students enrolled in a university, methods of teaching in non-formal environments, course. In addition, the researchers sought to describe student cognitive processing capability given higher or lower cognitive level processing opportunities during a ten-week university course.

Population and Sample

Students enrolled in a methods of teaching in non-formal environments course became the convenient population for the study. All students (N=14) agreed to have samples of their work reviewed for the purpose of the research [Appendix A]. Students enrolled in the course were not formal teacher preparation students; they were enrolled in the course for non-formal educator preparation. The majority of the students (n=8) were Agricultural and Extension Education majors in the Extension option. Five students were working toward an agricultural education minor. One study abroad student from England requested to audit the course. All students, except the study abroad student, were required to take the course to fulfill either their major or minor curriculum requirements for graduation.
Research Design

The research study was descriptive in nature. Four instruments were used to measure the following research objectives:

1. Describe observed student use of cooperative learning techniques during microteaching.

2. Describe student cognitive processing capabilities when responding to lower and higher cognitive level questions.

3. Describe student cognitive level of competency on the final examination.

4. Describe the relationship between student cognitive level of competency on the final examination between those who received lower cognitive level closing reflection questions and those who received higher cognitive level closing reflection questions.

5. Describe the relationship between observed student use of cooperative learning teaching techniques in microteaching and student cognitive level of competency on the final examination.

Instrumentation

The researchers implemented four instruments to collect the data. These included: closing reflections, a critical thinking rubric, the final examination, and student videos of the microteaching labs. All methodology was approved by the Behavioral and Social Sciences Institutional Review Board (# 2009B0405).

Closing Reflections

During each class session, students received an opening and closing reflection. Opening reflections referred to the previous class session’s content or the assigned reading. Closing reflections required students to reflect upon the content that was just taught.
On each closing reflection, researchers added one bonus question, which was created using the Florida Taxonomy of Cognitive Behavior (Webb, 1970). Two different closing reflections were used for each lecture, and were denoted by different colors used to print the hard-copy reflection questions. On one of the closing reflections, a bonus question was added that corresponded with lower cognitive level questions, (knowledge or comprehension), and on the other closing reflection, a bonus question corresponded to higher cognitive level questions (analysis, synthesis or evaluation). For example, the questions added to the closing reflection following a class session on primary and secondary principles of interest were, “Restate in your own words, a definition for the primary principle of interest ‘interest is contagious’” (lower cognitive level) and “You have chosen the primary principle of interest ‘interest is contagious’, produce a set of steps that we will see in your interest approach to help facilitate this principle” (higher cognitive level). Grades on these questions did not count against the student’s grade; rather they were denoted as bonus points to motivate students to think critically when answering the questions. Only the higher cognitive questions were evaluated using the critical thinking rubric; the lower cognitive questions were evaluated as right or wrong.

Validity.

A panel of experts in the field of teacher preparation and agricultural education reviewed the reflection questions to determine content validity of the questions used in the research. The panel determined the questions to be appropriate for assessing the cognitive level purported to be measured.
Reliability.

For intra-rater reliability, the same researcher using Bloom’s Taxonomy as a guide, consistently developed questions for the closing reflection. The Florida Taxonomy of Cognitive Behavior (Webb, 1970) was used when writing questions at both the lower and higher levels.

For inter-rater reliability, each day that closing reflections were created, the researcher took the questions to another researcher to obtain assessment of the cognitive level of questions that were being asked. The researchers established 100% agreement across the ten-week university course.

Critical Thinking Rubric

Researchers used the Florida Rubric for Assessing Critical Thinking Skills (FRACTS) as created by Friedel, Irani, and Rhoades (Friedel, personal communication, April 13, 2010) to evaluate student responses on each closing reflection (Appendix B). FRACTS was developed from the EMI: Critical thinking disposition assessment (EMI), which is comprised of three constructs: engagement, cognitive maturity, and innovativeness (Irani, Rudd, Gallo, Ricketts, Friedel, & Rhoades, 2007). When creating the EMI, Irani et al. (2007) characterized those with a high disposition in engagement as those who are a confident communicator, able to anticipate instances in which good reasoning is necessary, as well as look for such opportunities to utilize their reasoning skills. People who show high levels of cognitive maturity tend to be aware of any biases they might have in decision making, and understand that those biases have been influenced by the persons they are, their environment, and experiences they have encountered. Those who are cognitively mature also comprehend that most problems do
not have “one-right-answer” no matter how simply it appears (Irani et al., 2007). Finally, those with high innovativeness are characterized as those who are life long learners, always looking for new knowledge; they want to learn more about their profession, life, and world. One with high innovativeness is also a person who desires to know the truth, even though that truth might conflict with a belief or opinion they already hold (Irani et al., 2007).

An expert panel of researchers in critical thinking developed FRACTS; this panel of experts set out to determine the essential elements of each critical thinking skill: analysis, evaluation, and inference (Friedel, Irani, Rhoades, Fuhrman, & Gallo, 2008). The focus of the instrument was to examine the process of critical thinking, instead of the product; and can be used in both audible and written responses. For the purpose of this study, written responses were examined.

Each construct defined by FRACTS: analysis, evaluation, and inference, is broken into six descriptors. When evaluating a response, each descriptor received a score of one, two, or three. The score of one indicates the individual showed no evidence of demonstrating or using the specific critical thinking skill. The score of two indicates the individual provided hints of using the specific critical thinking skill. Finally, the score of three indicates the individual clearly provided evidence of demonstrating the specific critical thinking skill. The total range of scores for FRACTS is 18 to 54; within each construct the range of scores is 6 to 18. The recommended interpretation of both the construct and total scores received on FRACTS can be found in Table 3.1 and Table 3.2 respectfully.
Table 3.1

*Interpretation on Each Construct Score Received on the Florida Rubric for Assessing Critical Thinking Skills (FRACTS)*

<table>
<thead>
<tr>
<th>Construct Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 9</td>
<td>Low level of critical thinking</td>
</tr>
<tr>
<td>10 to 14</td>
<td>Common level of critical thinking</td>
</tr>
<tr>
<td>15 to 18</td>
<td>High level of critical thinking</td>
</tr>
</tbody>
</table>

Note: Friedel, personal communication, April 13, 2010.

