

ABSTRACT

WORLEY-DAVIS, LYNN. A Comparison of Learning Styles and Academic Performance of Students Enrolled in Introductory Poultry Science Courses in Bachelors of Science and Associates of Applied Science Programs. (Under the direction of Dr. Jim Flowers, Dr. Carmen Parkhurst, and Dr. Barry Croom.)

The purpose of this exploratory research was to determine if the learning styles of students enrolled in either a Bachelors of Science or an Associates of Applied Science program were different and if their dominant learning style affected academic performance.

Distribution of dominant learning styles, Concrete Sequential (CS); Abstract Sequential (AS); Abstract Random (AR); Concrete Random (CR), among both groups of students was not significantly different, $p=0.77$. Concrete sequential was determined to be the most dominant learning style for each group. Similar results regarding distribution were noted when learning styles were combined based on either perceptual or ordering capabilities (Concrete or Abstract; Sequential or Random). Both groups of students were dominant in a concrete perceptual quality and sequential ordering capability. No significant differences were noted between either group regarding perceptual ($p=0.88$) or ordering capabilities, ($p=0.39$).

When comparing the effects of dominant learning style on academic performance, no significant differences were noted in the lecture component of the course (quizzes and hourly exams) for either program or learning style ($p=.57$, 4 yr.; $p=.94$, 2 yr.). Although students enrolled in the Bachelors of Science introductory poultry science course had consistently higher scores on each of the laboratory components than students enrolled in a similar course in the Associates of Applied Science program no significant differences were noted in any of the laboratory components or the final laboratory grade ($p=.77$, 4 yr.; $p=.43$, 2 yr.) for either group of students or learning style.

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A Comparison of Learning Styles and Academic Performance of Students Enrolled in
Introductory Poultry Science Courses in Bachelors of Science and
Associates of Applied Science Programs

by
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DEDICATION

To family and friends, both past and present, who supported and encouraged my efforts.

BIOGRAPHY

Jenny Lynn Worley, born the daughter of Cherry Boyce and Raymond Earl Worley, lived most of her pre-adult life in the northeastern section of North Carolina in Northampton County. After graduating from North Carolina State University (NCSU) Lynn moved to Hoke County where she married Will Davis and worked in the poultry industry for 11 years. Lynn relocated to Raleigh, NC to coordinate field research at the NCSU Animal and Poultry Waste Management Center (APWMC) in the late 1990's and one month later gave birth to her only child, Mary Gray Davis.

Today Lynn continues to coordinate field research with the NCSU Animal and Poultry Management Center but has the primary task of instructing students in the NCSU Department of Poultry Science and the Agricultural Institute. She serves as an advisor to the Poultry Science Club, Young Farmer Rancher Club, and Sigma Alpha sorority. She teaches group fitness in the NCSU fitness program; serves on various university committees; runs with a pork industry sponsored running team; serves as a committee chair for the PTA; and teaches Sunday school. She considers her life full.

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CHAPTER I: INTRODUCTION

Conceptual Framework

Humans have adapted to their environments throughout history. These adaptive patterns have allowed us to survive these environments. Although we have evolved as part of the adaptation process we, as humans, are different; and the concept of one size fits all is inadequate, especially regarding the way we learn or the learning process. The concept of learning styles is one such example.

If instructors recognize students as being different, and if they assume, based on research regarding learning theories and learning styles, that each student has a preferred learning environment, determination of student learning styles could offer insight to instructors to help facilitate a more favorable learning environment for all students and potentially improve academic performance. Graham, Garton, and Gowdy (2001) reported, “[l]earning style has been found to be an important variable in students’ academic achievement, how students learn and teachers teach, and student-teacher interaction” (p.31). Rudd, Baker, and Hoover (1998) acknowledged that there are “many differences among students which can be easily observed and identified such as race, gender, age and academic ability” (p.18). They (Rudd et al.,1998) also suggested that individual learning styles are not as easily identified as these simple observations, and that instructors tend to teach the way they were taught and typically have a limited understanding of the different learning styles of their students.

Graham et al (2001) proposed that, due to the “diverse learning styles found in students entering institutions of higher education, it is crucial for instructors to identify

learning style differences and incorporate teaching strategies that address the learning needs of all students” (p. 31). Ricketts, Rohs, and Nichols (2005), described the need for instructors to determine learning styles of their students and utilize this information as a teaching tool, “Learning styles and preferences have been of interest to educators for decades. The more we know about learning styles of those we teach, the better able we are to design curriculum and deliver instruction. Educators should recognize that students differ in learning styles and we should use the information to facilitate learning” (p.46).

In *Teaching the Whole Class* (1998), Betty Lou Leaver offered the rationale for teaching to all students in the classroom, not just to the predominant learning style. Although her rationale appeared to be structured toward younger student populations many are important to all learners, this rationale included the following compiled sixteen points:

1. All students are capable of learning.
2. Not all students learn the same way.
3. Teachers need to determine how to motivate students.
4. Teachers need to help keep students motivated.
5. Student success involves the way the students are taught, as well as, individual learning style not with just their innate ability to learn.
6. Teacher awareness of the presence of learning styles can help with the learning process.
7. As teachers develop the ability to facilitate learning, they find solutions that can help with the organization of teaching strategies that address the needs of all students.
8. Once teachers invest in the idea of learning styles and their existence, students can be taught in a manner that enables them to learn best.
9. Learner-centered instruction or teaching to specific student needs based on learning style is not as easy answer, but is an effective approach.

10. Learner-centered instruction can reduce conflicts between the way student is taught and the way the student learns.
11. Learner-centered instruction can increase the success rate of learning and lower attrition.
12. Teacher observations and assessments can allow teachers to teach the whole class by creating a basic understanding of how to best help all students learn.
13. All teachers can teach all students if they realize one method doesn't fit all students.
14. Learner profiles describe how students learn and can help the teacher teach all students.
15. Parents need to understand how their children / students learn.
16. Students need to understand how they learn so they can help themselves in the learning process.

Leaver (1998) also suggested, "Students reveal their learning styles preferences by everything they do and do not do and by everything they say and do not say" (p.23). If this is the case, instructors need to be aware of the existence of learning styles among their students and how best to teach to all students not just to a few.

As a result of research by Gregorc and Ward (1977) two sets of dualities, abstract or concrete, both perceptual qualities; and sequential or random, ordering abilities, were determined to be present in the initial phase of learning. As the researchers assessed the behavior of the participants in the research, they found "the sets of dualities joined to form four distinct learning preference patterns or modes" (p.21). These learning preferences were: Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR) and Concrete Random (CR).

Gregorc created the *Gregorc Style Delineator*TM, *A Self-assessment Instrument for Adults* (Appendix A) which categorized each of the four individual learning preferences or styles with specific characteristics that represent each mediation channel (style). Characteristics for each learner or learning style were summarized by Gregorc and Ward (1977). They described the concrete sequential learning preference as having a highly developed use of the five senses. Learning occurs through direct, hands-on experience. The abstract sequential learning preference is characterized by excellent written, verbal and image symbols decoding capabilities. Conceptual “pictures” in the mind matches what he reads, hears, or sees in graphic and pictorial form. The abstract random learner has the ability to sense and interpret “vibrations” associated with human behavior, atmosphere and mood. These learners use emotions to guide them. The concrete random learning preference is characterized by an experimental attitude and behavior. These learners quickly grasp ideas and make intuitive leaps into exploring unstructured problem-solving tasks.

Existence of dominant learning styles is not to say students can't learn in less favored learning environments. According to Butler (1987), the dominant channels (styles) express our natural abilities and the non-dominant channels reveal our limitations. We can develop the non-dominant channels by directing energy toward those limitations or being conscious that these limitations exist. If students do not develop coping strategies to address the limitations, stress is created. The same result occurs if students are forced to repress their dominant channel.

Butler (1987) offered both coping strategies for the learner and bridging (teaching) strategies for the instructor related to how best to help students learn. She suggested for the

Concrete Sequential (CS) learners to: to provide structured instruction since the CS learner thinks in methodical and deliberate ways; to be clear and exact with directions because the learner thinks in linear and literal ways; and to offer practical and hands-on options since the learner thinks “within the physical world”. Studying strategies for the CS learner included options that build on their organizational strengths; concentrating on details and content; quiet environments; and studying out loud with activities.

