LEARNING STYLES AND MULTIPLE INTELLIGENCES IN ANIMAL SCIENCE: COLLEGE INSTRUCTORS AND THEIR STUDENTS

BY

CRYSTAL A. ALLEN

DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Animal Sciences
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2015

Urbana, Illinois

Doctoral Committee:

Professor Walter L. Hurley, Chair
Professor Romana A. Nowak
Assistant Professor Daniel W. Shike
Assistant Professor David M. Rosch

ABSTRACT

There is a disconnection between how college students are taught and what the research has shown to be the most effective teaching methods. A majority of college instructors currently teach primarily using lectures, PowerPoint presentations and written or online tests to assess knowledge. It is not known why these methods are still so prominent in college classrooms since they have repeatedly been found have inadequate effects on learning. The purpose of our study was to characterize the Learning Styles (LS) and Multiple Intelligences (MI) of both the instructors and students and to determine the similarities and differences between those. Using online assessments data was collected from 20 instructors who taught animal science courses and 448 students enrolled in those courses. Our working hypothesis was that there would be differences of the LS and MI between instructors and students. In addition, we hypothesized the instructors were not familiar with LS/MI, were not conscious of their own LS/MI and most likely taught in a manner that accommodated their own LS/MI without being aware of the LS/MI of their students. Results from the Index of Learning Styles (ILS) indicated that the LS preferences of the instructors and students were generally more closely aligned than predicted by our original hypothesis. A statistically significant difference was shown in the sensing/intuitive dimension and the sequential/global dimension of LS. Multiple intelligences of the instructors and students were profiled by the Multiple Intelligences Developmental Assessment Scales (MIDAS) and were generally more closely aligned than predicted by our original hypothesis. Both instructors and students were ranked in the high category for the naturalist MI scale. In addition, it was discovered that the instructors were not familiar with LS or MI and determined that most of the instructors had the desire to alter their courses to address

LS/MI of their students. Based on these findings, instructors and students possessed a spectrum of the LS preferences as well as exhibited a wide range of scores on the MI scales. The best instructional plan would include teaching methods and pedagogy that address all LS and MI within each course, allowing for students to use their strong capacities as well as strengthen their weaker ones.

ACKNOWLEDGEMENTS

I would like to personally thank the following people who have had a huge impact upon my life in the animal science world. I first want to thank my high school biology teacher, James E. Farney, for instilling in me the love of science. I am thankful for good instructors, Dr. Paul Curtis and Kyle Wittler at Parkland College in the beginning of my animal science career. I am grateful for my Animal Science professor and advisor at Illinois State University, Dr. Paul M. Walker, who believed in me, was tough on me, included me in beef cattle research projects, and was the first person to encourage me to teach. Dr. Joe G. Harper was my professor and advisor in Agricultural Education at the University of Illinois and he actually encouraged me to teach. I most appreciate my current professor/advisor in Animal Sciences at the University of Illinois, Dr. Walter L. Hurley, who took a chance on me and allowed me to work along side him. He has been a great inspiration as an animal scientist as well as an educator. I want to thank my other committee members, Dr. Romana A. Nowak, Dr. Daniel Shike and Dr. David M. Rosch. I also want to acknowledge Dr. Mathew B. Wheeler and Mr. Richard Cobb for their assistance during my time at the University of Illinois. A special thanks goes to my friend and mentor, Dr. Philip Dziuk, who always encouraged me with words of wisdom.

I can't forget all of my friends and colleagues who helped me through each step and taught me so much about life as well as animal science. Dr. Daniel Graugnard, Dr. M. Jawad Khan, Dr. Felipe Cardoso, Dr. Johan Osorio Estevez, Dr. Sonia J. Moisa, Elena Bichi Ruspoli Forteguerri and Arnulfo Pineda Baide have all continued on in animal sciences.

Dr. Branton Shearer has been helpful with assistance with the MIDAS questionnaire and permission to use his material in my dissertation.

And of course I am eternally grateful to my family, especially my husband, Jim, who has been so patient and put up with me for the last five years.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The most difficult challenge facing educational systems today is to design creative and effective approaches to teaching, learning, and assessment of learning that accounts for the intellectual gifts of each student (Diaz-Lefebvre & Finnegan, 1997). O'Banion (1995) advocates for a wide variety of learning options to provide broad assessment tools to measure student learning through many intelligences. His thought is that successful colleges will search for new ways to teach, learn, and assess student learning. Being aware of the wide range of learning styles and multiple intelligences of students allows instructors to vary their teaching methods to reach each individual.

Intelligence is defined by Webster's dictionary as "the ability to learn, understand, and deal with new or trying situations, skilled use of reason, ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria (tests)". Intelligence is not always viewed as a single ability but can also be thought to be separated into multiple cognitive capabilities or multiple intelligences (MI). Gardner (1983) professes "Each individual student is born with multiple intelligences, which are their own capabilities for learning." Gardner defines an intelligence as "an ability or set of abilities that allows a person to solve a problem or create a product that is valued within one or more cultural settings." He believes that everyone possess all eight multiple intelligences at varying levels and can improve upon each (Gardner, 1999). Every student also possesses learning styles with which they use to concentrate, process, and retain information (Hoover, 1998). Learning styles (LS) are characteristic cognitive, affective, and psychological behaviors that indicate an individual's perception, interaction with, and response to

a learning environment (Keefe, 1979). Learning styles are ways in which individuals prefer to approach a task or learning situation (Cassidy, 2004).

Student learning in higher education can be limited by the environment in which it occurs. In particular, student learning can be limited due to the way in which a course is taught. Many current students do not thoroughly understand what they are supposed to learn. According to research, the relationship between learning styles and teaching styles is a key factor in the success of college students (Sarasin, 2006). Education has become drill and response with few expectations for students to learn relevant material (Mims, 2003). Educational psychologists believe that for real learning to occur, the learner must be actively engaged in learning (Piaget, 1954, 1974). Education should not be thought of as a "black box" where our only interests are inputs (lectures material) and outputs (test scores). More importantly in higher education, it is essential that we be concerned with outcomes, primarily long-term knowledge gained by students. Our goals are for students to gain genuine knowledge or "learning with understanding" (Bransford, 2000) and not simply regurgitate facts and figures. Bloom (1956) established that teaching tended to be focused on facts and recall, which are the lowest levels of thinking. He believed education should focus on "mastery" of subjects, promoting higher levels of thinking, instead of merely transferring facts. Using multiple methods to convey concepts and ideas in a class reaches more students and assists in thorough and genuine understanding of a topic (Gardner, 2008). College instructors tend to teach their courses according to their own multiple intelligences and learning styles and not necessarily that of their students (Hoover, 1998). Usually instructors use a combination of methods, with which they are comfortable and often with which they were taught (Sarasin, 2006). Instructors need to be aware of differences in their students'

learning in order to teach effectively (Sarasin, 2006). Instructors should use a variety of teaching methods to reach diverse learning styles and address various capabilities of their students, so that a student can successfully learn regardless of their learning styles (Hoover, 1998).

The purpose of our study was to characterize the Learning Styles and Multiple Intelligences of both the instructors and students and to determine the similarities and differences between those. Using online assessments we were able to collect data from 20 instructors who taught animal science courses and 448 students enrolled in those courses. Our working hypothesis was that there would be differences of the LS and MI between instructors and students. In addition, we hypothesized the instructors were not familiar with LS/MI, were not conscious of their own LS/MI and most likely taught in a manner that accommodated their own LS/MI without being aware of the LS/MI of their students.

CHAPTER 2

LITERATURE REVIEW

Post secondary education began as a means to educate wealthy white men. Land Grant universities were created to train men in agriculture. For centuries, student demographics were very similar in background, lifestyles, and abilities. Over the decades the student body has drastically changed n terms of socioeconomic status, gender, race, and capabilities. College courses have been taught using didactic teaching, in teacher-centered classes, with students expected to memorize large amounts of information and regurgitate the content for exams. Didactic teaching is traditional teacher-centered using mostly lecture, note taking, memorization of facts, and assessments of knowledge by regurgitation of information. Didactic lecturing is an effective method to convey information to a large number of students, but relaying information to others does not guarantee that learning occurs (Silverthorn, 2006). Education has long used and continues to utilize didactic teaching and rote learning even though other methods have been proven to be more effective. . Long-term impacts on learning due to poor efficacy of lectures have been described (Sibley and Parmelee, 2008). The abilities and capabilities of the students were once much more uniform across the population due to several factors. It was more difficult to be accepted into college because of the higher requirements and absence of special programs. The student body was much less diverse due to unequal opportunities for minorities and lack of student aid for lower income students. Students who were accepted into colleges possessed very similar abilities and capabilities, being ones who could function well in didactic classroom settings. These students excelled in classroom environments that used lecture, note taking, memorization, and exams to assess regurgitation of content. With didactic teaching methods, the majority of learning actually occurs outside of the classroom, essentially initiated by the students

themselves. Students, who performed well in that manner and were able to essentially be self-taught, were the ones most successful in college. Those that then continued on in academia would continue the cycle and teach in the same manner, primarily using didactic teaching approaches. In the absence of specific training in teaching, professors and instructors typically will find themselves teaching in the same manner in which they were taught and in which they found most effective for their own learning. Concurrent with the changing college student population, evolving teaching methods have been utilizing more non-didactic methods and more learner-centered environments. Educators have realized that for students to actually learn material that they must be engaged, involved, and active. Studies support that the most effective college instruction is an active learning environment (Leonard, 2000). Even Aristotle realized that traditional teaching methods were not conducive to true learning, "For the things we have to learn before we can do them, we learn by doing them."

Experiential learning

Whether it is labeled active learning, experiential learning or learning by doing, the concept is the same. Research strongly supports active learning activities to enhance, improve, and possibly replace lectures in science courses (McCulley et al, 2014). Active learning is defined as "instructional activities involving students in doing things and thinking about what they are doing" (Bonwell & Eison, 1991). The constructivist theory is the basis of active learning strategies, where students are not passive recipients of knowledge but instead actively engaged at a deep conceptual level and applying the knowledge to solve real-world problems (Gilbert & Boulter, 2000). Constructivism theorizes that knowledge is actively built with learners building upon prior experiences and making their own understanding (Leonard, 2000). A number of

studies have demonstrated the impact that active learning strategies can have on learning outcome For example, active learning exercises have been shown to improve performance in a college biology course (Haak et al, 2011). Hake (1998) showed in college physics courses nationwide that the average learning gains were almost twice as high in courses using interactive engagement than in traditional courses. By using pre-tests and post-tests, performance was improved by 33% in a large upper level biology course when substituting more engaging activities for lectures (Knight & Wood, 2005). Student scores in a Harvard University physics course drastically improved when integrating the use of clicker questions (Watkins & Mazur, 2013).

Genuine Learning

Genuine or authentic learning generally centers on real-world issues and problem solving to attain the solutions. Higher education has historically focused on instilling and assessing lower level cognitive skills such as memorization, understanding and application. The focus more importantly should be on higher level cognitive skills including analysis, evaluation and creativity (Lombardi, 2007). The interaction among teaching styles, learning styles and the learning environment is essential for the learning process (Anderson, 1995). Authentic learning is a pedagogical approach that allows students to explore, discuss, realistically construct concepts and make connections using real-world issues and projects that are relevant to the learner (Donovan et al, 1999). "The true power of authentic learning is the ability to actively involve students and touch their intrinsic motivation" (Mehlinger, 1995). Authentic learning usually concentrates on real-world problems and solutions utilizing case studies, role-playing, and problem-based activities (Lombardi, 2007). Environments that are conducive to authentic

learning help foster transferable skills that are often difficult for learners to acquire on their own, skills such as determining reliable information, following long discussions, ability to recognize relevant patterns, and capability to work across disciplines to create innovative solutions (Jenkins et al, 2007). Authentic learning is typically interdisciplinary, connected to the real world and centered on authentic tasks of interest to the students. Students have the opportunity for social discourse, being engaged through exploration and inquiry, in the process of producing a product to share with others (Donovan et al, 1999).

Didactic Teaching Methods

Didactic teaching or traditional pedagogy is teacher-centered, when the teacher assumes the duty of communicating knowledge to the students and typically involves lecture as the main form of communication in the classroom. The teacher is seen as the dominant authority figure that states the lesson objectives and structures the learning tasks or assignments. Normally, the teacher asks students direct, recall questions and gives feedback. This is based upon a model where teachers are active and students are passive. Student is a passive learner in the traditional education system (Dewey, 1938). Even with the creation of new methods of teaching, the majority of college courses are traditionally taught with didactic methods including lectures, note taking, and textbooks (Marmah, 2014). College instructors are trained in their specific fields and have little or no background with pedagogical research (Sarasin, 2006). Instructors typically teach in the manner in which they learned or with the methods with which they are most comfortable. Studies show poor effectiveness of lectures for the purpose of genuine learning (Blighe, 2000). A traditional didactic, instructor-centered model using lectures and textbooks has attracted negative attention recently in the educational population (Sibley & Parmelee, 2008). There are multiple

research studies concerning the poor effectiveness of lectures, resulting in inadequate short-term and long-term effects on learning (Bligh, 2000; Freire, 2000; McKeachie, 1986).

A study by Griggs et al (2009) hypothesized that most students do not possess MI that are most receptive to lecture, which is how the majority of college courses are taught. They were trying to determine if the teaching methodology used by college instructors were aligned with the MI strengths of their students. They were questioning if instructors knew the strengths of their students and if the students knew their strengths and could implement strategies to enhance their own learning. The students surveyed possessed three MI strengths: Interpersonal, intrapersonal and kinesthetic whereas the lecturers strongly possessed linguistic MI. The study demonstrated that the MI of the students was not aligned with the typical teaching method of lecturing.

Many college courses still heavily rely upon the traditional teaching methods, including lectures and note taking, which are focused primarily on the linguistic/verbal intelligences (Griggs et al, 2009). Most students do not possess high levels of MI involving verbal/linguistic or logical/mathematical, capabilities that are predominantly involved with lecture and textbook learning (Griggs et al, 2009). It is still important for students to do traditional tasks such as listening to lectures, writing notes, doing research papers, and reading textbooks, but varying teaching methods in a course reaches more students and encourages genuine learning. Including a variety of teaching methods such as lecturing, discussion, videos, and using charts/graphs is effective because it addresses the different LS and engages the MI of students. Since most students learn in various ways, then information should be presented in a variety of methods (Minz, 2000).

Non-Didactic Teaching Methods

A non-didactic course is one in which the teaching methods used involve demonstration, laboratory study, and more active methods of teaching rather than lecture and textbook instruction. Effective instructors use a variety of teaching methods to reach diverse MI and LS to address various capabilities of their students. This allows any student to excel when taught in a manner that is responsive to his/her pattern of abilities. "This means teachers vary teaching styles and methods to encourage students to analyze, evaluate, compare/contrast, judge, critique and other times to create, invent, discover, imagine, suppose, apply, implement." (Sternberg, 2003) Utilizing a variety of teaching methods in a college course makes it more interesting for the students as well as more applicable and understandable to a wider range of students (Hoover, 1998). Since the students are not actively involved, it is difficult to keep their attention with lectures and passive listening seldom promotes learning (White & Manfred, 2011). By utilizing various teaching methods such as discussion, debates, case studies, demonstrations, student presentations, peer teaching, and small group activities the students are actively engaged and will retain more knowledge as well as make meaningful connections.

Learner Centered Pedagogy

Student-centered or learner-centered pedagogy is often called progressive and is based on the constructivist theory that learners construct their own understanding through experiences. This type of education originated from constructivist developmental theory (Kolb, 1984; Piaget, 1948). Piaget's constructivist theory recognizes that the ability to reason and understand develops as a person matures into adulthood (Piaget, 1970). Children were described as "concrete thinkers" requiring them to see, touch or hear to enable them to understand. By adulthood, an individual are

thought to be “formal thinkers” who are able to process and understand without direct experiences. The mental development from concrete to formal thinking is gradual and individualized, so not all college students are necessarily “formal thinkers”. Student-centered education is based upon the active student, where the teacher is not the sole source of knowledge in the classroom. Instructors are viewed as facilitators and ask more divergent, inferential questions so that the students are not just regurgitating information (Mascolo, 2009). Students are given neutral feedback and are encouraged to produce multiple solutions. Meaningful learning is directly connected to experiential learning. Labs, fieldtrips, fieldwork, group activities provide students to process, interpret, and internalize concepts as they experience (Leonard, 2000). It is important to help students acquire life long learning and problem-solving skills by allowing them to investigate and be in control of their own learning.

Learning Styles

A Learning Style (LS) is a preference or predisposition of an individual to perceive and process information in a particular way or combination of ways. Sometimes called cognitive learning styles, LS are individual differences in processing information and the fashion in which individuals approach learning and problem solving. LS are concerned with the process rather than the content of learning, including how one perceives, learns, solves problems, and relates to others. Though they are not unchangeable, LS have been shown to be stable and consistent over time (Witkin, 1962). Evidence suggests that the interaction between teaching styles and learning styles in the classroom environment is primary to the structure and process of learning (Anderson, 1995). O’Neil (1990) notes that teaching in terms of individual learning styles

emphasizes the positive. Understanding a student's LS focuses on the student's strengths not weaknesses.

There are many multidimensional models of learning styles using a variety of terms and definitions but essentially the same concept. The Myers-Briggs Type Indicator (MBTI) factors n personality and consists of four scales with two dimensions each: extraversion/introversion, sensation/intuition, thinking/feeling, and judging/ perceiving (Myers & Briggs, 1967).

The Gregorc Style Delineater describes four behaviors: abstract, concrete, random and sequential (Gregorc, 1982). Four LS are identified: concrete sequential, concrete random, abstract sequential, and abstract random. A survey was administered to one hundred seventy-three students in an introductory biology course at Longwood University in Virginia. The study was designed to demonstrate a relationship between the Gregorc LS of the students and their preference of teaching methods. Students with concrete sequential LS showed a significantly higher preference for structured lectures, use of workbooks/lab manuals and projects with specific instructions. Those with active LS preferred organized lectures, visual aids and multiple choice test questions. There was a high correlation between the highest overall grades earned and students who preferred working alone (Lehman, 2011).

The Felder-Silverman LS model categorizes an individual's learning style by answering four questions: what type of information does the individual preferentially perceive (sensing or intuitive); what type of sensory information is most effectively perceived (visual or verbal); how does the individual prefer to process information (active or reflective); and how does the

individual characteristically progress toward understanding (sequential or global). Individuals with a sensing style would prefer sight, sounds, or physical sensations, whereas one with intuitive style prefers insights, memories, and thoughts. People with visual style prefer information in charts, demonstrations, diagrams, or pictures while those with verbal style prefer spoken and written explanations. Active style learners process information through physical activity whereas the reflective style learner prefers to think quietly. A sequential style person would progress in logical steps where a global style person sees the "big picture" (Felder, 1993, Felder and Silverman, 1988). Studies have shown that LS of most engineering students and their professors do not match in several dimensions (Felder and Silverman, 1988). The majority of engineering students preferred visual, sensing and active LS whereas those teaching engineering preferred verbal, intuitive and sequential LS. The mismatching of LS and teaching styles leads to poor performance of students, frustration of the teachers and possible loss of potential talented future engineers. Another study in engineering education where conventional lecture based teaching approach was used favored intuitive, verbal, reflective and sequential learners. The study indicated that the students possessing those preferences or learning styles performed much better than those who possessed other learning styles. When additional alternative instruction was created to address the needs of all types (LS), the performance disparities decreased (Felder and Spurlin, 2005).