Table 3.2

*Interpretation of Total Score Received on the Florida Rubric for Assessing Critical Thinking Skills (FRACTS)*

<table>
<thead>
<tr>
<th>Construct Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 to 28</td>
<td>Low level of critical thinking</td>
</tr>
<tr>
<td>29 to 43</td>
<td>Common level of critical thinking</td>
</tr>
<tr>
<td>44 to 54</td>
<td>High level of critical thinking</td>
</tr>
</tbody>
</table>

Note: Friedel, personal communication, April 13, 2010.

**Validity.**

FRACTS was developed by an expert panel of researchers in critical thinking to determine the essential elements of the three critical thinking skills: analysis, evaluation, and inference. FRACTS was pilot-tested on audible responses to critical thinking questions posed to students (Friedel, personal communication, April 13, 2010).
Reliability.

Reliability for the critical thinking rubric instrument was established using test-retest procedures (Ary, Jacobs, & Razavieh, 2002). The researchers re-analyzed a randomly selected closing reflection using the critical thinking rubric. Intra- and inter-rater reliability are further described.

**Intra-rater reliability.**

The intra-rater reliability for the closing reflections was established for each researcher individually by analyzing a randomly selected closing reflection with the critical thinking rubric. Five weeks later, the same closing reflection was re-analyzed by the same researcher. A priori, a 95% confidence band was established as acceptable for each closing reflection. Upon one test-retest measure, each researcher had achieved the acceptable rate (95%).

**Inter-rater reliability.**

The inter-rater reliability for the closing reflections was established by having both researchers analyze the same randomly selected closing reflection with the critical thinking rubric. Five weeks later, that same closing reflection was re-analyzed by both researchers. A priori, a 95% confidence band was established as acceptable for each closing reflection. Upon one test-retest measure, the acceptable rate (95%) was achieved.

**Final Examination**

The final examination for the course was also used to evaluate the students’ cognitive level of competency. The final examination was not altered in any way for the two groups of students. The examination was constructed to test students on content from the entire course, and consisted of 204 points totaling 27 items. Questions on the final
examination were asked at various levels of Bloom’s Taxonomy. Each question was categorized into one of the six levels of Bloom’s Taxonomy (Appendix C). The majority of the questions were asked at the knowledge level (n=17), and accounted for 73 of the points. Two questions were compound questions with two parts; one asked at the knowledge and comprehension levels and the other asked at the knowledge and analysis levels. Together these questions accounted for 30 points. Six questions were asked at the application level and accounted for 24 points. One question was asked at the analysis level and accounted for 2 points. The final question on the examination was asked at the synthesis level, asking the students to create a daily plan of instruction; the item accounted for 75 points.

Validity.

A panel of experts in the field of teacher preparation and agricultural education reviewed the final examination to determine content validity of the questions created and used in the research. The panel agreed that the final exam was appropriate for the population being studied and that it would measure that which it purported to measure.

Reliability.

Reliability for the final examination instrument was established using test-retest procedures (Ary, Jacobs, & Razavieh, 2002). The graduate student researcher analyzed the final examination to determine the level of cognition for each question. Following the initial analysis, an expert in the area of cognitive levels and the graduate student researcher, discussed any discrepancies in the analysis. Two items were discussed and changes were made for an acceptable 92% confidence level. Five weeks later the researchers reanalyzed the final examination. A priori, a 95% confidence band was
established as acceptable for each closing reflection. Upon one test-retest measure each researcher had achieved the acceptable rate (95%).

**Microteaching Lab Videos**

Students were required, as part of the course, to participate in microteaching laboratories, in which they developed daily plans and taught the content to their classmates. All of these lessons were recorded for the students to self-evaluate after they taught the content. The researchers retained a copy of these videos, with permission from the students, in order for the researchers to evaluate the lesson as well. Students were randomly assigned a number at the beginning of the course; numbers were denoted in the title of the saved video, so that a relationship could be drawn between the cooperative learning teaching techniques used in their microteaching lessons, and the cognition group to which they were randomly assigned. Each student’s lesson was evaluated, with a frequency count, for the use of cooperative learning teaching techniques as demonstrated during class sessions.

**Reliability.**

Reliability for the microteaching lab videos was established using test-retest procedures (Ary, Jacobs, & Razavieh, 2002). The researchers reanalyzed a randomly selected microteaching video. Intra-rater reliability for the microteaching laboratory videos was established for the researcher by analyzing a randomly selected microteaching laboratory video. Five weeks later the same researcher reanalyzed the same microteaching lab video. A priori, a 95% confidence band was established as acceptable for each closing reflection. Upon one test-retest measure, the researcher had achieved the acceptable rate (95%).
Data Collection

Closing Reflection

Before the quarter began, the researcher created a seating chart to randomly place students around a “U” shaped desk arrangement. After the seating chart was created, the students were split into two groups (lower cognitive group and higher cognitive group) with students in each group seated in every other seat; these were their assigned seats for the duration of the course. At the beginning of the first class session, students pulled a number out of a bag, which was how they identified themselves for all assignments. Only the main instructor had access to the list of students and their corresponding number, and the instructor only referred to this list if students were missing assignments and needed to be contacted individually. All indentifying documents were stored in separate offices. No assignments were handed back to the students in person. Each student had a folder in the department’s copy room with their number denoted on it, so they could retrieve their assignments.