For the Abstract Sequential (AS) learner, Butler (1987) suggested: instruction that promotes analysis and evaluation since the learner thinks with intellect and logic; incorporation of traditional classroom structure and lecture to provide the learner with “traditional” ways of instruction; and offer instruction that includes research since the learner is concerned with subject matter expertise. Studying strategies included: rereading notes; note taking during the lectures; planning ahead with an outline; and summarizing notes through writing.

According to Butler (1987), the Abstract Random (AR) learner needs instruction that is flexible and open to accommodate thematic thinking; strategies that explores feelings and personal reactions since the AR learner experiences emotionally; and instruction that allows time for personal ideas and beliefs to tune into the “inner patterns” of the learner. Studying strategies included studying in groups; being aware how environments affect their emotions; visualize details and provide verbal associations; and the use of mind maps and color coding.

Butler (1987) also described the Concrete Random (CR) learner as needing instruction that requires inquiry, discovery, and exploration to assist with the concerns with problems and possibilities; inclusion of problem-solving since the learner thinks with

“insight and penetration”; and instruction that allows creativity and originality because the learner thinks beyond logic and convention. Studying strategies included: offer alternate ideas regarding a topic through brainstorming; create study problems; request deadlines; and accept the need for change and find support of the learner’s way of thinking.

If instructors and students are aware that learning styles exist and that all students do not learn in the same way, they may be able to facilitate the learning process through modifications in teaching, studying, and coping strategies. This can become very critical in institutions of higher learning since the populations are often very diverse and the dynamics of the class based on learning style can vary from course to course and semester to semester.

North Carolina State University College of Agriculture and Life Sciences

Land grant institutions were established as a result of the passage of the 1862 Land Grant College Act (Morrill Act) and 1890 Morrill Act. The Morrill Acts transferred federally owned land to states which could be sold to raise revenue to build institutions of higher education (colleges and universities). One of the primary goals of the 1862 Morrill Act was to offer agriculture, military tactics and mechanic arts (engineering), as well as classical studies, so the “working classes” could obtain a practical education in addition to the liberal arts. The 1890 Morrill Act extended these institutions to include African American populations. Additional funding was provided in 1994 to allow the establishment of institutions for Native Americans.

North Carolina State University (NCSU) is one of 106 currently existing land grant institutions in the United States. In the College of Agriculture and Life Sciences (CALS) there are 19 independent departments and the potential of 30 separate Bachelors of Science

degrees with some having numerous concentration options. In *Achieving Success in the Agricultural Institute* (2011), the mission of the College of Agriculture and Life Sciences is stated as: “to discover, develop, teach, and apply knowledge and technology that enable students, clientele and citizens of North Carolina and others to improve the quality of their lives and to enhance the agricultural, economic, environmental and social well-being of the state and world and to create and extend new knowledge through scientific research and extension in agriculture and the life sciences” (p.5).

Although the Agricultural Institute (AGI) program is included in the College of Agriculture and Life Sciences, the AGI program offers an Associates of Applied Science degree (2 year program) with 7 different majors and 8 concentration options.

The Agricultural Institute was established in 1959 and first offered classes in 1960 with the mission of offering students a technical education (Associates of Applied Science) that would prepare students to enter the agricultural industry after graduation. Students may enter the Associates degree program with the intent to apply to undergraduate programs at a later date or as an alternative to similar programs offered by community colleges or technical institutes. Admissions criteria for the AGI are different than NCSU undergraduate programs. Potential students can apply to the AGI program with a high school GPA of 2.0 or higher and, unlike the Bachelors of Science programs, no entrance exam (SAT) is required.

During the 2010 fall semester approximately 34,400 students were enrolled at North Carolina State University. Of the 34,400 students, 4669 students were enrolled as undergraduates in the College of Agriculture and Life Sciences (CALs), and 335 were enrolled in the Agricultural Institute (AGI). During the same semester NCSU employed

1904 faculty members who had teaching appointments for either undergraduate, graduate or both groups of students. Approximately 433 of this faculty had teaching appointments in the NCSU College of Agriculture and Life Sciences with an estimation of 50, teaching in the Agriculture Institute (AGI).

Statement of the Problem

Since CALS faculty often teach courses in both undergraduate and AGI programs, by determining the learning styles of students enrolled in both of the academic programs insight may be offered to both faculty and students as to how best help the students succeed academically. If there are differences in learning styles between the student groups, do these differences impact the students' academic performance? If so, simple modifications in teaching methodologies or additional resources could be offered to provide an environment that would be more beneficial to all students.

Research Objectives

The objectives of this exploratory descriptive research study were:

- 1) To determine if the learning styles of students enrolled in either the Bachelors of Science or Associates of Applied Science programs were different.
- 2) To determine if the learning styles of students impacted student academic performance based on introductory poultry science courses which included lecture and laboratory components.

Definition of Terms

For the purpose of this study, the following terms are defined:

Learning Styles - An individual's preferred learning environment or the ability to adapt to a specific learning environment based on the way the individual processes information. Although students have the ability to adapt or have the capabilities of learning independent of their preferred learning styles, dominant learning styles refers the student's choice in the way he or she processes information, concrete or abstract; sequential or random.

According to Pashler, McDaniel, Rohrer, and Bjork (2009), "[t]he term learning styles refers to the view that different people learn information in different ways" and also "...refers to the concept that individuals differ in regard to what mode of instruction or study is most effective for them" (p.105). Anthony Gregorc (1979) described learning styles as consisting "...of distinctive behaviors which serve as stable indicators of how a person learns from and adapts to his/her learning environment"...and also "gives clues as to how a person's mind operates" (p. 234). Dunn (1983), (as reported by Landrum and McDuffie, 2010, p.11), described learning style as, "a combination of environmental, emotional, sociological, physical, and psychological elements that permit individuals to receive, store, and use knowledge" (p.496).

Dominant learning style (DLS) – The preferred learning environment of an individual based on the numerical value calculated from the *Gregorc Style Delineator™ A Self-assessment Instrument for Adults* which ranged from 27-40 points in one particular learning preference. These learning preferences included: Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR) and Concrete Random (CR).

Academic performance - The mean grade that each student received in an introductory poultry course for the lecture component based on quizzes and exams; and grades received for each component of the laboratory final grade.

Assumptions

Assumptions related to the study were:

- 1) Students completed the *Gregorc Style Delineator™ A Self-assessment Instrument for Adults* accurately.
- 2) Students understood the instrument assessment descriptors.

Summary

Often instructors in institutions of higher education have teaching appointments that require them to teach a variety of students (associates, undergraduate, and graduate programs). Since each student is considered an individual with individual learning environment preferences, determination of the learning styles of students may provide a simple tool to enable educators to help students reach academic success. The learning styles of students enrolled in courses may vary from semester to semester especially since the instructor has little control over the enrollment into introductory courses due the prerequisites of these courses. If the instructor can make simple modifications in teaching approaches based on learning styles of the students in the classroom; or offer alternative resources related to the course material, the instructor may be able to provide an environment that enhances the learning capabilities of their students.

This exploratory research addressed two objectives: first, determine if the learning styles of students enrolled in an Associates of Applied Science (2 yr) degree program

introductory poultry science course were different from the students enrolled in a similar Bachelors of Science (4 yr) introductory poultry science course; and second, using the lecture quizzes and exams, and the laboratory components of the course as the barometer, did learning styles impact the student's academic performance? Dunn (1981) states, "[i]dentifying one's learning style is much easier than explaining its existence, yet that and many other questions must be answered before teachers will be able to respond to each student" (p.34).

CHAPTER II. REVIEW OF LITERATURE

Theoretical Framework

In *The Praeger Handbook of Learning and the Brain*, Feinstein (2006) suggested that although humans use their senses to assimilate environmental stimuli, each sense doesn't contribute the same amount of information to their brain. Individuals appear to learn differently or have different learning preferences or styles. She also reported the work of Dunn and Dunn (1987) in describing three styles of learning which are: auditory, visual, and tactile/kinesthetic.

Based on the descriptions of each of the learning style preferences, Feinstein (2006) offered that auditory learners prefer to discuss what they are learning. This act helps them process the information. The auditory learner tends to be analytical, logical, and a sequential thinker. Visual learners assimilate information most effectively by reading or seeing something. They tend to be more holistic thinkers and need to see the "big picture" before they are given the bits and pieces that contribute to the big picture. The tactile learner depends on drawings, games, experiments, models and writing to provide the connection between the brain and the hand.