The purpose of identifying learning styles of students is not to label them but to modify instruction to fit their performance (Felder and Spurlin, 2005). If instruction leans too heavily toward one of the LS, mismatched students may be too uncomfortable to learn effectively, while students with LS that match the teaching style may not develop critical skills in the LS that they

possess in lower levels. Hoover and Marshall (2011) conducted a study to determine the LS of students enrolled in animal science courses at the University of Florida. Learning styles of animal science students were identified and compared with their demographics. A majority (58%) of the students preferred analytical or field independent LS. Rural students preferred global or field dependent LS whereas suburban/urban students were more likely to prefer analytical or field independent LS. There was no difference shown in LS preferences between male and female students. A difference was found between the preferred LS of the faculty (field dependent) and the students in animal science/ pre-vet med majors (field independent). Faculty should be aware of their own LS and LS of their students so they can facilitate learning for all students. The ideal teaching style is a balanced one that sometimes matches students' learning styles so their discomfort level is not too high for them to learn effectively and sometimes goes against their LS to challenge them. The most important application of learning styles is to help instructors create a balanced teaching approach that addresses the learning needs of all their students (Felder and Spurlin, 2005).

Other Studies in Learning Styles

Much research has previously been conducted on LS, but the majority primarily involved younger students, not college level students. Very few studies can be found comparing LS of students and instructors. There have been many studies concerning the LS of students but those that have evaluated gender differences seem to show conflicting results. It is difficult to draw a definitive conclusion about differences in LS between male and female students.

A study investigated the relationship between undergraduate physiology students' preferred LS, gender and course scores. Females preferred visual LS (46%), aural LS (27%), read/write LS (23%) and kinesthetic LS (4%). Males preferred visual LS (49%), aural LS (17%), read/write LS (29%) and kinesthetic LS (5%). With 901 students completing online questionnaires, the results indicated that males and females had statistically significant differences in LS preferences and there was a significant correlation between LS preferences and student scores in the course (Dobson, 2009).

Dobson (2010) studied sixty-four students (50 undergraduate, 14 graduate students) in exercise and physiology courses at the University of Florida. Learning style preferences were compared based upon gender, level of education and performance in the courses. Sensory modality preferences include visual, aural, read-write and kinesthetic (VARK) modalities. Using sensory modality preferences (SMP) assessments with four modalities, the highest number of students chose the visual modality. There was no association found between SMP and the level of education, whether they were an undergraduate or graduate student. The relationship was found between SMP and gender suggested a statistically significant trend (X^2 =17.36, p=0.09). A significant relationship was shown between SMP and students' scores in the courses. Students preferring the kinesthetic modality scored lower than any of the other modality preferences.

Forty-eight undergraduate physiology students in a capstone physiology lab at Michigan State University completed VARK questionnaires to determine if a difference of LS preferences existed between male and female students. The study found that there was a significant difference in LS preferences between male and female students where the majority of female

students preferred a single LS mode whereas only 12.5% of male students had a uni-modal preference. (Wehrwein et al, 2007). Utilizing a VARK questionnaire, Slater et al (2007) found with ninety-seven first year medical students that the majority of both male and female students preferred multiple LS modes.

A study involving undergraduate physiology students interested in health professions was conducted to find if there was a connection between individuals' LS and their chosen career paths. The majority of students interested in health professions had a preference for multi-modal LS. A higher percentage of pre-med students preferred multi-modal LS compared to pre-dental and pre-scientist. A larger number of female students preferred multi-modal compared to male students. More pre-med male students had a multi-modal preference compared to males not in pre-med. There was little difference shown in LS profiles between male and female students irrelevant of their career path. This study concluded that career choice might be important in determining if gender differences exist among students' LS preferences (Breckler et al, 2009).

Multiple Intelligences

Gardner (1983) created the Multiple Intelligence Theory (MI theory) to illustrate that individuals possess a variety of intellectual capabilities and not solely an intelligence quotient or IQ. He defines Multiple Intelligence as the "ability or set of abilities that allows a person to solve problems or create a product that is valued within one or more cultural settings," (Gardner, 1983). Gardner claims that people possess all eight of the multiple intelligences at varying degrees. Most individuals possess some at a higher degree and also tend to learn in a variety of means. Gardner states "It's not how smart you are that matters, what really counts are how you

are smart." Gardner originally (1983) described seven multiple intelligences (MI): verbal/linguistic, logical/mathematical, visual/special, bodily/kinesthetic, musical, interpersonal, and intrapersonal. Naturalistic, an eighth intelligence was added later (Gardner, 1996). Most traditional teaching utilizes verbal/linguistic and logical/mathematical intelligences. A classroom of students can represent all combinations of the multiple intelligences. When instructors know the strengths of their students they can better prepare lessons that engage and are relevant to address those strengths (Griggs et al, 2009).

Effective application of MI theory provides students with varying strengths in each MI the opportunity to demonstrate how they are smart and therefore learn for understanding. This is an opportunity to challenge, motivate, and stimulate all students to gain genuine knowledge and understanding not to just memorize and regurgitate information. Utilizing MI theory model of teaching helps instructors to be more respectful of all students by attempting to match teaching methods to the needs of the students (Hunts, 2002). Hunts (2002) of Montana State University prefers lectures, readings and problem-solving to learn but most of her students in her Health and Human Development courses reported mostly interpersonal and intrapersonal MI skills. She utilizes Gardner's MI model because it helps her appreciate her students' strengths and skills and allows her to include their MI in her teaching methods. According to Bertrand (2005), educators using MI theory have designed successful curricula that address all multiple intelligences. Teachers who have an understanding of the MI theory and use it in classrooms report more success and intellectual engagement of students who might not possess exceptionally high levels of verbal/linguistic and logical/mathematical intelligences (Bertrand, 2005). Dillon (2006) admits that applying MI theory to her college English composition course took more time, research,

effort, and creativity, but was overwhelmed by the positive results. She discovered that it was not only an effective technique to teach but also a means to create excitement in a sometimes otherwise dull required course. Students' learning potentials are multidimensional and therefore teaching methods should be also. Applying MI theory to a college English composition course took more time, effort and creativity but the positive feedback resulted in more effective teaching methods and an interesting learning environment for the students (Dillon, 2006). The more varied a college course or classroom is developed, the more MI can be engaged in learning.

Other Studies in Multiple Intelligences

Though many studies have been conducted regarding MI, there are very few comparing those of the instructors and their students. Most MI research has been concerned with younger students or a narrowly defined population of students such as within a specific college major. There is even more limited research on the MI of college instructors and college students. Available studies are summarized here.

A study by McMahon (2004) identified and evaluated instruments designed to assess MI. The Teal Inventory of Multiple Intelligences (TIMI) was given to two hundred eighty-eight fourth graders in Chicago and Evanston, Illinois. Reliability of TIMI and relationship between MI and reading achievement were being tested. The TIMI was found to have poor reliability. The study did find that students with higher logical-mathematical MI scores were more likely to have higher than grade level reading comprehension scores. There were no other MI scales predictive of students reading achievement.

Shearer (1997) showed that there was a correlation between the strongest MI of an individual and their career choice. A study by Harris and Sykes (1999) examined one hundred seventy-two undergraduate students at Indiana University The data show modest correlation between certain MI and selected career paths of college students.

University of California-Los Angeles surveyed 260,000 college freshmen and found that many students reported boredom, drudgery and disengagement in the classroom, creating a lack of interest in school. When the Multiple Intelligence Teaching Approach (MITA) model is applied it can create active learning and alleviate student passivity in college courses. More students in diverse populations can be helped by MITA for problem-solving and authentic learning situations can be created (Weber, 2000).

Instruction based on MI theory can positively affect the attitudes and achievements of students. Research showed that when MI theory was effectively applied in the classroom, the attitudes of students toward learning improved as well as their achievement levels increased Acosta, (2004). Campbell et al (1997) claim that by using instruction based on MI theory impacts the whole person, having byproducts of better attitudes, fewer behavior issues, improved self concept, increased leadership skills and development of love of learning. A modest increase of student achievement and elevated confidence and self-image resulted from use of MI activities and strategies (Eilers et al, 1998).

How Instructors Teach

The majority of college instructors teach in the same manner in which they were taught by their professors. Instructors typically teach the ways in which they learn using methods that are comfortable for them (Sarasin, 2006). Most college instructors were not trained as teachers and are not familiar with educational theories, methods, or pedagogy. Teacher-centered pedagogy involves the use of lecture as the primary communication in the classroom. In this traditional pedagogy, the teacher assumes the primary responsibility for transference of knowledge to the students. The teacher determines the content as well as the delivery, based upon the model of an active teacher and passive student (Mascolo, 2009). Students with diverse learning styles may be engaged if instructors go beyond the teaching methods that were utilized on them and discover new approaches that expand science learning for a wider range of students (Tanner & Allen, 2004).

Two questionnaires were given to dental students in a physiology course in South Africa to assess their preference of teaching styles. Students preferred active teaching and cooperative learning activities though the lecturers did not often employ such methods. The study emphasized the importance of student engagement and active involvement in the learning process. Cooperative teaching methods enhance students' abilities to use cognitive skills such as critical thinking and problem solving (Allers, 2010).

So, why do college instructors still use lecture as their main teaching method? One explanation is provided by Hestenes (1979) who suggests that professors have not thought much about it and do not care to think about it. No studies have been found that show lectures to be more effective than

other teaching methods, though there are many studies that showed lecturing to be less effective than other methods (Gibbs, 1981). Professors lecture because that is how it was done previously and is fairly easy to distribute information to the students.

What Students Need to Learn?

Employers are conveying the necessity for students who can acquire knowledge, communicate, solve problems, and work well in teams throughout their whole career (Sibley and Parmelee, 2008). It is essential to assist college students in the process of learning these skills for their future careers. Communication skills are the foundation of any career or employment. When activities are created that lead to intellectual debates and result in constructive discussion, students are assisted to reach a higher-level reasoning, encourage divergent thinking, foster creativity, and promote long-term retention (Johnson and Johnson, 1995). It is essential to impress upon students the importance of working in groups or teams, since many students as well as instructors had previous bad group experiences that may make them less interested in pursuing collaborative work in the future. Students begin to identify that "teams can give individuals insights and understandings that could never be achieved alone" (Johnson and Johnson, 2004). Hung (2004) believes that it is not possible to cover everything an undergraduate needs to know for their profession since "knowledge is constantly expanding, and we question the possibility that any course or program of studies can provide a full understanding of a content's breadth." Since it is not possible or desirable to cover everything in a subject area, should not instructors assist students in gaining problem-solving skills that will be required in their professions? Many experts in curriculum design think that instructors ought to be more concerned with depth of learning rather than the amount of material covered, meaning that "learning with understanding" must occur instead of superficial coverage of material in courses (Bransford, 2000). Haidet et al

(2004) compared outcomes from didactic lecturing to an active learning strategy and found that the same amount of complex content could be covered in the both sessions with no negative effects on short-term or long-term gain of knowledge. Instructors must also foster lifelong learning skills in college students. Critical reading and assimilation of information from various sources is important in successful careers (Ryan, 2008). Employers are demanding that their future employees possess communication skills, problem-solving skills, and the ability to acquire knowledge (Sibley & Parmelee, 2008).

Perceived Shortcomings in Higher Education

Research in education has constantly demonstrated that what is taught and what is learned can be very different (Zirbel, 2006). There seems to be a disconnection between the evidence presented in the literature and the reality of teaching at the university level. Instructors do not always teach in a manner, which enhances the gaining of genuine knowledge by the students. Often students are encouraged to memorize facts and regurgitate information for exams and actual learning of the material or concept is not promoted. Science learning is more than memorization of facts and info but rather understanding and applying science concepts and methods. As shown by studies, greater learning occurs when teaching styles match learning styles than when they are mismatched (Felder, 1993).

Instructors could be utilizing more inclusive teaching methodology and pedagogy to address the multiple intelligences and learning styles of their students. College course instruction utilizing a variety of teaching methods will engage a larger number of students and allow them more opportunities for genuine learning. Instructors should be aware of the learning styles of their

students in order to facilitate learning for all students (Hoover, 1998). When instructors know their students' strengths, relevant and engaging lessons can be prepared to make connections and align with those capabilities (Griggs et al, 2009).

Project Objectives and Hypotheses

The overall goal of this study was to determine if instructors were attentive to students' abilities and capabilities and in response taught courses in a manner to accommodate the range of LS and MI of their students. We were interested in determining if instructors were familiar with LS/MI, if they were conscious of their own LS/MI, and if they purposely planned to alter their courses to address LS/MI of their students. By acquiring the LS/MI profiles for instructors and students, comparisons and correlations could be made. The hypotheses were that the LS and MI profiles of the instructors and students were not similar, and that the instructors were not familiar with LS/MI , were not conscious of their own LS/MI and most likely taught in a manner that accommodated their own LS/MI without being aware of the LS/MI of their students. We were interested in determining if instructors were familiar with LS/MI, if they were conscious of their own LS/MI, and if they purposely planned to alter their courses to address LS/MI of their students. By acquiring the LS/MI profiles for instructors and students, comparisons and correlations could be made. We hypothesized the instructors were not familiar with LS/MI, were not conscious of their own LS/MI and most likely taught in a manner that accommodated their own LS/MI without being aware of the LS/MI of their students. Instructors were possibly not aware of the varying range of LS/MI of their students and consequently did not teach their courses with methods to address those. The instructors probably did not plan to alter their teaching methods and pedagogy to accommodate the wide variety of LS/MI possessed by their

students. Data was gathered from two online assessments administered to both instructors and students. Personal interviews were conducted, soliciting information from the instructors about their perceptions of LS/MI of their students and gathering data concerning the manner in which the courses were taught. The interviews disclosed information that helped determine if the instructors were teaching their courses in a student-centered style, addressing LS/MI of their students and if courses could have been improved by using varied teaching methods.

CHAPTER 3

MATERIALS AND METHODS

IRB

The Institutional Review Board (IRB) approved the project entitled *Learning Styles and Multiple Intelligences: College Instructors and Their Students* with protocol number 12802. It was determined that the research activities described in the application met criteria at exemption 45CFR46.101(b). Upon approval from Internal Review Board at the University of Illinois, introductory letters, explaining the research project and the online assessments, were sent electronically to all instructors of Animal Science courses at the University of Illinois. Consent forms were required prior to instructors taking the MI and LS assessments. The instructors were also asked to have each of their students participate by completing the MI and LS assessments and collecting the consent forms from the students. Consent forms were required prior to students taking the assessments. The instructors also were asked to participate in two individual interviews, one before participating in the MI and LS assessments and one after receiving the results of their students' and their own assessments.

Sampling

Subject samples were from the population of all current teaching instructors of Animal Science courses at the University of Illinois Urbana-Champaign campus during the period of August 2012 and May 2014. Approximately fifty Animal Science instructors, including academic professionals, adjunct professors, associate professors, assistant professors, professors, and emeritus professors who still teach animal science courses were contacted via email messages and were asked to complete the online assessments. Participating instructors were required to sign a consent form

prior to taking the assessments. Twenty-five instructors agreed to participate in the research project, but only 20 completed both assessments and participated in both interviews. Animal Science instructors who completed the assessments were asked to take part in two interviews for more comprehensive data. The graduate student, Crystal A. Allen, conducted the instructor interviews at a mutually designated place and time by using an interview protocol. Consent forms were required from the instructors who agreed to be interviewed.

Animal Science instructors also were approached about allowing their students to participate in the online questionnaires. Subject samples were students enrolled in courses taught by the twenty-five participating instructors teaching Animal Science courses at the University of Illinois Urbana-Champaign campus. Students who participated were required to sign a consent form stating the project requirements and research information.

Instrumentation

The two online assessments utilized by the instructors and students were: Index of Learning Styles Questionnaire (ILS) and Multiple Intelligence Developmental Assessment Scales (MIDAS). These instruments were chosen because of their tested reliability and validity.

The Index of Learning Styles (ILS) Questionnaire was an online instrument developed by Richard Felder and Barbara Soloman of North Carolina State University to assess individuals' preferences on the four dimensions of the Felder-Silverman learning style model. The ILS was a forty-four item questionnaire with forced-choice (only two choices) available online to anyone at no charge. Individuals assess their own preferences, instructors can use it for classroom

instruction, and it can also be used for research. Individuals submit their answers online and immediately receive results including a four-page explanation of the instrument results at no cost.

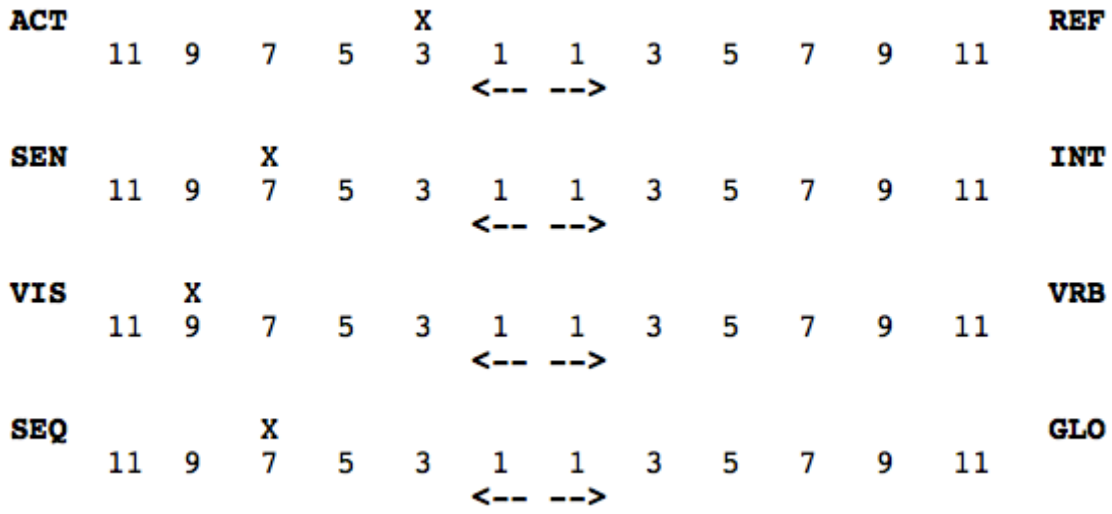
The Multiple Intelligence Developmental Assessment Scales (MIDAS) was an assessment developed to objectively measure the multiple intelligences of an individual (Shearer, 1996). The MIDAS questionnaires were a one hundred nineteen question instrument with multiple answers to choose where the individual self-reports. The MIDAS questionnaires were based on Howard Gardner's Theory of Multiple Intelligences (Gardner, *1983, 1993).* Results were automatically tabulated and responses were offered back to the individual as a profile. MIDAS provided information not available from standard aptitude tests and can be used to assist in designing of curriculum, personalization of learning, and enhancement of classroom teaching. The MIDAS questionnaires were purchased from Multiple Intelligences Research and Consulting, Inc. (1316 S. Lincoln St., Kent, Ohio 44240 U.S.).

Index of Learning Styles

The Index of Learning Styles (ILS) was an online instrument developed by Richard Felder and Barbara Soloman of North Carolina State University to assess individuals' preferences on the four dimensions of the Felder-Silverman learning style model. The four dimensions address how an individual prefers to gain information (sensing or intuitive), how they prefer to have the information presented (visual or verbal), what they prefer to do with the information (active or reflective), and how they prefer to process the information (sequential or global). The ILS was a forty-four item instrument with forced-choice (only two choices) available online to anyone at no

charge. Individuals assess their own preferences, instructors can use it for classroom instruction, and it can also be used for research. A typical ILS result page is provided in Figure 1. This individual is fairly well balanced in the active/reflective dimensions with a score of "3", has a moderate preference for both sensing and sequential dimensions scoring a "7" on both, and has a very strong preference for the visual dimension with a score of "9".

