DESCRIBING TIME SPENT USING VARIOUS TEACHING TECHNIQUES AND STUDENT IMMEDIATE, SHORT-TERM, AND LONG-TERM COGNITIVE RETENTION

THESIS

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By

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ABSTRACT

The purpose of the study was to describe teacher time spent using various teaching techniques and student cognitive retention of content during a secondary animal science unit of instruction. This observational case study was descriptive in nature.

One high school teacher was video-taped while teaching an Agricultural Science I class of 12 freshman students. The teacher taught 18 one-hour lessons that compiled an animal science unit of instruction. Eight instruments were used to describe the time that the teacher spent using teaching techniques and the immediate, short-term, and long-term cognitive retention of the students.

Results of the study showed that student notebooks and information sheets were the most widely used individualized teaching techniques. Lecture and discussion were the most often used group teaching techniques. Other teaching techniques were used occasionally.

Student immediate, short-term, and long-term cognitive retention of the animal science subject matter taught during the unit of instruction was measured. Student immediate cognitive retention was measured by multiplying the score of the final unit exam taken immediately after the unit of instruction was taught by the cognitive
weighted score of the final unit exam. The mean student immediate cognitive retention score was 75%.

Student short-term cognitive retention was measured by multiplying the score of the final unit exam taken 42 days after the unit of instruction was taught by the cognitive weighted score of the final unit exam. The mean student short-term cognitive retention score was 78%. The mean difference between the test taken immediately after the unit and the test taken 42 days after the unit was 3%.

Student long-term cognitive retention was measured by multiplying the score of the final unit exam taken 182 days after the unit of instruction was taught by the cognitive weighted score of the final unit exam. The mean student long-term cognitive retention score was 74%. The mean difference between the test taken 42 days after the unit and the test taken 182 days after the unit was -4%. The mean difference between the test taken immediately after the unit and the test taken 182 days after the unit was -0.8%.
Dedicated to my parents, David and Cathy Beck and my brother Jordan
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CHAPTER 1

INTRODUCTION

Background and Setting

The nationwide graduation rate of high school students in the United States is 74.7%; 9.3% of high school students drop out each year (U.S. Department of Education, National Center for Education Statistics, 2006, 2008). Research must be conducted to establish the best teaching techniques to use in the classroom for students to retain knowledge and succeed in school. Edwards (2004) recommended that research be conducted to evaluate how agricultural education might best serve students in enhancing science, mathematics, reading skills, and knowledge.

Cano (1990) suggested that research be conducted on “the level of cognition of instruction and student performance in agricultural education on a broader, more comprehensive level” (p. 79). In this study, therefore, teaching techniques used in the classroom, and the content knowledge cognitively retained by students in an Agricultural Education classroom was described.

Purpose

The purpose of the study was to describe teacher time spent using various teaching techniques and student cognitive retention of content during a secondary
animal science unit of instruction. This observational case study was descriptive in nature.

**Objectives**

The objectives guiding this descriptive study were:

1. To describe the amount of time the teacher spent using group teaching techniques (cooperative learning, demonstration, discussion, field trip, lecture, resource person, role play) and individualized teaching techniques (assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, supervised study) (Newcomb, McCracken, Warmbrod & Whittington, 2004) during a secondary animal science unit of instruction.

2. To describe student immediate cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

3. To describe student short-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

4. To describe student long-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

**Definition of Terms**

*Demonstration* – Teaching technique used to teach students how to accomplish a specific task or process (Newcomb et al.). Demonstration was described as any time that the teacher used a model or other concrete object to further show or explain a concept.
Discussion – A group teaching technique that may include the entire class, or groups of students to brainstorm, answer a question, or discuss a problem or topic (Newcomb et al.). Discussion was described as any time that the teacher engaged in conversation related to the unit of instruction with the students, or students engaged in conversation related to the unit of instruction with other students.

Final unit exam – The teacher-developed paper and pencil test that summarized the material covered in the 18-day animal science unit taught by the teacher to the Agricultural Science I class (see Appendix A).

Group teaching techniques – Teaching techniques that are appropriate for instructing a group of students in the same setting, including cooperative learning, demonstration, discussion, field trip, lecture, resource person, and role play (Newcomb et al., 2004).

Higher cognitive levels – The four highest levels in Bloom's Taxonomy of educational objectives in the cognitive domain, including application, analysis, synthesis, and evaluation (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956).

Individualized teaching techniques – Teaching techniques that are designed for use by each learner as an individual, including assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, and supervised study (Newcomb et al.).

Lower cognitive levels – The two lowest levels in Bloom's Taxonomy of educational objectives in the cognitive domain, including knowledge and comprehension (Bloom et al., 1956).
**Student immediate cognitive retention** – The amount of content knowledge, weighted cognitively, that was retained by students immediately after the unit of instruction was taught.

**Student immediate retention of content** – The amount of content knowledge that students remembered immediately after the unit of instruction had been taught as evidenced by student responses on a teacher-developed final unit exam.

**Student long-term cognitive retention** – The amount of content knowledge, weighted cognitively, that was retained by students 182 days after the unit of instruction was taught.

**Student long-term retention of content** – The amount of content knowledge that students remembered 182 days after the unit of instruction had been taught as evidenced by student responses on a teacher-developed final unit exam.

**Student short-term cognitive retention** – The amount of content knowledge, weighted cognitively, that was retained by students 42 days after the unit of instruction was taught.

**Student short-term retention of content** – The amount of content knowledge that students remembered 42 days after the unit of instruction had been taught as evidenced by student responses on a teacher-developed final unit exam.

**Teaching techniques** – The tools that teachers use to present information and to guide students in discovering knowledge (Newcomb et al., 2004).
Operational Definitions of Terms

*Group teaching techniques* – The number of minutes the teacher spent using cooperative learning, demonstration, discussion, field trip, lecture, resource person, or role play as evidenced using the “Group and individualized teaching techniques: Time spent using during class session” instrument. The score was recorded as a sum of the total number of minutes the specific technique was used across the unit of instruction.

*Individualized teaching techniques* – The number of minutes the teacher spent using assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, or supervised study as evidenced using the “Group and individualized teaching techniques: Time spent using during class session” instrument. The score was recorded as a sum of the total number of minutes the specific technique was used across the unit of instruction.

*Student immediate cognitive retention* – The amount of content knowledge cognitively retained by students immediately after the unit of instruction, as evidenced by each student’s final unit exam score multiplied by the cognitively weighted score of the final unit exam.

*Student immediate retention of content* – The amount of knowledge that the student retained immediately after the unit of instruction, as evidenced by the final unit exam score.

*Student long-term cognitive retention* – The amount of content knowledge cognitively retained by students 182 days after the unit of instruction, as evidenced by each
student’s final unit exam score multiplied by the cognitively weighted score of the final unit exam.

*Student long-term retention of content* – The amount of knowledge that the student retained 182 days after the unit of instruction, as evidenced by the final unit exam score.

*Student short-term cognitive retention* – The amount of content knowledge cognitively retained by students 42 days after the unit of instruction, as evidenced by each student’s final unit exam score multiplied by the cognitively weighted score of the final unit exam.

*Student short-term retention of content* – The amount of knowledge that the student retained 42 days after the unit of instruction, as evidenced by the final unit exam score.

**Limitations of the Study**

The school, teacher, and classroom of the observation were not chosen randomly; the school was selected by a faculty member at The Ohio State University. The selection was based upon choosing a teacher who had received his college education and degree in Agricultural Education from The Ohio State University. The teacher had also received instruction in methods of teaching from the faculty member involved in the study. Choosing one teacher held classroom protocol variables constant in the delivery of the content.

The dates of the observations were not chosen randomly, as they were, instead, chosen to accommodate the teacher and the classroom situation. The size of the study limits the generalizability. This study observed one teacher with twelve students in high school Agricultural Education in rural Ohio.
There was uncertainty regarding the grading process of the final unit exam. The researcher re-graded the exams to ensure consistency in the grading process.

Basic Assumptions

The researcher assumed that the teacher delivered the content of the unit of instruction in the same way as he would have delivered the content if there was no video camera in the room and he was not part of the study. The researcher also assumed that the students enrolled in the course behaved in the same manner that they would have without the video camera in the room and without being a part of the study. Further, it was assumed that given that the research data collection took place daily across 18 days, even if initial reaction to videotaping occurred, it would have subsided by the end of the videotaping period.
CHAPTER 2

REVIEW OF RELATED LITERATURE

Jean Piaget identified four factors, which influence a change in thinking (Woolfolk, 2004). The four factors included biological maturation, activity, social experiences, and equilibrium (Woolfolk). Woolfolk defined maturation as the “unfolding of the biological changes that are genetically programmed” (p. 30). Activity involves changing one’s way of thinking based on activity in the environment (Woolfolk). Social experiences involve interacting with and learning from others, while equilibrium is the search for balance (Woolfolk).

Piaget then developed the four stages of cognitive development, which include sensorimotor, preoperational, concrete operational, and formal operational (Woolfolk, 2004). According to Piaget, sensorimotor involves imitation, memory, and thought (Woolfolk). Preoperational is most often reached between years two and seven (Woolfolk). Preoperational includes the development of language and logical thinking, while still having trouble seeing others’ points of view (Woolfolk).

Concrete operational is usually reached between the ages of seven and 11 (Woolfolk, 2004). Concrete operational involves solving hands-on, or concrete problems logically, as well as understanding reversibility (Woolfolk). Formal operational is generally reached between the ages of 11 and adulthood (Woolfolk).
Formal operational involves solving abstract problems logically, scientific thinking, and being concerned with social issues (Woolfolk).

Piaget admitted that most adults are only able to reach formal operational with the areas which they are most interested and have the most experiences (Woolfolk, 2004). Because most people never reach formal operational in every subject area, teachers must remember to teach accordingly and to not expect students to think abstractly about problems (Woolfolk).