The kinesthetic learner needs to be actively (bodily) engaged in the learning process with real world activities and with activities that have meaning to the learner. This learning process is considered one of the most important learning styles since the learned information is stored in one of the strongest memory (procedural) systems of the brain. This procedural memory storage is what allows people to remember how to drive cars, ride bicycles, and swim once they have learned or mastered the skill. As noted in *The Praeger Handbook of*

Learning and the Brain, the Chinese proverb, “Tell me and I’ll forget; show me and I may remember; involve me and I’ll understand” seems appropriate.

There are numerous methods of determining learning styles. Leaver (1998) offered four learning style groupings in efforts to make them less overwhelming to teachers and instructors. These groupings included: sensory modalities; personality types; cognitive styles; and environmental preferences.

Sensory modalities most commonly include visual, auditory, and motor (tactile / kinesthetic) learning styles. Although visual learners take in new information through sight, Leaver (1998) divided the visual learner into two sub-groups: verbalist and imagists. The verbalist sees words and imagists see pictures in the learning process. She further explained that auditory learners who process information through sound, can also be divided into two groups. These were aural, those who learn by listening to others, and oral, those who learn by talking and hearing themselves. The motor learner receives information through movement. Leaver divided these into two sub-groups which were: kinesthetic and mechanical. Kinesthetic use gross motor muscles and mechanical use fine motor muscles. Each involved frequency, pressure, duration and intensity during the use of these muscles.

According to Leaver (1998), personality type instruments were derived from the earlier works of Carl Jung. One of the most commonly used instruments is the Myers-Briggs Type Indicator (MBTI) which is based on a combination of traits found in personality type domains. These domains are: Introversion- Extraversion; Sensing- Intuitive; Thinking- Feeling; and Judging – Perceiving. Combinations of these four domains (16 combinations

total) exhibit different patterns of learning. These, like the sensory modalities, may include the learning preferences of the sight, auditory provisions and the use of motion.

Leaver (1998) described cognitive learning styles as a complex set of actions that take place as a result of the thinking process. She categorizes the cognitive learners into global/particular; leveler/sharpeners; synthetic/analytic; impulsive/reflective; inductive/deductive; concrete/abstract; and sequential/random. She also included divergers, assimilators, and accommodators in her review of cognitive style types. As with the sensory modalities and personality types, parallels can be drawn among each of the learner descriptions. An example of this comparison could be between students considered to be a concrete (cognitive) learner or a motor (sensory) learner. Although the learning style is based on different instruments or classifications, both learners are considered “hands on” learners. In a similar comparison, the abstract (cognitive) learner can be compared to the visual (sensory) learner since both have the preference of “pictures” in the learning process.

Leaver (1998) also explained the difference in student preferences related to their learning environment and optimal learning. She classified these as both physical and physiological conditions. Although instructors may have limitations related to these environmental preferences in the classroom, such as low lighting preference and time of day, if students are aware that certain environments are more favorable for their learning, they may be able to accommodate this environment at the home / dorm room when studying or when they have a “choice”.

Gregorc (1982) developed his learning theory as the result of his concern that children and adults were not learning to their full potential. With the objective of identifying

how individuals learn and why they learn as they do, he studied four psychological forces which were: behavioral; psychoanalytic; humanistic; and transpersonal. With emphasis on behaviors, their causes and phenomenology (the way we experience things), Gregorc designed his Energetic Model of Mindstyles which later became the Mind Styles Model (Gregorc, 1984). Butler (1987) described the model as being based on the Gregorc's Mediation Ability Theory which theorizes that the mind possesses natural qualities that help individuals realize and actualize one's personal essence. These qualities are based on perceptual or ordering capabilities that are expressed through mind channels which are described as being either concrete sequential, abstract sequential, concrete random; or abstract random. According to Gregorc (1982), these four combinations reveal "...a particular qualitative orientation to life" (p.6). He also explained that although everyone has each of these qualities most individuals naturally migrate to one or two of these channels over others. This preference affects how individuals view the world, themselves, and how the world perceives them. The environment also places demands on the individual to adapt by modifying their natural mediation abilities. This adaptation process occurs daily in the classroom, at home, at work, or interaction with other individuals.

Gregorc (1984) described inferences drawn based on his 1974 study with 40 people (20 males and 20 females) who were considered "successful" learners. These inferences included: the existence of natural and learned dispositions; existence of qualities for establishing reality; and the existence of the ability to relate best to certain conditions.

Gregorc (1984) suggested in his first inference that individuals' dispositions are both natural and learned. These dispositions for interacting with the world in specific ways are both inborn (natural) and/or adopted (learned) as a result of the interaction with the world.

His second inference was "...behind each system of thought lies specific 'driving force' qualities [space, time, mental processing and relationships] used for establishing existential reality" (p.53). The space qualities dealt with concrete or abstract space. Time qualities dealt with the ordered structuring of realities (sequential or random). Mental processing occurred through deduction or induction. The relationships were driven by stand alone qualities or associative qualities (sharing or groups). Since all of the participants in the research showed each of the qualities, it was concluded these qualities were universal. However, individuals tended to lean toward one type of space, time, mental processing and relationship.

Gregorc's third inference was that individuals are predisposed to relate best to certain conditions for personal growth and development. The latter inference was directed more to the conditions in which the individual found to be favorable or unfavorable such as practical activities or emotional concepts.

Related Research

Numerous studies related to learning styles and academic performances have been documented over the past twenty-five years. Orr, Park, Thompson, D. & Thompson, C., (1999) studied the predominant learning style of 322 (228 female; 94 male) students enrolled in postsecondary technical education institutes in Arkansas. They also studied if there were differences related to learning styles among the students based on gender; program area

(Business Education; Health Occupations: and Trade and Industrial); and work experience.

As a result of their study, it was determined the dominant learning style of the students, based on the Gregorc Style Delineator, was concrete sequential (CS), however, most of the students were considered bimodal (dominant in two learning styles). There was no significant difference among learning styles noted based on program area. Participants with more work experience tended to be concrete sequential learners. Regarding the distribution of the participants based on gender; concrete sequential learners were similar between the males and females; more males were abstract sequential and abstract random learners; and more females were considered to be concrete random learners.

Drysdale, Ross, and Schulz (2001) studied the overall academic success (GPA) of 4546 students enrolled at an urban Canadian university in 19 introductory university courses based on their dominant learning styles. These courses included: various sciences; social sciences; art and drama; business and math. As a result of this research, it was indicated that in 9 of the 19 courses involved in the study, the dominant learning style was concrete sequential, and that these students (followed closely by abstract sequential) tended to have higher grades in each of the courses studied, especially in courses related to math and science. Concrete random learners' performances varied, and abstract random learners appeared to struggle academically as a group.

With the goal of determining the effects of instructional strategies and learning styles on undergraduate student achievement based on learning style, Moss, Seitz, Anton, W., and Anton, T. (2002) noted a similar distribution of learning styles of the 186 students enrolled in an University of Illinois Urbana-Champaign, agricultural economic resources,

agriculture and food course. Thirty-eight percent of the students were determined to have a concrete sequential (CS) learning style. Concrete random, abstract sequential, and abstract random learning styles were evenly distributed. Results indicated that when supplemental exercises were offered to traditional lectures, such as those considered active or problem-based, student learning (academic performance) was influenced positively.

Schmidt and Javenkoski (2000) conducted an exploratory qualitative study at the same institution (University of Illinois Urbana-Champaign) to determine the impact of selected teaching strategies on student learning of 208 students enrolled in an introductory Food Science and Human Nutrition course. Schmidt et al (2000) reported the distribution of learning styles of the students as being 42% concrete sequential learners; 14% being abstract sequential learners; 26% abstract random learners; and 18% being concrete random learners. It was also noted that based on the research results when instructors were better prepared to modify instructional activities, methods, and content the learning needs of the students were better fulfilled based on feedback offered by the participants in the study.

Cartmell, Majors, Ashlock, and Sitton (2007), compared the learning styles, GPA's, and demographics (gender; classification (Sr, Jr, So, Fr); and permanent residency) of 135 students enrolled in agricultural communications at Oklahoma State University. Most of the students were determined to be concrete sequential learners (42%) with abstract sequential and concrete random learners, having a distribution of 23% and 21%, respectively; and the abstract random learners or bimodal learners had the least representation of 7% each. Overall GPA's of the students were also higher for the concrete sequential learners.