Figure 1. Individual result page from Index of Learning Styles



Reliability and Validity of Index of Learning Styles

Felder and Spurlin (2005) found that their analysis as well as other published analyses suggested that the ILS could be considered reliable, valid, and suitable as long as it was used properly. Data collected from twelve sample populations were utilized to infer the reliability and validity of the ILS. Test-retest reliability should be determined using an interval large enough so that the participant forgets their previous responses to the questionnaire but not so large that their responses might be altered due to natural occurrences. According to Seery et al (2003) a four-week interval is best. The study reported high correlations and statistical significance, concluding that the test-retest reliability is satisfactory for the ILS scores (Livesay et al, 2002 and Zywno, 2003). Internal consistency reliability means how similar are the items used for measurement or how closely correlated are the responses to the items. Using Cronbach's coefficient alpha, the values are all higher than 0.5 except for the sequential/global dimension (Van Zwanenberg and Wilkinson, 2000). Construct validity denotes if the instrument actually measured the construct for which it was intended. The construct validity of the ILS was supported by ANOVA statistics with no significant differences being shown between means of scales in various years. Zywno (2003) and Livesay et al (2002) claimed that the ILS was an appropriate instrument to assess learning styles by their conclusions from their reliability and validity data. The reliability and construct validity of the Felder-Soloman Index of Learning Styles were assessed by a research study (Litzinger et al, 2007). The objective of the study was to determine reliability of collected data and find support for validity of the instrument. Data was collected from 448 students in colleges of Education, Engineering, and Liberal Arts at Pennsylvania state University. The data from the study included internal consistency reliability between 0.55 and 0.77 across the four scales of the ILS. Evidence of the construct validity was supplied by factor analysis and student

feedback. “The ILS generates data with satisfactory internal consistency reliability and that evidence for its construct validity from both factor analysis and student feedback is strong” (Litzinger et al, 2007).

Multiple Intelligences Developmental Assessment Scales

The Multiple Intelligences Developmental Assessment Scales (MIDAS) was an assessment developed to objectively measure the multiple intelligences of an individual (Shearer, 1996). The MIDAS questionnaires were a one hundred nineteen question instrument with multiple answers to choose where the individual self-reports. The MIDAS questionnaires were based on Howard Gardner’s Theory of Multiple Intelligences (Gardner, *1983, 1993).* Results were automatically tabulated and responses were offered back to the individual as a profile. MIDAS provided information not available from standard aptitude tests and can be used to assist in designing of curriculum, personalization of learning, and enhancement of classroom teaching. The MIDAS questionnaires were purchased from Multiple Intelligences Research and Consulting, Inc. (1316 S. Lincoln St., Kent, Ohio 44240 U.S.). Six studies scrutinized the validity of the MIDAS, with results concerning content validity, construct validity, concurrent validity, and contrasted criterion groups (Shearer, 2007; www.MIResearch.org).

FIGURE 2. Individual profile from MIDAS.

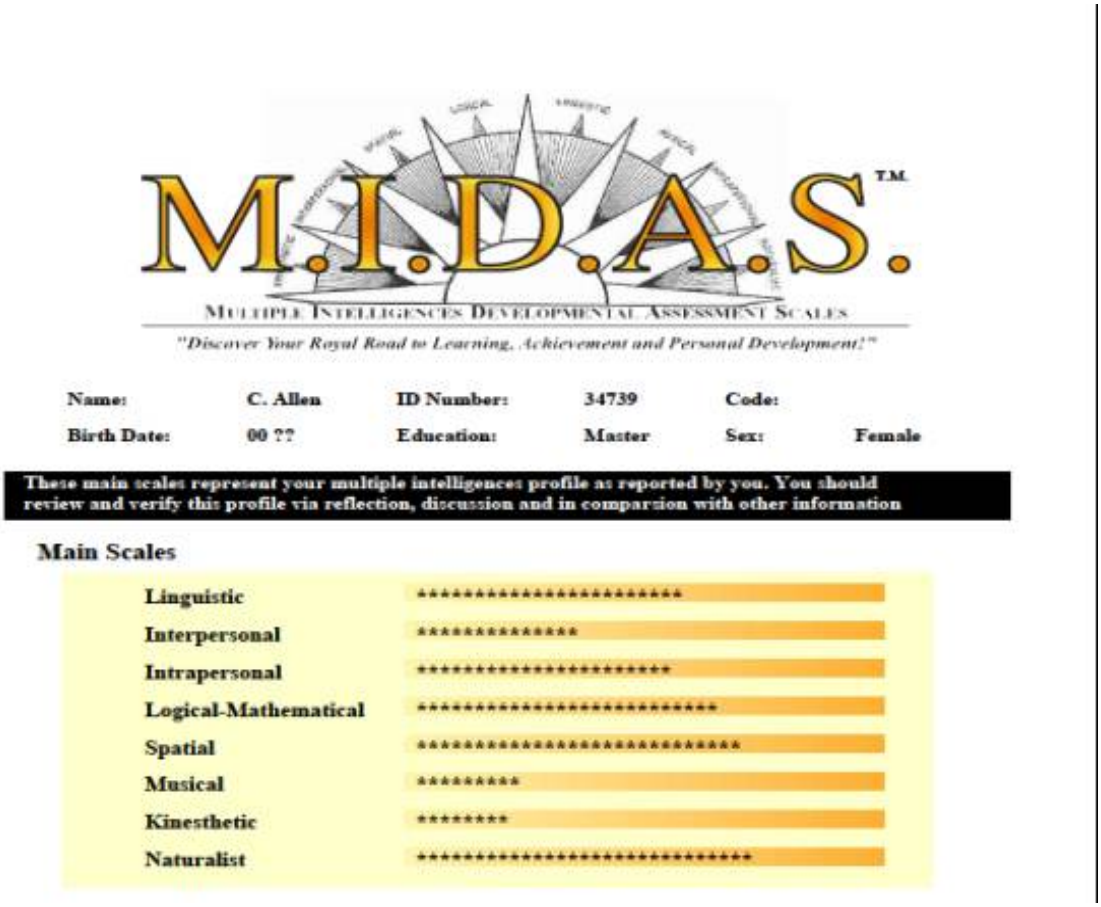


Figure 2 provides a sample result from the MIDAS assessment. This individual scored highly in naturalist, spatial, and logical-mathematical MI, moderately in linguistic and intrapersonal, and lowly in interpersonal, musical and kinesthetic.

The MIDAS was assessed for reliability and validity using standards typical for evaluation of standard tests. Reliability was tested for internal consistency, temporal stability, and inter-rater reliability. Internal consistency of items within each scale was examined by five research studies, with Alpha coefficients for the seven scales ranging from .78 to .89 for the aggregated data. Temporal stability was tested in three studies, resulting in adequate stability in the responses during second completion of the assessment. In one study, using test re-test results showed 90% of items agreed within one category. Inter-rater reliability was tested to determine the raters' reliability and construct reliability

Reliability and Validity of MIDAS

Six studies scrutinized the validity of the MIDAS, with results concerning content validity, construct validity, concurrent validity, and contrasted criterion groups (Shearer, 2007; www.MIResearch.org). The MIDAS was assessed for reliability and validity using standards typical for evaluation of standard tests. Reliability was tested for internal consistency, temporal stability, and inter-rater reliability. Internal consistency of items within each scale was examined by five research studies, with Alpha coefficients for the seven scales ranging from .78 to .89 for the aggregated data. Temporal stability was tested in three studies, resulting in adequate stability in the responses during second completion of the assessment. In one study, using test re-test

results showed 90% of items agreed within one category. Inter-rater reliability was tested to determine the raters' reliability and construct reliability

Instructor Interviews

In addition to the assessments, the instructors were solicited for individual interviews in order to gather additional data on their thoughts concerning their students' MI and LS and the correlation with their own. Initial interviews were conducted using a set of predetermined questions, attempting to gauge their demographics and teaching methodology and pedagogy. After instructors and their students completed both assessments, the final interviews were conducted, using a second set of questions. The final interview concentrated on the results of the ILS and MIDAS of both instructors and their students.

Collection of Data

Data was collected over a three-year period between the fall semester of 2012 and the spring semester of 2014, in an attempt to gather information from most of the students enrolled in Animal Science courses at the University of Illinois as well as all of the instructors. All fifty instructors in animal Sciences department were contacted and asked to participate, with twenty actually completing both the assessments and interviews. Out of the nearly five hundred students enrolled in the Animal Sciences department, 447 students completed both assessments.

Statistical Analysis

All results of the ILS were entered into Excel spreadsheets. Figures were created using Excel Descriptive Data Analysis for mean, STDEV.S for standard deviation, and Pearson coefficient

correlation for r value. SAS-Proc mixed (SD, p-val), Proc corr used for further statistical analysis.

CHAPTER 4

LEARNING STYLES OF COLLEGE INSTRUCTORS AND STUDENTS IN ANIMAL SCIENCE COURSES AT THE UNIVERSITY OF ILLINOIS

Introduction

A Learning Style is a preference or predisposition of an individual to perceive and process information in a particular way or combination of ways. Every student possesses learning styles with which they use to concentrate, process, and retain information (Hoover, 1998). Learning styles are characteristic cognitive, affective, and psychological behaviors that indicate an individual's perception, interaction with, and response to a learning environment (Keefe, 1979). Learning styles are ways in which individuals prefer to approach a task or learning situation (Cassidy, 2004). Terminology differs between various theories and models used to measure learning styles, but the same concept is implied.

Evidence suggests that the interaction between teaching styles and learning styles in the classroom environment is primary to the structure and process of learning (Anderson et al, 2000). According to research, the relationship between learning styles and teaching styles is a key factor in the success of college students (Sarasin, 2006). Instructors need to be aware of differences in their students' learning styles in order to teach effectively (Sarasin, 2006). Understanding a student's learning style focuses on the student's strengths not weaknesses. O'Neil (1990) notes that teaching in terms of individual learning styles emphasizes the positive. The purpose of identifying learning styles of students is not to label them but to modify instruction to fit their performance (Felder & Spurlin, 2005). If instruction leans too heavily

toward one of the LS, mismatched students may be too uncomfortable to learn effectively, while students with LS that match the teaching style may not develop critical skills in the LS that they possess in lower levels. The ideal teaching style is a balanced one that sometimes matches students' learning styles so their discomfort level is not too high for them to learn effectively and sometimes goes against their LS to challenge them. The most important application of learning styles is to help instructors create a balanced teaching approach that addresses the learning needs of all their students (Felder & Spurlin, 2005). Instructors should use a variety of teaching methods to reach diverse learning styles so that each student can successfully learn regardless of their learning styles (Hoover, 1998).

Objectives of Project

The hypothesis was that the LS profiles of the instructors and students were not similar. The goals were to determine the learning style profiles of the instructors, determine the learning style profiles of their students in the department of animal sciences and find how they compared. The model used in this study, Felder-Silverman Learning Styles Model, included five category levels for each pair: Active/Reflective, Sensing/Intuitive, Visual/Verbal, and Sequential/global (Felder & Silverman, 1988). The major finding was that the LS of the instructors and their students were generally aligned.

METHODS

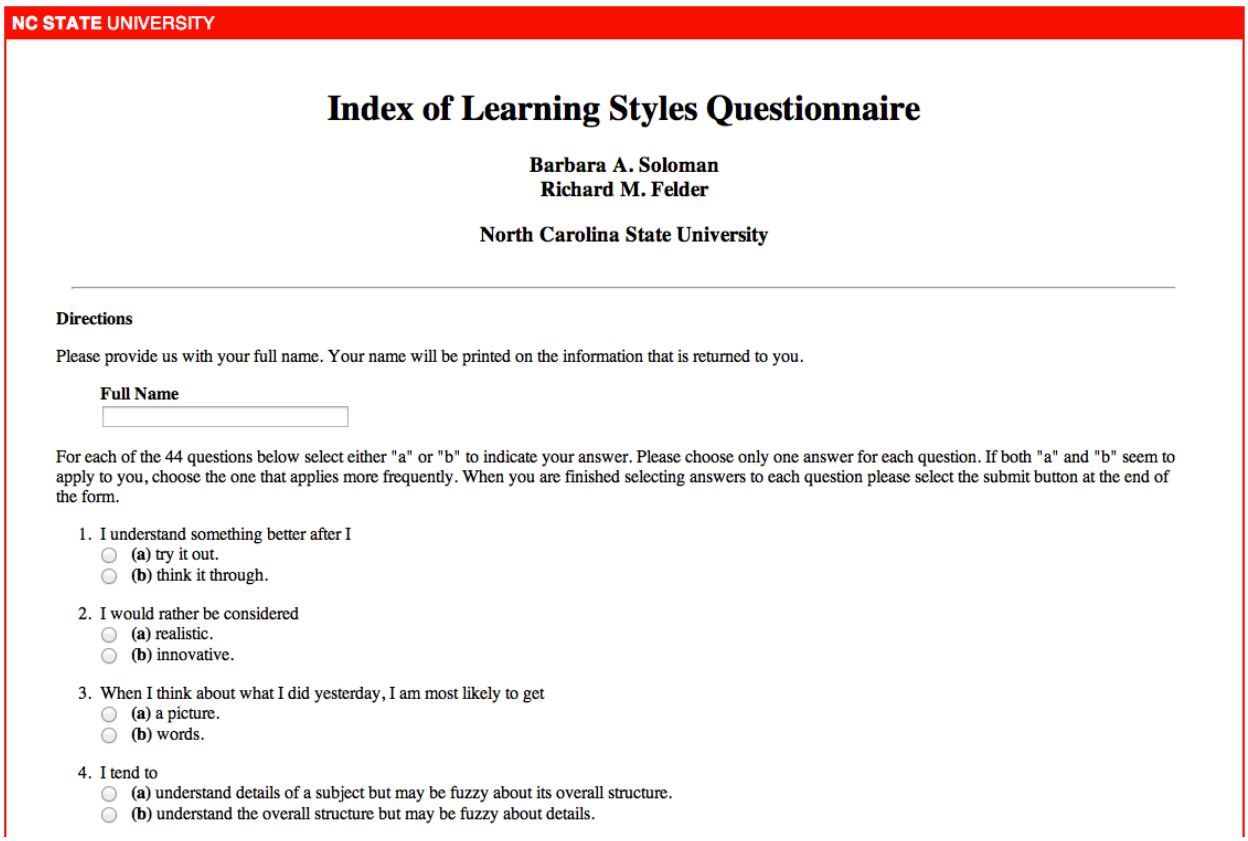
Model and Instrumentation

For this study, the Felder-Silverman model was used because the online assessment was available at no charge, easily accessible online and the instrument had been tested for reliability

and validity. The Felder-Silverman model defines an individual's learning style by answering four questions: What type of information does the individual preferentially perceive (sensing), how does the individual prefer to process information (active or reflective), how does the individual characteristically progress toward understanding (sequential or global)? Individuals with a sensing style would prefer sight, sounds, or physical sensations, whereas one with intuitive style prefers insights, memories, and thoughts. People with visual style prefer information in charts, demonstrations, diagrams, or pictures while those with verbal style prefer spoken and written explanations. Active style learners process information through physical activity whereas the reflective style learner prefers to think quietly. A sequential style person would progress in logical steps where a global style person sees the "big picture" (Felder, 1993, Felder & Silverman, 1988).

The Index of Learning Styles (ILS) Questionnaire was an online instrument developed by Richard Felder and Barbara Soloman of North Carolina State University to assess individuals' preferences on the four dimensions of the Felder-Silverman learning style model. The ILS was a forty-four item questionnaire with forced-choice (only two choices) available online to anyone at no charge (Figure 1). Individuals assess their own preferences, instructors can use it for classroom instruction, and it can also be used for research. Individuals submit their answers online and immediately receive results including a four-page explanation of the instrument results.

Figure 3. Index of Learning Styles Questionnaire (ILS)



NC STATE UNIVERSITY

Index of Learning Styles Questionnaire

Barbara A. Soloman
Richard M. Felder

North Carolina State University

Directions

Please provide us with your full name. Your name will be printed on the information that is returned to you.

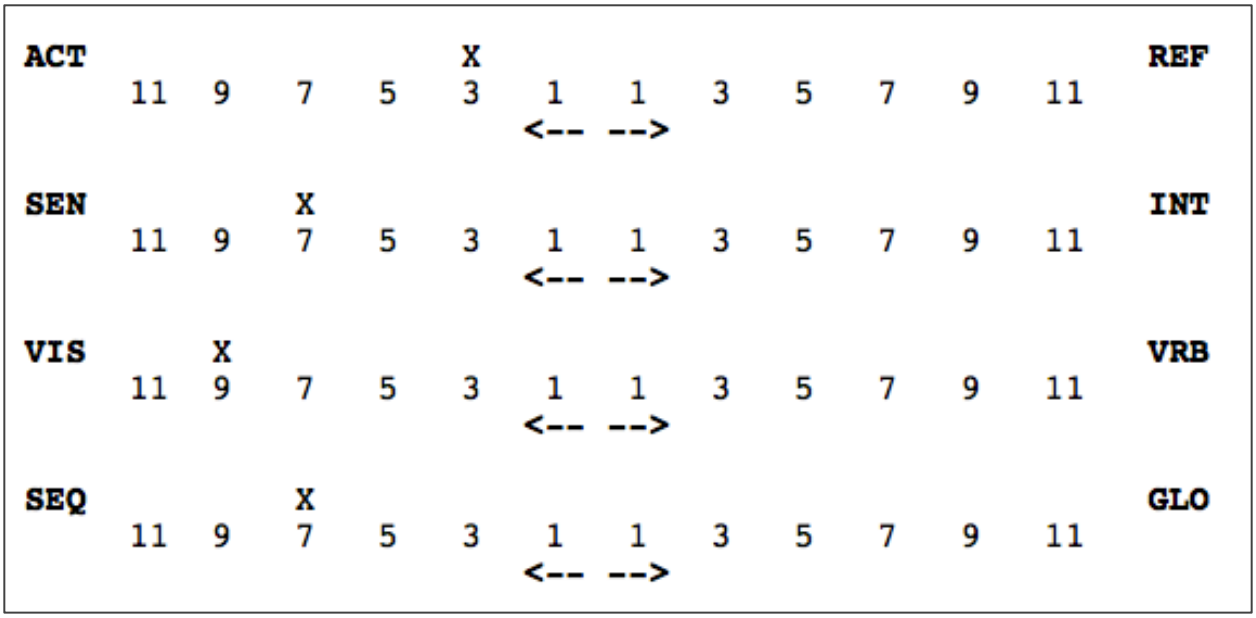
Full Name

For each of the 44 questions below select either "a" or "b" to indicate your answer. Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

1. I understand something better after I
   - **(a)** try it out.
   - **(b)** think it through.
2. I would rather be considered
   - **(a)** realistic.
   - **(b)** innovative.
3. When I think about what I did yesterday, I am most likely to get
   - **(a)** a picture.
   - **(b)** words.
4. I tend to
   - **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - **(b)** understand the overall structure but may be fuzzy about details.

A study of reliability and validity of Index of Learning Styles (ILS) was performed using data collected from Penn State students. Evidence of construct validity for the instrument was provided by analyzing the underlying construct for each factor revealing the appropriate match to the intent of the scales. “The ILS generates data with satisfactory internal consistency reliability and that evidence for its construct validity from both factor analysis and student feedback is strong” (Litzinger et al, 2007). Cronbach alpha coefficient was calculated for each of the four scales of ILS to estimate the internal consistency reliability of the scores. Felder and Spurlin (2005) found that their analysis as well as other published analyses suggested that the ILS may be considered reliable, valid, and suitable as long as it is used properly.

Figure 4. Example of Index of Learning Styles Results
A score of 1-3 indicates that the individual is fairly well balanced on the two dimensions of the scale; 5-7, the individual has a moderate preference for one dimension of the scale and will learn more easily in teaching environment which favors that dimension; and 9-11, the individual has a very strong preference for one dimension of scale and may have real difficulty learning in teaching environment which does not support that preference. The individual represented in this figure would be considered well balanced in the Active/Reflective dimension, moderate sensing in the Sensing/Intuitive dimension, strongly visual in the Visual/Verbal dimension and moderate sequential in the Sequential/Global dimension.