The graduate student researcher always handed out the closing reflection during class sessions, to ensure that each student received the correct cognitive level of question. To help combat any researcher bias, an undergraduate student worker in the department graded all of the reflections. After the reflections were graded, a copy was made and the original was returned to the student’s folder.

Critical Thinking Rubric

The critical thinking rubric (CTR) was used to evaluate student answers for the higher cognitive level questions on the closing reflection. Both the graduate student researcher and the undergraduate student worker evaluated the closing reflection using
the CTR. Each rater received training from a researcher with extensive experience in the use of the CTR. Training involved an explanation of the instrument followed by practice evaluating several closing reflection responses. The trainer was present during the first practice rating to answer questions for the raters. After the training, inter-rater reliability (a measure of rater consistency) was assessed by using fourteen closing reflection questions. The researcher calculated the percent agreement between the coders, which calculated to be an inter-rater reliability of .93.

**Final Examination**

The student cognitive level of competency on the final examination was calculated using the process employed by Pickford and Newcomb (1989). A weighting system was implemented to give higher levels of cognition more weight due to the cognitive level of processing required to perform the task. The weighting factors were developed by two researchers (Newcomb & Trefz, 1987) who possessed expertise in the area of cognitive levels of teaching and learning. The weighting factors were developed in consultation with Krathwohl, an original author of Bloom’s Taxonomy, and are consistent with the general support given to the hierarchical nature of Bloom’s Taxonomy (1956). Table 3.3 displays the cognitive weighting factors used for the final examination in the study.
Table 3.3

*Cognitive Weighting Factors for Final Examination*

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Weighting Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>.10</td>
</tr>
<tr>
<td>Comprehension</td>
<td>.20</td>
</tr>
<tr>
<td>Application</td>
<td>.30</td>
</tr>
<tr>
<td>Analysis</td>
<td>.40</td>
</tr>
<tr>
<td>Synthesis</td>
<td>.50</td>
</tr>
<tr>
<td>Evaluation</td>
<td>.50</td>
</tr>
</tbody>
</table>

Note: Bloom et al. (1956), Newcomb & Trefz (1987), Pickford (1988).

For each question on the final examination, the total number of points associated with the question was multiplied by the corresponding cognitive weighting factor. For example, question one was asked at the knowledge level of cognition and had four points associated with it, because the cognitive weighting factor for a knowledge level question is .10, four was then multiplied by .10, to get a cognitively weighted score of .40. Once each question was given a weighted score, all of the weighted scores were summed to create a total weighted score for the examination.

The same scale was used to give each student a weighted score. Student weighted scores were used to examine the relationships between responses on the final examination and the cognition group to which the students were randomly assigned.
Microteaching Lab Videos

Three of the lectures were taught using cooperative learning teaching techniques. All of the students received the same instruction. The graduate student researcher gave these lectures so the students could easily distinguish between instruction practices used in the cooperative learning class sessions and the other class sessions. Three to five of the listed techniques were used during each class session: jot thoughts, paraphrase passport, timed pair-share, inside-outside circle, Q-approach, send a star, and window-paning as described by the Kagan (1994) curriculum of cooperative learning techniques.

Student’s use of cooperative learning teaching techniques was collected as a frequency count. The researcher watched each student’s microteaching lab video and recorded the frequency of use of cooperative learning teaching techniques.

Data Analysis

Following the data collection period, all student responses, and observations were entered in the Statistical Package for the Social Sciences 17.0 (SPSS 17.0). Appropriate measures of central tendency, variability, frequency counts, and percentages were generated for each characteristic of interest in the study. The SPSS 17.0 was used to run all analysis of the data for the study. The unit of analysis for this study was post-secondary students (N=14). The SPSS program was designed especially for analyzing data collected in studies related to social and behavioral research.

A Pearson’s Coefficient was then calculated to describe the relationship between student use of cooperative learning techniques and their cognitive level of competency on the final examination. Both variables were at the ratio scale level. The relationship between student’s cognitive processing capability for answering higher cognitive
questions, and their cognitive level of competency on the final examination were also described using a Pearson’s Coefficient, with both variables at the scale level. An Independent t test was run to describe the relationship between student’s cognitive level of competency on the final exam and their cognitive processing capability when responding to higher and lower cognitive questions. The mean scores from both groups were used. Magnitudes of relationships from correlations were explained (see Table 3.4) using the Davis Convention (Davis, 1971).

Table 3.4

The Davis Convention for Describing Relationships

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Descriptors</th>
</tr>
</thead>
<tbody>
<tr>
<td>.70 and higher</td>
<td>Very strong</td>
</tr>
<tr>
<td>.50 - .69</td>
<td>Substantial</td>
</tr>
<tr>
<td>.30 - .49</td>
<td>Moderate</td>
</tr>
<tr>
<td>.10 - .29</td>
<td>Low</td>
</tr>
<tr>
<td>.01 - .09</td>
<td>Negligible</td>
</tr>
</tbody>
</table>
CHAPTER 4

RESULTS

Chapter four contains the findings related to the research questions that guided this study. The purpose of this study was to describe the frequency use of cooperative learning techniques by students enrolled in a university, methods of teaching in non-formal environments, course. In addition, the researchers sought to describe student cognitive processing capability given higher or lower cognitive level processing opportunities during a ten-week university course.