Lehman (2011) studied the relationships of learning styles, course grades, and instructional preferences, as well as gender differences related to learning styles in an introductory biology course taught at Longwood University. Her research indicated that of the 173 students (47 male; 126 female) the dominant learning style was concrete sequential (39%). Twelve percent of the students were abstract sequential learners with 21% having abstract random and 28% having concrete random learning styles. No significant differences were noted between gender; grades; or instructional preferences based on learning style. The most popular instructional preferences regardless of learning style were “hands on” activities; field trips; clearly organized and structured lectures; lectures with pictures and diagrams; and educational games or simulations. In an earlier study using the same biology course, Lehman (2007) reported distributions of 43% CS; 14% AS; 23% AR; and 20% CR as a result of combined data from multiple studies. Although distributions varied over the six year period, CS was the dominant learning style observed consistently (in both males and females), and AS was the learning style least common. The final grade received in the course was not significantly different for either of the learning styles or for gender. When students were assigned to group projects based on like learning styles (homogeneity) or different learning styles (heterogeneity), project grades were not significantly different. Student satisfaction based on a survey indicated there were significant correlations observed between grades, satisfaction, and perceived learning. Students with the highest course grade were more satisfied with their contribution to the project or their own work and less satisfied with the benefits of cooperative group work.

Myers and Dyer (2006) reported no significant differences in the learning styles of males (n=29) and females (n=82) enrolled in an agricultural leadership development course at the University of Florida nor in their critical thinking skill. However, it was noted that for individuals with a deeply embedded abstract sequential learning style, their critical thinking skill scores were significantly higher than other deep embedded learning styles. Results noted that the dominant learning style was CS (64%) followed by AR (42.3%), CR (38.7%), and AS (36.0%). Frequencies were greater than 100% due to the inclusion of more than one dominant learning style for any participant that was considered bimodal. Although combinations (bimodal) of learning styles were monitored, Friedel and Rudd (2006) found similar results in learning style distribution in their study comparing creative thinking and learning styles. Students (n=110; 41 male; 69 female) enrolled in a University of Florida Effective Oral Communications course completed the Torrance Test of Creative Thinking and were asked to self-report their GPA's. Based on the data, there were no correlations between learning styles and creative thinking ability. Learning styles were significantly related to the self-reported cumulative GPAs. It was noted that CS learners had higher GPAs and CR learners had the lowest GPAs.

Pottmeyer (2004) reported learning style could be used as a predictor in student performance relative to the laboratory component of an introductory North Carolina State University botany course. Of the 146 students enrolled in the botany course, major and college were not significant factors in determining academic performance. No significant differences were noted in exam scores for the lecture component of the course for either of

the learning styles. Students with CS learning styles had the highest laboratory average score followed by AS, CR, and AR respectively.

Two hundred sixty nursing students enrolled in a University of Calgary human anatomy and physiology course participated in a study lead by Harasym, Leong, Lucier, and Lorscheider (1995). Results indicated that CS was the dominant learning style of the participants. Abstract random, abstract sequential, and concrete random learning styles followed in distribution. No significant correlations were observed between dominant learning style and examination scores. Gould and Caswell (2006) studied learning preferences in 200 undergraduates and 43 program directors of an athletic training program at the University of Southern Mississippi. Results indicated that the dominant learning style was concrete sequential for both the undergraduates and the directors, and abstract sequential was the least favored.

Esa, Radzali, Misdi, and Jaafar (2009) reported the dominant learning style of 232 students enrolled in engineering disciplines at the University Tun Hussein Omn Malaysia to be AS (48.3%). Abstract Random, concrete sequential, and concrete random learning styles followed with 36.2%, 32.8%, and 31.9% respectively. Lecturers (n=37) of these students reported a similar distribution of AS (78.4%), with concrete sequential making up 32.4% of the instructor's learning styles and an equal distribution of AR and CR learning styles of 18.9%. As reported with Myers and Dyer (2006), frequencies for each of the learning styles are greater than 100% due to the inclusion of multiple learning styles if participants had more than one dominant learning style (bimodial).

Relationships between students' learning styles, a teacher's teaching performance and students' performance were studied by Graham, Garton, and Gowdy (2001) at the University of Missouri in an upper level plant propagation course. The Group Embedded Figures Test (GEFT) was administered to 31 students enrolled in the course. Results indicated that 55% of the students were considered field independent; 19% were considered field dependent; and 26% were considered field neutral. A field independent learner was described as being analytic, self-motivated, and preferred to work alone. Field dependent learners were described as being global, having social orientation, and being driven by instructors or others. Myer and Dyer (1995) compared the field dependent learner to Gregorc's abstract learner (AS/AR) and the field independent learner to the concrete learner (CS/CR). Other studies using the GEFT instrument found similar results related to the learning styles of students enrolled in agricultural or science based courses or curricula (O'Brien, Butler, & Bernold, 2001; Garton, Dyer, & King, 2000; Hoover & Marshall, 1998; Cano, 1999).

Garton, Spain, Lamberson, and Spiers (1999) conducted a study to identify relationships that existed between learning styles, teaching performance, and student achievement of students (n=187) enrolled in an animal science course at the University of Missouri. Results indicated that the majority of the students preferred a field independent learning style. A significant (low positive) relationship was noted between learning style and academic performance depending on the instructor. They also reported these results were similar to the earlier research of Torres and Cano (1994) which also indicated that the majority of college students (n=103) enrolled in agricultural related majors at The Ohio State

University favored a field independent learning style, however, females tended to be more field-dependent than males.

Summary

There are numerous methods of determining the learning styles of individuals. Leaver (1998) offered four learning style groupings in efforts to make them less overwhelming to teachers and instructors. These groupings included: sensory modalities; personality types; cognitive styles; and environmental preferences. Sensory modalities most commonly include visual, auditory, and motor (tactile / kinesthetic) learning styles. Leaver (1998) described personality types as, “[t]he ways in which learners relate to other people and to the physical and intellectual world around them influence their learning” (p.29). Cognitive learning styles are described as a complex set of actions that take place as a result of the thinking process and environmental preferences refers to the physical surroundings and the physiological conditions that influence learning.

Anthony Gregorc developed the *Gregorc Style Delineator*TM as a method to determine the cognitive learning style of adults. Its design is based on two sets of dualities, abstract or concrete, both perceptual qualities; and sequential or random, ordering abilities. Each set of dualities is based on: the existence of natural and learned dispositions; existence of qualities for establishing reality; and the existence of the ability to relate best to certain conditions. Gregorc categorized learning preferences as a result of his research as: Concrete Sequential (CS), Abstract Sequential (AS), Abstract Random (AR) and Concrete Random (CR).

Research related to dominant learning styles observed in agricultural sciences and core science courses taught at postsecondary institutions indicated that concrete sequential is

the dominant learning styles for students enrolled in these types of courses. Other research indicated that field independent learning styles (similar to the concrete learning style) are also observed more often in students enrolled in courses related to agriculture.

If the primary goal of instructors is to help students learn and if we assume each of the dominant learning styles are consistently exhibited by the students enrolled in our classrooms, making efforts to address each of the learning styles should help the students succeed academically. Gregorc and Ward (1977) stated, “[i]f educators are to successfully address the needs of the individual learner, they must understand what the word individual means. They must relate teaching style to individual learning preference” (p.20).

CHAPTER III: METHODOLOGY

Landrum and McDuffie (2010) stated, “[t]he idea that people learn things differently has tremendous appeal...some things are learned more quickly than others, skills are mastered with greatly varying amounts of practice, and the acquisition of some skills demands different types and levels of instruction and support” (p.6). Drysdale, Ross, and Schulz (2001), suggested, “[i]n higher education, the material is presented differently in that the content is complex and more extensive. Some students might have to change their cognitive approach to learning to master the material. For some, this may be more difficult and may affect overall performance” (p.272). Each of these ideas leads to the question, do students enrolled in college courses learn differently, and can this impact academic performance?

Research Design and Population

Students enrolled in North Carolina State University (NCSU) either undergraduate (n=21) or associates of applied science (n=36) introductory poultry science courses were asked to participate in an exploratory study in fall of 2010 to determine; if learning styles between the two groups of students were different; and if their learning styles affected their academic performance in the lecture and laboratory components of the course.

If students met requisite criteria and class enrollment limits, students were allowed to enroll in the introductory courses that matched their academic program. Lecture included regularly scheduled classes, quizzes, and hourly exams. Although class attendance was highly recommended it was not mandatory. Mean grades for the lecture component consisted of a combination of quizzes and exams (hourly and final). Quizzes were given

during the first 10 minutes of class and were either formatted as short answer or matching a term to a corresponding definition or statement. Hourly and final exams consisted of multiple choice questions, short answer, or essay questions. Different instructors taught the lecture components of the introductory courses. The researcher taught the lecture component for the 2 year introductory course.