An example of an ILS result page is provided in Figure 1. This individual is fairly well balanced in the active/reflective dimensions with a score of "3", has a moderate preference for both sensing and sequential dimensions scoring a "7" on both, and has a very strong preference for the visual dimension with a score of "9".

Subject Sampling

Subject samples were from the population of all current teaching instructors of Animal Science courses at the University of Illinois Urbana-Champaign campus. Approximately fifty Animal Science instructors, including academic professionals, adjunct professors, associate professors, assistant professors, professors, and emeritus professors who still teach animal science courses were contacted via email messages and were asked to complete the online assessments. Participating instructors were required to sign a consent form prior to taking the assessments. Twenty-five instructors initially agreed to participate in the research project, with twenty instructors completing both assessments and participated in both interviews.

Animal Science instructors also were approached about allowing their students to participate in the online questionnaires. Subject samples were students enrolled in courses taught by the twenty-five participating instructors teaching Animal Science courses at the University of Illinois Urbana-Champaign campus. Students who participated were required to sign a consent form stating the project requirements and research information. Final data were collected from 20 instructors and 428 students.

Statistical Analysis

All results of the ILS were entered into Excel spreadsheets. Figures were created using Excel Descriptive Data Analysis STDEV.S for standard deviation and mean. Statistical significance was determined by Excel chisq.test and X^2 was calculated with the equation $X^2 = \mathbf{\Sigma}$ (observed value-expected value)^2/expected value.

RESULTS

Mean percentage of ILS results for instructors and their students were summarized for each dimension pair. Scores of 1-3 were combined to reflect the individual as fairly well balanced on the two dimensions of the scale. Scores of 5-7 were combined to reflect the individual has a moderate preference for one dimension of the scale. Scores of 9-11 were combined to reflect the individual has a very strong preference for one dimension of the scale.

Active and Reflective Dimensions

In the active/reflective learning styles dimension, the majority of both instructors (11 of 20, 55%) and students (250 of 428, 58%) were well balanced between the two dimensions. The active dimension was moderately favored by 10% of instructors (2 of 20) and by 23% of students (99 of 428). No instructors strongly favored the active dimension whereas 4% of students did (15 of 428). Twenty five percent of instructors (5 of 20) and 13% of students (55 of 428) moderately favored the reflective dimension. Some instructors (2 of 20) and 2% of students (9 out of 428) strongly favored the reflective dimension. A chi-square test of independence was performed to examine the relationship between the active/reflective LS scores of the instructors and students. The difference

between these variables was not statistically significant [X^2 (4, n=428) =9.16, p=0.0572], but could be viewed as a statistical trend and possibly could be worth further investigation.

Sensing and Intuitive Dimensions

A majority of both instructors and students preferred the sensing dimension over the intuitive dimension. Strong preferences of the sensing dimension were found for 15% of instructors (3 of 20) and 21% of students (88 of 428) as well as moderate preferences of 40% of instructors (8 of 20) and 34% of students (146 of 428). It was found that 25% (5 of 20) of instructors were well balanced between the sensing and the intuitive dimensions compared to 40% of students (173 of 428). Few instructors (3 of 20, 15%) or students (15 of 428, 4%) had moderate preference for the intuitive dimension and even fewer instructors (1 out of 20, 5%) and students (6 out of 428, 1%) had a strong preference. A chi-square test of independence was performed to examine the relationship between the sensing/intuitive LS scores of the instructors and students. The difference between these variables was statistically significant [X^2 (4, n=448) =9.49, p=0.0499].

Visual and Verbal Dimensions

The distribution of preferences of both instructors and students was skewed toward the visual dimension over the verbal dimension. The visual dimension was strongly or moderately preferred over verbal by 55% of instructors (7 of 20 or 35% were strongly and preferred, and 4 of 20 or20% were moderately preferred) and by 52% of students (81 of 428 or 19% were strongly preferred and 141 of 428 or 33% were moderately

preferred). It was found that 35% of instructors (7 of 20) and 42% of students (181 of 428) were well balanced between the visual and verbal dimensions. Only a few instructors (2 of 20, 10%) student (25 of 428, 6%) had a moderate preference for the verbal over visual dimension. No instructors or students strongly preferred the verbal dimension. A chi-square test of independence was performed to examine the relationship between the visual/verbal LS scores of the instructors and students. The difference between these variables was not significant [X^2 (4, n=428) = 4.29, p=0.2315].

Sequential and Global Dimensions

The overall distribution of instructors and students between the sequential and global dimensions was centered primarily at the well-balanced level. Thirty five percent of the instructors (7 of 20) and 55% of the students (237 of 428) expressed a well-balanced preference between the sequential and global dimensions. Twenty five percent of the instructors had a moderate preference for sequential (5 of 20), while no instructors had a strong preference for the sequential dimension. In contrast, the sequential dimension was moderately preferred by 30% of students (129of 428) and strongly preferred by 8% of the students (36 of 428). For the global dimension, the distribution of instructors indicated a moderate preference (6 of 20, 30%) or a strong preference (2 of 20, 10%). In contrast, only two students (1%) indicated a strong preference and only 6% of students had a moderate preference (24 of 428). A chi-square test of independence was performed to examine the relationship between the sequential/global LS scores of the instructors and students. The difference between these variables was shown to be highly statistically significant [X^2 (4, n=428) =39.73, p< 0.0001].

Figure 5. Comparing Percentage of Active Versus Reflective Dimensions

Learning styles of instructors and students, Students n=428, Instructors n=20

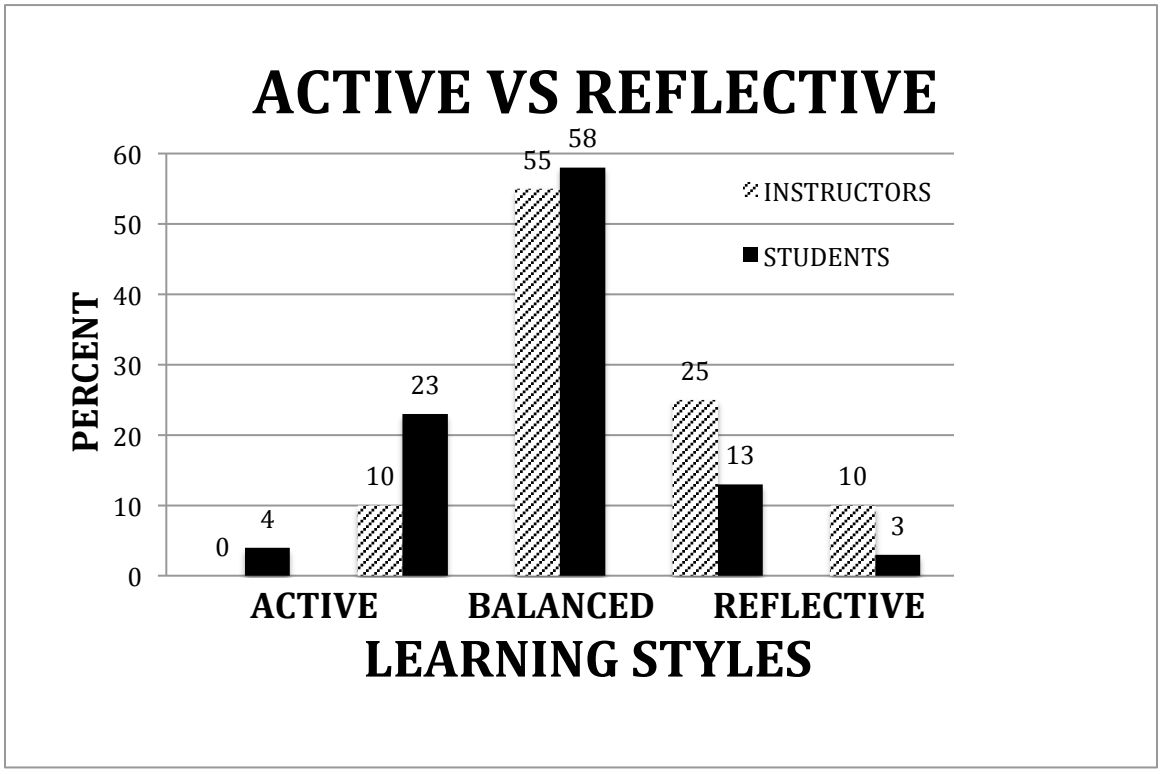


Figure 6. Comparing Percentage of Sensing Versus Intuitive Dimensions

Learning styles of instructors and students, Students n=428, Instructors n=20

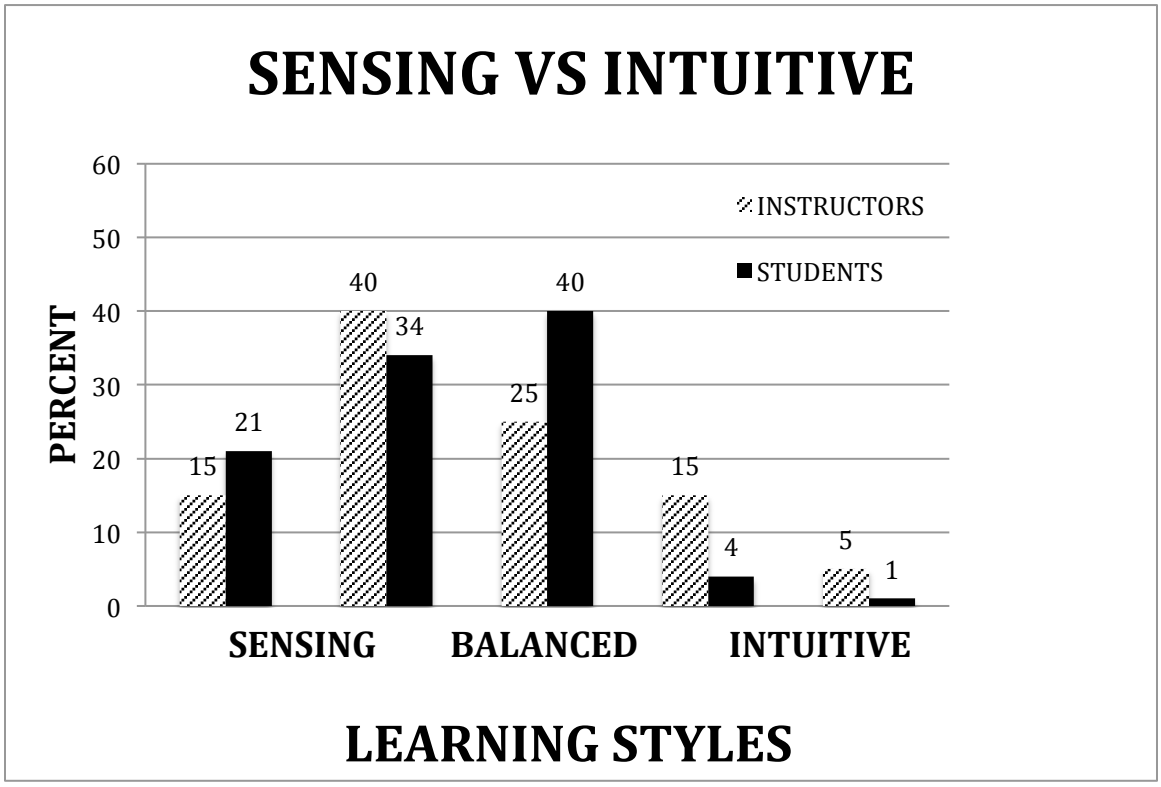


Figure 7. Comparing Percentage of Visual Versus Verbal Dimensions

Learning styles of instructors and students, Students n=428, Instructors n=20

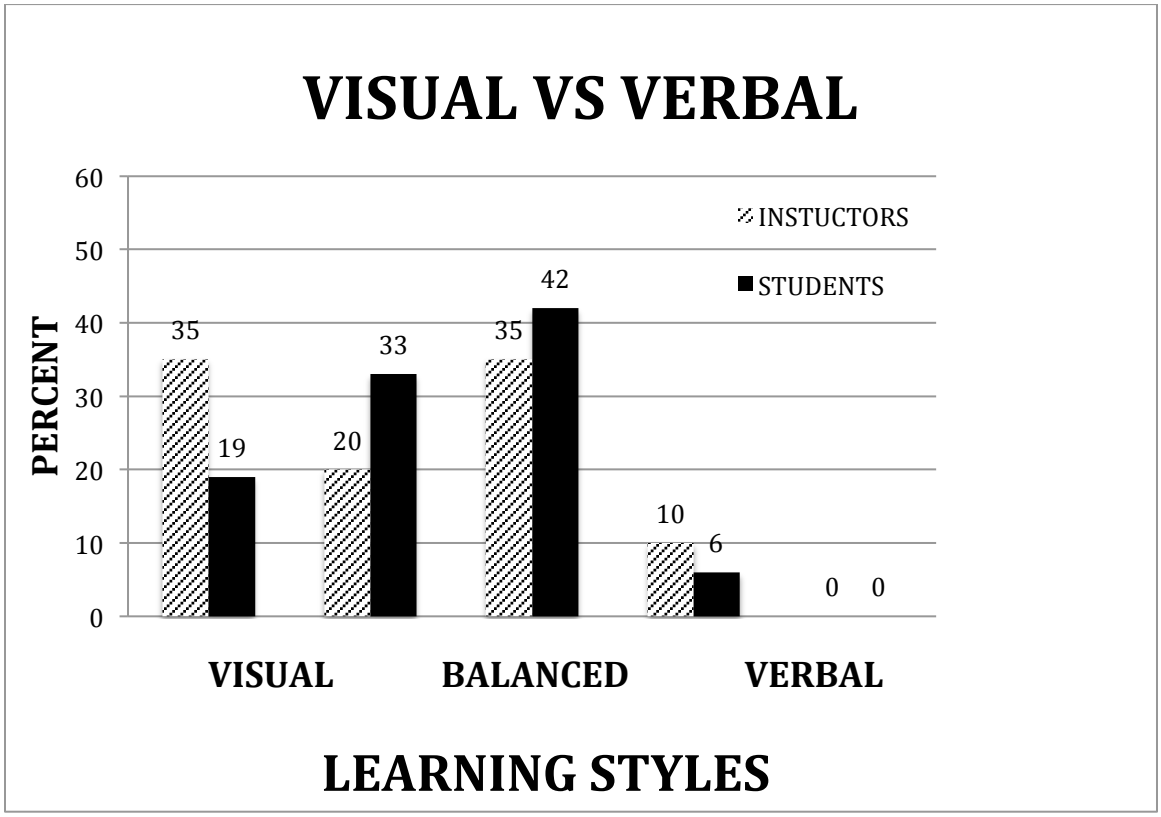
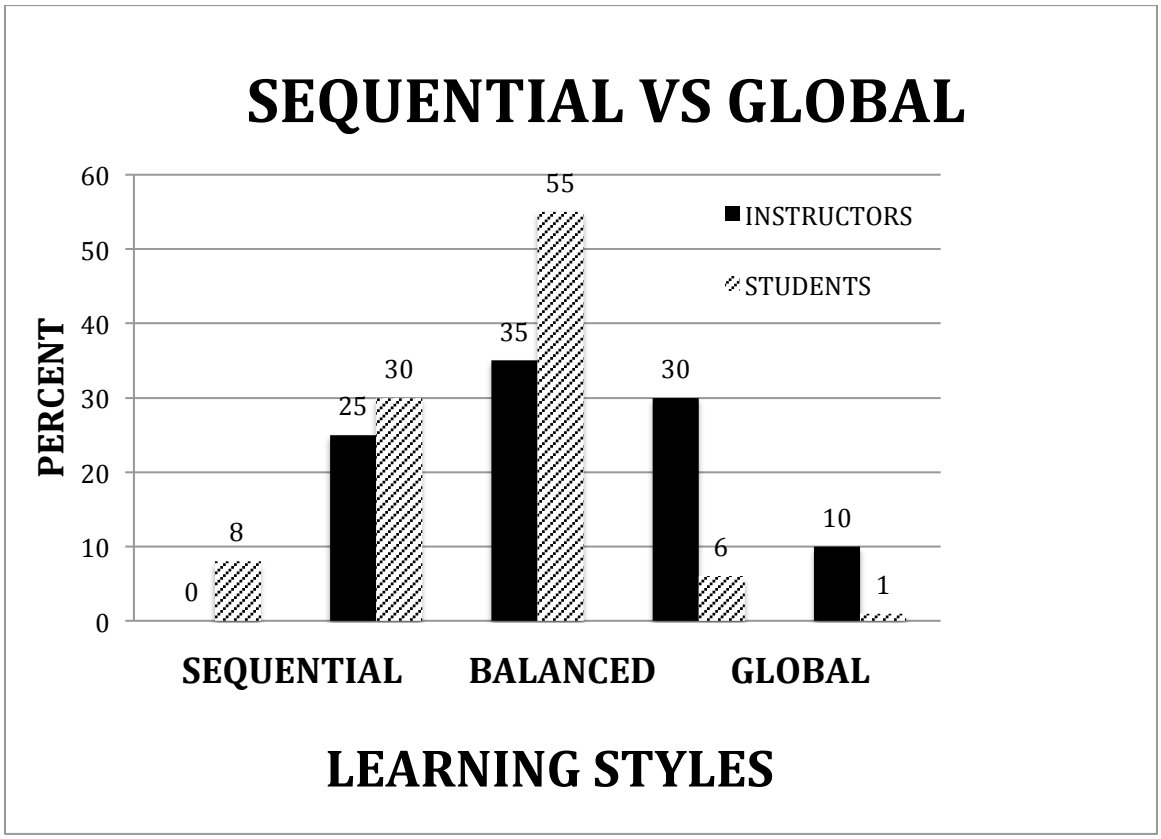


Figure 8. Comparing Percentage of Sequential Versus Global Dimensions

Learning styles of instructors and students, Students n=428, Instructors n=20



Discussion

Several differences were noted in the distributions of instructors and students across the four sets of dimensions in the ILS assessments.. While greater than 50% of both the instructors and students were well balanced in the active/reflective dimension, there were differences in the distribution of the remaining instructors and students. For example, the instructors tended to have a moderate to strong preference for the reflective dimension vs. the active dimension (35% vs. 10%, respectively), while the students tended to have a moderate to strong preference for the active dimension vs. the reflective dimension (27% vs. 15%, respectively). A higher percentage of both instructors and students preferred the sensing dimension over the intuitive dimension, although there was not a difference between those populations. Similarly, a higher percentage of both instructors and students preferred the visual dimension as opposed to the verbal dimension. Again, no difference between those populations was found. The highest percentage of both instructors and students were well balanced between the sequential and global dimensions of learning styles, however the differences in the preferences of the remaining instructors and students in those dimensions significantly impacted the comparison of the overall distributions among instructors and students. Forty percent of the instructors had a moderate or strong global preference compared with 25% having a moderate sequential preference. In contrast, only 6% of students had any global preference at all vs. 38% of students had a moderate or strong sequential preference.

Active and Reflective

Learning styles are thought to potentially change slightly in individuals according to their age, experience and level of education (Breckler et al, 2009). While the distribution of instructors and students was heavily centered on the well-balanced preference between the active and reflective dimensions, the apparent greater distribution of students toward the active dimension, compared with the distribution of instructors for the reflective dimension, may have resulted from the greater age, experience level and education level of the instructors vs. the student population. Dobson (2014) stated that varying levels of education might explain those discrepancies.

This significant difference in distribution between instructors and students across the active/reflective dimensions suggests that instructors might give more time to incorporating active learning methods. Active learning strategies are instructional activities for students to be involved and reflect upon their learning (Bonwell & Eison, 2004). Active learning has been shown to be effective in many disciplines from physiology (Michael, 2006) to engineering (Prince, 2004). Many studies support the benefits of active learning, including improved recall as well as student engagement (Prince, 2004). There is evidence that active learning, student-centered teaching methods work better than more passive approaches such as lecture (Michael, 2006). Teachers of science, technology, engineering, and mathematics (STEM) concluded that students learn best with active learning that engages students (National Academy of Sciences, 1997).