This chapter presents the findings related to the study, which was designed to answer the following research objectives:

1. Describe observed student use of cooperative learning teaching techniques during microteaching.

2. Describe student processing capabilities when responding to lower and higher cognitive level questions.

3. Describe student cognitive level of competency on the final examination.

4. Describe the relationship between student cognitive level of competency on the final examination between those who received lower cognitive level closing reflection questions and those who received higher cognitive level closing reflection questions.

5. Describe the relationship between observed student use of cooperative learning teaching techniques in microteaching and student cognitive level of competency on the final examination.
Student Use of Cooperative Learning Teaching Techniques During Microteaching

Analysis was conducted using videotapes from each student’s microteaching labs. Researchers conducted a frequency count of how often the students used cooperative learning techniques in their lessons. Findings were that, out of the 27-microteaching lessons recorded, 12 cooperative learning teaching techniques were utilized by five students. Frequency of student’s use of cooperative learning techniques is reported in Table 4.2. The cooperative learning techniques used by the students included: timed-pair share, jot-thoughts, and window-paning. In Table 4.1 is reported the frequency of techniques used during microteaching by the students.

Table 4.1

Techniques Used By Students During Microteaching

<table>
<thead>
<tr>
<th>Technique Used</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timed-Pair Share</td>
<td>9</td>
</tr>
<tr>
<td>Jot-Thoughts</td>
<td>2</td>
</tr>
<tr>
<td>Window-Paning</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4.2

*Student’s Use of Cooperative Learning Techniques During Microteaching*

<table>
<thead>
<tr>
<th>Student</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #1</td>
<td>0</td>
</tr>
<tr>
<td>Student #2</td>
<td>1</td>
</tr>
<tr>
<td>Student #3</td>
<td>0</td>
</tr>
<tr>
<td>Student #4</td>
<td>0</td>
</tr>
<tr>
<td>Student #5</td>
<td>4</td>
</tr>
<tr>
<td>Student #6</td>
<td>0</td>
</tr>
<tr>
<td>Student #7</td>
<td>2</td>
</tr>
<tr>
<td>Student #8</td>
<td>4</td>
</tr>
<tr>
<td>Student #9</td>
<td>0</td>
</tr>
<tr>
<td>Student #10</td>
<td>0</td>
</tr>
<tr>
<td>Student #11</td>
<td>0</td>
</tr>
<tr>
<td>Student #12</td>
<td>1</td>
</tr>
<tr>
<td>Student #13</td>
<td>0</td>
</tr>
<tr>
<td>Student #14</td>
<td>0</td>
</tr>
</tbody>
</table>

Total: 12

**Student Cognitive Processing Capability When Responding to Lower and Higher Cognitive Questions**

At the beginning of the 10-week course, students were randomly placed into one of two groups (lower cognitive and higher cognitive). On each of the closing reflections
one bonus question was added. On one-half of the reflections (n=7) a lower cognitive question was added, created using Bloom’s Taxonomy (Bloom et al., 1956). On the other seven reflections a higher cognitive question was added, also created using Bloom’s Taxonomy (1956). A total of 14 closing reflections were administered to the students. Both the lower and higher cognitive groups processing capabilities are described further in their respective sections.

**Lower cognitive group’s processing capability.**

Student answers to lower cognitive questions were analyzed as dichotomous (right or wrong) variables. Data were reported missing if the students chose to not answer the question or if they were absent for the day. A total of ten closing reflections were reported as missing data, leaving 89.8% of the closing reflections to be analyzed. On average, students got ten questions right, three questions wrong, and had one missing closing reflection; frequencies of student’s answers are reported in Table 4.3.
Table 4.3

*Student’s Ability to Answer Lower Cognitive Questions*

<table>
<thead>
<tr>
<th>Student</th>
<th>Right Answers</th>
<th>Wrong Answers</th>
<th>Missing Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #2</td>
<td>10</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Student #6</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Student #7</td>
<td>11</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student #8</td>
<td>10</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Student #10</td>
<td>10</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Student #11</td>
<td>11</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student #13</td>
<td>10</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Higher cognitive group’s processing capability.**

Student answers in the higher cognitive group were analyzed with a critical thinking rubric (see Chapter 3). Data were reported missing if the students chose to not answer the questions or if they were absent for the day. A total of ten closing reflections were reported as missing data, leaving 89.8% of the closing reflections to be analyzed. On average, student answers to the higher cognitive questions scored 18.9 on the critical thinking rubric, with a total range of 18 to 28. As described in Chapter 3, these scores all fell in the low level of critical thinking category. Each student’s cognitive processing capability are further reported in Table 4.4.
Table 4.4

*Student’s Ability to Answer Higher Cognitive Questions*

<table>
<thead>
<tr>
<th>Student</th>
<th>Missing Data</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #1</td>
<td>2</td>
<td>18-21</td>
<td>18.8</td>
</tr>
<tr>
<td>Student #3</td>
<td>1</td>
<td>18-21</td>
<td>18.9</td>
</tr>
<tr>
<td>Student #4</td>
<td>2</td>
<td>18-23</td>
<td>18.8</td>
</tr>
<tr>
<td>Student #5</td>
<td>0</td>
<td>18-22</td>
<td>18.9</td>
</tr>
<tr>
<td>Student #9</td>
<td>1</td>
<td>18-20</td>
<td>18.5</td>
</tr>
<tr>
<td>Student #12</td>
<td>1</td>
<td>18-28</td>
<td>19.7</td>
</tr>
<tr>
<td>Student #14</td>
<td>3</td>
<td>18-19</td>
<td>18.4</td>
</tr>
</tbody>
</table>

**Student Cognitive Level of Competency on the Final Examination**

All of the students were required to take a final examination at the end of the course to test their retention of the content material. The final examination was given a weighted score (see Chapter 3) based on the level of cognition for which each question was asked, for a total weighted score of 57.8 [Appendix D]. Student’s weighted score on the final examination ranged from 47.1 to 55.6, with a mean of 52.72 (SD= 2.76).