Each introductory course had a laboratory component associated with the course. The researcher taught each of the course laboratories (two sections for each course; 4 sections total). The laboratory was designed to enhance the lecture component of course. Labs included brief lectures related to the course material; hands on learning experiences and field trips. During the first scheduled laboratory students were given a laboratory syllabus which included an outline of the laboratory requirements and the percentages assigned to each laboratory component that when combined would result in a final laboratory grade. The graded components were designed to test the students' abilities to work independently (worksheets), provide structure (attendance) and test proficiency of course materials through a mid-term quiz, final exam, and lab practical which also included student demonstrations of lab practices.

Each student was asked to complete a consent form and the *Gregorc Style Delineator*TM was administered to both groups of students to determine the learning style of each student during the same (first) scheduled laboratory. In order to prevent any potential bias regarding instruction of the course laboratory by the researcher, the delineators for each student were stored until all labs were completed and then scored by the researcher. Data collected on any students who either withdrew from the course (n=1; 2 yr) or failed to

complete all components of the laboratory (n=1; 2 yr) after the instrument was administered were not included in the data analysis.

Final grades for the laboratory component of the course were determined for each group of students (undergraduate or associates of applied science programs) based on a predetermined set of criteria which included: attendance (10%); 3 worksheets (10% each; 30% total); a mid-term quiz (10%); a final laboratory exam (25%); and a final lab practical (25%).

Attendance to 15 of the scheduled labs was recorded for each student. If students attended all labs 100 points were given to the students; a percentage was given if they missed a lab (Ex. $[(14/15) * 100]$ if students missed 1 class; $[(13/15) * 100]$ if students missed 2 classes; etc. Three worksheets were distributed during the course of the semester which required each student to perform an activity outside the normal laboratory period. Grades for the worksheets were assigned as: 100% for completion of the each worksheet; 50% if completed but turned in past the due date; and 0% if the worksheet was not completed or not returned to the instructor. A mid-term quiz was administered to each group of students which covered material discussed in the first four scheduled laboratories. The quiz format included short answer questions and a section that required students to match a term with a brief definition. A final exam and lab practical were given at the end of the semester. The final exam included 28 questions (8 short answer questions and 20 questions with a matching format) similar to the mid-term quiz. The lab practical required students to answer questions related to tasks demonstrated in labs during the semester and to identify items associated with the laboratories at 10 separate stations. Both the lab practical and final exam included an

extra credit question with the potential of a maximum score of 105 on each component. A final laboratory grade was determined for each student and recorded. A final grade for the lecture component was also calculated based on the quizzes and exams given during lecture and recorded.

Instrumentation

The *Gregorc Style Delineator*TM *A Self-assessment Instrument for Adults* (Appendix A) developed by Anthony F. Gregorc was purchased from Gregorc Associates, Inc. and used to determine individual learning styles for each student in this study. This instrument was chosen due to the ease of administering the delineator to the students. A vocabulary sheet (Appendix B) was constructed by the researcher based on *Thesaurus* to assist students with the delineator's word matrix as needed.

Learning styles for each group of students were determined and recorded based on the four potential learning style categories determined by the Gregorc Learning Style DelineatorTM. The instrument (Gregorc, 2009) was “designed to help reveal a special set of mental qualities and mediation channels available [to handle] the demands and opportunities of life” (2009). The four combinations of individual ordering and perceptual abilities included: Concrete Sequential (CS); Concrete Random (CR); Abstract Sequential (AS); and Abstract Random (AR). The instrument was based on 7 key ideas which are listed on the Gregorc Style DelinatorTM (2009) as being:

1. *“We, as human beings, need to make sense of our world.”*
2. *Perception and ordering are mind qualities found within for basic mediation channels (CS, AS, AR, CR).*

3. *Each of us has the same BASIC amount of CS, AS, AR and CR abilities at our disposal.*
4. *Beyond the basic amount of CS, AS, AR and CR abilities, most of us are naturally predisposed to function best using one or two mediation channels.*
5. *Our individualistic inclinations prompt us to realize that some environmental conditions, everyday products and ways of thinking are attractive to us while others are not.*
6. *Individuals can be broad-minded and narrow-minded.*
7. *Serious self-study enables individuals to grow in understanding of their Mind StylesTM .”*

The combinations of ordering and perceptual abilities or learning styles of the students were determined based on a word matrix or descriptors listed on the instrument and a self (student) assigned numerical value (1 – 4) to these descriptors where “4” was perceived to be most like the individual and “1” was least like the individual. The delineator consisted of two sets of 5 columns with 4 rows of descriptors labeled A-D (40 total). Students could also refer to the vocabulary sheet (Appendix B) that was constructed by the researcher if needed. Values for each delineator set were calculated and placed in the appropriate boxes to determine learning style. The delineator is designed to provide a score that equals exactly 100. Any delineators completed by the students (n=10; 2yr) with scores either greater or less than 100 were asked complete the instrument a second time using the same vocabulary sheet created by the researcher. A learning style profile for each student was based on the scale outlined by the *Gregorc Style DelineatorTM*. Scores of 27 – 40 points in any of the four categories (CS; AS; AR; or CR) were considered “dominant”. Scores of 16 -26 were considered “intermediate” and scores of 10 – 15 were considered “low”. The graphic style profile is shown in Appendix C. For students who were “dominant” in more than one

channel, the higher score was used in the data analysis. Students (n=2; 2 yr) with no dominant learning style (score below 27 for each of the categories) were not included in the chi-square test or analysis of variance (ANOVA). Characteristics for each learning style (Appendix D); what the learner likes; how the individual learns best; and what is difficult for the learner was offered to each student who completed the delineator.

Reio and Wiswell (2006), stated that Gregorc (1982) reported test-retest correlation coefficients of .85 to .89 and alpha coefficients of .89 to .93 on all four scales (CS, AS, CR, AR). In their study (Reio and Wiswell, 2006) Cronbach's alpha coefficients were reported to be .54 to .68. Ouellette (2000) also reported a correlation coefficient of stability of 0.87 based on Gregorc's test for reliability (Gregorc, 1982).

Data Analysis

Final course and laboratory grades were matched with individual learning styles. Mean grade values and standard deviations were determined for each of the four learning styles within each group of students (either undergraduate or associates of applied science programs). A statistical analysis was performed using Statistical Analysis System (SAS) to determine if there were significant differences in learning style distribution between the undergraduate and applied science students. Analysis was also performed to determine if learning style affected academic performance within each group. Since the research study was considered exploratory and the sample size was small a confidence level of 90% was used. Chi-square (X^2) analysis was performed to determine if distribution (frequencies and percentages) of the learning styles for each of the academic groups was significantly different. Chi-square (X^2) analysis was also performed to determine if distribution

(frequencies and percentages) of the of each of the perceptual and ordering qualities - Concrete or Abstract; Sequential or Random, utilized in the Gregorc Learning Styles Delineator for each program (2yr or 4 yr) was significantly different. A one way analysis of variance (ANOVA) was performed to analyze the effect of learning styles, if any, on academic performance for students enrolled in either the Associates or Bachelors academic program or determine if there was a relationship between learning style and academic performance.

Summary

Students enrolled in two introductory poultry science courses were asked to participate in a study that compared the learning styles of students enrolled in either a Bachelor's of Science (n=21) or Associates of Applied Science (n=36) program at North Carolina State University. The purpose of the study was also designed to determine if learning styles impacted academic performance using the lecture and laboratory components as the rubric.

Due to the ease of administration, the *Gregorc Style Delineator*TM was used as the instrument to determine the learning style of each participant. A learning style profile for each student was based on the scale outlined by the *Gregorc Style Delineator*TM. Scores of 27 – 40 points in any of the four categories (CS; AS; AR; or CR) were considered “dominant”. Scores of 16 -26 were considered “intermediate” and scores of 10 – 15 were considered “low”. Gregorc reported correlation coefficients of .85 to .89.

The lecture component of the course grade included quizzes; hourly exams; and a final exam administered during the lecture and based on material covered during lecture.