Active learning activities can be as simple as brainstorming or think-pair-sharing to more involved activities like cooperative group assignments or peer teaching. A simple handout with a few questions pertaining to the instructor's class objectives encourages students to think, discuss and attempt to correlate the material to their lives, making it relevant to them. Students develop their own conceptual abilities the focus is on meaning and not just facts.

Sensing and Intuitive

The distributions of instructors and students across the sensing/intuitive dimensions were relatively similar. Nevertheless, it is important for instructors to be cognizant of the variation of their students across these dimensions and account for that diversity of LS in their teaching. Since students with sensing preference prefer to learn by observing and gaining information through senses and those with intuitive preference prefer to learn by direct perception using speculation and imagination, instructors might use a variety of strategies to address both (Felder & Silverman, 1988). Instructors could utilize strategies that would use facts and standard experimental methods mixed with theories and principles. An example would be having a typical lab assignment and then allowing the students to create their own experiment using similar concepts.

Visual and Verbal

The distribution of both instructors and students across the visual/verbal dimensions was clearly shifted to the visual side of the spectrum in this study. Individuals with visual

preferences learn best with visual representation of material such as pictures and graphs (Felder & Silverman, 1988). The visual LS can be addressed by using charts, diagrams, flow charts, graphs, or timelines. Instructors can also use demonstrations, short video clips or animated lessons to enhance learning for students with visual LS preferences.

On the other hand it is important for college instructors to engage students in verbal-based activities to help them develop learning skills in that dimension. Students with verbal preference prefer to learn with verbal explanation, both written and oral (Felder & Silverman, 1988). Instructors can lecture and give reading assignments to enhance learning of students with verbal LS preference, but they might also assign class presentations or peer tutoring. Such students learn effectively by verbally explaining concepts to others.

Sequential and Global

A major difference between the instructors' learning styles and that of their students was that instructors generally preferred the global dimension while their students showed only a limited preference for the global dimension. The instructors may be more inclined to see the big picture and prefer or be more able to learn in large chunks, quickly integrating new knowledge into existing complex knowledge organizations (Ambrose et al, 2010). Students prefer to learn in small bits with orderly, step-by-step instructions. Students don't see the big picture until they learn it incrementally.

Conversely, the intellectual developmental stage of the students may be such that they are still assimilating new knowledge in discrete pieces with limited connections to existing knowledge. Ambrose et al (2010) attempts to explain this difference by "Expert versus Novice Knowledge Organizations," which shows connections between concepts, facts and skills possessed by individuals. The number of connections differs between instructors who are the experts and the students who are the novices. Students have not developed the ability to make connections between facts and concepts or concepts and skills, making it more difficult to retrieve information (Bradshaw & Anderson, 1982). Students tend to learn in small chunks or linearly which makes it difficult to make connections. Experts have more complex connected knowledge structures allowing for more efficient and effective use of their knowledge (Ambrose et al, 2010).

Another perspective on this observation of a difference between instructors and students on LS preferences along the sequential vs. global dimensions may lie in the concepts of cognitive-structural theories based on developmental changes. King and Kitchener's Reflective Judgment Model involves seven building stages, each with set of assumptions about knowledge and how it was gained (King & Kitchener, 1994). The seven stages are divided into three categories: Pre-reflective thinking, Quasi-reflective thinking and reflective thinking. Pre-reflective thinkers are not aware that knowledge is not absolute. Quasi-reflective thinkers realize that knowledge can be uncertain and abstract. Reflective thinkers know that knowledge id actively constructed and should be considered in relation to context. The development of reflective thinkers evolves slowly over time with age and education (King & Kitchener, 1994).

Baxter Magolda's Epistemological Reflection Model includes four reasoning patterns: Absolute knowing, transitional knowing, independent knowing and contextual knowing. Absolut knowers perceive knowledge as absolute with only one correct answer to a question or problem. Transitional knowers begin to understand that knowledge is not absolute and may have more than one correct answer. Independent knowers view knowledge ass uncertain concentrating on their own thinking. Contextual knowers are independent thinkers who integrate the knowledge of others to judge the validity of knowledge based on evidence (Pascarella & Terenzini, 2005). Students evolve from accepting all knowledge as truth and acquiring it from instructors to integrating ideas of others with their own to create their own knowledge. During this process, the students become more actively involved in their learning, have the desire to be able to express their views, and become more accepting of others' views. Instructors might enhance this progression with activities that allow students to share their ideas, collaborate with others, and be actively engaged in learning. Cooperative group projects and peer teaching would be beneficial to allow students to develop through these stages.

Instructors cannot possibly address all students at all times due to the diversity of LS in the classes. No individual completely prefers one dimension of these learning styles or another. Students may not learn well if only one teaching style is utilized. Learning styles differ and students may not learn well if only one teaching style is utilized. Instructors must incorporate varying methods into the classroom, even it they do not correspond with their own learning styles. Lectures only address those students with verbal LS preferences.

Active learning assignments that promote the use of diverse learning styles may enhance learning, student satisfaction, and retention of information (Rubin, & Hebert, 1998, Regan 2003). Ogden (2003) altered traditional lecture to engage students with differing learning style preferences and discovered that it enhanced student learning with their own strengths and allowed them to develop in other areas where they may be weaker. A teaching environment that allows for active learning as well as teaching methods and activities that provide active engagement and reflective opportunities for the students would be beneficial (McCully et al, 2013). It is pertinent for instructors to create their teaching methods to fit both their course objectives and the wide range of students' LS (National Academy of Science, 1997).

Conclusions

The learning style preferences of the instructors and students were generally more closely aligned than predicted by our original hypothesis. With many of both instructors and students having a well-balanced preference for active/reflective dimensions, utilizing varying teaching methods that address both should be used, yet more students had a preferences for the active LS. Since students prefer the visual dimension rather than the verbal dimension of LS, instructors might present information with charts, graphs, and pictures to support that specific LS. (Felder et al, 1989). Instructors will find students possessing a spectrum of the LS preferences at varying levels, so the best instructional plan would include teaching methods and pedagogy that address all LS within each course.

REFERENCES

Allers, N. (2010). Teaching physiology to dental students: Matching teaching and learning styles in a South African dental school. *Journal of Dental Education.*74(9), 986-992.

Ambrose, S.A., Bridges, M.W., Lovett, M.C., DiPietro, M. and Norman, M.K. (2010). *How learning works,* San Francisco, California, Jossey-Bass.

Anderson, J.R., Reder, R.M. and Simon, H.A. (2000). Applications and misapplications of cognitive psychology to mathematics education. *Texas Educational Review.*

Bradshaw, G.L., Anderson, J.R. (1982). Elaborative encoding as an explanation of levels of Processing. *Journal of Verbal Learning and Verbal Behavior, 21, 165-174.*

Breckler, J., Joun, D. and Ngo, H. (2009). Learning styles of psychology students interested in the health professions. *Advances in Physiology Education,* 33, 30-36.

Cassidy, S. (2004). Learning styles: An overview of theories, models, and measures. *Educational Psychology,* 21 (4), 419-444.

Dobson, J.L. (2009). Learning Style preferences and course performance in an undergraduate physiology class. *Advances in Physiology Education,* 33, 308-314.

Dobson, J.L. (2010). A comparison between ;earning style preferences and sex, status, and course performance. *Advances in Physiology Education,* 34, 197-204.

Evans, N.J., Forney, D.S., Guido, F.M., Patton, L.D. and Renn, K.A. (2010). *Student development in college: Theory, research and practice. San Francisco, California, Jossey-Bass.*

Felder, R.M. (1993). Reaching the second tier: learning and teaching styles in college science education. *Journal of College Science Teaching*, 23, 286-290.

Felder, R.M., Felder, G.N. and Dietz, E.J. (1998). A longitudinal study of engineering student performances and retention: comparisons with traditionally taught students. *Journal of Engineering Education,* 87(4), 469-480.

Felder, R.M, Leonard, R. and Porter, R.L. (1989). Oh god, not another teaching workshop. *Engineering Education, 79*(6), 622. Reprinted in *Journal of College Science Teaching, 21*(4), 207-209.

Felder, R.M. and Silverman, L.K. (1988). Learning and teaching styles in engineering education. *Journal of Engineering Education,*78(7), 674-681.

Felder, R.M. and Soloman, B.A. (2004). *Index of Learning Styles (ILS).* www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSpage.html

Felder, R.M. and Spurlin, J. (2005). Reliability and validity of the index of learning styles: A meta-analysis. *International Journal of Engineering Education,* 21(1), 103-112.

Gregorc, A.F. (1979). Learning/teaching styles: potent forces behind them. *Educational Leadership,*36, 234-236.

Haidet, P. et al. (2004). A controlled trial of active versus passive learning strategies in a Large group setting. *Advances in Health Sciences Education.* Vol 9,15-27.

Hoover, T.S. (1998). A comparison of learning styles and demographic characteristics of students enrolled in selected animal science courses. *Journal of Animal Science, 76*(12), 369-373.

Jones, C., Reichard, C. and Mokhtari, K. (2003). Are students learning styles discipline specific? *Community College Journal of Research Practices,* 27, 363-375.

King, P.M. and Kitchener, K.S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults. San Francisco, California, Jossey-Bass.*

Keefe, J.W. (1979). Learning style: An overview. *Student Learning Styles: Diagnosing and Prescribing Programs,* National Association of Secondary School Principals, Reston, VA.

Litzinger, T.A., Lee, S.H., Wise, J.C. and Felder, R.M. (2007). A psychometric study of the index of learning styles. *Journal of Engineering Education, 96*(4), 309-319.

Livesay, G.A., Dee, K.C. and Hites Jr., L.S. (2002). Engineering student learning styles: A statistical analysis using Felder's index of learning styles. Presented at the 2002 AnnualConference of the ASEE, Montreal, Quebec, June 2002.

Lujan, H.L.and DiCarlo, S.E. (2006). First-year medical students prefer multiple learning styles. *Advances in Physiology Education,* 30, 13-16.

McCully, K., Zurbick, C.M. and Ash, D.B. (2013). Innovative teaching strategies for large-enrollment science courses.

Michael, J. (2006). Where's the evidence that active learning works? *Advances in Physiology Education, 30(4), 159-167.*

National Academy of Science (1997). *Science Teaching Reconsidered: A Handbook,* National Academies Press, Washington, DC.

Nulty, D. and Barrett, M. (1996). Transitions in students learning styles. *Studies in Higher Education,* 21(3), 333-346.

Pascarella, E.T. and Terenzini, P.T. (2005). *How college affects students.* San Francisco, California, Jossey-Bass.

Prince, M. (2004). Does active learning work? A review of research *Journal of engineering Education, 93(3), 223-231.*

Sarasin, L.C. (1999). *Learning style perspectives impact in the classroom*. Madison, Wisconsin: Atwood Publishing.

Slater, J.A., Lujan, H.L., and DiCarlo, S.E. (2007). Does gender influence learning style preferences of first-year medical students? *Advances in Physiology Education,* 31, 336-342.

Soloman, B.A., and Felder, R.M. *Index of learning styles questionnaire.* Retrieved 12/22, 2011, from http://www.engr.ncsu.edu/learningstyles/ilsweb.html

Van Zwanenberg, N. and Wilkinson, L.J. (2000). Felder and Silverman's index of learning styles. And Honey and Mumford's learning style questionnaire: How do they compare and how do they predict? *Educational Psychology,* 20(3), 365-381.

Wehrwein, E.A., Lujan, H.L. and DiCarlo, S.E., (2007). Gender Differences in learning style preferences among undergraduate physiology students. *Advances in Physiology Education*, (31), 153-157.

Yates, G.C. (1999). Cognitive styles and learning strategies: understanding style differences in learning and behavior/thinking styles. *Educational Psychology,*19(1), 103-105.

Zywno, M.S. (2003). A contribution of validation of score meaning for Felder-Soloman's index of learning styles. Proceedings of the 2003 Annual ASEE Conference. Washington DC.

http://www.cirtl.net/print/book/export/html/2509 Planning a course: Teaching and learning styles: the Academic culture

CHAPTER 5

MULTIPLE INTELLIGENCES OF COLLEGE INSTRUCTORS AND STUDENTS IN ANIMAL SCIENCE COURSES AT THE UNIVERSITY OF ILLINOIS

Introduction

Intelligence was once measured by the standard intelligence theory and the intelligence quotient (IQ) test, where one numerical score represented the level of intelligence of an individual. Gardner thought the standard view of a "single, unitary, indecomposable intelligence" was incorrect hence the Theory of Multiple Intelligences (MI theory) was created (Gardner, 1983). His initial goal was not to disprove the accepted theory, but his work with gifted children and people with brain trauma led him to believe that there was more to the intelligence of individuals. A definition of an intelligence and set of criteria were developed to determine an initial seven multiple intelligences (MI; linguistic, logical mathematical, spatial, kinesthetic, musical, interpersonal and intrapersonal: Gardner, 1983) with an eighth added later (naturalist; Gardner, 1996). Gardner defined an intelligence as "a biological and psychological potential to solve problems and/or create products that are valued in one or more cultural contexts.

Gardner (1983) created the Multiple Intelligence Theory (MI theory) to illustrate that individuals possess a variety of intellectual capabilities and not solely an IQ. Gardner claims that people possess all eight of the multiple intelligences at varying degrees and no two individuals, not even identical twins possess exactly the same profile of MI. With varying degrees of the eight MI, each individual performs differently as well as learns in various manners. For example, if an individual possesses the linguistic MI at a high level, he probably

prefers to learn by reading information and listening to lectures. The individual probably enjoys reading and writing, having an aptitude toward a career involving writing or speaking. On the other hand, if an individual possesses the logical-mathematical MI at a high level, he quite likely prefers learning with calculations and mathematical functions. He presumably enjoys puzzles and problem solving and has an aptitude toward a field involving numbers and calculations. Gardner said, "It's not how smart you are that matters, what really counts is *how* you are smart." Most traditional teaching methods teach toward linguistic and logical-mathematical intelligences. A classroom of students can represent a wide array of combinations of the multiple intelligences. When instructors know the strengths of their students they can better prepare lessons and activities that engage and are relevant to address those strengths (Griggs et al, 2009). Effective application of MI theory provides students with varying strengths in each MI the opportunity to demonstrate how they are smart and therefore learn for understanding. This is an opportunity to challenge, motivate, and stimulate all students to gain genuine knowledge and understanding not to just memorize and regurgitate information. Utilizing the MI theory model of teaching helps instructors to be more respectful of all students by attempting to match teaching methods to the needs of the students (Hunts, 2002). According to Bertrand (2005), educators using MI theory have designed successful curricula that address all multiple intelligences. Teachers who have an understanding of the MI theory and use it in classrooms report greater success and intellectual engagement of students who might not possess exceptionally high levels of verbal/linguistic and logical/mathematical intelligences (Bertrand, 2005). Dillon (2006) admits that applying MI theory to her college English composition course took more time, research, effort, and creativity, but was overwhelmed by the positive results. She discovered that it was not only an effective technique to teach but also a means to create

excitement in a sometimes otherwise dull required course. The more varied a college course or classroom is developed, the more MI can be engaged in learning.

Objectives of Project

The hypothesis was that the MI profiles of the instructors and students were not similar. The goals were to determine the MI profiles of the instructors, determine the MI profiles of their students in the department of animal sciences and find how they compared. The model utilized was the theory of Multiple Intelligences composed of eight intelligences: linguistic, logical-mathematical, spatial, kinesthetic, musical, interpersonal, intrapersonal and naturalist (Gardner, 1983). The major finding was that the students and instructors alike had a very wide range of MI and both possessed the naturalist MI at the highest level.

Methods

Multiple Intelligences Developmental Assessment Scales

The Multiple Intelligences Developmental Assessment Scales (MIDAS) was an assessment developed to objectively measure the multiple intelligences of an individual (Shearer, 1996). The MIDAS questionnaires were a one hundred nineteen question instrument with multiple-choice responses to choose where the individual self-reports. The MIDAS questionnaires were based on Howard Gardner's Theory of Multiple Intelligences (Gardner, *1983, 1993).* Results were automatically tabulated and responses were provided back to the individual as a profile. MIDAS provided information not available from standard aptitude tests and can be used to assist in designing of curriculum, personalization of learning, and enhancement of classroom teaching. The MIDAS questionnaires were purchased from Multiple Intelligences Research and Consulting, Inc.

(1316 S. Lincoln St., Kent, Ohio 44240 U.S.). The main scale, one part of the MIDAS profile, represents the multiple intelligences profile of an individual. The profile should be reviewed, reflected upon, and compared to other information received. An interpretive packet is also sent to assist in interpreting the individual's MIDAS profile.

Figure 9. MIDAS Questionnaire Sample Questions

The following is copy written material not to be reproduced without permission of the author, Branton Shearer, Ph.D.

MIDAS™ Sample Questions

MUSICAL

1. As a child, did you have a strong liking for music or music classes?
A= A little.
B= Sometimes.
C= Usually.
D= Often.
E= All the time.
F= I don't know.

2. Did you ever learn to play an instrument?
A= No.
B= A little.
C= Fair.
D= Good.
E= Excellent.
F= I don't know.

3. Can you sing 'in tune'?
A= A little bit.
B= Fair.
C= Well.
D= Very well.
E= Excellent.
F= I don't know.

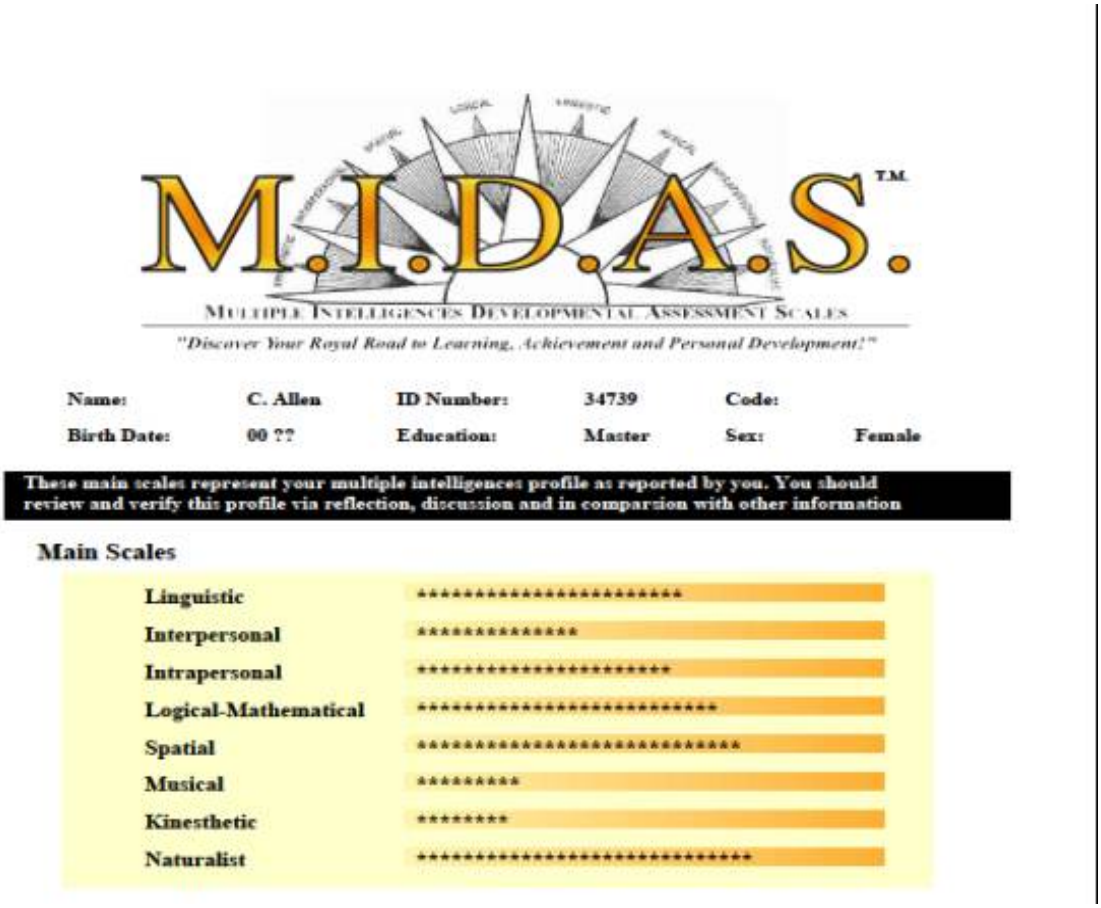
4. Do you have a good voice for singing with other people in harmony?
A= A little bit.
B= Fair.
C= Good.
D= Very good.
E= Excellent.
F= I don't know.