The final examination was asked at five of the six levels of cognition as described by Bloom et al. (1956), including the knowledge, comprehension, application, analysis, and synthesis levels. The majority of the questions were asked at the knowledge level (n=17), and accounted for 73 of the points. Two questions were compound questions with
two parts; one asked at the knowledge and comprehension levels and the other asked at
the knowledge and analysis levels; together these questions accounted for 30 points. Six
questions were asked at the application level and accounted for 24 points. One question
was asked at the analysis level and accounted for 2 points. The final question on the
examination was asked at the synthesis level, asking the students to create a daily plan of
instruction, accounting for 75 points. Each of the cognitive areas was given a weighted
score, which were: knowledge 9.3; comprehension 1.0; application 7.2; analysis 2.8; and
synthesis 37.5. Each student’s total weighted score and weighted score of each cognitive
level are reported in Table 4.5.
Table 4.5

*Student’s Weighted Scores on the Final Examination*

<table>
<thead>
<tr>
<th>Student</th>
<th>Knowledge</th>
<th>Comprehension</th>
<th>Application</th>
<th>Analysis</th>
<th>Synthesis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #1</td>
<td>6.8</td>
<td>0.6</td>
<td>6.0</td>
<td>2.0</td>
<td>37.5</td>
<td>52.9</td>
</tr>
<tr>
<td>Student #2</td>
<td>7.9</td>
<td>1.0</td>
<td>6.3</td>
<td>2.4</td>
<td>37.0</td>
<td>54.6</td>
</tr>
<tr>
<td>Student #3</td>
<td>7.7</td>
<td>1.0</td>
<td>6.9</td>
<td>2.8</td>
<td>37.0</td>
<td>55.4</td>
</tr>
<tr>
<td>Student #4</td>
<td>8.2</td>
<td>1.0</td>
<td>6.9</td>
<td>2.4</td>
<td>36.5</td>
<td>55.0</td>
</tr>
<tr>
<td>Student #5</td>
<td>7.2</td>
<td>0.6</td>
<td>4.5</td>
<td>2.4</td>
<td>34.5</td>
<td>49.2</td>
</tr>
<tr>
<td>Student #6</td>
<td>6.5</td>
<td>0.8</td>
<td>5.4</td>
<td>0.8</td>
<td>35.0</td>
<td>48.5</td>
</tr>
<tr>
<td>Student #7</td>
<td>7.9</td>
<td>0.8</td>
<td>6.9</td>
<td>2.8</td>
<td>36.5</td>
<td>54.9</td>
</tr>
<tr>
<td>Student #8</td>
<td>8.0</td>
<td>0.8</td>
<td>7.2</td>
<td>2.8</td>
<td>35.0</td>
<td>53.8</td>
</tr>
<tr>
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<td>6.0</td>
<td>0.8</td>
<td>4.8</td>
<td>2.4</td>
<td>37.0</td>
<td>51.0</td>
</tr>
<tr>
<td>Student #10</td>
<td>6.8</td>
<td>1.0</td>
<td>6.9</td>
<td>2.4</td>
<td>37.5</td>
<td>54.6</td>
</tr>
<tr>
<td>Student #11</td>
<td>7.5</td>
<td>0.8</td>
<td>6.0</td>
<td>2.0</td>
<td>37.0</td>
<td>53.3</td>
</tr>
<tr>
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<td>1.0</td>
<td>5.7</td>
<td>2.8</td>
<td>37.5</td>
<td>55.6</td>
</tr>
<tr>
<td>Student #13</td>
<td>6.3</td>
<td>1.0</td>
<td>5.4</td>
<td>2.0</td>
<td>37.5</td>
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</tr>
<tr>
<td>Student #14</td>
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<td>0.0</td>
<td>4.5</td>
<td>0.0</td>
<td>37.0</td>
<td>47.1</td>
</tr>
<tr>
<td>Mean Score:</td>
<td>7.21</td>
<td>0.80</td>
<td>5.96</td>
<td>2.14</td>
<td>36.61</td>
<td>52.72</td>
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<tr>
<td>Standard Deviation:</td>
<td>0.90</td>
<td>0.27</td>
<td>0.94</td>
<td>0.80</td>
<td>1.02</td>
<td>2.76</td>
</tr>
</tbody>
</table>
Relationship Between Student Cognitive Level of Competency on the Final Examination and Student Cognitive Processing Capability When Responding to Lower and Higher Cognitive Questions

The researcher examined the relationship between each student’s cognitive level of competency on the final examination and their cognitive processing capability when responding to lower and higher cognitive questions by conducting an independent samples t test. A relationship was examined using the following question, “Is the difference of the mean final examination score for students in the lower and higher cognitive groups significant at the .05 level”?

Final examination scores were collected from all 14 students, seven of whom were in the lower cognitive group, with a mean of 53.13 (SD = 2.24) and seven students in the higher cognitive group, with a mean of 52.31 (SD = 3.33). According to Levene’s test, the homogeneity of variance assumption was satisfied ($F = 2.206, p = .163$). The independent t test indicated final examination score means were not statistically different ($t = -.537, df = 12, p = .601$). Thus, the null hypothesis that the final examination score means were the same for students in the lower and higher cognitive groups could not be rejected at the .05 level of significance.

Relationship between cognitive level of competency on the final examination and student processing capabilities in the higher cognitive group.