**Bloom’s Taxonomy**

Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) established a taxonomy of educational objectives in the cognitive domain. The six levels in the taxonomy include: knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom et al., 1956).

According to Bloom et al. (1956), knowledge involves recalling specifics, methods, patterns, and structures. Knowledge emphasizes remembering the most, and requires organization and re-organization of a problem (Bloom et al.). Examples of knowledge include the knowledge of terminology, specific facts, methodology, principles and generalizations, and theories and structures (Bloom et al.).

Comprehension is the second level of cognition, and the lowest level of understanding (Bloom et al., 1956). Comprehension involves understanding and making use of the material that is being communicated, without relating it to other implications (Bloom, et al.). Examples of comprehension include translation and interpretation (Bloom et al.).
Application is the third level of cognition. Application involves the use of abstractions, such as general ideas and technical theories, as well as concrete situations (Bloom et al., 1956). Examples of application include application of phenomena from one scientific paper to another paper, and the ability to predict the change in a biological situation (Bloom et al.).

Analysis is the fourth level, and includes the breaking of communication into elements in a hierarchy (Bloom et al., 1956). The organization of the communication, the effects that the communication conveys, and the basis and arrangement of the communication are established (Bloom et al.). Examples of analysis include analysis of elements, relationships, and organizational principles (Bloom et al.).

Synthesis involves putting together parts to make a whole idea (Bloom et al., 1956). The parts or elements are arranged and combined to produce a new pattern or structure (Bloom et al.). Examples of synthesis include the production of a unique communication, production of a plan, or proposed set of operation, and the derivation of a set of abstract relations (Bloom et al.).

Evaluation is the sixth level in the hierarchy, and includes judgments about the material that have been communicated (Bloom et al., 1956). Both qualitative and quantitative judgments are made regarding the material and methods (Bloom et al.). Examples of evaluation include judgments in terms of internal evidence, and judgments in terms of external evidence (Bloom et al.).

Torres and Cano (1995) emphasized the importance of developing higher-order thinking in students, beginning in the freshmen year of college. In addition, the
researchers advocated that teachers should teach at higher cognitive levels, forcing students to do more than simply restate learned facts (Torres & Cano, 1995). Torres and Cano (1995) also stated that tests and assignments should be written at higher levels of cognition.

**Teaching Techniques Used in the Classroom**

There are many teaching techniques used in the Agricultural Education classroom, and several books outline these techniques. According to Ball and Knobloch (2005), *Methods of Teaching Agriculture* (Newcomb et al., 2004) was the most commonly required textbook in Agricultural Education teaching methods college courses. Out of 74 courses, *Methods of Teaching Agriculture* was the textbook required in 19 courses (Ball and Knobloch). The next highest textbooks required were *Effective Teaching in Agriculture and Life Sciences* by Raven, *Handbook on Agricultural Education* by Phipps and Osborne, and *Agriculture Teacher’s Manual* by the National FFA Organization, which were each required in five classrooms (Ball and Knobloch). In the 40 syllabi reviewed, nine out of the top ten most common teaching methods taught in Agricultural Education teaching methods courses were identical to the teaching methods identified in *Methods of Teaching Agriculture* (Ball and Knobloch).

Phipps and Osborne (1988) outlined the following teaching techniques to be used within the problem-solving teaching framework: discussion, role playing, dramatic skit, laboratory experience, lectures, field trips, demonstrations, tests, experiments, and supervised study. According to Phipps and Osborne, the use of these strategies and
techniques within the problem-solving framework provided variety and held interest in the teaching-learning process.

Newcomb et al. (2004) outlined the teaching techniques used in the agricultural education classroom in *Methods of Teaching Agriculture*. The authors divided the teaching techniques into two groups: group teaching techniques and individualized teaching techniques, based upon the classroom application of the techniques (Newcomb et al.).

*Group Teaching Techniques*

Group teaching techniques are used when teaching time and resources are limited, and the same information needs to be taught to a group of students (Newcomb et al., 2004). Newcomb et al. encouraged teachers to use various teaching techniques that are appropriate for the group and the situation. Using a variety of techniques will lead to a more productive and interesting class session. The group teaching techniques include: lecture, discussion, demonstrations, field trips, role-play, resource people, and cooperative learning (Newcomb et al.).

Newcomb et al. (2004) stated that lectures are used to teach factual information, and should be planned and organized before the class session. The authors stated that lectures should be systematic. Some examples of lecture formats include chronological, problems and solutions, and cause and effect (Newcomb et al.). Teachers should talk with enthusiasm and include visual aids in lectures to be effective (Newcomb et al.).

According to Newcomb et al. (2004), discussions may be held in classes in a variety of ways. Newcomb et al. stated that class discussions, brainstorming, buzz
groups, and pair-share are all good discussion methods. The researchers stated that the teacher may lead the group, or students may lead each other to discuss class content. Newcomb et al. further stated that questioning is one of the most important aspects of the success of discussions. Teachers should prepare questions and discussion items before class (Newcomb et al.).

Newcomb et al. (2004) stated that demonstrations are particularly used in agricultural education, as the hands-on approach to learning is so widely advocated. The authors wrote that students have the opportunity to use their psychomotor skills and practice during demonstrations (Newcomb et al.). Demonstrations are particularly useful when teaching students how to accomplish specific tasks (Newcomb et al.).

According to Newcomb et al. (2004), field trips are widely used in agricultural education classrooms. The authors stated that because agriculture is a broad field, each high school classroom is not able to provide every aspect of agriculture for students to experience. Field trips offer students the opportunity to see and experience many different aspects of agriculture (Newcomb et al.). Teachers must organize the field trips and be prepared in order to maximize the learning opportunity (Newcomb et al.).

Newcomb et al. (2004) stated that role-plays assign students, and possibly guests, a specific role to act-out in front of the class to teach a specific concept or information. Role-plays are best used to teach human relations skills, leadership skills, and sales abilities (Newcomb et al.).

According to Newcomb et al. (2004), resource people are experts in a field who come into the classroom to teach specific content to students. Resource people add
information to the lesson, while also introducing students to agricultural experts in the community (Newcomb et al.).

Cooperative learning offers students the opportunity to work together in small groups to master specific content (Newcomb et al., 2004). Cooperative learning is especially useful for reviewing for tests, gathering project information, team building, concluding a unit of instruction, providing a felt need, and researching information (Newcomb et al.).

*Individualized Teaching Techniques*

According to Newcomb et al. (2004), individualized teaching techniques are used when students need different types of instruction. The authors stated that teachers can match the student needs to individualized techniques to enhance learning. While teachers have limited time, incorporating some individualized techniques into teaching will help students to learn certain material better (Newcomb et al.). Individualized teaching techniques include supervised study, experiments, independent study, student notebooks, information sheets, assignment sheets, and skill sheets (Newcomb et al.).

Supervised study includes proposing a question to students, in which each student will attempt to answer (Newcomb et al., 2004). The researchers stated that a *felt need* is imperative to ensure that students put forth effort to answer the question (Newcomb et al.). Teachers should discuss available resources, how to use the resources, how to record notes, and how to report findings to answer the question (Newcomb et al.).
According to Newcomb et al. (2004), experiments offer students opportunities to be directly involved in learning. The researchers stated that students physically set-up the experiment, collect data, and write their conclusions from the experiment. Newcomb et al. further explained that students learn systematically and must gather all of the facts before making a conclusion. Experiments offer the opportunity to see real agricultural items, and provide hands-on opportunities for students (Newcomb et al.).

According to Newcomb et al. (2004), independent study offers students an environment to work on projects by themselves. The researchers stated that independent study meets each individual student’s learning needs (Newcomb et al.). Teachers must teach students how to work independently, while keeping in mind that all students work differently and have different interests (Newcomb et al.). Teachers must also make sure that each student has a place to work independently, and teachers should interact with all students during the independent study (Newcomb et al.).

The use of student notebooks teaches students the values of keeping good, organized notes (Newcomb et al., 2004). The researchers stated that students are able to synthesize information in their notebooks to answer questions, thus they see how a unit of instruction fits together in the course (Newcomb et al.). Students may also use the notebooks in the future to reference information learned in the agricultural education course (Newcomb et al.).

According to Newcomb et al. (2004), information sheets provide students a short handout with basic information. Information sheets are mostly used to introduce new information or as a summary of a classroom study (Newcomb et al.).
Assignment sheets state the assignments that the learners must complete (Newcomb et al., 2004). According to the researchers, assignment sheets state how to complete the assignment and check to make sure that nothing is missed (Newcomb et al.).

Skill sheets focus on a specific skill that the learner is to master (Newcomb et al., 2004). Skill sheets include information and steps to master the skill, and may include pictures and illustrations (Newcomb et al.).

**Student Cognitive Retention**

Gall (1970), in a comprehensive study of the research conducted about the use of questioning in teaching students of all ages, found that 60% of instructional methods occurred at the remembering stage of Bloom’s Taxonomy. Twenty percent of methods occurred at processing, and 20% at creating and evaluating (Gall).

Gardiner (1998) reviewed several studies about college students. Combined, the studies showed that students’ college experiments included “loosely organized, unfocused curriculum, with undefined outcomes, classes that emphasize passive listening, lectures that transmit low-level information, and assessments of learning that frequently demand only the recall of memorized material or low-level comprehension of concepts” (Gardiner, p. 72).

At the high school level, Foyle and Bailey (1985) studied the relationship between homework and student cognition in 131 tenth grade students enrolled in six different American history classes. Foyle and Bailey found that student achievement scores increased when students were assigned homework assignments that were
regularly assigned, clearly stated, regularly collected, promptly graded, and promptly returned. Additionally, there were no significant differences in achievement between males and females (Foyle & Bailey). There were no significant differences in achievement between those students assigned preparation homework compared to those students assigned practice homework (Foyle & Bailey).

The Relationship Between Teaching Approach and Student Cognition

Cano (1990) recommended that instructors design a curriculum that covers every level of cognition, and that challenges students. Cano and Newcomb (1990) further recommended that teachers create learning situations that teach students at higher levels of cognition.