5. As an adult, did you ever play an instrument, play with a band or sing with a group?
A= Never.
B= Every once in a while.
C= Sometimes.
D= Often.
E= Almost all of the time.
F= I don't know. Does not apply.

6. Do you spend a lot of time listening to music?
A= Every once in a while.
B= Sometimes.
C= Often.
D= Almost all the time.
E= All the time.
F= I don't know.

Figure 10. Main Scale of a MIDAS Profile

Representing the multiple intelligences profile of an individual. The Main Scale is only one part of a three-page profile automatically generated and sent to individual electronically.



M.I.D.A.S.™

MULTIPLE INTELLIGENCES DEVELOPMENTAL ASSESSMENT SCALES

"Discover Your Royal Road to Learning, Achievement and Personal Development!"

Name:	**C. Allen**	**ID Number:**	**34739**	**Code:**	
Birth Date:	**00 ??**	**Education:**	**Master**	**Sex:**	**Female**

These main scales represent your multiple intelligences profile as reported by you. You should review and verify this profile via reflection, discussion and in comparison with other information

Main Scales

Linguistic	**********
Interpersonal	**********
Intrapersonal	**********
Logical-Mathematical	**********
Spatial	**********
Musical	**********
Kinesthetic	**********
Naturalist	**********

Reliability and Validity of Instrument

Six studies have scrutinized the validity of the MIDAS, with results concerning content validity, construct validity, concurrent validity, and contrasted criterion groups (Shearer, 2007; www.MIResearch.org). The MIDAS was assessed for reliability and validity using standards typical for evaluation of standard tests. Reliability was tested for internal consistency, temporal stability, and inter-rater reliability. Internal consistency of items within each scale was examined by five research studies, with Alpha coefficients for the seven scales ranging from .78 to .89 for the aggregated data. Temporal stability was tested in three studies, resulting in adequate stability in the responses during second completion of the assessment. In one study, using test re-test results showed 90% of items agreed within one category. Inter-rater reliability was tested to determine the raters' reliability and construct reliability

Subject Sampling

Subject samples were from the population of all current teaching instructors of Animal Science courses at the University of Illinois Urbana-Champaign campus. Data were collected over a three- year period between the fall semester of 2012 and the spring semester of 2014, in an attempt to gather information from most of the students enrolled in Animal Science courses at the University of Illinois as well as the instructors. Approximately fifty Animal Science instructors, including academic professionals, adjunct professors, associate professors, assistant professors, professors, and emeritus professors who still teach animal science courses were contacted via email messages and were asked to complete the online assessments. Twenty-five instructors initially agreed to participate in the research project, with twenty instructors completing the assessment.

Animal Science instructors also were approached about allowing their students to participate in the online questionnaires. Subject samples were students enrolled in courses taught by the twenty-five participating instructors teaching Animal Science courses at the University of Illinois Urbana-Champaign campus. Students who participated were required to sign a consent form stating the project requirements and research information. Final data were collected from 20 instructors and 448 students.

Analysis of Data

Summary of information from the MIDAS questionnaire was compiled electronically and received as a MI profile in an interpretive packet. Percentage scores for main scales and subscales were included for all eight MI for each individual. All results of the MIDAS were entered into Excel spreadsheets. Figures were created using Excel- Pearson coefficient correlation (r), STDEV.S (SD), Descriptive Data Analysis (mean).

Results

Mean scores of MIDAS scales for instructors and students were summarized for each of the eight MI. Scores of 60-100 were ranked as high, 40-60 as moderate and 0-40 as low.

Linguistic

In the linguistic MI, instructors ranked in the high category presenting a mean score of 67.65 with a standard deviation (SD) of 11.68 and a range of 54 while the students were in the moderate rank showing a mean score of 55.22 with a SD of 15.84 and a range of 81.

Interpersonal

In the interpersonal MI, instructors ranked in the high category presenting a mean score of 65.15 with a standard deviation (SD) of 15.87 and a range of 53, while the students were in the moderate rank showing a mean score of 59.37 with a SD of 14.79 and a range of 81.

Intrapersonal

In the intrapersonal MI, instructors ranked in the high category presenting a mean score of 68.75 with a standard deviation (SD) of 13.79 and a range of 54, while the students were in the moderate rank showing a mean score of 57.35 with a SD of 11.51 and a range of 67.

Logical-Mathematical

In the logical-mathematical MI, instructors ranked in the high category presenting a mean score of 67 with a standard deviation (SD) of 17.04 and a range of 67, while the students were in the moderate rank showing a mean score of 56.71 with a SD of 13.554and a range of 77.

Spatial

Both instructors and students ranked in the moderate category for the spatial MI, with instructors presenting a mean score of 56.2 with a standard deviation (SD) of 17.82 and a range of 61, and the students showing a mean score of 47.23 with a SD of 16.58 and a range of 92.

Musical

In the musical MI, instructors ranked in the low category presenting a mean score of 38.9 with a standard deviation (SD) of 21.81 and a range of 68, while the students were in the moderate rank showing a mean score of 48.72 with a SD of 19.35 and a range of 91.

Kinesthetic

Both instructors and students ranked in the moderate category for the kinesthetic MI, with instructors presenting a mean score of 41.9 with a standard deviation (SD) of 16.17 and a range of 70 and the students showing a mean score of 48.84 with a SD of 17.41 and a range of 96.

Naturalist

Both instructors and students ranked in the high category for the naturalist MI, with instructors presenting a mean score of 76.95 with a standard deviation (SD) of 10.67 and a range of 45 and the students showing a mean score of 72.35 with a SD of 13.44 and a range of 94.

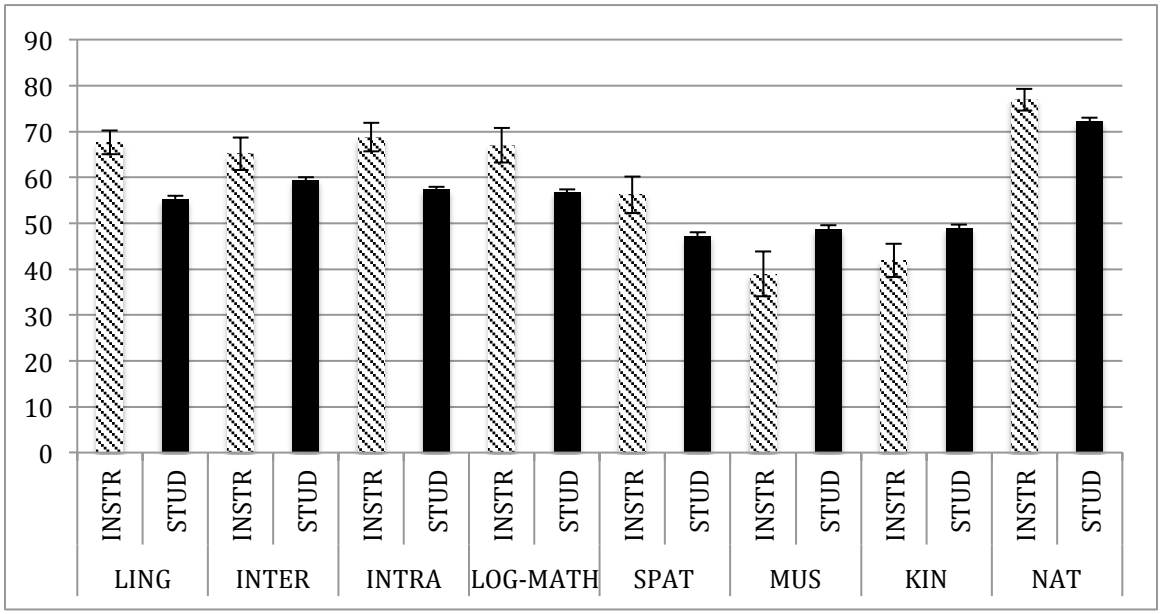
TABLE 1. Mean and SD of Multiple Intelligences of Instructors and Students.

LS	LINGUISTIC		INTERPERSONL		INTRAPERSONAL		LOGICAL-MATH	
	INSTR	STUD	INSTR	STUD	INSTR	STUD	INSTR	STUD
N	20	448	20	448	20	448	20	448
MEAN	67.65	55.22	65.15	59.37	68.75	57.35	67	56.71
MIN	37	11	40	12	37	19	24	14
MAX	91	92	93	93	91	86	91	91
RANGE	54	81	53	81	54	67	67	77
SD	11.68	15.84	15.87	14.79	13.79	11.51	17.04	13.54
SE	2.612	0.745	3.55	0.691	3.083	0.538	3.811	0.633

LS	SPATIAL		MUSICAL		KINESTHETIC		NATURALIST	
	INSTR	STUD	INSTR	STUD	INSTR	STUD	INSTR	STUD
N	20	448	20	448	20	448	20	448
MEAN	56.2	47.23	38.9	48.72	41.9	48.84	76.95	72.35
MIN	22	2	9	4	15	4	50	6
MAX	83	94	77	95	85	100	95	100
RANGE	61	92	68	91	70	96	45	94
SD	17.82	16.58	21.81	19.35	16.17	17.41	10.67	13.44
SE	3.98	0.774	4.877	0.904	3.617	0.813	2.386	0.628

Figure 11. Mean Multiple Intelligences of Instructors and Students

(+/_1 SE). Instructors n=20, students n=448)



Discussion

Overall, there was a wide range in the distribution across the eight scales of the MIDAS profiles for the 20 instructors and 448 students participating in this study. Statistically, there were no significant differences demonstrated in the interpersonal, kinesthetic and naturalist MI between the instructors and the students.

Linguistic

In the linguistic MI scale the instructors ranked in the high category while the students were in the moderate category, showing a statistical significant difference in their mean (67.65%, 55.22% respectively, $p < 0.05$). Students possessed a higher SD (15.84) than the instructors (11.68) as well as larger range (81 for students vs. 54 for instructors). Instructors naturally tend to teach with lectures and PowerPoint presentation due to their high capabilities in this MI. Individuals with linguistic MI employ several components in addition to reading, writing, and speaking. A highly linguistic individual is sensitive to sounds or phonology, can manipulate the structure or syntax of language, might appreciate the meaning or semantics of language and has the ability to use language for practical purposes (Armstrong, 1993). Individuals high in linguistic MI think in words, like to use language and are thought to be "word smart." Occupations might include writers, poets, lawyers, teachers, reporters, and journalist.

Interpersonal

Even though in the interpersonal MI scale the instructors ranked in the high category while the students were in the moderate category, their mean scores were not significantly

different statistically (65.15%, 59.37% respectively, p> 0.05). Instructors possessed a higher SD (15.87) than the students (14.79), but smaller range than (53 for instructors vs. 81 for students) than students. Those with high interpersonal MI enjoy interacting with others and do well in cooperative group activities (Armstrong, 2009). They understand other people, their feelings, are sensitive towards others and are thought to be "people smart." One might be in a career such as a clergy, counselor, nurse, or a social worker.

Intrapersonal

In the intrapersonal MI scale the instructors ranked in the high category while the students were in the moderate category, their mean scores were statistically significantly different (68.75%, 57.36% respectively, p< 0.05). Instructors possessed a higher SD (13.79) than the students (11.51), but a smaller range (54 for instructors vs. 67 for students). Having a high level of intrapersonal MI gives one an introspective view, understanding oneself and thus making good life decisions. Individuals are enabled to know their own capabilities and are able to use them correctly (Kornhaber and Gardner, 1991). These individuals have an understanding of themselves and are known as "self smart." They might be n the field of psychology, philosophy or creative writing.

Logical-mathematical

In the logical-mathematical MI scale the instructors ranked in the high category while the students were in the moderate category, with their mean scores being significantly different (67%, 56.71% respectively, p< 0.05). Instructors possessed a higher SD (17.04) than the students (13.54), but a smaller range (67 for instructors vs. 77 for students). Once

thought as limited to math and science courses, the logical-mathematical MI is utilized for critical thinking. It is important that college graduates possess the ability to critically think as well as have a base knowledge (White et al, 2012). An individual high in logical-mathematical MI employs deductive and inductive reasoning skills as well as problem-solving skills (Shearer, 1996). Logical-mathematical individuals make connections and understand relationships, using critical thinking and problem-solving skills. Those individuals may be employed as researchers, engineers, biologists or accountants and are said to be "logic smart."

Spatial

Both instructors and students were ranked in the moderate category for the spatial MI scale with mean scores of 56.2% and 47.23% respectively, the scores are not significantly different statistically($p > 0.05$). Instructors possessed a higher SD (17.82) than the students (16.58), but a smaller range (61 for instructors vs. 92 for students). The ability to perceive the visual world accurately is involved in the spatial MI (Armstrong, 1993). They think three dimensionally to see the world and often become architects, engineers, pilots, mechanics, or carpenters and are thought as "picture smart."

Musical

In the musical MI scale the instructors ranked in the low category while the students were in the moderate category, their mean scores were significantly different (38.9%, 48.72% respectively, $p > 0.05$). Instructors possessed a slightly higher SD (21.81) than the students (19.35), but a smaller range (68 for instructors vs. 91 for students). The musical MI allows

individuals to communicate, understand and create meanings from sound (Gardner et al, 1996). Musical individuals are sensitive to sounds, rhythm and tone, being "music smart." They may become composers, songwriters, singers, or music teachers.

Kinesthetic

Both instructors and students were ranked in the moderate category for the kinesthetic MI scale with mean scores of 41.9% and 48.85%, respectively with no significant difference ($p > 0.05$). Instructors possessed a lower SD (16.17) than the students (17.41), and a smaller range (70 for instructors vs. 96 for students). Kinesthetic individuals use body movements in skilled and complicated manners (Shearer, 1996). Ones who are kinesthetically inclined use their bodies skillfully and might be called "body smart." Those individuals often are athletes, dancers, choreographers, magicians or surgeons.

Naturalist

Both instructors and students were ranked in the high category for the naturalist MI scale with mean scores of 76.95% and 72.35%, respectively with no significant difference ($p > 0.05$). Instructors possessed a lower SD (10.67) than the students (13.44), but a much smaller range (45 for instructors vs. 94 for students). High naturalist MI scores were possessed by 70% (14 of 20) of the instructors and 83% (378 of 458) of the students. With subcategories of science, animals and plants, it was expected that instructors and students in the animal science department alike would score high in the naturalist MI. The MIDAS professional manual lists college majors for those scoring high in the naturalist MI, including: Biological sciences, human biology, animal behavior, zoology, oceanography and

agricultural science (Shearer, 1996). The MI scores of participants would be much higher if the subcategory of plants was omitted. Many of the participants of this study possessed a very low score in the plant subcategory and thus reduced the scores somewhat. Individuals high in the naturalist MI tend to understand plants, animals, and science in of the world. They may become biologists, farmers, scientists or veterinarians.

Conclusions

The multiple intelligences shown by the MIDAS profiles of the instructors and students showed some statistically significant differences. Instructors will find students possessing a large spectrum of scores on the MI scales, exhibiting a wide range of capabilities. Instructors should integrate instruction into their courses that encourages the students to develop weaker intelligences by drawing from their strengths (Checkley, 1997). Students can be helped by using their capacities (MI) possessed in high levels as well as strengthening ones in which they may be weak (Lazear, 1994). Students can be taught to develop MI that they possess at a low level (Torff, 1997). Gardner (1983) states that an individual can develop their MI to a reasonably high level with proper environment, encouragement and stimulation. The best instructional plan would include teaching methods and pedagogy that addresses all MI within each course, allowing for students to use their strong capacities as well as strengthen their weaker ones.

REFERENCES

Armstrong, T. (1993). *7 kinds of smart*. New York: Plume.

Armstrong, T. (2000). *Multiple intelligences in the classroom* (3rd). Alexandria, Virginia: Association for Supervision and Curriculum Development.

P. Bertrand, "Multiple Intelligences in the Physics Classroom," *AP Central*, The College Board online publication (2005).

Campbell, L., Campbell, B. and Dickinson, D. (2004). *Teaching and learning through multiple intelligences*. Boston: Pearson Education.

Checkley, K. (September 1997). The first seven...and the eighth: A conversation with Howard Gardner. *Educational Leadership*, 8-13.

Dillon, L.M. (2006). Multiple intelligences theory and the college English classroom. *Minnesota English Journal,* 42(Fall), 115-128.

Gardner, H. (1983). *Frames of mind*. New York: Basic books.

Gardner, H. (1999). *The disciplined mind*. New York: Penguin Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. New York: Basic Books.

Gardner, H. (2008). *5 minds for the future*. Boston, Massachusetts: Harvard Business Press.

Gardner, H., Kornhaber, M.L. and Wake, W.K. (1996). *Intelligence: Multiple perspectives*. Belmont, California: Thomson Wadsworth.

Griggs, L., Barney, S., Brown-Sederberg, J., Collins, E., Keith, S. and Iannacci, L. (2009). Varying pedagogy to address student multiple intelligences. *Human Architecture: Journal of The Sociology of Self-Knowledge, 2* (1), 55-60.

Gutierrez, D., Perri, K. and Quackenbush, A. (2006). Exploring the multiple intelligences of community college students enrolled in online courses. *Journal of College Teaching and Learning, 3*(11), 85-90.

Hunts, H. *Multiple intelligences in the college classroom.* (2002). Montana State University Bozeman: Teaching Learning Committee.

Kagan, S. and Kagan, M. (1998). *Multiple intelligences: The complete MI book*. San Clemente, California: Kagan Cooperative Learning.

Lazear, D. (1994) Seven pathways of learning: teaching students and parents about multiple intelligences. Tucson, AZ: Zephyr Press.

Lazear, D. (1994) Multiple intelligences approaches to assessment: solving the conundrum. Tucson, AZ: Zephyr Press.

Prashnig, B. (2005). Learning styles vs. multiple intelligences (MI): two concepts for enhancing learning and teaching www.teachingexpertise.com, *9, 8-9.*

Reichert, A. (2004). Using multiple intelligences to create better (teachers of) writers: A guide to MI theory for the composition teacher. *Teaching English in the Two-Year College,* (32.2), 166-172.

Shearer, C.B. (1997). Reliability, validity and utility of a multiple intelligences assessment for career planning. Paper presented at 105th Annual Convention of the American Psychological Association, Chicago, Illinois. August 15, 1997.

Simeone, W. (1995). Accommodating multiple intelligences in the english classroom. *The English Journal,* (84.8), 60-62.

Torff, B. (1997). *Multiple Intelligences and assessment: a collection of articles.* Arlington Heights, IL: Skylight Training and Publishing, Inc.

Weber, E. (2000). Five-phases to PBL: MITA (multiple intelligence teaching approach) model for redesigned higher education classes. In Penny Little, Tan Seng, Jane Conway, Hee Yin (Ed.), *Problem-based learning: Educational innovation across disciplines* (pp. 65-76). Singapore: Tamasek Center for Problem Based Learning.

CHAPTER 6

PERSONAL INTERVIEWS DETAILING LEARNING STYLES, MULTIPLE INTELLIGENCES AND TEACHING METHODS OF INSTRUCTORS IN ANIMAL SCIENCES

Introduction

The majority of college instructors teach in the same manner in which they were taught by their professors. Instructors typically teach the ways in which they learn using methods that are comfortable for them (Sarasin, 2006). Most college instructors were not trained as teachers and are not familiar with educational theories, methods, or pedagogy.