The researchers also examined the relationship between cognitive level of competency on the final examination and student cognitive processing capability in the higher cognitive group using a Pearson Correlation. The Pearson Correlation between the total weighted score on the final examination and the average critical thinking score for students in the higher cognitive group was .66 (substantial). Therefore, as the average
critical thinking score increased, the total weighted score on the final exam increased as well. The proportion of variability in the total weighted score on the final examination accounted for by knowledge of the average critical thinking score is \( r^2 = (.66)^2 = .44 = 44\% \).

**Relationship Between Observed Student Use of Cooperative Learning Techniques (CLT) in Microteaching and Student Cognitive Level of Competency on the Final Examination**

The researchers examined the relationship between the observed use of cooperative learning techniques (CLT) in microteaching and the cognitive level of competency on the final examination for each student (\( N = 14 \)) using a Pearson Correlation. The Pearson Correlation between the total weighted score on the final examination and use of CLT was .05 (negligible). Therefore, as the frequency of CLT used increased, the total weighted score on the final examination increased slightly. The proportion of variability in the total weighted score on the final examination accounted for by knowledge of the average critical thinking score was \( r^2 = (.05)^2 = .003 = 0.3\% \). In Table 4.6, each student’s score, in ranked order, along with the frequency of cooperative learning techniques they used as shown. The relationship between student use of CLT and their competency on the final examination, is further described.
Table 4.6

*Student’s Adoption of Cooperative Learning Teaching Techniques (CLTT) and Their Competency on the Final Examination (FE)*

<table>
<thead>
<tr>
<th>Student</th>
<th>Competency on FE</th>
<th>Frequency of CLTT</th>
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</thead>
<tbody>
<tr>
<td>Student #12</td>
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<tr>
<td>Student #3</td>
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</tr>
<tr>
<td>Student #4</td>
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<td>0</td>
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<tr>
<td>Student #7</td>
<td>54.9</td>
<td>2</td>
</tr>
<tr>
<td>Student #2</td>
<td>54.6</td>
<td>1</td>
</tr>
<tr>
<td>Student #10</td>
<td>54.6</td>
<td>0</td>
</tr>
<tr>
<td>Student #8</td>
<td>53.8</td>
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<td>Student #13</td>
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<td>Student #9</td>
<td>51.0</td>
<td>0</td>
</tr>
<tr>
<td>Student #5</td>
<td>49.2</td>
<td>4</td>
</tr>
<tr>
<td>Student #6</td>
<td>48.5</td>
<td>0</td>
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<tr>
<td>Student #14</td>
<td>47.1</td>
<td>0</td>
</tr>
<tr>
<td>Mean:</td>
<td>52.72</td>
<td>Total: 12</td>
</tr>
</tbody>
</table>
CHAPTER 5
CONCLUSIONS

Previous researchers have said that cooperative learning techniques help students develop social skills that are desirable for the workforce (Ravenscroft, 1997; Gillies, 2007; Johnson and Johnson, 2007). In most cases, cooperative learning techniques allow students to think critically and at higher levels of cognition to complete the task (Costa, 1984; Johnson and Johnson, 2007; Kagan, 1989). The purpose of this study was to describe the frequency use of cooperative learning techniques by students enrolled in a university, methods of teaching in non-formal environments, course. In addition, the researchers sought to describe student cognitive processing capability given higher or lower cognitive level processing opportunities during a ten-week university course.

The objectives guiding this descriptive study were:

1. Describe observed student use of cooperative learning teaching techniques during microteaching.

2. Describe student processing capabilities when responding to lower and higher cognitive level questions.

3. Describe student cognitive level of competency on the final examination.

4. Describe the relationship between student cognitive level of competency on the final examination between those who received lower cognitive level closing reflection questions and those who received higher cognitive level closing reflection questions.
5. Describe the relationship between observed student use of cooperative learning teaching techniques in microteaching and student cognitive level of competency on the final examination.

The researchers used the students enrolled in a 10-week methods of teaching in nonformal environments course at a large Midwestern University as the convenient population. A total of 14 students were enrolled in the course. Before the classes started, each student was randomly assigned to one of two groups (lower cognitive or higher cognitive). During each class session, a closing reflection was handed to each student to complete in order to assess his or her retention of the content delivered. On each closing reflection (N=14), researchers added one bonus question; half of the students received a bonus question asked at the lower cognitive levels of Bloom’s Taxonomy (1956), and the other group received a bonus question asked at the higher cognitive levels of Bloom’s Taxonomy (1956).

In addition to students receiving closing reflections, the researchers implemented cooperative learning techniques in three of the lecture sessions. All of the students received the same instruction. The graduate student researcher presented the cooperative learning techniques, so the students could easily distinguish between instruction practices used in the cooperative learning class sessions and the other class sessions. Three to five of the listed techniques were used during each class session: jot thoughts, paraphrase passport, timed pair-share, inside-outside circle, Q-approach, send a star, and window-paning as described by the Kagan (1994) curriculum of cooperative learning techniques.

Student’s use of cooperative learning techniques as demonstrated in class sessions was collected as a frequency count. The researcher watched each student’s microteaching
laboratory video and recorded the frequency of use of cooperative learning teaching techniques.

Four instruments were used in this research study to explore and describe the research objectives. Closing reflections were created for each class session, which were assessed using the Florida Rubric for Assessing Critical Thinking Skills (FRACTS), created by Friedel, Irani, and Rhoades (Friedel, personal communication, April 13, 2010). Student final examinations were assessed using a cognitively weighted score (Pickford & Newcomb, 1989). Finally, each student’s microteaching lesson was recorded and a frequency count was conducted of cooperative learning teaching techniques used by the students.