Cano and Metzger (1995), in a study of nine high school horticulture teachers, found that 84% of teaching was occurring at Bloom’s knowledge, translation, interpretation, and application levels. Cano and Metzger also found that 16% of teaching occurred at Bloom’s higher levels of cognition (analysis, synthesis, and evaluation).

Cano (1990) conducted a study of the relationship between instruction and student performance at various levels of cognition among 81 twelfth grade high school students enrolled in production agriculture classes with ten different teachers. The researcher found that 31% of instructional objectives were written at Bloom’s taxonomy level of remembering, 38% at processing, 19% at creating, and 12% at evaluating (Cano). The cognitive level of student performance was determined by the percent of correct answers to questions written at the various levels of Bloom’s Taxonomy (Cano).
The students correctly answered 64% of remembering level questions, 55% of processing, 40% of creating, and 28% of evaluating (Cano). Cano found a significant relationship between the cognitive level of instruction and student cognitive performance in high school agricultural education students.

In further research, Winne (1979) reviewed several studies looking at cognitive levels of questions in relation to student achievement with varying ages of students. Winne could make no sound conclusion regarding the relationship between questioning and student achievement based on the research studies that had been conducted.

In a quasi-experimental study of 352 high school students enrolled in introductory Agricultural Science courses, Myers and Dyer (2006) concluded that there is a concern with the great amount of time spent teaching a unit of instruction that then results in little student knowledge gain. Using pre-test and post-test instruments, Myers and Dyer concluded that students with less prior knowledge had higher content knowledge gain scores at the conclusion of the instruction, and students with higher science processing skill achievement prior to the instruction had higher content knowledge gain at the conclusion. Field-independent learners had more than double the content knowledge gain when compared with field-dependent learners (Myers & Dyer). Myers and Dyer stated that field independent learners could enjoy more and be more successful in a classroom where the investigative teaching approach is used. The authors suggested that further research be conducted in this area (Myers and Dyer). The subject matter and investigative laboratory approaches to teaching resulted in higher content knowledge gain and science-processing skills when compared with the
prescriptive laboratory treatment (Myers & Dyer). Myers and Dyer recommended that further research be conducted to find the effect of teaching methods on student attitude and long-term and short-term content knowledge retention.

Variables Influencing Student Cognition

Ewing and Whittington (2007) studied the variables that influenced student cognition during college class sessions. Ewing and Whittington, in a study of 21 total class sessions with 12 different instructors in an agricultural college, described the professor discourse, teaching techniques, cognitive level of questions asked by the professor, student engagement in class, and cognitive level of student questions during class sessions. Ewing and Whittington used researcher-developed instruments to describe the variables during class sessions and used think-aloud protocols to describe the thoughts of the students.

Ewing and Whittington (in press) found that 62% of professor discourse occurred at Bloom’s knowledge and comprehension levels of cognition. Further, independent study and supervised study were the two individualized teaching techniques used (Ewing & Whittington). Cooperative learning, demonstration, discussion, lecture, resource people, and role-play were the group teaching techniques used (Ewing & Whittington). While group teaching techniques were used more than individualized teaching techniques, lecture and discussion were the most widely used group teaching techniques (Ewing & Whittington).

The question type used most frequently (42%) by professors was closed-type (Ewing & Whittington, 2007). Professor questions were mostly (43%) at the knowledge
level of cognition (Ewing & Whittington). Sixty-three percent of the course objectives were written at the knowledge and comprehension levels of cognition (Ewing & Whittington).

Furthermore, 62% of student thoughts and questions pertaining to class content occurred at Bloom’s (Bloom et al., 1956) knowledge and comprehension levels of cognition (Ewing & Whittington, 2007). Approximately 9% of student thoughts occurred at Bloom’s application level, 17% at analysis, 5% at synthesis, and 6% at evaluation (Ewing & Whittington). Sixty percent of student thoughts in general were unrelated to the class content (Ewing & Whittington).

Ewing and Whittington (in press) recommended that professors analyze the cognitive levels of student thoughts to ensure the course is at the most appropriate cognitive level. Ewing and Whittington stated that if the student thoughts were at lower-cognitive levels, professors should consider changing course objectives, delivery, and discourse to enhance student cognition.

The Relationship Between Teaching Techniques and Student Cognitive Retention

Simulation Gaming Versus Lecture-Discussion Techniques and Cognitive Retention

Lucas, Postma, and Thompson (1975) studied cognitive retention using simulation gaming and lecture-discussion techniques. The researchers randomly assigned high school classes to experimental and control groups (Lucas et al., 1975). Each teacher taught one class in the control group and one class in the experimental group (Lucas et al.). The control groups were taught through textbook reading and
lectures, while the experimental groups played three different simulation games during class followed by a debriefing session (Lucas et al.).

Lucas et al. (1975) used a 30-item instrument to measure cognitive achievement and retention in 294 high school students studying United States history. The identical 30-item instrument was given as a pre-test, post-test, and delayed-interval post-test (Lucas et al.).

Lucas et al. (1975) concluded that students in both the simulation gaming and lecture-discussion performed well on achievement measures. However, the students taught using simulation-gaming techniques retained the content significantly better than those students taught with the lecture-discussion method (Lucas et al.).

Model Building Teaching Method, Student Cognitive Retention, and Transfer of Learning

Egan (2007) studied the effects of different study methods on information retention and transfer of learning among 30 students between the ages of 23 and 40. Egan evaluated the two groups of students in the knowledge that they gained, retained, and transferred. Egan played a narrative on the computer for all students. Following the first narrative, the control group read the narrative in a booklet while the experimental group designed a conceptual model on the computer based upon the narrative (Egan). The second and third narrative passages were then played (Egan). The control group again studied their booklet about the second narrative, while the experimental group designed a conceptual model for the second narrative (Egan). All students took a five-minute break, followed by the control group reading their booklet pertaining to the third
narrative (Egan). The experimental group created a conceptual model on the computer for the third narrative as well (Egan). At the conclusion, all students took three tests (Egan).

Egan (2007) used four different tests to measure cognition, information retention, and transfer of learning. A five-question multiple choice pre-test was administered to test knowledge of human cognition, learning transfer, and spaced practice (Egan). Three narratives were read, at different intervals, to test cognition, information retention, and transfer of learning (Egan). At the conclusion of the narratives and brief study sessions, a twelve-question matching test was administered to test for rote memory of conceptual definitions from the narratives (Egan). A three-essay type question test was given to test for the participants’ abilities to transfer knowledge by new contexts (Egan). Finally, a satisfaction questionnaire was completed by the participants (Egan).

Egan (2007) found no significant differences between the model-building and free study groups in the retention and transfer of learning. With statistical confidence, Egan concluded that the spaced narratives used, along with the model-building did enhance transfer of learning. Egan also found a non-significant trend of decreasing knowledge extension test scores as the time between narratives read increased.

*Learning Time and Cognitive Retention in Students with Learning Disabilities*

Gettinger (1991) studied the difference in time that it took for students with learning disabilities and students without learning disabilities to retain knowledge. Gettinger studied 44 fourth and fifth grade students from schools in four different
communities. There were 36 boys and eight girls (Gettinger). Gettinger first administered intelligence scale and reading pre-tests to identify those students with and without learning disabilities. Twenty-two of the total 44 students had learning disabilities. Additionally, an interest inventory, intrinsic versus extrinsic orientation in the classroom scale, and pre-task knowledge test were administered to students at the beginning of the study (Gettinger).

Gettinger (1991) created learning task units and administered them to students individually. Time needed for learning was measured by the number of trials that students needed to achieve 100% accuracy on the learning task (Gettinger). Time spent learning was measured by the number of self-determined trials that the students completed to learn an alternate form of the learning task (Gettinger).

Gettinger (1991) found that, on average, the students needed approximately five learning trials to master the learning tasks. The students that did not have learning disabilities retained significantly greater amounts of knowledge than the students with learning disabilities (Gettinger). Gettinger suggested that more learning time should be given to students with learning disabilities, although increased learning time did not guarantee increased knowledge retention. Further, Gettinger found that within one day, students with no learning disabilities had a 15% decrease in retention when they spent 25% less time than needed. The students with learning disabilities had a 61% decrease in retention (Gettinger).
The Relationship Between Problem Solving Teaching Approach, Cognitive Achievement, and Cognitive Retention

*The Effect of Problem Solving and Subject Matter Approaches on Student Achievement and Cognitive Retention*

Flowers and Osborne (1987) studied the effects of the problem solving approach and subject matter approach to teaching on student achievement and cognitive retention in 126 high school students enrolled in Agricultural Education. Flowers and Osborne conducted an in-service training for the four teachers in the study to learn how to use the problem solving approach and subject matter approach to teaching. The teachers were randomly assigned a unit of instruction (corn production) using either the problem solving approach or subject matter approach to teaching (Flowers & Osborne). The quasi-experimental design involved 66 students in the problem solving group and 60 students in the subject matter group (Flowers & Osborne).

Flowers and Osborne (1987) used researcher-developed instruments, a problem based achievement test, and a parallel problem area retention test to measure retention. The researchers’ tests included high-level cognitive items and low-level cognitive items (Flowers & Osborne). The differences in test scores were used to measure student cognitive retention (Flowers & Osborne).

Flowers and Osborne (1987) concluded that the problem solving approach was not more or less effective than the subject matter approach to teaching on student achievement among the 126 high school students enrolled in Agricultural Education. Further, neither the problem solving approach nor subject matter approach to teaching...
produced higher retention scores (Flowers & Osborne). The problem solving approach to teaching, however, did lead to lower achievement loss in students when compared to the subject matter approach (Flowers & Osborne).