The laboratory course grade was based on five components which included attendance; worksheets; a mid-term quiz; a lab practical; and a lab final exam. Chi-square (X^2) analysis was performed to determine if distribution (frequencies and percentages) of the learning styles for each of the academic groups were significantly different. A one way analysis of variance (ANOVA) was performed to analyze the effect of learning styles, if any, on academic performance for students or to determine if there was a relationship between learning style and academic performance.

CHAPTER IV: RESULTS

Students enrolled in North Carolina State University (NCSU) undergraduate (n=21) and associates of applied science (n=36) Fall 2010 introductory poultry science courses were asked to participate in an exploratory research study to determine if learning styles between the two groups of students were different and if their learning styles affected their academic performance. Any data collected on students (n=1; 2 yr) that did not complete each of the laboratory components were not used in the data analysis.

Distribution of the “dominant” (scores of 27 - 40 in one of the mediation channels outlined in the *Gregorc Style Delineator*TM, CS; AS; CR; AR) learning styles for each group of students was analyzed by using a Chi-square analysis in SAS. Results indicated there was no significant difference, $p = 0.77$, regarding the distribution of learning styles for both groups. Data on students that were determined to have no dominant learning style (n=2; 2yr) were not used in the data analysis. The Concrete Sequential learning style had the highest frequency (47.62%, 4yr; 60.01%, 2yr) for both groups of students. Students enrolled in the Bachelor’s degree program had learning style distributions of 14.29 % in both Abstract Sequential and Abstract Random modalities and 23.80% in Concrete Random. Distributions of learning styles for the Associates degree program were 13.33 % in AS, AR, and CR respectively. Results are shown below in Table 1.

Table 1.

Frequency and percentage (%) of dominant learning styles of students enrolled in either the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs.

Dominant Learning Style (DLS)	Associates (2 Yr)		Bachelors (4 Yr)		X^2	p^*
	<i>n</i>	%	<i>n</i>	%		
Concrete Sequential	18	60.01	10	47.62	1.13	0.77
Abstract Sequential	4	13.33	3	14.29		
Abstract Random	4	13.33	3	14.29		
Concrete Random	4	13.33	5	23.80		
Total	30	100.00	21	100.00		

* $\alpha = 0.10$; chi-square test

Using the same analysis, distributions of each of the perceptual and ordering qualities, Concrete or Abstract; Sequential or Random, were also analyzed for each academic group. No significant differences, $p = 0.88$ (Concrete or Abstract) and $p = 0.39$ (Sequential or Random), were observed in the distributions and are shown in Table 2. The concrete perceptual quality and the sequential ordering quality had the highest frequencies for both groups of students.

Table 2.

Frequency and percentage (%) of dominant learning styles based on perceptual, Concrete or Abstract, and ordering, Sequential or Random, qualities for students enrolled in either the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs.

Dominant Quality		Associates (2 Yr)		Bachelors (4 Yr)		X^2	p^*
		<i>n</i>	%	<i>n</i>	%		
Perceptual	Concrete	18	73.33	10	71.43	0.02	0.88
	Abstract	4	26.67	3	28.57		
Ordering	Sequential	4	73.33	3	61.90	0.75	0.39
	Random	4	26.67	5	38.10		
Total		30	100.00	21	100.00		

* $\alpha = 0.10$; chi-square test

Mean values and standard deviations were determined for both lecture (quizzes, hourly exams and a final exam) and laboratory (attendance, worksheets, mid-term quiz, lab practical, and lab final exam) components based on dominant learning style and academic program. An one way analysis of variance (ANOVA) was performed to analyze the effect of learning styles, if any, on academic performance for students enrolled in either the Associate's or Bachelor's academic program. Although the distribution of the learning styles for both groups of students were the same, results indicated there was no interaction

between dominant learning style and academic performance related to the final grade component. There were also no significant differences observed for lecture grades or for either of the laboratory components related to dominant learning style. Results for the lecture and laboratory components are displayed in Tables 3.1 - 3.7.

Course grades based on quizzes, hourly exams and final exams given during lecture were monitored for each academic group. Results indicated that there were no significant differences in academic groups, 4 yr, $p=0.57$; 2 yr, $p=0.94$. Results are shown in Table 3.1.

Table 3.1.
Comparison of academic performance (Lecture) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Course Grade for Lecture)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	<i>p</i> *
4 Yr	CS	10	84.94	9.51	0.70	0.57
	AS	3	79.74	3.57		
	CR	5	79.78	9.26		
	AR	3	79.99	4.82		
2 Yr	CS	18	88.25	9.51	0.14	0.94
	AS	5	89.75	8.12		
	CR	4	90.75	7.51		
	AR	4	90.88	11.82		

* $\alpha = 0.10$; One way analysis of variance (ANOVA).

Attendance for each academic group was similar with a p value of 0.88 in the Bachelor’s program and 0.63 in the Associates program indicating all learning styles in both programs attended lab on a regular basis and are noted in Table3.2.

Table 3.2.

Comparison of academic performance (Attendance) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Attendance)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	p*
4 Yr	CS	10	98.30	5.38	0.22	0.88
	AS	3	100.00	0.00		
	CR	5	98.00	4.00		
	AR	3	100.00	0.00		
2 Yr	CS	18	95.83	10.48	0.58	0.63
	AS	5	100.00	0.00		
	CR	4	100.00	0.00		
	AR	4	100.00	0.00		

* $\alpha = 0.10$; One way analysis of variance (ANOVA)

Worksheets included three independent activities which required students to visit local grocery stores (twice) to determine how poultry products are marketed and a poultry exhibit to explore the various poultry breeds. Worksheets were checked for accuracy based

on the activity by the instructor. If students failed to complete an activity a “0” was given as a grade for that worksheet. Although no significant differences were observed (Table 3.3) between learning styles it should be noted that the CS students enrolled in the 2 year program had greater variation (SD=26.04) in their mean worksheet grades. No comparisons could be made for the 4 year program because all students completed all of the activities correctly.

Table 3.3.
Comparison of academic performance (Worksheets) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Worksheets)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	p*
4 Yr	CS	10	100.00	0.00	.	.
	AS	3	100.00	0.00		
	CR	5	100.00	0.00		
	AR	3	100.00	0.00		
2 Yr	CS	18	84.78	26.04	1.16	0.34
	AS	5	100.00	0.00		
	CR	4	98.25	3.50		
	AR	4	100.00	0.00		

* $\alpha = 0.10$; One way analysis of variance (ANOVA)

Mid-term quizzes were given to students to test proficiency of material covered during the first four laboratories. No significant differences (4 year, $p=0.77$; 2 year, $p=0.71$)

were noted in the mean mid-term quiz grades of either of the learning styles for either of the academic groups. Results are shown in Table 3.4.

Table 3.4.

Comparison of academic performance (Mid-Term Quiz) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Mid-Term Quiz)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	p*
4 Yr	CS	10	96.50	10.55	0.37	0.77
	AS	3	95.00	17.32		
	CR	5	92.02	13.04		
	AR	3	88.33	15.28		
2 Yr	CS	18	82.92	12.73	0.47	0.71
	AS	5	91.25	15.25		
	CR	4	88.13	18.19		
	AR	4	83.13	16.75		

* $\alpha = 0.10$; One way analysis of variance (ANOVA)

The lab practical component required students to physically identify processes or systems that were covered during lab periods, such as gross anatomy, embryology, feed milling and poultry processing. Results (Table 3.5) for the lab practical component indicated no significant differences among learning styles for either group, although grades for the

Associates students were observed to have greater variation than students enrolled in the Bachelor's program.

Table 3.5.

Comparison of academic performance (Lab Practical) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Lab Practical)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	p*
4 Yr	CS	10	91.00	12.65	0.38	0.77
	AS	3	88.33	7.64		
	CR	5	85.00	7.91		
	AR	3	90.00	5.00		
2 Yr	CS	18	70.28	18.90	0.40	0.75
	AS	5	70.00	18.37		
	CR	4	66.25	31.46		
	AR	4	81.25	21.36		

* $\alpha = 0.10$; One way analysis of variance (ANOVA)

Results for the lab final are shown in Table 3.6. The laboratory final exam consisted of short answer and matching questions. There were no significant differences, noted for either of the academic programs based on dominant learning style.

Table 3.6.