The researchers made conclusions based on the results of this study. The researchers sought to describe the relationship between students’ use of cooperative learning techniques and their cognitive level of competency on the final examination. As well as describe the relationship between students cognitive level of competency on the final exam and their processing capabilities when responding to lower and higher questions. Conclusions for the five objectives of this study are described further individually.

**Student Use of Cooperative Learning Techniques during Microteaching**

Students did not tend to use cooperative learning techniques during microteaching lessons after seeing them demonstrated during class sessions. Three different cognitive learning techniques (timed-pair share, jot-thought, and window-paning) were used 12 times during the 27-microteaching lessons recorded.
Student Cognitive Processing Capability When Responding to Lower and Higher Cognitive Level Questions

Students in the lower cognitive group were able to answer the questions. Students in the higher cognitive group answered questions at the lowest level of critical thinking when responding to their bonus questions on the closing reflection.

Student Cognitive Level of Competency on the Final Examination

Students had high cognitive competency scores on the final examination regardless of the cognitive group they were assigned.

Relationship Between Student Cognitive Level of Competency on the Final Examination and Student Cognitive Processing Capability When Responding to Lower and Higher Cognitive Questions

Students in the lower cognitive group scored higher on the final examination than students in the higher cognitive group.

Relationship Between Observed Student Use of Cooperative Learning Techniques (CLT) in Microteaching and Student Cognitive Level of Competency on the Final Examination

Students who used cooperative learning techniques in their microteaching lessons, were among the top scoring students on the final examination.

Recommendations

Educators should teach and assess students at the level of cognition that is stated. Crowe et al. (2008) stated that if educators are teaching at higher cognitive levels, but testing only at the knowledge level, students assume that they really do not need to put forth as much effort at the higher levels. Likewise, if educators teach at the knowledge level, but test at higher levels, students often perform poorly because they have not had the opportunity to cultivate higher level thinking skills. Whittington and Newcomb
(1993) recommended that students be tested at higher cognitive levels only after the students have received instruction at the higher cognitive levels.

Implications

When preparing future educators, Gillies and Boyle (2010), stated they should be “trained in the skills needed to implement cooperative learning in their classroom” (p. 938), including, the use of structured cooperative activities, creating challenging tasks, and being able to teach students the social skills needed to effectively work in groups. Ravenscroft (1997) indicated that research done on cooperative learning shows positive achievement in students. Not only will students put forth more effort to achieve a goal when participating in structured cooperative activities, they will also develop positive and supportive relationships (Johnson & Johnson, 1999). When engaging in cooperative learning activities, students are able to observe outstanding group member behaviors and emulate them to become better students themselves (Johnson, Johnson, & Smith, 2007).

Discussion

Cooperative learning allows for higher-level reasoning and meta-cognition, and transfer of content material learned from one situation to another (Johnson, Johnson, & Smith, 2007). Research suggests that students retain content material longer when taught at higher levels of cognition. Using various techniques in the classroom allows for variety, which can help to maintain the students’ attention.

Student’s cognitive level of competency on the final examination, in this study, did not differ. However, those students who used cooperative learning techniques in their own microteaching lessons, scored in the upper one-half on the final examination, possibly suggesting that students who use cooperative learning techniques, tend to think
better at higher levels of Bloom’s Taxonomy (1956), than students who do not use cooperative learning techniques.

More research needs to be done, to further examine the relationship of cooperative learning techniques and cognitive levels of competency. Students in this study were not required or asked to use cooperative learning techniques, the researchers wanted to see if and how often the students would use the techniques in their own teaching. In a future study, researchers might suggest that the students use the cooperative learning techniques in their microteaching. Questions asked at higher cognitive levels should be structured in way that promotes thinking critically about the problem. Students should also be taught how to critically think about a problem. Students in this study did not exhibit high levels of critical thinking skills. A larger population is recommended for future studies as well.

At the end of the methods of teaching course used in this study, one of the comments received from one student was, “this class was all about teaching, and I don’t plan on teaching.” Because the students in this study were either Extension option students or Agriculture and Extension Education minors, they do not have the same classroom internship requirement as an agricultural education teacher preparation students. The comment made by the student made the researchers wonder if the students did not use the cooperative learning techniques because the students were not required to teach in a formal learning environment, and therefore, there was no real relevance for the students to incorporate varying techniques in their lessons.

During another methods of teaching course in which students were in the formal teaching option, cooperative learning techniques were introduced during two class
sessions; None of the students were asked to use any of the cooperative learning techniques. However, after just one use of the cooperative learning techniques during lecture, the researcher saw evidence of students using the techniques in their lessons while teaching in the laboratory. The researcher saw two out of three students use cooperative learning techniques in their next lesson; Both jot-thoughts and timed-pair share were used. The students in this methods of teaching course consisted of students majoring in Agriculture and Extension Education, preparing to student teach. If a similar study is done, it is recommended that a formal teacher preparation course be used, in hopes that more cooperative learning techniques would be used by the students.

**Summary**

Cooperative learning techniques can enhance student’s level of cognitive competency. Although no statistically significant relationship could be drawn, in this study, between student competency on the final examination and their cognitive processing capability, educators should assess their students at the level of cognition at which they teach. Educators should not teach at only the high levels of cognition, but rather use a mixture of techniques at varying levels of cognition. Using cooperative learning techniques not only helps with higher cognitive thinking skills, but also assists students in developing social skills that are vital to their future work endeavors.

Students, in this study, did not widely use cooperative learning techniques, but those who did faired better on the final examination than those who did not use the techniques at all. Another recommendation is that educators in training should have exposure to the use of cooperative learning techniques, and understand the importance of implementing various techniques in the learning environment.
REFERENCES


Newmann, F. (1987). Higher order thinking in the high school curriculum. [microform].