The Effect of the Teaching Approach on Student Achievement, Retention, and Attitude

Boone and Newcomb (1990) studied the effect of the teaching approach used on student achievement, retention, and attitude among 121 ninth grade students in an Agricultural Education course. Boone and Newcomb created two instructional units; one was taught using the problem solving method, and one was taught using a subject matter approach to teaching. The teachers in the study each taught both units to their classes (Boone & Newcomb). Tests were given to the students at the end of the units (Boone & Newcomb).

Boone and Newcomb (1990) used a forty-item achievement test to study the effects of the teaching approach on student achievement and retention. The forty questions were arranged differently to create three different tests with identical questions (Boone & Newcomb). The forty question test was then used as a pre-test, post-test #1, and post-test #2 (Boone & Newcomb).

Boone and Newcomb (1990) found a significant interaction in the students who were taught using a problem solving approach prior to being taught with the subject matter approach. Boone and Newcomb concluded that students who were taught first by a teacher using the problem solving approach had higher achievement scores. Further, a positive relationship was found between the level of student achievement and the extent
to which the teacher used the problem solving approach (Boone & Newcomb). No significant relationships were established with student retention (Boone & Newcomb).

In a similar study, Boone (1990) studied the effect of problem solving on student achievement and retention in 99 ninth grade students enrolled in Agricultural Education, with six different vocational agriculture teachers. Boone used two different units of instruction; one was taught using the problem solving approach and the second using the subject matter approach. The units of instruction included the same amount of instructional materials (Boone). The differences in the units of instruction were the subject matter (preparing beef cattle for show, controlling weeds in corn), teaching methods used, and whether the unit was taught first or second in relation to the other unit (Boone). Teachers were audio-taped during the teaching of the units, as each teacher taught both units to their classes (Boone). Achievement tests were administered at the conclusion on the units (Boone).

Boone (1990) concluded, “the problem solving approach to teaching increases the level of student retention of agricultural knowledge” (p. 25). Further, prior knowledge of the subject matter and individual teacher characteristics both influenced student achievement (Boone). Student retention of the subject matter increased when students solved real problems using the scientific method to reason through the problem, tested possible solutions, and evaluated the results (Boone).

Torres and Cano (1995), in a study of 196 senior college students enrolled in an agriculture college, attempted to discover the development of three cognitive levels of the students. Torres and Cano found that the students had “less than adequate cognitive
skills to allow them to solve problems, make decisions, and think critically” (p. 51).

Torres and Cano discussed the importance of teaching at higher cognitive levels to increase higher level thinking in students. Torres and Cano mentioned instructor discourse, tests, and assignments as specific areas that should be taught at higher levels of cognition. Additionally, Torres and Cano agreed that incorporating laboratories, homework, group projects, and term papers would increase student cognition.

The Effects of Student Learning Styles on Retention of Subject Matter Using Various Teaching Approaches

Dyer and Osborne (1999) studied the effects of student learning styles on retention of subject matter when various teaching approaches were used in Agricultural Education classes with a total of 258 high school students. Each teacher taught two different units: applying principles of plant science and germinating seeds (Dyer & Osborne). Each teacher taught one class both units using the problem solving approach, and a different class both units using the subject matter approach to teaching (Dyer & Osborne). The teachers were audio-recorded to ensure appropriate methods were used (Dyer & Osborne). A pre-test and post-test were administered according to the content of each instructional unit (Dyer & Osborne).

Dyer and Osborne (1999) administered a pre-test to the high school agriculture students before any treatments were administered. At the conclusion of the unit of instruction, a multiple choice test was given (Dyer & Osborne). The difference between the pre-test and post-test was measured for each student (Dyer & Osborne). Two weeks after the post-test had been given, a parallel test was administered to measure short-term
retention (Dyer & Osborne). Five months later, a second retention test was administered to measure long-term retention (Dyer & Osborne). The difference in scores between each test was used to measure retention (Dyer & Osborne).

Dyer and Osborne (1999) concluded that there was no significant difference in short-term retention or long-term retention between the problem solving approach and subject matter approach to teaching. Dyer and Osborne also found that the effectiveness of the problem solving and subject matter approaches to increasing short-term or long-term retention were not influenced by student learning styles.

Dyer and Osborne (1999) found a moderate correlation between student learning styles and normal curve equivalent scores. The normal curve equivalent scores statistically controlled for the ability levels of the student prior to the study (Dyer & Osborne). Dyer and Osborne found that field-independent learners tended to have higher ability levels than field-neutral and field-dependent learners.

Writing-to-Learn Activities, Cognitive Achievement, and Cognitive Retention

Reaves, Flowers, and Jewell (1993) studied the effects of writing-to-learn activities used in the classroom on content knowledge, retention, and attitudes of 177 ninth grade agricultural education students. Eighty-nine students in six different classes were placed in the experimental group, with 88 students in the comparison group (Reaves et al., 1993). The researchers created a groundwater resource protection unit of instruction, which used writing-to-learn activities that included short writing activities at three different points throughout the instructional unit (Reaves et al.). The traditional unit of instruction included the same subject matter and activities (Reaves et al.).
However, the traditional unit of instruction did not include writing responses to questions, but rather instructed students to orally answer the teacher’s questions (Reaves et al.).

Reaves et al. (1993) concluded that there were no significant differences in initial knowledge or achievement. However, a significant difference in retention was discovered (Reaves et al.). Reaves et al. found that students tended to retain more of the knowledge when taught by the writing-to-learn techniques than those students taught by traditional teaching methods.

**Summary**

Based on the research discussed, writing-to-learn activities, problem solving approach to teaching, and simulation gaming enhanced student retention in some studies. Increased time between narratives read in class tended to decrease retention, as did delayed time after initially learning the material. Students with learning disabilities retained less knowledge than students without learning disabilities. In some cases, the use of the problem solving approach to teaching did not increase or decrease student retention.

Edwards (2004) recommended that research be conducted to evaluate how agricultural education might best serve students in enhancing science, mathematics, reading skills, and knowledge. Cano (1990) suggested that research should be conducted on “the level of cognition of instruction and student performance in agricultural education on a broader, more comprehensive level” (p. 79). Myers and Dyer (2006) recommended that further research be conducted to find the effect of
teaching methods on student attitude and long-term and short-term content knowledge retention.

Little research has been conducted in the area of student cognitive retention in agricultural education. Further, video-taped high school classroom instruction is rich data that can be analyzed in a variety of ways. The combination of the video-taped data and unique piece of cognitive retention make this study an important contribution to agricultural education research.
CHAPTER 3
METHODS

Research design

This case study involving one teacher, 12 students, and eight instruments was descriptive. The findings cannot be generalized beyond the teacher and students in this study.

Initiating the Process

Subject Selection

The researcher contacted the potential subject to request his cooperation in the study via telephone. The subject verbally agreed to be videotaped during an approximate three-week animal science unit that he taught to his ninth grade Agricultural Science class of 12 students.

Population and Sample

The Teacher

The subject was a male Agricultural Education teacher, who had taught at Cory-Rawson High School for two years. Previous to his employment at Cory-Rawson High School, he was a student at The Ohio State University. He graduated from The Ohio State University with a Bachelor of Science Degree in Agriculture, majoring in
Agricultural Education with a minor in Production Agriculture. He also spent one year at The Ohio State University taking graduate classes.

*Cory-Rawson High School*

Cory-Rawson High School is a comprehensive high school in the rural community of Rawson, which is located in northwest Ohio with a population of 465. The class was taught March 27 through April 25 from 9:17 a.m. to 10:17 a.m. Monday through Friday.

*Agricultural Science I Class*

There were 12 students enrolled in the Agricultural Science I class at Cory-Rawson High School in the 2007-2008 school year. All were 9th grade students; the class was comprised of four females and eight males. Ten students grew up on farms, while two students did not, but these two students had experience helping a family member or friend with a farming enterprise. Nine students grew up around livestock, and seven students had a livestock-related supervised agricultural experience program. Eight students showed livestock as a 4-H project.

The teacher taught a three-week unit about animal science during this study. The teacher used his own curriculum, unit of instruction, lesson plans, worksheets, quizzes, tests, and other resources. The teacher taught a total of 18 one-hour lessons during this study.

*Data Collection*

The subject chose one twelfth grade student to set-up and take-down the video camera every day before and after the Agricultural Science I class. The researcher wrote
a protocol for the student to follow when setting up the camera (see Appendix B). The researcher also wrote a protocol for the teacher to read the first day when the camera was placed in the classroom (see Appendix C). The researcher visited and took the camera and protocol to the high school previous to the study. The researcher discussed, in detail, how to set up the camera. The researcher also discussed other details of the study with the teacher.

**Instrumentation**

Eight instruments were used, including the Praxis III interview, time spent using teaching techniques, student immediate cognitive retention, student short-term cognitive retention, student long-term cognitive retention, demographic information, class materials, and the journal. In the following sections, the development, validity, reliability, data collection, and data analysis for each instrument are discussed. Only the rationale and process are discussed for the class materials and journal.

**PRAXIS Interview**

The PRAXIS III Teacher Performance Assessment is used to assess the skills of beginning teachers, specifically analyzing the teacher context and classroom settings. The PRAXIS III assessments were designed for use when licensing teachers.

**Validity**

Danielson (1996) developed the four domains of teaching through a framework of teaching. Since teaching is so complex, Danielson divided teaching into 22 components, which were then clustered into four domains. Each domain consists of specific components of teaching that are related to each other (Danielson). The four
domains of the PRAXIS III assessment were taken directly from Danielson. Each domain contains several components.

Reliability

Reliability for this instrument was based upon its use in evaluating teacher performance across the country.

Data Collection

One researcher conducted the PRAXIS III post-interview with the subject at the conclusion of the video-taped period. The video-taping period consisted of 18 days during the animal science unit that the teacher taught to the Agricultural Science I class.

Data Analysis

The answers to the PRAXIS III post-interview were used to evaluate possible outside influences in the cognitive retention of the students.