Student learning can be limited due to the way in which a course is taught. Many current students do not thoroughly understand what they are supposed to learn. According to research, the relationship between learning styles and teaching styles is a key factor in the success of college students (Sarasin, 2006). Education has become drill and response with few expectations for students to learn relevant material (Mims, 2003). Educational psychologists believe that for real learning to occur, the learner must be actively engaged in learning (Piaget, 1954, 1974).

So, why do college instructors still use lecture as their main teaching method? One explanation is provided by Hestenes (1979) who states that professors have not thought much about it and do not care to think about it. No studies have been found that show lectures to be more effective than other teaching methods, though there are many studies that showed lecturing to be less effective than other methods (Gibbs, 1981). Professors lecture because that is how it was done previously and is fairly easy to distribute information to the students.

Objectives of Project

We hypothesized the instructors were not conscious of their own LS and MI and most likely taught in a manner that accommodated their own LS/MI rather than purposefully addressing the LS and MI of their students. The purpose of the study was to determine if instructors were attentive to students' abilities and capabilities and in response taught courses in a manner to accommodate the range of LS/MI of their students. Our study was designed to determine if instructors were conscious of their own learning styles, cognizant of their students' learning styles, and if they purposely altered their courses to address LS and MI of their students. By acquiring the LS and MI profiles for both instructors and students, comparisons and correlations could be made. We hypothesized the instructors were not conscious of their own LS and MI and most likely taught in a manner that accommodated their own LS/MI rather than purposefully addressing the LS and MI of their students. Instructors were possibly not aware of the varying range of LS/MI of their students and consequently did not teach their courses with methods to address those. The instructors probably were not altering their teaching methods and pedagogy to accommodate the wide variety of LS/MI possessed by their students. Data was gathered from two online assessments administered to both instructors and students. Individual interviews were conducted, soliciting information from the instructors about their perceptions of LS/MI of their students and gathering data concerning the manner in which the courses were taught. The interviews disclosed information that helped determine if the instructors were teaching their courses in a student-centered style, addressing LS/MI of their students and if courses could have been improved by using varied teaching methods.

Methods

The two online assessments utilized by the instructors and students were: Index of Learning Styles Questionnaire (ILS) and Multiple Intelligence Developmental Assessment Scales (MIDAS). These instruments were chosen because of their tested reliability and validity.

Index of Learning Styles

The Index of Learning Styles (ILS) Questionnaire was an online instrument developed by Richard Felder and Barbara Soloman of North Carolina State University to assess individuals' preferences on the four dimensions of the Felder-Silverman learning style model. The ILS was a forty-four item questionnaire with forced-choice (only two choices) available online to anyone at no charge. Individuals submit their answers online and immediately receive results including a four-page explanation of the instrument results at no cost.

Multiple Intelligences Developmental Assessment Scales

The Multiple Intelligences Developmental Assessment Scales (MIDAS) was an assessment developed to objectively measure the multiple intelligences of an individual (Shearer, 1996). The MIDAS questionnaires were a one hundred nineteen question instrument with multiple answers to choose where the individual self-reports. The MIDAS questionnaires were based on Howard Gardner's Theory of Multiple Intelligences (Gardner, *1983, 1993).* Results were automatically tabulated and responses were offered back to the individual as a profile.

Instructor Interviews

In addition to the assessments, the participating instructors were solicited for individual interviews in order to gather additional data on their thoughts concerning their students' MI and

LS and the correlation with their own. Initial interviews were conducted using a set of predetermined questions, attempting to gauge their demographics and teaching methodology and pedagogy. After instructors and their students completed both assessments, the final interviews were conducted, using a second set of questions. The final interview concentrated on the results of the ILS and MIDAS of both instructors and their students.

Figure 12. Instructor Interview #1
This was given prior to instructors taking online assessments.

Interview #1 Questions- Prior to completing online surveys

1. How many years have you taught at the University of Illinois?

2. How many years have you taught science courses?

3. How many hours do you teach per year?

4. What gets you excited about teaching in your courses? How do you do that?

5. If you have the "perfect student" in your class, what are they doing? Why do you say that?

6. What do you do to teach students with diverse learning styles in your courses?

7. Tell me about the assignments in your courses.

8. In your opinion, what makes an excellent scientist? How do you help prepare an excellent scientist?

Figure 13. Instructor Interview #2
This was given after both instructors and students had completed online assessments.

Interview #2 Questions- After instructor and students complete both online surveys

1. What do you do in your courses? What are your students doing?

2. To what would you compare your students? (ANALOGY)
   block of clay conduit empty pitcher fallow field
   sponge

3. Were you familiar with Multiple Intelligences before this research project? If so, to what extent?

4. Were you familiar with Learning Styles before this research project? If so, to what extent?

Discuss results of Instructor LS/MI assessments:

5. What Multiple Intelligences were more prevalent in your online evaluation?

6. Were you surprised at the outcome or was it as you expected?

7. What seems to be your Learning styles from the online evaluation?

8. Were you surprised at the outcome or was it as you expected?

9. How do you think the surveys of most college students compare with yours?

10. How do you think your students' surveys compare with yours?

SHOW RESULTS OF STUDENTS' MULTIPLE INTELLIGENCE SURVEYS
SHOW RESULTS OF STUDENTS' LEARNING STYLES SURVEYS

11. Do the student results surprise you?

12. How do you teach your course(s) according to the MI and LS of your students?

13. What changes could be made in teaching science courses to encompass more Multiple Intelligences and Learning Styles to enhance student learning?

14. Do you intend to change anything in your courses to address MI/LS?

15. Are there any obstacles that might keep you from making such changes?

Subject Sampling

Subject samples were from the population of all current teaching instructors of Animal Science courses at the University of Illinois Urbana-Champaign campus during the period of August 2012 and May 2014. Approximately fifty Animal Science instructors, including academic professionals, adjunct professors, associate professors, assistant professors, professors, and emeritus professors who still teach animal science courses were contacted via email messages and were asked to complete the online assessments. Participating instructors were required to sign a consent form prior to taking the assessments. Twenty instructors completed both assessments and participated in both interviews. Animal Science instructors who completed the assessments were asked to take part in two interviews for more comprehensive data. The graduate student, Crystal A. Allen, conducted the instructor interviews at a mutually designated place and time by using an interview protocol.

Analysis of Data

All results of the ILS and MIDAS were entered into Excel spreadsheets. Figures were created using Excel Descriptive Data Analysis for mean, STDEV.S for standard deviation, and Pearson coefficient correlation for r-value. Standard error was calculated by using Excel formula $SE = \frac{S}{\sqrt{n}}$.

Qualitative data was coded according to similarities of wording. Any response mentioning time (time limitations, worth time, investment of time, takes time) was coded as such. The cost category included anything mentioning money or expenses. Effort was distinctly mentioned verbatim. The category for number of students included class size and room layout.

Results

Of the twenty animal science instructors who participated, eleven were full professors, two were associate professors, five were assistant professors and two were academic professionals. The range of age of instructors was twenty-eight to seventy-seven years, with the mean being fifty-one years of age. The number of years of teaching experience range from zero to thirty-eight years, with a mean of 16.6 years. Thirty five percent of the instructors had taught less than five years and thirty percent had taught more than thirty years.

Comparison of Learning Styles

Overall, there was general agreement in the distribution across the four sets of dimensions in the ILS assessments for the 20 instructors and their 447 of their students participating in this study. Greater than 50% of both the instructors and students were well balanced in the **active/reflective** dimension. There were, however, some apparent differences in the distribution of the remaining instructors and students. For example, the instructors tended to have a moderate to strong preference for the **reflective** dimension vs. the **active** dimension (35% vs. 10%, respectively), while the students tended to have a moderate to strong preference for the **active** dimension vs. the **reflective** dimension (26% vs. 16%, respectively). A higher percentage of both instructors and students preferred the **sensing** dimension above the **intuitive** dimension. Similarly, a higher percentage of both instructors and students preferred the **visual** dimension as opposed to the **verbal** dimension. The highest percentage of both instructors and students were well balanced between the **sequential** and **global** dimensions of learning styles. Here again, there were

apparent differences in the preferences of the remaining instructors and students in those dimensions. Forty percent of the instructors had a moderate or strong **global** preference compared with 25% having a moderate **sequential** preference. In contrast, only 6% of students had any **global** preference at all vs. 39% of students had a moderate or strong **sequential** preference.

Comparison of Multiple intelligences

In the **linguistic** MI, instructors ranked in the high category presenting a mean score of 67.65 while the students were in the moderate rank showing a mean score of 55.23. In the **interpersonal** MI, instructors ranked in the high category presenting a mean score of 65.15, while the students were in the moderate rank showing a mean score of 59.38. In the **intrapersonal** MI, instructors ranked in the high category presenting a mean score of 68.75, while the students were in the moderate rank showing a mean score of 57.36. In the **logical-mathematical** MI, instructors ranked in the high category presenting a mean score of 67, while the students were in the moderate rank showing a mean score of 56.71. Both instructors and students ranked in the moderate category for the **spatial** MI, with instructors presenting a mean score of 56.2 and the students showing a mean score of 47.24. In the **musical** MI, instructors ranked in the low category presenting a mean score of 38.9, while the students were in the moderate rank showing a mean score of 48.72. Both instructors and students ranked in the moderate category for the **kinesthetic** MI, with instructors presenting a mean score of 41.9 and the students showing a mean score of 48.85. Both instructors and students ranked in the high category for the **naturalist** MI,

with instructors presenting a mean score of 76 and the students showing a mean score of 72.

Instructor interviews

The instructors were asked to compare their students to an item using an analogy and given choices of: block of clay, conduit, empty pitcher, fallow field or sponge. Sponge was chosen by 26% (5 of 20), fallow field by 26% (5 of 20), block of clay by 21% (4 of 20), conduit by 21% (4 of 20), and empty pitcher by 5% (1 of 20). This demonstrated the wide range of instructors' perception of their students and their understanding of how students process information. From the interviews it was discovered that 40% (8 of 20) of the instructors had never heard of learning styles or multiple intelligences and 45% (9 of 20) had only heard of the terms but were not familiar with them. One instructor was somewhat familiar, one pretty familiar and only one was very familiar with LS and MI.

Figure 14. How Instructors Think of Their Students.
To what would you compare your students? Analogy-block of clay, conduit, empty pitcher, fallow field or sponge.

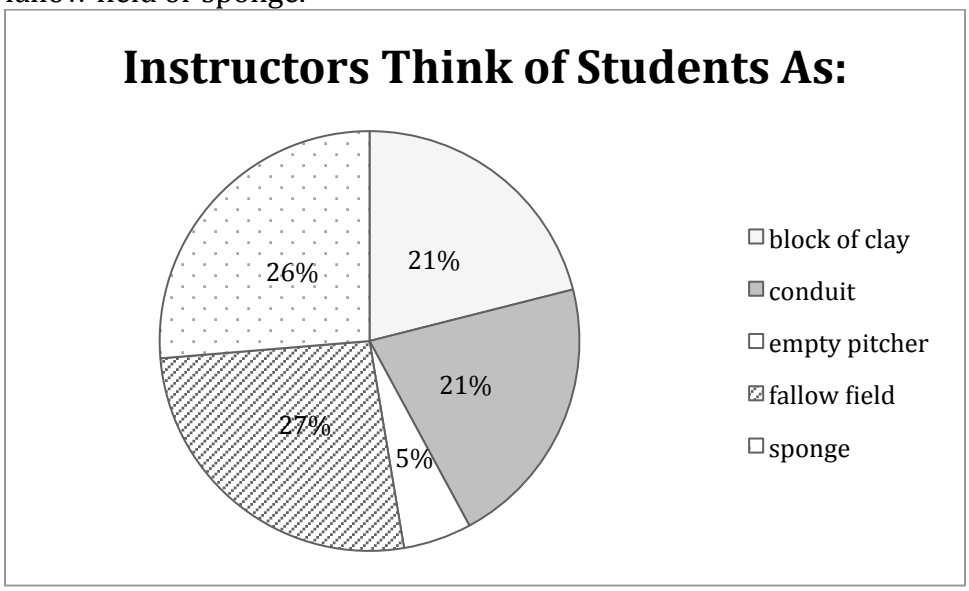
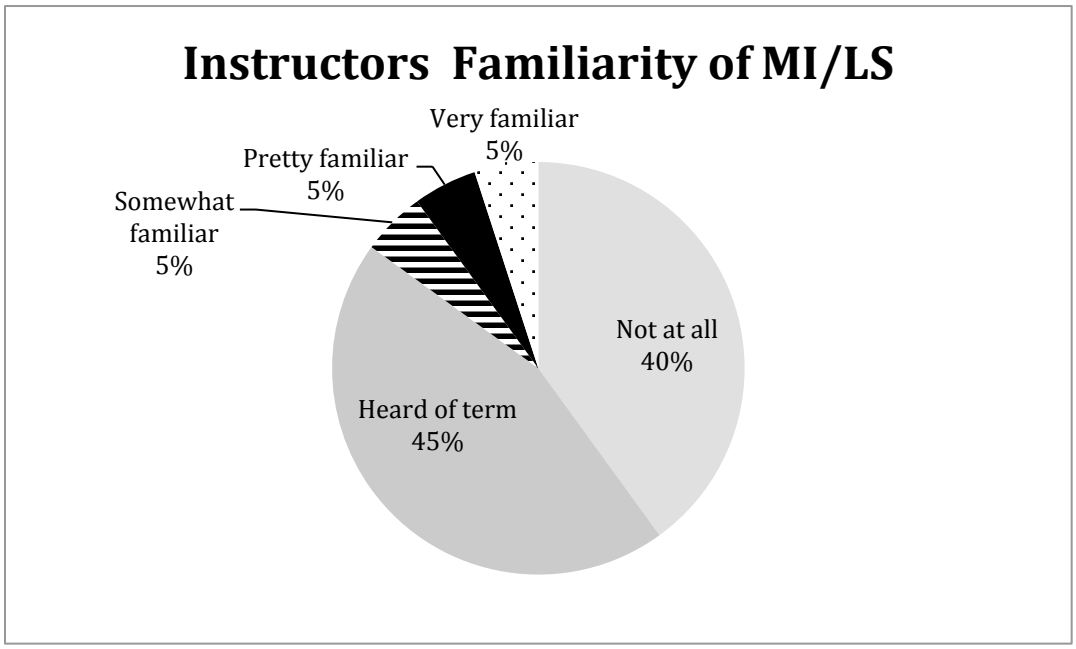


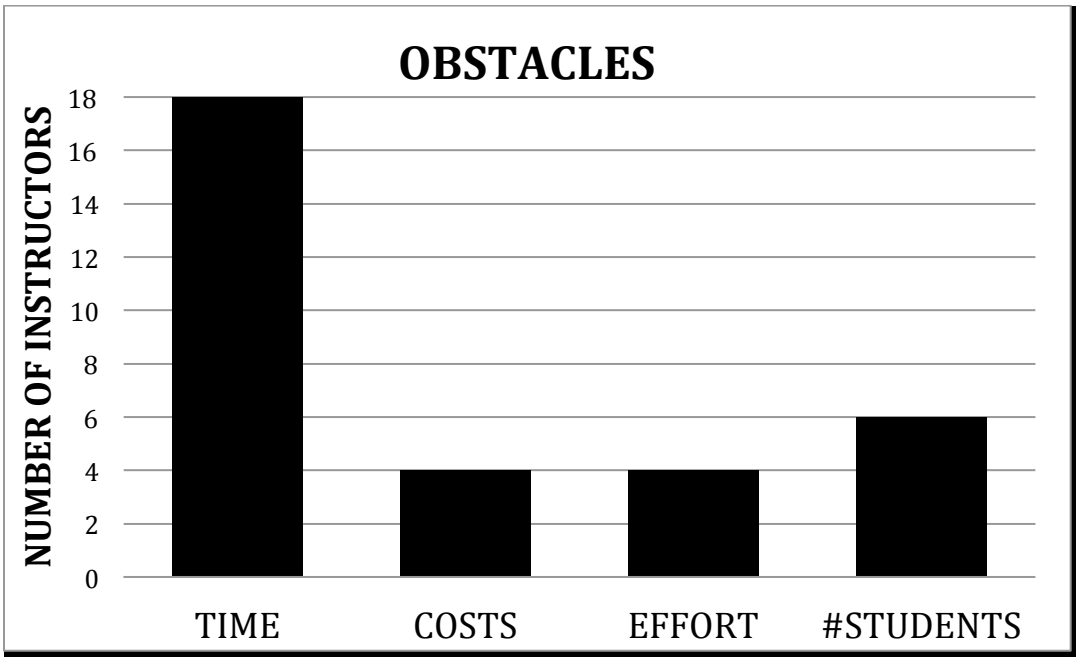
Figure 15. Instructors' Familiarity of Multiple Intelligences and Learning Styles



Obstacles for Implementation of Methods to Address LS/MI

Most all of the participating instructors were interested in learning more about LS and MI in order to implement new methods into their courses to reach a larger number of students. Eighty-five percent (17 of 20) of the instructors stated that they intended to alter their courses accordingly to better address LS and MI of their students. Two instructors (10%) stated that they had no intentions of changing anything for the purpose of addressing more LS or MI of their students. Instructors mentioned four major obstacles for them related to changing teaching methods in their courses including: Time, cost, effort and number of students. Ninety percent of the instructors stated time to be an obstacle, mentioning time limitations, lack of time and investment of time. They felt that it takes extra time to make changes and questioned if it was worthwhile. One instructor indicated limited time to allow for fieldtrips and another thought it risky to invest time for something with which they were not comfortable. Also they were worried about time away from research and balancing research and teaching. There were several aspects in the cost category, including cost for labs, cost of transportation for fieldtrips, and the cost to implement new unfamiliar methods. Several instructors considered it to take more effort to change their courses since they taught in the same manner, doing the same thing each year. Other obstacles mentioned were ability, desire, incentive, space, technology and teaching assistant support.

Figure 16. Obstacles to Implementation of Teaching Methods in Courses



Discussion

College instructors tend to teach their courses according to their own multiple intelligences and learning styles and not necessarily that of their students (Hoover, 1998). Usually instructors use a combination of methods, with which they are comfortable and often with which they were taught (Sarasin, 2006). Instructors need to be aware of differences in their students' learning in order to teach effectively (Sarasin, 2006). Instructors should use a variety of teaching methods to reach diverse learning styles and address various capabilities of their students, so that a student can successfully learn regardless of their learning styles (Hoover, 1998).

What Students Need to Learn

Employers are conveying the necessity for students who can acquire knowledge, communicate, solve problems, and work well in teams throughout their whole career (Sibley and Parmelee, 2008). It is essential to assist college students in the process of learning these skills for their future careers. Communication skills are the foundation of any career or employment. When activities are created that lead to intellectual debates and result in constructive discussion, students are assisted to reach a higher-level reasoning, encourage divergent thinking, foster creativity, and promote long-term retention (Johnson and Johnson, 1995). It is essential to impress upon students the importance of working in groups or teams, since many students as well as instructors had previous bad group experiences that may make them less interested in pursuing collaborative work in the future. Students begin to identify that "teams can give individuals insights and understandings that could never be achieved alone" (Johnson and Johnson, 2004). Hung (2004) believes that it is not possible to cover everything an undergraduate needs to know for their profession since "knowledge is constantly expanding, and we question the possibility

that any course or program of studies can provide a full understanding of a content's breadth." Since it is not possible or desirable to cover everything in a subject area, should not instructors assist students in gaining problem-solving skills that will be required in their professions? Many experts in curriculum design think that instructors ought to be more concerned with depth of learning rather than the amount of material covered, meaning that "learning with understanding" must occur instead of superficial coverage of material in courses (Bransford, 2000). Haidet et al (2004) compared outcomes from didactic lecturing to an active learning strategy and found that the same amount of complex content was able to be covered in the both sessions with no negative effects on short-term or long-term gain of knowledge. Instructors must also foster lifelong learning skills in college students. Critical reading and assimilation of information from various sources is important in successful careers (Ryan, 2008). Employers are demanding that their future employees possess communication skills, problem-solving skills, and the ability to acquire knowledge (Sibley & Parmelee, 2008).