APPENDIX A

STUDENT CONSENT FORM
Agricultural and Extension Education 530
The Ohio State University

This is a consent form for research participation. It contains important information about what to expect if you decide to participate.

Your participation is voluntary.
Please consider the information carefully. Feel free to ask questions before making your decision whether or not to participate. If you decide to participate, you will be asked to sign this form and will receive a copy of the form.

Samples of your work, and respective assessments of such work will be maintained and reviewed as part of this research. If you choose to participate, the study will last for the duration of the Agricultural and Extension Education 530 course.

Efforts will be made to keep your study-related information confidential. All names and identifiable references will be removed from all documents used. All work samples used in this study will be properly disposed of in a timely fashion following its conclusion.

You may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you, and you will not lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University or the Agricultural and Extension Education Staff.

If you choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights you may have as a participant in this study.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

I have read (or someone has read to me) this form and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study.

__________________________________________________________
Signature of Candidate

__________________________________________________________
Date of Signature

For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

Investigator contact information:

Dr. Susie Whittington.1
2120 Fyffe Road
Rm 203 Ag Admin Bldg
614-292-6321

Carla Jagger.16
2120 Fyffe Road
Rm 311 Ag Admin Bldg
419-560-3487

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APPENDIX B

FLORIDA RUBRIC FOR ASSESSING CRITICAL THINKING SKILLS
Florida Rubric for Assessing Critical Thinking Skills

Scorer:___________

Student’s Number:_________ Problem:_________

Analysis:
Differentiates between facts, judgments and opinions within the conclusion. _____
Identifies the contextual components of the issue. ______
Uses logic to support the conclusion. ______
Uses logic to contest the conclusion. ______
Recognizes irrelevant components of the conclusion. _____
Recognizes relevant components of the conclusion. ______

Evaluation:
Assesses credibility of facts and opinions used to form a conclusion. _____
Assesses people’s general acceptance of the conclusion as being correct. ______
Anticipates questions or objections to weaknesses in the conclusion. _____
Offers supplementary information that may strengthen the conclusion. ______
Determines the significance of the conclusion based on future implications. _____
Identifies the logical strength of the conclusion as supported by good reasoning. __

Inference:
Forms a plausible judgment (agree-disagree) from the given information. ______
States criteria used to form their judgment. ______
Uses scientific reasoning to confirm their judgment. _____
Develops possible alternative conclusions to consider. _____
Identifies specific implications as a result of the given conclusion. ______
Gives recommendation or a plan to gather more information. _____

<table>
<thead>
<tr>
<th>Summed Score</th>
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<td>Analysis</td>
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<tr>
<td>Evaluation</td>
</tr>
<tr>
<td>Inference</td>
</tr>
<tr>
<td>Total Score</td>
</tr>
</tbody>
</table>

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Directions:

Each construct has six items. For each item, grade the total response to the stimulus with a score of 1, 2, or 3.

- The score of 3 will indicate that the individual clearly provided evidence of demonstrating the specific critical thinking skill.
- The score of 2 will indicate that the individual provided hints that he/she may have used the specific critical thinking skill.
- The score of 1 will indicate that the individual provided no evidence of demonstrating of using the specific critical thinking skill.

From experience, we have found it necessary to stay alert and make every effort to distinguish differences between 1, 2, and 3.

Once you have determined the score of each sub-skill item, proceed to calculate the sum for each critical thinking skill construct and write the number in the chart.
APPENDIX C

FINAL EXAMINATION: COGNITIVE LEVEL OF QUESTIONS
530.01 Final Examination: Cognitive level of questions

<table>
<thead>
<tr>
<th>Final examination Questions</th>
<th>Cognitive Level of Question (Frequency)</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Knowledge (10)</td>
<td>Comprehension (20)</td>
</tr>
<tr>
<td>Question 1</td>
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<tr>
<td>Question 2</td>
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<td>Question 3</td>
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<td>Question 4</td>
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<td>Question 5</td>
<td>✔x5</td>
<td>✔x5</td>
</tr>
<tr>
<td>Question 6</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Question 7</td>
<td>✔x3</td>
<td></td>
</tr>
<tr>
<td>Question 8</td>
<td>✔x4</td>
<td></td>
</tr>
<tr>
<td>Question 9</td>
<td>✔* ✔** ✔***</td>
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</tr>
<tr>
<td>Question 10</td>
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<td></td>
</tr>
<tr>
<td>Question 11</td>
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<tr>
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<td>Question 15</td>
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</tr>
<tr>
<td>Question 16</td>
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</tr>
<tr>
<td>Question 17</td>
<td>✔</td>
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<td>Question 18</td>
<td>✔</td>
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<td>Question 19</td>
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<td></td>
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<tr>
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<td></td>
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<td>Question 23</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Question 24</td>
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<td>Question 26</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Question 27 (Daily Plan)</td>
<td>✔</td>
<td></td>
</tr>
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</table>

Key: "x#" number of items under that question; *part one of question; **part two of question; ***part three of question
APPENDIX D

FINAL EXAMINATION: WEIGHTED SCORE
<table>
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<tr>
<th>Final examination questions (Overall 204 Possible Points)</th>
<th>Cognitively Weighted Score of Test Questions</th>
</tr>
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<td>4</td>
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<td>Question 2</td>
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<td>Question 3</td>
<td>6</td>
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<td>Question 5</td>
<td>10</td>
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<td>Question 6</td>
<td>2</td>
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<td>Question 7</td>
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<td>Question 9</td>
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<td>Question 15</td>
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<td>Question 16</td>
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<td>Question 17</td>
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<td>Question 18</td>
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<td>Question 27 (Daily Plan)</td>
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<td>Total Weighted Score for Cognitive Levels</td>
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