Time Spent Using Teaching Techniques

The time spent using group teaching techniques and individualized teaching techniques was described using the Group and Individualized Teaching Techniques: Time Spent Using During Class Session instrument, which was developed by the researcher. The instrument included the following individualized teaching techniques: assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, and supervised study (Newcomb et al., 2004). The group teaching techniques included on the instrument were cooperative learning, demonstration, discussion, field trip, lecture, resource person, and role play (Newcomb et al.).
Validity

Validity for this instrument was based upon its direct development from Newcomb et al.’s (2004) teaching techniques and the theory and evidence (Ary, Jacobs, & Razavieh, 2002) accumulated to support Newcomb et al.’s group and individualized teaching techniques.

Reliability

Intra-rater reliability was established by one researcher watching a randomly selected videotaped class session from a college course and recording the time that the professor used each of the group and individualized teaching techniques. Twenty-one days later, the researcher watched the video again and again recorded the time that the teacher spent using each of the teaching techniques. A priori, a 90% confidence band was established as acceptable for group teaching techniques and individualized teaching techniques. The researcher watched the video tapes until the 90% confidence band was achieved for group teaching techniques and individualized teaching techniques. Because the researcher was the only person to complete the analysis, inter-rated reliability was not established.

Data Collection

The beginning and ending time of the use of each specific technique was recorded by the researcher. At the conclusion of the videotaped class session, the minutes spent on each technique were summarized. The total time spent using the various teaching techniques, during the entire unit of instruction, was summed.
**Data Analysis**

Central tendency statistics were used to describe this ratio data. Percentages of time using each technique was also included.

**Student Immediate, Short-Term, and Long-Term Cognitive Retention**

Student cognitive retention was measured through the cognitively weighted final unit exam. Immediate cognitive retention was measured from the final unit exam taken immediately after the unit of instruction was taught. Short-term cognitive retention was measured from the final unit exam taken 42 days after the unit, and long-term cognitive retention was measured from the final unit exam taken 182 days after the unit.

**Validity**

A professor, graduate students, and the subject in this study (the high school teacher) stated that the final unit exam did measure the content that the students learned during the unit of instruction (see Appendix D).

**Reliability**

The Pearson Correlation Coefficient was computed, and resulted in 0.76 for tests 1 and 2, and 0.87 for tests 1 and 3. A Cronbach’s Alpha Reliability test was computed to establish internal consistency, which was 0.79.

**Data Collection of Student Immediate Cognitive Retention**

The student immediate cognitive retention was described using the cognitive weighting of the teacher-developed final unit exam immediately after the conclusion of the unit of instruction. This final unit exam was administered on April 25, 2008. Each item on the exam was assigned a cognitive weighted score (Pickford & Newcomb,
The weighting system was developed to give higher cognitive levels more weight due to the cognitive level of processing required to answer higher cognitive level questions. The weighting factors were developed by Newcomb and Trefz (1987), who were experts in the area of cognitive levels of teaching and learning. Additionally, one author from the original work in the cognitive levels of teaching and learning contributed to development of the scale. Validity for this scale was based upon its direct development from Bloom’s Taxonomy (1956) and the theory and evidence (Ary, Jacobs, & Razavieh, 2002) accumulated to support Bloom’s widely accepted higher and lower levels of cognition.

The weighting factors were consistent Bloom’s Taxonomy (1956). The sum of the individual question scores (final unit exam score) was established as the student immediate retention of content. Each student’s score on the final unit exam was multiplied by the final unit exam cognitive weighted score to calculate the student short-term cognitive retention score.
<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>Translation</td>
<td>.20</td>
</tr>
<tr>
<td>Interpretation</td>
<td>.25</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>


Figure 3.1
Cognitive Weighting Factors for Final Unit Exam

Data Collection of Student Short-Term Cognitive Retention

The student short-term cognitive retention was described using the cognitive weighting of the teacher-developed final unit exam 42 days after the conclusion of the unit of instruction. This final unit exam was administered on June 6, 2008. Each item on the exam was assigned a cognitive weighted score (Pickford & Newcomb, 1989). The sum of the individual question scores (final unit exam score) was established as the student short-term retention of content. Each student’s score on the final unit exam was multiplied by the final unit exam cognitive weighted score to calculate the student short-term cognitive retention score.
Data Collection of Student Long-Term Cognitive Retention

The student long-term cognitive retention was described using the cognitive weighting of the teacher-developed final unit exam 182 days after the conclusion of the unit of instruction. This final unit exam was administered on October 24, 2008. Summer break had taken place between the second and third final unit exams. Each item on the exam was assigned a cognitive weighted score (Pickford & Newcomb, 1989). The sum of the individual question scores (final unit exam score) was established as the student long-term retention of content. Each student’s score on the final unit exam was multiplied by the final unit exam cognitive weighted score to calculate the student long-term cognitive retention score.

Data Analysis

The student immediate, short-term, and long-term cognitive retention scores were interval data, and were used as individual test scores for each student. The means of the immediate, short-term, and long-term cognitive retention scores were calculated for the entire class.

Demographic Information

Demographic information of each student was collected to establish the prior animal science knowledge of each student.

Validity

The teacher, who had known the students for a minimum of one year, was contacted by the researchers to verify the demographic information. Four questions
were drawn from four different students’ demographic information sheets. The teacher validated the student responses.

Reliability

The instrument was developed by the researchers, and was reviewed by a professor in Agricultural Education and the subject (high school teacher) to establish reliability.

Data Collection

Demographic information of the class was received from the teacher. The students were numbered. Only the subject had the list of student names. The demographic information included whether students lived on a farm or not, student involvement in 4-H projects and FFA supervised agricultural experience programs, and students’ prior knowledge of animal science.

Data Analysis

The demographic information was used to find any unusual circumstances that may have influenced the data collection.

Class materials

Worksheets, quizzes, and other handouts used during the unit were collected at the conclusion of the study.

Rationale

Any materials used during the unit of instruction were collected to calculate the cognitive level of teaching and learning.
Process

The researchers requested that the teacher put into a notebook every handout, worksheet, quiz, or other materials that the students were given during the unit of instruction. The notebook was collected at the conclusion of the video-taping period.

Journal

The subject kept a detailed journal every day that was collected at the end of the video-taping period.

Rationale

The journal was used to identify any unusual circumstances that may have influenced the data that were collected in the study.

Process

The subject was asked to keep a journal of daily attendance and any abnormal circumstances occurring during the class period.

Cognitive Retention

At the conclusion of the animal science unit, the teacher administered a paper and pencil unit exam. The teacher then graded the exams and recorded the student grades by student number. The teacher handed the graded tests back to the students two days after they took the test. The teacher announced the class average and then had each student read a test question and answer until all multiple choice and fill-in questions were read. The teacher asked specific students to read their answers to the short answer questions, which the teacher felt were exemplary answers. The teacher collected the tests, made copies of them, and handed the copies back to the students to keep.
Forty-two days after the exam was taken, the same animal science unit exam was administered again to the same students. Prior to giving the test the second time, the teacher announced that the students’ final exam would cover the animal science unit. The teacher stated that the students should study the notes, slides, and other information from the unit. After the students took the exams, the exams were graded by the same teacher with the same answer key, and the scores were again recorded by student number.

One hundred eighty-two days after the first exam was administered, the students retook the same animal science unit exam. The teacher gave no forewarning that the students would be taking the test. Each student received five dollars as a token of appreciation for taking the test. The exams were again graded by the same teacher with the same answer key and scores were recorded by student number.

The researchers wrote a protocol for the teacher to read every day that the test was given (see Appendix E). The teacher read the same test directions to the students before distributing the tests each time that the test was given.

The researchers determined that one test item was miswritten and deleted it. The researchers rescored the exams accordingly and checked all test scores for consistency.

As shown in Figure 3.2, each of the eight instruments was developed and used to answer the respective research objectives.
The objectives guiding this descriptive study were:

<table>
<thead>
<tr>
<th>Objective</th>
<th>Instrumentation used to measure the respective objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To describe the amount of time the teacher spent using group teaching techniques (cooperative learning, demonstration, discussion, field trip, lecture, resource person, role play) and individualized teaching techniques (assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, supervised study) (Newcomb et al., 2004) during a secondary animal science unit of instruction.</td>
<td>Time spent using teaching techniques</td>
</tr>
<tr>
<td>2. To describe student immediate cognitive retention using the cognitive weighting of the teacher-developed final unit exam.</td>
<td>PRAXIS interview, student immediate cognitive retention, demographic information, class materials, journal</td>
</tr>
<tr>
<td>3. To describe student short-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.</td>
<td>PRAXIS interview, student short-term cognitive retention, demographic information, class materials, journal</td>
</tr>
<tr>
<td>4. To describe student long-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.</td>
<td>PRAXIS interview, student long-term cognitive retention, demographic information, class materials, journal</td>
</tr>
</tbody>
</table>

Figure 3.2
*Instruments Used to Measure Research Objectives*
CHAPTER 4

RESULTS

Objectives

The objectives guiding this descriptive study were:

1. To describe the amount of time the teacher spent using group teaching techniques (cooperative learning, demonstration, discussion, field trip, lecture, resource person, role play) and individualized teaching techniques (assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, supervised study) (Newcomb et al., 2004) during a secondary animal science unit of instruction.

2. To describe student immediate cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

3. To describe student short-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

4. To describe student long-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

Describing the Time Spent Using Teaching Techniques

The amount of time that the teacher spent using each of the teaching techniques examined was first calculated as a percentage of the total time spent using teaching
techniques. The total time spent using teaching techniques (the sum of all techniques) was 28 hours, 48 minutes, and 8 seconds. The second calculation was the specific teaching technique used, as a percentage of the total actual instruction time (amount of time that students spent in class being instructed by the teacher). The total time spent in class was 15 hours, 39 minutes, and 30 seconds. In table 4.1, each specific individualized and group teaching technique, as a percentage of total time using techniques and total class time, is shown.