Comparison of academic performance (Lab Final Exam) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Lab Final Exam)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	p*
4 Yr	CS	10	103.50	1.90	1.69	0.21
	AS	3	100.00	3.00		
	CR	5	102.00	3.67		
	AR	3	100.00	5.00		
2 Yr	CS	18	96.50	9.68	0.20	0.90
	AS	5	99.50	7.31		
	CR	4	95.75	14.52		
	AR	4	99.50	7.77		

* $\alpha = 0.10$; One way analysis of variance (ANOVA)

As indicated previously, dominant learning style did not appear to have a significant effect on either of the laboratory components for either of the academic programs. The final grade was determined based on a percentage for each component. Attendance accounted for 10% of the final grade; worksheets contributed to 30% of the final grade; the mid-term quiz accounted for 10% of the final grade; the lab practical and lab final exam contributing 25% each to the final grade. The results are listed in Table 3.7.

Table 3.7.

Comparison of academic performance (Final Lab Grade) between students enrolled in the Bachelors of Science (4 yr) or Associates of Applied Science (2 yr) degree programs based on dominant learning style.

Academic Program	Dominant Learning Style	Academic Performance (Final Lab Grade)				
		<i>n</i>	<i>Mean</i>	<i>S.D.</i>	F	p*
4 Yr	CS	10	98.14	4.70	0.38	0.77
	AS	3	96.63	4.19		
	CR	5	95.80	4.03		
	AR	3	96.33	3.69		
2 Yr	CS	18	85.07	11.04	0.95	0.43
	AS	5	91.55	6.31		
	CR	4	88.83	13.90		
	AR	4	93.55	7.84		

* $\alpha = 0.10$; One way analysis of variance (ANOVA)

CHAPTER V: SUMMARY

If instructors recognize students as being different, and if they assume, based on research regarding learning theories and learning styles, that each student has a preferred learning environment, determination of student learning styles could offer insight to instructors to help facilitate a more favorable learning environment for all students and potentially improve academic performance.

Often instructors in institutions of higher education have teaching appointments that require them to teach a variety of students (associates, undergraduate, and graduate programs). The learning styles of students enrolled in courses may vary from semester to semester especially since the instructor has little control over the enrollment into introductory courses due to the prerequisites of these courses. If the instructor can make simple modifications in teaching approaches based on learning styles of the students in the classroom; or offer alternative resources related to the course material, the instructor may be able to provide an environment that enhances the learning capabilities of their students.

The purpose of this exploratory research was to determine if the learning styles of students enrolled in either a Bachelors of Science or an Associates of Applied Science course were different and if their dominant learning style affected academic performance.

Summary of the Procedures

Students enrolled in two introductory poultry science courses were asked to participate in a study that compared the learning styles of students enrolled in either a Bachelor's of Science (n=21) or Associates of Applied Science (n=36) program at North Carolina State University. Each introductory course consisted of a lecture and laboratory

component which was used as the rubric for determining academic performance. Grades associated with the lecture component consisted of lecture quizzes, hourly exams, and final exams. Labs included brief lectures related to the course material; hands on learning experiences and field trips. Final grades for the laboratory component of the course were determined for each group of students (undergraduate or associates of applied science programs) based on a predetermined set of criteria which included: attendance (10%); 3 worksheets (10% each; 30% total); a mid-term quiz (10%); a final laboratory exam (25%); and a final lab practical (25%).

Each student was asked to complete a consent form and the *Gregorc Style Delineator*TM was administered to both groups of students to determine the learning style of each student during the same (first) scheduled laboratory. A learning style profile for each student was based on the scale outlined by the *Gregorc Style Delineator*TM. Scores of 27 – 40 points in any of the four categories (CS; AS; AR; or CR) were considered “dominant”. Dominant learning style was matched with academic performance. Chi-square analysis was performed to determine if the distributions of learning styles for either group was significantly different. A one way analysis of variance (ANOVA) was also performed to determine if there was a relationship between student learning style and academic performance.

Summary of the Findings

Results from this exploratory research indicated there were no significant differences, $p \leq 0.10$, in learning style distribution or academic performance based on dominant learning style for students enrolled in either of the academic programs. Lecture grades were determined for each academic group and were based on quizzes and exams given as a

component of the lecture. No significant differences were noted for either academic group based on dominant learning style (4 yr, $p=0.57$; 2 yr, $p=0.94$). No significant differences were noted in either of the laboratory components or the final laboratory grade.

Although students enrolled in the Bachelors of Science introductory poultry science course had consistently higher scores on each of the laboratory components than students enrolled in a similar course in the Associates of Applied Science program; distribution of dominant learning styles, CS, AS, AR, CR, among both groups was not significantly different, $p=0.77$. Concrete sequential was determined to be the most dominant learning style for each group. Similar results regarding distribution were noted when learning styles were combined based on either perceptual or ordering capabilities (Concrete or Abstract; Sequential or Random). Both groups of students were dominant in a concrete perceptual quality ($p=0.88$) and sequential ordering capability ($p=0.39$).

Conclusions

Based on the results of this study, the learning styles of students enrolled in an Associates of Applied Science (2 yr) degree program introductory poultry science course laboratory were the same as students enrolled in a similar Bachelors of Science (4 yr) introductory poultry science course and dominant learning style did not impact academic performance. Distributions of the four learning styles determined by the *Gregorc Style Delineator*TM for both groups of students were similar with the dominant learning style for both groups being concrete sequential. Final grades for both the lecture component of the course and the lab grade indicated that learning style had no impact on academic performance.

Implications

Students enrolled in various curricula associated with science and/or agriculture, in both vocational and undergraduate studies, are often characterized as having a concrete or sequential learning style or field independent (similar to the concrete learner) over an abstract or random learning style or field dependent learning style (Orr et al., 1999; Moss et al. , 2002; Drysdale et al., 1995; Cartmell et al.,2007; Schmidt & Javenkoski, 2000; Lehman, 2011; Lehman, 2007; Myers & Dyer, 2006; Friedel & Rudd, 2006; Pottmeyer, 2004; Harasym et al., 1995; Gould & Caswell, 2006; Graham et al., 2001; Garton et al. 1999; Torres & Cano, 1995). Although there are implications that learning styles do not impact academic performance (Drysdale et al., 1995; Lehman, 2011; Lehman, 2007; Harasym et al., 1995), modifications to teaching strategies, supplemental activities, specifically those considered active or problem based, or alternatives to the traditional lectures, may result with a positive effect academic performance when offered to the students (Moss et al., 2002; Schmidt & Javenkoski, 2000; Cartmell et al., 2007; Friedel & Rudd, 2006; Garton et al., 1999). Academic performance may also improve positively as a result of a specific instructor teaching a specific course (Garton et al., 1999).

Recommendations

If distribution of learning styles is similar between students enrolled both vocational and undergraduate academic programs and if dominant learning style doesn't appear to have a significant effect on academic performance; how can determination of learning style be helpful to the student or instructor?

Although there are similarities among students, there are also differences. Instructors and students should recognize that the way each person processes information varies.

Understanding of the concept of learning styles or that they merely exist may provide an opportunity to provide a more favorable learning environment for all students. Opportunities may include supplemental or alternative activities; or hands on activities especially for the concrete sequential often seen agriculture and life sciences programs. Student opportunities may include simply modifications in the way they study or the environments that are more favorable to their specific learning style.

Although students may be grouped based on academic program, each student is an individual and one size fits all is a misnomer. If an instructor can acknowledge that students are individuals and that each class may have a different dynamic based on the heterogeneity of the students alone, instructors may reach more students and succeed in the overall goal, education.

Recommendations for Future Research

Recommendations for future research may include:

1. Comparison of learning styles, grade distribution and instructor / course evaluations for courses offered in college agriculture and life science programs.
2. Comparison of learning styles and grade distribution in introductory courses and higher level courses within the same curricula.
2. Determination of what motivates college students such as grades, desire to excel, goals.