The most frequently used teaching technique was student notebooks (54% of total class time), followed by lecture (40% of total class time), discussion (33% of total class time), information sheets (23% of total class time), and cooperative learning (21% of total class time). Supervised study was used 8% of the total class time, and demonstration was used 5% of the total class time. Assignment sheets, experiments, independent study, skill sheets, field trip, resource people, and role play were not used.
<table>
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<th>Teaching Technique</th>
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<th>Percent of Total Class Time</th>
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</tbody>
</table>

Note: It was typical for the teacher to use a combination of group and individualized teaching techniques simultaneously. Therefore, the percent of total class time sums to 184%.

Table 4.1
Percent of Time Teaching Techniques Were Used in the Classroom

Describing Student Immediate, Short-Term, and Long-Term Cognitive Retention

Throughout chapter 4, cognitively weighted test #1 represents student immediate cognitive retention. Student immediate cognitive retention was measured using the final unit exam score taken immediately after the unit was taught, multiplied by the cognitive weighted score of the exam. Cognitively weighted test #2 represents student short-term cognitive retention. Student short-term cognitive retention was measured using the final unit exam score taken 42 days after the unit was taught, multiplied by the cognitive weighting of the exam. Cognitively weighted test #3 represents student long-term cognitive retention. Student long-term cognitive retention was measured using the final
unit exam score taken 182 days after the unit was taught, multiplied by the cognitive weighting of the exam.

**Describing Student Immediate Cognitive Retention**

The mean immediate cognitively weighted test score, out of 1080 points, was 807 points (sd = 114). The mean percent immediate cognitively weighted test score was 75% (sd = 11%). The median percent immediate cognitively weighted test score was 76%, and the mode was 75%. The minimum percent immediate cognitively weighted test score was 57%, and the maximum was 88%. These scores indicate that students scored 75% on their final unit exams immediately after the unit was taught. The range of scores was 57% to 88%.

**Describing Student Short-Term Cognitive Retention**

The mean short-term cognitively weighted test score, out of 1080 points, was 840 points (sd = 80). The mean percent short-term cognitively weighted test score was 78% (sd = 7%). The median percent short-term cognitively weighted test score was 80%, and the mode was 81%. The minimum percent short-term cognitively weighted test score was 63%, and the maximum was 88%. These scores indicate that students scored 78% on their final unit exams 42 days after the unit was taught. The range of scores was 63% to 88%.

**Describing Student Long-Term Cognitive Retention**

The mean long-term cognitively weighted test score, out of 1080 points, was 798 points (sd = 183). The mean percent long-term cognitively weighted test score was 74% (sd = 17%). The median percent long-term cognitively weighted test score was 74%.
73%, and the mode was 89%. The minimum percent long-term cognitively weighted test score was 47%, and the maximum was 97%. These scores indicate that students scored 74% on their final unit exams 182 days after the unit was taught. The range of scores was 47% to 97%.

**Describing Student Immediate, Short-Term, and Long-Term Cognitive Retention and Changes in Cognitive Retention**

The means of the cognitively weighted test scores, respectively, were 807 (sd = 114), 840 (sd = 80), and 798 (sd = 183) out of 1080 total points. The mean changes in the cognitively weighted test scores, respectively, were 32 (sd = 183), -41 (sd = 75), and -9 (sd = 139). The changes in scores indicate that students better cognitively retained the information for the test taken 42 days after the unit of instruction, but retained less information cognitively 182 days after the unit was taught. In table 4.2, the raw cognitively weighted scores for each student, as well as the changes in points between the three tests are shown.
Table 4.2
Cognitively Weighted Test Scores and Changes in Cognitively Weighted Test Scores

In table 4.3, the changes in cognitively weighted test scores, in percentages for each student are shown. The mean test scores, respectively, were 75% (sd = 11%), 78% (sd = 7%), and 74% (sd = 17%). The minimum percentages, respectively, were 57%, 63%, and 47%. The maximum percentages, respectively, were 88%, 88%, and 97%. The mean percentage change between tests 1 and 2 was 3% (sd = 7%), tests 2 and 3 was -4% (sd = 13%), and tests 1 and 3 was -0.8% (sd = 9%). The minimum changes, respectively, were -8%, -20%, and -17%. The maximum changes, respectively, were 15%, 16%, and 13%. The changes in scores indicate that students better cognitively retained the information for the test taken 42 days after the unit of instruction, but retained less information cognitively 182 days after the unit was taught. However, the loss of cognitive retention was very small, 0.8%. The range in changes was wide; the lowest and highest single student changes were between tests 1 and 2.

<table>
<thead>
<tr>
<th>Student</th>
<th>Cognitively Weighted Test Score #1</th>
<th>Cognitively Weighted Test Score #2</th>
<th>Cognitively Weighted Test Score #3</th>
<th>Change in Cognitively Weighted Test Scores 1 &amp; 2</th>
<th>Change in Cognitively Weighted Test Scores 2 &amp; 3</th>
<th>Change in Cognitively Weighted Test Scores 1 &amp; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>821</td>
<td>788</td>
<td>961</td>
<td>-32</td>
<td>173</td>
<td>140</td>
</tr>
<tr>
<td>2</td>
<td>810</td>
<td>875</td>
<td>921</td>
<td>-65</td>
<td>-54</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>810</td>
<td>907</td>
<td>756</td>
<td>97</td>
<td>-151</td>
<td>-54</td>
</tr>
<tr>
<td>4</td>
<td>918</td>
<td>929</td>
<td>961</td>
<td>11</td>
<td>32</td>
<td>43</td>
</tr>
<tr>
<td>5</td>
<td>691</td>
<td>853</td>
<td>637</td>
<td>162</td>
<td>-216</td>
<td>-54</td>
</tr>
<tr>
<td>6</td>
<td>918</td>
<td>950</td>
<td>1048</td>
<td>32</td>
<td>97</td>
<td>130</td>
</tr>
<tr>
<td>7</td>
<td>929</td>
<td>875</td>
<td>929</td>
<td>-54</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>950</td>
<td>864</td>
<td>1004</td>
<td>-86</td>
<td>140</td>
<td>54</td>
</tr>
<tr>
<td>9</td>
<td>616</td>
<td>745</td>
<td>551</td>
<td>130</td>
<td>-194</td>
<td>-65</td>
</tr>
<tr>
<td>10</td>
<td>853</td>
<td>842</td>
<td>670</td>
<td>-11</td>
<td>-173</td>
<td>-184</td>
</tr>
<tr>
<td>11</td>
<td>670</td>
<td>680</td>
<td>508</td>
<td>11</td>
<td>-173</td>
<td>-162</td>
</tr>
<tr>
<td>12</td>
<td>702</td>
<td>767</td>
<td>734</td>
<td>65</td>
<td>-32</td>
<td>32</td>
</tr>
<tr>
<td>Mean</td>
<td>807</td>
<td>840</td>
<td>798</td>
<td>32</td>
<td>-41</td>
<td>-9</td>
</tr>
</tbody>
</table>
In Table 4.3, central tendency statistics are shown for the cognitively weighted test scores, changes in cognitively weighted test scores, cognitively weighted test score percentages, and percentage change in cognitively weighted test scores. The mean test scores, out of 1080 total points, were 807 (sd = 114), 840 (sd = 80), and 798 (sd = 183), respectively. The mean test score changes, respectively, were 32 (sd = 75), -41 (sd = 139), and -9 (sd = 101). The mean percentage test scores were 75% (sd = 11%), 78%
(sd = 7%), and 74% (sd = 17%). The percentage changes in the test scores, respectively, were 3% (sd = 7%), -4% (sd = 13%), and -0.8% (sd = 9%).

The median cognitively weighted test scores, out of 1080 points, were 815, 859, and 788, respectively. The median changes in cognitively weighted test scores, respectively, were 22, -43, and 5. The median cognitively weighted test score percents, respectively, were 76%, 80%, and 73%. The median changes in percent cognitively weighted test scores were 2%, -4%, and 1%, respectively.

The mode cognitively weighted test scores, out of 1080 total points, were 810, 875, and 961, respectively. The mode changes in cognitively weighted test scores, respectively, were 65, -173, and -54. The mode percent cognitively weighted test scores, respectively, were 75%, 81%, and 89%. The percent changes in the cognitively weighted test scores, respectively, were 6%, -16%, and -5%.

The minimum cognitively weighted test scores, out of 1080 total points, were 616, 680, and 508, respectively. The maximum of the cognitively weighted test scores, respectively, were 950, 950, and 1048. The minimum changes in cognitively weighted test scores, respectively, were -86, -216, and -184. The maximum changes, respectively, were 162, 173, and 140. The minimum percent cognitively weighted test scores, respectively, were 57%, 63%, and 47%. The maximum percent test scores, respectively, were 88%, 88%, and 97%. The minimum percent changes in the cognitively weighted test scores, respectively, were -8%, -20%, and -17%. The maximum percent changes in test scores, respectively, were 15%, 16%, and 13%.
Demographic Information

Demographic information was collected from each student. In table 4.5, the farm experiences of each student are shown. There were 12 students enrolled in the Agricultural Science I class at Cory-Rawson High School in the 2007-2008 school year. All were 9th grade students; the class was comprised of four females and eight males.
Ten students grew up on farms, while two students did not, but these two students had experience helping a family member or friend with a farming enterprise. Nine students grew up around livestock, and seven students had a livestock-related supervised agricultural experience program. Eight students showed livestock as a 4-H project.

<table>
<thead>
<tr>
<th>Student</th>
<th>Gender</th>
<th>Grew up on a farm</th>
<th>Helped family member farm</th>
<th>Type of farm</th>
<th>Current/ previous 4-H member</th>
<th>4-H project</th>
<th>Supervised agricultural experience program</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>Yes</td>
<td>Yes</td>
<td>Horse, Grain, hogs, goats</td>
<td>Yes</td>
<td>Horse, Goats, hogs, clothing</td>
<td>Chickens</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>Yes</td>
<td>Yes</td>
<td>Cattle, sheep, llamas, hogs, grain, hay</td>
<td>Yes</td>
<td>Goats, dairy, feeder calves, hogs</td>
<td>Goats</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>Yes</td>
<td>Yes</td>
<td>Grain</td>
<td>No</td>
<td>N/A</td>
<td>Work at Llama Nation (feed, water, care for llamas)</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>Yes</td>
<td>Yes</td>
<td>Grain</td>
<td>No</td>
<td>N/A</td>
<td>Build engines for power and efficiency demands; sweet corn</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>Yes</td>
<td>Yes</td>
<td>Grain</td>
<td>No</td>
<td>N/A</td>
<td>Trapping, sweet corn</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>Yes</td>
<td>Yes</td>
<td>Grain</td>
<td>Yes</td>
<td>N/A</td>
<td>Beef cattle</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>Yes</td>
<td>Yes</td>
<td>Cattle, grain</td>
<td>Yes</td>
<td>N/A</td>
<td>Dairy feeder calves</td>
</tr>
<tr>
<td>8</td>
<td>Female</td>
<td>Yes</td>
<td>Yes</td>
<td>Dairy, sheep, hogs, cattle, goats</td>
<td>Yes</td>
<td>N/A</td>
<td>Market lambs</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>No</td>
<td>Yes</td>
<td>Hogs, cattle, goats</td>
<td>Yes</td>
<td>Market lambs</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Male</td>
<td>No</td>
<td>Yes</td>
<td>Grain</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>11</td>
<td>Female</td>
<td>Yes</td>
<td>Yes</td>
<td>Goats, grain</td>
<td>Yes</td>
<td>Goats</td>
<td>Goats, Mowing</td>
</tr>
<tr>
<td>12</td>
<td>Male</td>
<td>Yes</td>
<td>No</td>
<td>Grain</td>
<td>No</td>
<td>N/A</td>
<td>Work for landscaping &amp; excavating business</td>
</tr>
</tbody>
</table>

Table 4.5
Student Demographic Information
CHAPTER 5
CONCLUSIONS

Previous researchers recommended that teachers create learning situations that teach students at higher levels of cognition (Cano & Newcomb, 1990). In addition, Myers and Dyer (2006) recommended that further research be conducted on the effect of teaching methods to student attitude and long-term and short-term content knowledge retention. Therefore, the purpose of the study was to describe teacher time spent using various teaching techniques, and student cognitive retention of content during a secondary animal science unit of instruction. The observational case study was descriptive in nature.

The objectives guiding this descriptive study were:

1. To describe the amount of time the teacher spent using group teaching techniques (cooperative learning, demonstration, discussion, field trip, lecture, resource person, role play) and individualized teaching techniques (assignment sheets, experiments, independent study, information sheets, student notebooks, skill sheets, supervised study) (Newcomb et al., 2004) during a secondary animal science unit of instruction.

2. To describe student immediate cognitive retention using the cognitive weighting of the teacher-developed final unit exam.
3. To describe student short-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

4. To describe student long-term cognitive retention using the cognitive weighting of the teacher-developed final unit exam.

The researcher worked with one teacher in a rural high school. The teacher spent 18 one-hour class sessions teaching an animal science unit to the Agricultural Science I class. Each of the 18 class sessions was video-recorded. The researcher then watched the videos and documented the time spent using each of the group and individualized teaching techniques. Additionally, the student took a final unit exam immediately after the unit was taught, 42 days after the unit was taught, and 182 days after the unit was taught.

Eight instruments were used to describe the time spent using teaching techniques and student cognitive retention. Time spent using teaching techniques was measured by a researcher-developed instrument, which used group and individualized teaching techniques from the teaching methods book (Newcomb et al., 2004) most widely used in agricultural education to teach methods courses (Ball & Knobloch, 2005). The student cognitive retention scores were developed from multiplying the final unit exam score by a cognitive weight (Pickford & Newcomb, 1989).

Conclusions Related to Time Spent Using Teaching Techniques

The teacher used a combination of teaching techniques throughout the class sessions. The individualized teaching techniques used were student notebooks,
information sheets, and supervised study. The group teaching techniques used were lecture, discussion, cooperative learning, and demonstration.

**Recommendations Related to Time Spent Using Teaching Techniques**

Teachers should strive to use a variety of teaching techniques in the classroom. Gregory (2001) stated that using a variety of teaching methods enables students to continue developing their own thinking abilities, compared to one continuous method of teaching. Students stop retaining content very quickly into the lesson when lecture is the main, or only, technique used. Teachers should diversify the techniques used in each class session, so that students are constantly being forced to pay attention and show what they have learned. According to Phipps and Osborne, the use of various specific strategies and techniques within the problem-solving framework provided variety and held interest in the teaching-learning process (1988).

**Implications Related to Time Spent Using Teaching Techniques**

While several teaching techniques were used, the majority of the 18 class sessions were spent using student notebooks, lecture, and discussion. Students may have retained the content better if more diverse teaching techniques were used. Lucas et al. (1975) found that students taught using simulation-gaming techniques retained content significantly better than those students taught with the lecture-discussion method.

In a future study, the researcher might write a unit of instruction with specific teaching techniques used, to ensure a variety of teaching methods is used. Writing the unit of instruction will better gauge the effectiveness of the methods.
Conclusions Related to Student Immediate Cognitive Retention

Students cognitively retained 75% of the animal science content taught in the unit of instruction.

Recommendations Related to Student Immediate Cognitive Retention

Teachers should teach content in the most appropriate way for students to learn the material at higher cognitive levels. Students learn according to the levels of cognition in which they are taught. For example, in Ewing and Whittington’s (2007) study, professor questions were mostly (43%) at the knowledge level of cognition, and 63% of the course objectives were written at the knowledge and comprehension levels of cognition. Sixty-two percent of student thoughts and questions pertaining to class content were at Bloom’s knowledge and comprehension levels of cognition (Ewing & Whittington). Teachers should also write their assessments to contain questions that require students to think at various levels of cognition.

Conclusions Related to Student Short-Term Cognitive Retention

Students cognitively retained 78% of the animal science content 42 days after the unit of instruction was taught.

Recommendations Related to Student Short-Term Cognitive Retention

Teachers should teach content in the most appropriate way for students to learn the material at higher cognitive levels. For example, students correctly answered 64% of test questions at remembering, 55% at processing, 40% at creating, and 28% at evaluating levels of cognition in a study by Cano (1990). Cano found a significant relationship between the cognitive level of instruction and student cognitive
performance in high school agricultural education students in this study. Teachers should also write their assessments to contain questions that require students to think at various levels of cognition. When testing for retention, teachers should simply give the students a re-test one day with no forewarning.

Conclusions Related to Student Long-Term Cognitive Retention

Students cognitively retained 74% of the animal science content 182 days after the unit of instruction was taught. Further, the lecture and discussion techniques were found to be appropriate for students to retain knowledge level information long-term (between tests one and three).

Recommendations Related to Student Long-Term Cognitive Retention

Torres and Cano (1995) advocated that teachers should teach at higher cognitive levels, forcing students to do more than simply restate learned facts. The researchers also stated that tests and assignments should be written at higher cognitive levels (Torres & Cano). In agreement with Torres and Cano, teachers should teach content in the most appropriate way for students to learn the material at higher cognitive levels.

Myers and Dyer (2006) found that student with less prior knowledge had higher content knowledge gain scores at the conclusion of instruction, and students with higher science processing skill achievement prior to the instruction had higher content knowledge gain at the conclusion. Further research should be conducted to evaluate student achievement in relation to prior knowledge and skills. Teachers should also write their assessments to contain questions that require students to think at various levels of cognition.
Implications Related to Student Immediate, Short-Term, and Long-Term Cognitive Retention

The final unit exam contained 29 questions written at the knowledge level (Pickford & Newcomb, 1989), and two questions written at the interpretation level (Pickford & Newcomb, 1989). In a future study, the researcher should write the final unit exam to contain questions at various cognitive levels.

One student had an individualized education program, which may have impacted his or her scores. This student scored below average on all three tests. Three students had no apparent livestock experiences prior to the study. One student scored above average, and two students scored below average. Students with livestock experience also scored below average and above average. Therefore, previous knowledge may or may not have impacted student scores.

Discussion

Teachers should focus on using a variety of teaching techniques in the classroom to ensure maximum student achievement and cognitive retention. The teacher in this study used lecture and discussion the most, and supplemented with student notebooks. Using a wider variety of teaching techniques more often may help students retain the animal science content better, at higher levels of cognition, and longer.

Teachers should also teach so that students are learning the content at higher levels of cognition. Teachers should make a conscious effort to ask higher level cognitive questions during class, while also using teaching techniques that force students to think at higher levels of cognition. Teachers should write assessments to
gauge students’ progress in learning at higher cognitive levels. In order to do this, teachers should include questions of varying levels of cognition when writing assessments.

Research suggests that when higher cognitive levels of teaching are used, students retain knowledge longer. In this study, the teacher primarily used lecture and discussion which are considered lower cognitive levels of teaching. The teacher also assessed the students primarily at the knowledge level on the final unit exam. The question is therefore raised, if the final unit exam would be written at higher cognitive levels and the teacher would have taught at lower cognitive levels, would the student final unit exam scores have been lower? Research should be conducted to answer this question.

Based on the findings of this study, the students retained the majority of the animal science content over 182 days. There was a mean of -0.8% change in cognitive retention between the first unit exam taken and the third unit exam taken. The range of scores on final unit exam three was much wider than the range of scores on final unit exams one and two. Research should be conducted to investigate the reason for this change in range of scores. A future study might include additional tests over a longer period of time.

A larger study should be conducted to include more subjects, in more classrooms, in more communities. The study should include classes comprised of students with varying levels of previous knowledge of the subject matter; their previous knowledge should be documented. The unit of instruction could be guided to include a
larger variety of teaching techniques, with more time spent on techniques other than lecture and discussion. Potentially, a quasi-experimental study could be designed where two teachers teach the same content, but use two different methodological approaches. The researcher should write the final unit exam, to include questions at varying levels of cognition. The teacher should give no forewarning to students before they take the additional tests. Finally, future research should include examining how much the affective domain contributes to student retention of content.