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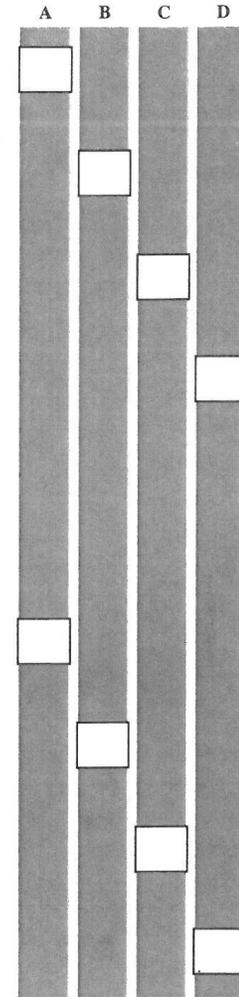
APPENDICES

APENDIX A

Word Matrix

	1	2	3	4	5
A	<input type="checkbox"/> objective	<input type="checkbox"/> perfectionist	<input type="checkbox"/> solid	<input type="checkbox"/> practical	<input type="checkbox"/> careful with detail
B	<input type="checkbox"/> evaluate	<input type="checkbox"/> research	<input type="checkbox"/> quality	<input type="checkbox"/> rational	<input type="checkbox"/> ideas
C	<input type="checkbox"/> sensitive	<input type="checkbox"/> colorful	<input type="checkbox"/> non judgmental	<input type="checkbox"/> lively	<input type="checkbox"/> aware
D	<input type="checkbox"/> intuitive	<input type="checkbox"/> risk-taker	<input type="checkbox"/> insightful	<input type="checkbox"/> perceptive	<input type="checkbox"/> creative

	6	7	8	9	10
A	<input type="checkbox"/> thorough	<input type="checkbox"/> realistic	<input type="checkbox"/> ordered	<input type="checkbox"/> persistent	<input type="checkbox"/> product oriented
B	<input type="checkbox"/> logical	<input type="checkbox"/> referential	<input type="checkbox"/> proof	<input type="checkbox"/> analytical	<input type="checkbox"/> judge
C	<input type="checkbox"/> spontaneous	<input type="checkbox"/> empathy	<input type="checkbox"/> attuned	<input type="checkbox"/> aesthetic	<input type="checkbox"/> person oriented
D	<input type="checkbox"/> trouble shooter	<input type="checkbox"/> innovative	<input type="checkbox"/> multi- solutions	<input type="checkbox"/> experimenting	<input type="checkbox"/> practical dreamer



Total of
Above

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CS	AS	AR	CR

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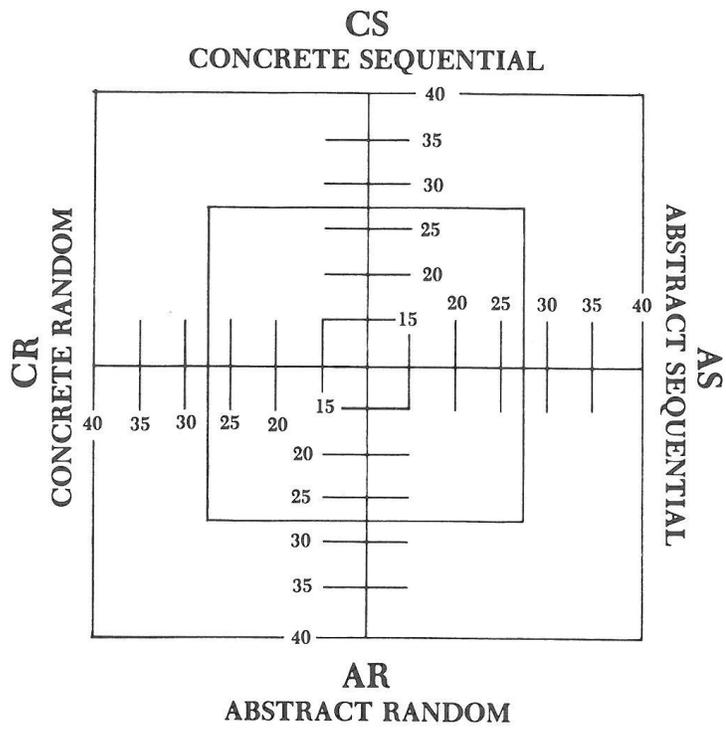
APPENDIX B

Supplemental Vocabulary List

	1	2	3	4	5
A	Objective (impartial)	Perfectionist (purist)	Solid (stable)	Practical (sensible)	Careful with detail (organized)
B	Evaluate (assess)	Research (investigate)	Quality (value)	Rational (logical)	Ideas (thoughts)
C	Sensitive (insightful)	Colorful (lively)	Non-judgmental (not critical)	Lively (energetic)	Aware (attentive)
D	Intuitive (perceptive)	Risk-taker (chance)	Insightful (understanding)	Perceptive (aware)	Creative (imaginative)
	6	7	8	9	10
A	Thorough (detailed)	Realistic (practical)	Ordered (structured)	Persistent (determined)	Product oriented (technology)
B	Logical (rational)	Referential (referring to)	Proof (evidence)	Analytical (investigative)	Judge (authority)
C	Spontaneous (impulsive)	Empathy (understanding)	Attuned (adjusted)	Aesthetic (artistic)	Person oriented (friendly)
D	Trouble shooter (problem solver)	Innovative (inventive)	Multi-solutions (options)	Experimenting (research)	Practical dreamer (creative)

APPENDIX C

STYLE PROFILE



APPENDIX D

Style Comparisons

The following brief synopses are condensed from the Mind Styles™ research of Anthony F. Gregorc. Dominant Characteristics from fifteen of forty frames of reference are listed for each of the four mediation channels.

Frames of Reference	CS Concrete Sequential	AS Abstract Sequential	AR Abstract Random	CR Concrete Random
KEY WORDS	Practical	Probable	Potential	Possible
WORLD OF REALITY	Concrete world of the physical senses	Abstract world of the intellect; vicarious	Abstract world of feelings and emotions	Concrete world of activity viewed through insight
ORDERING ABILITY	Step-by-step linear progression	Two-dimensional and tree-like	Web-like and multi-dimensional	3-D patterns and links
VIEW OF TIME	Discrete units of past, present, future	The present, historical past and projected future	The moment: time is artificial and restrictive	Now: sum of past, present and seed of future
THINKING PROCESSES	Instinctive, methodical, deliberate	Intellectual, logical, analytical, correlative	Emotional, psychic, perceptive, holistic	Intuitive, cutting-edge, impulsive independent
VALIDATION PROCESS	Personal proof via the senses, tradition, experts	Personal intellectual formulae, accredited experts	Inner guidance system	Practical demonstration, personal criteria
FOCUS OF ATTENTION	Material reality, physical objects, practicality	Knowledge, facts, documentation, concepts, ideas	Emotional attachments, relations, caring, memories	Ideals; unique applications, methods & products
CREATIVITY	Products, prototype, refinement, duplication	Synthesis, theories, models, matrices	Imagination, the arts, refinement, relationships	Charisma, originality, inventive, futuristic, change
ENVIRONMENTAL PREFERENCE	Neat, clean, quiet, practical, orderly, stable, controlled	Intellectually stimulating, ordered, quiet	Emotional, rich, active, open, colorful	Stimulus-rich, busy, competitive, unrestricted
USE OF LANGUAGE	Literal meaning and labels, succinct, logical	Polysyllabic words, precise, highly verbal	Metaphoric, vibrant; body language	Informative, bold, lively, colorful, creates words
PRIMARY EVALUATIVE WORD(S)	Good, Not Bad	Excellent	Super, Fantastic	Great, Superior
DISLIKES	Rare Compliments	Few compliments	Many compliments	Some compliments
STRONG DISLIKES	Theories, mixed signals, broken promises, clutter, loss-of-face	Close relationships, emotionality, practicality, opinions, being questioned	Repressing feelings, criticism, dogmatists, lies, restriction, rumors	Incompetence, not being #1, political correctness, repetition, <i>status quo</i>
FEARS	Liars, unearned privileges, rule breakers, being unable to forget	“Lesser” minds, competition, responsibility, being disregarded	Sneaky people, mockery, rudeness, cruelty, being fooled and put-down	“Elitists” and “drones”, treason, cowards, being wrongly accused
NEGATIVE CHARACTERISTICS	Unknowns, chaos, uncertainty, loss of security, being wrong	Commitment, reality checks and consequences, being exposed and disgraced	Possession, rejection, abandonment, being unloved and abused	Confinement, accountability, boredom, being ignored & demonized
	Domineering, petty, opinionated, unfeeling, gloomy, stubborn, cold, control freak, coarse, ruthless	Conceited, aloof, arrogant, sarcastic, character assassins, hypocrites, blamers, reality avoiders, condescending	Spacey, wishy-washy, irresponsible, indiscriminate, lazy, revengeful, controls through guilt, overbearing	Deceitful, ego-centric, manipulator, neglectful, reckless, childish, opportunist, unscrupulous, user, misleads, narcissistic

*Sources: Anthony F. Gregorc, *An Adult's Guide to Style*, Extenda-charts, and Diane F. Gregorc, *Relating with Style*.

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