Summary

While there are many teaching techniques available to use, some teachers focus on using a select few in the classroom. Lecture and discussion were the most widely used group teaching techniques in this study. The most widely used individualized teaching techniques were student notebooks and information sheets. Teachers should focus on diversifying the techniques that they use, to better teach all students in the classroom.

Students were assessed at the knowledge level 87% of the time on the final unit exam, and at the interpretation level 13% of the time. Students retained the content taught with little cognitive retention loss using this test format. Teachers should focus on assessing students at varying levels of cognition.

Using a variety of teaching techniques, and dividing class time between the various techniques will enhance student learning and interest in the subject matter. Further, teachers should continually assess student achievement and retention at various
cognitive levels. Further research should be conducted to evaluate time spent using teaching techniques in relation to student cognitive retention.
LIST OF REFERENCES


Ewing, J. C., & Whittington, M. S. (in press). Describing the cognitive level of professor discourse and student cognition in college of agriculture class sessions. *Journal of Agricultural Education*.


Agricultural Science I

Animal Science Test

Instructions

Matching
Complete the following ten statements with the words included in the table below. You will use only ten words, two will remain after you have answered all statements. Clearly write the letter next to the statement to complete. 10 problems / 2 points each / 20 points possible

|-------------|------------------|--------|---------------|--------|-------------|-------------|---------|-------------|---------|-------------|--------------|

1) _______ One of the most efficient ways of converting feed stuffs into food products.
2) _______ Works in horses to allow for fermentation of plant material during digestion.
3) _______ Regurgitating, rechewing and swallowing of ingested food.
4) _______ Layers are egg-producing chickens, while _______ are meat chickens.
5) _______ The process of converting large complex nutrient molecules into simpler molecules capable of being used as food for the organism.
6) _______ The time period in which fetuses develop before birth.
7) _______ The birthing of the animal’s young.
8) _______ The number one red meat eaten in the U.S.
9) _______ Chemical substances that provide nourishment to the body.
10) _______ Organs and other by-product items that are of lower value than cuts of meat.
Identify
On the following diagrams please complete the blank portions by correctly identifying the digestive structure that we have learned about in class. Each box corresponds to a description below the diagram. 12 items / 2 points each / 24 points possible

1) Glands that moisten feed to aid with swallowing and is the first step in digestion.

2) A gland-lined sac that performs chemical and physical digestion. Excretes acids.

3) The tube from the mouth to the stomach.

4) Performs both digestion and nutrient absorption within its three sections.

5) Primary responsibility is water absorption.

6) What kind of digestive system is this? (name the type, not the animals)

Word Bank

<table>
<thead>
<tr>
<th>Stomach</th>
<th>Small Intestine</th>
<th>Esophagus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumen</td>
<td>Duodenum</td>
<td>Salivary</td>
</tr>
<tr>
<td>Abomasum</td>
<td>Large Intestine</td>
<td>Gizzard</td>
</tr>
</tbody>
</table>
1) What kind of digestive system is this? (name the type, not the animal)

2) True stomach, gastric juices act on ingesta.

3) Honeycomb, hardware stomach.

4) Full of folded tissue, absorbs water.

5) Large fermentation vat, first and largest chamber.

6) The tube from the mouth to the stomach and stomach to mouth.

Word Bank

<table>
<thead>
<tr>
<th>Proventriculus</th>
<th>Esophagus</th>
<th>Rumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jejunum</td>
<td>Abomasum</td>
<td>Omasum</td>
</tr>
<tr>
<td>Reticulum</td>
<td>Cecum</td>
<td>Cloaca</td>
</tr>
</tbody>
</table>
Short Answer
Please answer the following items as completely as possible. I do expect everything to be in complete sentences, just your answers to be complete. 5 problems / 6 pts each / 30 pts possible

1) Cattle are raised to produce two food products, name these products. Additionally, select one breed of cattle and describe two identifying characteristics of that breed.

2) The humane harvesting of animals includes the use of two tools, what are these tools? Why are these tools used and considered “humane”?

3) What are the most eaten red meats in the U.S. and how much of each do Americans consume on average each year?
4) Identify two species, that we discussed, which are considered “multi-purpose” animals. Along with identifying them, explain why they are considered this way.

5) The ruminant digestive system is highly efficient at processing cellulose from the plant-based diet these animals consume. Why is it important to process this cellulose and explain how it is processed in a ruminant.

**Multiple Choice**
Select the correct answer that completes the statement. There is only one correct answer for each statement. *4 statements / 4 points each / 16 points possible*

_______ The ____________________ produces bile.

a. Liver       b. gallbladder

   c. pancreas   d. small intestine

_______ The ____________________ is the part of the avian digestive system that is responsible for the muscular processing of ingesta.

a. crop       b. gizzard

   c. proventriculus   d. vent

_______ A wether, barrow, steer and gelding are terms referring to animals that have been ____.

a. harvested       b. castrated

   c. born       d. gestated

_______ One of the six nutrients categories required for proper health is ____________.

a. carbohydrates   b. corn

   c. fiber       d. oils
APPENDIX B

CAMERA SET UP PROTOCOL
DIRECTIONS FOR CAMERA

A. Setting up the tripod
1. Unzip long black bag and remove tripod. Set the tripod on the ground with the head up.
2. Lift the lever to rotate the head up.
3. Unsnap all “c-snarps” at the bottom of the metal tubes (three total). They are color coded red.
4. Separate the legs, making sure that the tripod stays level and does not slip on the floor. It should be stable and placed securely in position.
5. Loosen knobs on each leg and lengthen the legs to approximately the same length. Tighten the knobs (total of six). The height should be around 4 ft. (Knobs: righty tightly, lefty loosely)
6. Level the tripod using the small green level bubble on the top of it.
7. Unzip the blue camera case and remove video camera.
8. When looking at the bottom of the camera, there is a black “plate” screwed to the bottom.
9. Slide the square bottom of the black plate on the bottom of the camera into the square that is on the top of the tripod from the back. Be sure that the plate is centered on top of the tripod and clicks into place.
10. Use the small lever on the right to tighten the camera to the head of the tripod. The camera should be secure on top of the tripod.

B. Setting up the Video Camera
1. Position the camera so that the lens end (with lens cap) is facing away from you. You should be looking at the back of the camera.
2. Remove the power supply from the camera case (in the small green tabbed compartment on the front of the camera bag).
3. Plug the cord from the camera into the power supply, and plug the electrical plug into an electrical outlet.
4. Remove the lens cap from the front (by pinching gently).
5. Turn the camera on by rotating the large knob forward to the green square. This knob is located on the left side of the camera. A red power light will turn on.
6. Open the DV tape slot by pushing forward on the “eject” button under the handle on top of the camera directly behind the large red button. This opens the tape slot. This is automatic, so do not force it open.
7. Place the specific day’s DV tape into the inside slot. Insert the tape green side down, spools to the inside.
8. Close the inside slot, then the outside slot gently.
9. Use the “W/T” button to zoom. This is on the front right side of the camera.
10. Position the camera and zoom out to view as much of the classroom as possible. The W/T button should not be used because the camera will always need to be as zoomed out as possible.
11. Turn the “view finder” switch on top to “far.”
12. Push the large red “Start/Stop” button on the top of the camera to begin recording. A red light will flash when the camera is recording. Be sure to begin recording 3 minutes before class starts, and leave it recording 3 minutes after the class ends.
13. Three minutes after class ends, push the “Start/Stop” button to stop recording.

D. Putting the Camera Away
1. Remove the DV tape by opening the tape slot and closing the inside and outside slots.
2. Place sticker with the day number written on it onto the tape after the tape is used. Be sure to return the DV tape to the correct case (the day on the tape and on the case should be the same).
3. Turn the knob on the left side of the camera to the OFF position.
4. Place lens cap back on the camera lens.
5. Unplug the power source from the camera.
6. Use the small lever on the right side of the head to loosen the camera.
7. Remove the camera from the tripod by holding the red button on the left side of the head.
8. Put the camera away. Be sure to wrap up the battery cord neatly.
9. Put the tripod away.

E. Daily Tape Routine
1. Choose any unrecorded tape to use for each day.
2. There are enough tapes for each day, so use a different tape each day.
3. Begin recording about 1 minute before class.
4. After class, write on the cassette:
   - Day (number 1-15)
   - Date (ex. 3-17-08)
5. Write this info on the spine and face of the case, and on the sticker.
6. Be sure to put the sticker on the cassette so it won’t be used again.
7. Slide the green square, on cassette, to SAVE.
APPENDIX C

FIRST DAY PROTOCOL
“As you might have noticed, there is a video camera set up in the back of the classroom. It will be here for the next month or so because I have agreed to let The Ohio State University videotape me teaching your class. This will in no way affect you, your grades, or the way that I will teach.”
APPENDIX D

VALIDITY OF FINAL UNIT EXAM
Professor of Agricultural Education

“I have reviewed the final exam that was used to collect content knowledge. The final exam certainly measures student content knowledge of the animal science unit that was taught.”

Graduate Student in Agricultural Education

“The final exam given to the students measured what the instructor wanted it to measure.”

Subject

“The final examination measured what the students were instructed on.”
APPENDIX E

TEST DAY PROTOCOL
Day of test taken immediately after the unit of instruction

“As you know, today is your Animal Science Test. Please be sure to read all of the directions thoroughly.”

Day of tests taken 42 days and 182 days after the unit of instruction

“Just to see what you’ve remembered from this past year, I’ve pulled up an old test that you’ve already taken. To show my appreciation for you taking the time to re-take the test as seriously as you did the first time, I’ve clipped $5 to each of your tests to spend however you want. Please be sure to read all of the directions thoroughly.”