Perceived Shortcomings in Higher Education

Research in education has constantly demonstrated that what is taught and what is learned can be very different (Zirbel, 2006). There seems to be a disconnection between the evidence presented in the literature and the reality of teaching at the university level. Instructors do not always teach in a manner, which enhances the gaining of genuine knowledge by the students. Often students are encouraged to memorize facts and regurgitate information for exams and actual learning of the material or concept is not promoted. Science learning is more than memorization of facts and info but rather understanding and applying science concepts and methods. As shown by studies,

greater learning occurs when teaching styles match learning styles than when they are mismatched (Felder, 1993).

Instructors could be utilizing more inclusive teaching methodology and pedagogy to address the multiple intelligences and learning styles of their students. College course instruction utilizing a variety of teaching methods will engage a larger number of students and allow them more opportunities for genuine learning. Instructors should be aware of the learning styles of their students in order to facilitate learning for all students (Hoover, 1998). When instructors know their students' strengths, relevant and engaging lessons can be prepared to make connections and align with those capabilities (Griggs et al, 2009).

Conclusions

When instructors learn about LS and MI, most see the importance and express the desire to implement methods to address them. The issue is mainly the time to alter their courses and the knowledge of how to teach accordingly. It is essential that all instructors are made aware of their LS and MI as well as the LS and MI of their students. Instructors should be provided with workshops and resources to learn about LS and MI and have assistance with creation of material and lessons for their courses that address MI and LS of their students.

REFERENCES

Bransford, J.D. (2000). *How people learn*. Washington, D.C. National Academy Press.

Felder, R.M. (1993). Reaching the second tier: learning and teaching styles in college science education. *Journal of College Science Teaching*, 23, 286-290.

Gardner, H. (1993). *Frames of mind*. New York: Basic books.

Griggs, L., Barney, S., Brown-Sederberg, J., Collins, E., Keith, S. and Iannacci, L. (2009). Varying pedagogy to address student multiple intelligences. *Human Architecture: Journal of The Sociology of Self-Knowledge, 2* (1), 55-60.

Haidet, P. et al. (2004). A controlled trial of active versus passive learning strategies in a large group setting. *Advances in Health Sciences Education.* Vol 9, 15-27.

Hestenes, D. (1979). Wherefore a science of teaching. *The Physics Teacher*, *17*(4), 235-242.

Hoover, T.S. (1998). A comparison of learning styles and demographic characteristics of students enrolled in selected animal science courses. *Journal of Animal Science, 76*(12), 369-373.

Hung, P., Bailey and J.H., Jonassen, D.H. (2004). Exploring the tension of problem-base learning: Insights from research. *Problem-Based Learning in the Information Age.* No 95. San Fransisco: Jossey-Bass

Johnson, D.W., Johnson, R.T. and Smith, K.A. (1991). *Active learning cooperation in the college classroom.* Edina, MN: Interaction Book Company.

Johnson, D.W. and Johnson, R.T. (1995). *Teaching students to be peacemakers*. Interaction Book Company.

Mims, C. (2003). Authentic learning: A practical introduction & guide for implementation. *Meridian: A Middle School Computer Technologies Journal*, *6*(1), 1-3.

Piaget, J. (1954). *The construction of reality in the child*. New York: Basic Books.

Piaget, J. (1974). *To understand is to invent: The future of education*. New York: Grossman.

Ryan, J.B., Pierce, C.D. and Mooney, P. (2008). Evidence-based teaching strategies for students with EBD. *Beyond Behavior*, *17*(3), 22-29.

Sarasin, L.C. (1999). *Learning style perspectives impact in the classroom*. Madison, Wisconsin: Atwood Publishing.

Shearer, C.B. (1996). *The MIDAS: A professional manual*. Greyden Press.

Sibley, J. and Parmalee, D.X. (2008). Knowledge is no longer enough: Enhancing professional education with team-based learning. *New Directions for Teaching and Learning, 116*(Winter), 41-53.

Zirbel, E.L. (2006). *Teaching to Promote Understanding and Instigate Conceptual Change*, Science Education Review, in press.

CHAPTER 7

CONCLUSIONS

The overall objective of the study was to determine if college instructors were aware of the abilities and capabilities of their students and in response intended to purposefully alter their teaching methodology and pedagogy to accommodate the range of learning styles and multiple intelligences of their students. The hypotheses were that: 1) the learning styles (LS) and multiple intelligence (MI) profiles of the instructors and students were not similar; 2) instructors were not conscious of their own learning styles and multiple intelligences; 3) instructors did not recognize the varying range of learning styles and multiple intelligences of their students and consequently did not teach their courses to address those, and 4) instructors were not planning to purposefully alter their teaching methods or pedagogy to accommodate the wide variety of learning styles and multiple intelligences possessed by their students.

In chapter four, various aspects related to learning styles were discussed, assessments given and Index of Learning Styles (ILS) profiles of instructors and students in the animal science department of the University of Illinois were evaluated. Chapter five highlighted the facets of multiple intelligences, instructors and students were assessed and Multiple Intelligences Developmental Assessment Scales (MIDAS) profiles were evaluated. The ILS and MIDAS profiles of the instructors and students were compared. The individual instructor interviews were discussed and evaluated to determine if the instructors were conscious of their own LS and MI and those of their students and if they used methodology and pedagogy to address them in their courses.

Results from chapter four indicated that the LS preferences of the instructors and students were generally more closely aligned than predicted by our original hypothesis. Overall, there was general agreement in the distribution across the four sets of dimensions in the ILS assessments for the 20 instructors and their 428 of their students participating in this study. Though the majority of both instructors and students were well balanced in the **active/reflective** dimension, some instructors had a moderate to strong preference for the **reflective** dimension while some students had a moderate to strong preference for the **active** dimension. There was no statistically significant difference ($p \geq 0.05$) found in the distribution of instructors and students between the **active/reflective** LS. A higher percentage of both instructors and students preferred the **sensing** dimension above the **intuitive** dimension, as well as the **visual** dimension as opposed to the **verbal** dimension. A low significant difference was shown in the sensing/intuitive dimensions ($p \leq 0.05$). No significant difference was shown in **visual/verbal** dimensions. The highest percentage of both instructors and students were well balanced between the **sequential and global** dimensions of learning styles, but forty percent of the instructors had a moderate or strong **global** preference however thirty-nine percent of students had a moderate or strong **sequential** preference. A highly significant difference ($p < 0.01$) was found in the distribution of instructors and students between the sequential/global LS.

Chapter five multiple intelligences were shown by MIDAS profiles of the instructors and students were generally more closely aligned than predicted by our original hypothesis. Overall, there was a general agreement in the distribution across the eight scales of the MIDAS profiles for the 20 instructors and 448 students participating in this study. There is

also a large range within the MI of both students and instructors signifying that a large range of MI exists. In the **linguistic** MI scale the instructors ranked in the high category while the students were in the moderate category. Instructors ranked in the high category of the **interpersonal** MI while the students were in the moderate rank. In the **intrapersonal** MI scale the instructors ranked in the high category while the students were in the moderate category. Instructors ranked in the high category of the **logical-mathematical** MI scale while the students were in the moderate category. Both instructors and students were ranked in the moderate category for the **spatial** MI scale. In the **musical** MI scale the instructors ranked in the low category while the students were in the moderate category. Both instructors and students were ranked in the moderate category for the **kinesthetic** MI and both instructors and students were ranked in the high category for the **naturalist** MI scale.

Chapter six included individual instructor interviews that found when instructors learned about LS and MI, most saw the importance and expressed the desire to implement methods to address them. From the interviews it was discovered that 40% of the instructors had never heard of learning styles or multiple intelligences and 45% had only heard of the terms but were not familiar with them. One instructor was somewhat familiar, one pretty familiar and only one was very familiar with LS and MI. Eighty-five percent of the instructors stated that they intended to alter their courses accordingly to better address LS and MI of their students. Instructors mentioned four major obstacles for them related to changing teaching methods in their courses including: Time, cost, effort

and number of students. Other obstacles mentioned were ability, desire, incentive, space, technology and teaching assistant support.

Recommendations

According to our results, the students enrolled in animal science courses on average possess active, sensing, visual and sequential LS compared with the respective reflective, intuitive, verbal and global LS. Teaching towards the students' preferred LS would allow them to grasp content more easily. On the other hand, using teaching methods addressing reflective, intuitive, verbal and global LS would not only assist students possessing those LS but might also help the others improve in those dimensions. Students ranked moderately in all the MI except naturalist, demonstrating the need for a variety of teaching methods to address the large range of capacities of the students.

Instructors should provide ample opportunities for students to actively be engaged in the leaning process with activities and assignments to employ active learning beyond note-taking. The **active LS** could be addressed easily by using an audience response system (ARS) such as i-clickers, student demonstrations/presentations, labs and field trips and also uses their **kinesthetic MI**. An effective way to address the **reflective LS** would be journaling or movie reflections. Having the students write their own thoughts about what has been discussed or viewed enhances their ability to reflect and also uses their **intrapersonal MI**. Students with **sensing LS** learn well with practical problem-solving such as case studies, which would also address the **logical-mathematical MI**. Ones with **intuitive LS** and **global LS** would appreciate open ended questions possibly with a creative solution or no correct answer. Charts, graphs and

pictures should be utilized to assist the students possessing the **visual LS** and **spatial MI**. Using modules, whether in class or online, aids students with **sequential MI** to learn material by orderly steps. Small group or whole class discussions, student presentations, peer teaching and team based projects promotes the **interpersonal MI**, **linguistic MI** and **verbal LS**. Animal science students who have a high **naturalist MI** flourish when working with animals and in laboratory settings.

Assigning students quizzes, puzzles and games enhances the kinesthetic MI, interpersonal MI and the logical-mathematical MI. Having a game day where groups of students create and demonstrate their content knowledge in a new game creation encourages many LS and MI as well. The creation of posters, demonstrations or alternative presentations by students is a manner in which to address many LS and MI. Allowing students to make presentations using alternative media from PowerPoint, such as a song, poem, rap or skit, can be beneficial towards most all of the LS and MI possibly even address the **musical MI**. Even animal science content can be presented in this manner if you allow the students to be creative.

Based on our findings, instructors will find students possessing a spectrum of the LS preferences a well as exhibiting a wide range of scores on the MI scales. It is essential that all instructors are made aware of their LS and MI as well as the LS and MI of their students. Instructors should be provided with workshops and resources to learn about LS and MI and have assistance with creation of material and lessons for their courses that address MI and LS of their students. The best instructional plan would include teaching methods and pedagogy that address all LS and

MI within each course, allowing for students to use their strong capacities as well as strengthen their weaker ones.

If instructors are aware of their own LS and MI as well as those of their students, the teaching methods and pedagogy can be altered to accommodate all learning styles and capacities throughout the course. Being cognizant of the wide range of LS and spectrum of MI, the instructors should utilize a wide variety of teaching methods, assignments, activities and assessments in order to make learning more readily accessible to students. It would require instructors to go beyond their comfort zone and possibly teach with a fashion that is not natural for them. Lecturing is simple, direct and easy for instructors to create and present, but has repeatedly been shown to be the least effective method of teaching. By using varied teaching methods to actively engage students, the courses could be more interesting, more relevant to the students as well as reaching more students who possess the wide array of LS and MI.

REFERENCES

Adelman, C. (1984). *Starting with students: Promising approaches in American higher education.* Washington D.C.: National Institute of Education.

Allers, N. (2010). Teaching physiology to dental students: Matching teaching and learningstyles in a South African dental school. *Journal of Dental Education.*74(9), 986-992.

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C. and Norman, M. K. (2010). *How learning works*. San Francisco, California: Jossey-Bass.

Anderson, J.R., Reder, R.M. and Simon, H.A. (2000). Applications and misapplications of cognitive psychology to mathematics education. *Texas Educational Review.*

Angelo, T.A. and Cross, K.P. (1993). *Classroom assessment techniques: A handbook for college teachers* (2nd). San Francisco, California: Jossey-Bass.

Armstrong, T. (1993). *7 kinds of smart*. New York: Plume.

Armstrong, T. (2000). *Multiple intelligences in the classroom* (3rd). Alexandria, Virginia: Association for Supervision and Curriculum Development.

Astin, A.W. (1985). *Achieving educational excellence.* San Francisco: Jossey-Bass.

Bertrand, P. (2005). "Multiple Intelligences in the Physics Classroom," *AP Central*, The College Board online publication.
http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/37025.html

Bligh, D.A. (2000). *What's the use of lectures?* San Francisco: Jossey-Bass.

Boyer, E.L. (1987). *College: The undergraduate experience in America.* New York: Harper & Row.

Bloom, B.S., Englehart, M.D., Furst, E.J., Hill, W.H. and Kraftwohl, D.R. (1956). *Taxonomy of educational objectives*. New York, New York, Longwood.

Bonwell, C. and Eison, J. (2004). *Active learning: Creating excitement in the classroom.* Washington DC: George Washington University Press.

Bradshaw, G.L. and Anderson, J.R. (1982). Elaborative encoding as an explanation of levels of Processing. *Journal of Verbal Learning and Verbal Behavior, 21, 165-174.*

Bransford, J.D. (2000). *How people learn*. Washington, D.C. National Academy Press.

Breckler, J., Joun, D. and Ngo, H. (2009). Learning styles of psychology students interested in the health professions. *Advances in Physiology Education,* 33, 30-36.

Breckler, J. and Yu, J.R. (2011). Student responses to a hands-on kinesthetic lecture activity for learning the oxygen carrying capacity of blood. *Advances in Physiology Education.* 35: 39-47.

Campbell, L., Campbell, B. and Dickinson, D. (2004). *Teaching and learning through multiple intelligences*. Boston: Pearson Education.

Campbell, W. and Smith, K. (1997). *New paradigm for college teaching.* Edina, MN: Interactions Book Company.

Cassidy, S., (2004). Learning styles: An overview of theories, models, and measures. *Educational Psychology,* 21 (4), 419-444.

Checkley, K. (September 1997). The first seven...and the eighth: A conversation with Howard Gardner. *Educational Leadership*, 8-13.

DeBono, E. (1971). *New think*. New York: Avon books.

DeBono, E. (1973). *Lateral thinking: Creativity step by step*. New York: Harper & Row Publishers.

DeBono, E. (1985). *Six thinking hats*. New York: Back Bay Books.

DeBono, E. (1992). *Teach your child how to think*. New York: Penguin Books.

Dewey, J. (1910). *How we think*. New York, NewYork: Cosimo.

Dewey, J. (1938). *Experience & education*. New York: Touchtone.

Diaz-Lefebvre, R. and Finnegan, P. (1997). Coloring outside the lines: Applying the theory of multiple intelligences to the community college setting. *Community College Journal*. 68(2), 28-31.

Dillon, L.M. (2006). Multiple intelligences theory and the college English classroom. *Minnesota English Journal,* 42(Fall), 115-128.

Dobson, J.L. (2009). Learning style preferences and course performance in an undergraduate physiology class. *Advances in Physiology Education,* 33, 308-314.

Dobson, J.L. (2010). A comparison between learning style preferences and sex, status, and course performance. *Advances in Physiology Education,*34, 197-204.

Evans, N.J., Forney, D.S., Guido, F.M., Patton, L.D. and Renn, K.A. (2010). *Student Development in College: Theory, Research and Practice. Jossey-Bass, San Francisco, CA.*

Felder, R.M. (1993). Reaching the second tier: learning and teaching styles in college science education. *Journal of College Science Teaching*, 23, 286-290.

Felder, R.M., Felder, G.N. and Dietz, E.J. (1998). A longitudinal study of engineering student performances and retention: comparisons with traditionally taught students. *Journal of Engineering Education,* 87(4), 469-480.

Felder, R.M. and Silverman, L.K. (1988). Learning and teaching styles in engineering education. *Journal of Engineering Education,*78(7), 674-681.

Felder, R.M. and Soloman, B.A. (2004). *Index of Learning Styles (ILS).* www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSpage.html

Felder, R.M. and Spurlin, J. (2005). Reliability and validity of the index of learning styles: A meta-analysis. *International Journal of Engineering Education,* 21(1), 103-112.

Fleming, N. and Baume, D. (2006). Learning styles again: VARKing up the right tree! *Educational Developments*. 7.4, 4-7.

Freire, P. (2000). *Pedagogy of the Opressed.* New York: Continuum International.

Gardner, H. (1993). *Frames of mind*. New York: Basic books.

Gardner, H. (1999). *The disciplined mind*. New York: Penguin Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. New York: Basic Books.

Gardner, H. (2008). *5 minds for the future*. Boston, Massachusetts: Harvard Business Press.

Gardner, H., Kornhaber, M.L., & Wake, W.K. (1996). *Intelligence: Multiple perspectives*. Belmont, California: Thomson Wadsworth.

Gibbs, G. (1981). Twenty terrible reasons for lecturing. *Science Education* occasional paper o8, Birminham, Alabama.

Gregorc, A.F. (1979). Learning/teaching styles: potent forces behind them. *Educational Leadership,*36, 234-236.

Gregorc, A.F. (1982).

Griggs, L., Barney, S., Brown-Sederberg, J., Collins, E., Keith, S. and Iannacci, L. (2009). Varying pedagogy to address student multiple intelligences. *Human Architecture: Journal of The Sociology of Self-Knowledge, 2* (1), 55-60.

Gutierrez, D., Perri, K. and Quackenbush, A. (2006). Exploring the multiple intelligences of community college students enrolled in online courses. *Journal of College Teaching and Learning, 3*(11), 85-90.

Haidet, P. et al. (2004). A controlled trial of active versus passive learning strategies in a large group setting. *Advances in Health Sciences Education.* Vol 9, 15-27.

Hestenes, D. (1979). Wherefore a science of teaching. *The Physics Teacher*, *17*(4), 235-242.

Harris, K.A. and Sykes, W.E. (1999). Professional predispositions: Assessing multiple intelligences theory in undergraduates. Indiana University Undergraduate Research Conference, Indianapolis, Indiana.

Hoover, T.S. (1998). A comparison of learning styles and demographic characteristics of students enrolled in selected animal science courses. *Journal of Animal Science, 76*(12), 369-373.

Hung, P., Bailey, J.H. and Jonassen, D.H. (2004). Exploring the tension of problem-based learning: Insights from research. *Problem-Based Learning in the Information Age.* No 95. San Fransisco: Jossey-Bass.

Hunts, H. *Multiple intelligences in the college classroom.* (2002). Montana State University Bozeman: Teaching Learning Committee.

Ip, Y.K. (2003). *Active learning.* Retrieved 12/29, 2010, from http://www.cdtl.nus.edu.sg/Ideas/iot3.htm

Johnson, K.E. and Eilers, A.T. (1998). Effects of knowledge and development on the extension and evolution of subordinate categories. *Cognitive Development*. 13, 515–545.

Johnson, D.W. and Johnson, R.T. (1995). *Teaching students to be peacemakers*. Interaction Book Company.

Johnson, D.W., Johnson, R.T. and Smith, K.A. (1991). *Active learning cooperation in the college classroom.* Edina, MN: Interaction Book Company.

Johnson, D.W. and Johnson, R.T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Journal of Educational Researcher*, 38 (5), 365–379.

Johnson, D.W. and Johnson, R.T. (1990). Using cooperative learning in math, In Davidson, N. (ed.), Cooperative Learning In Mathematics (pp.103-125). Menlo Park, California, USA: Addison-Wesley Publishing.

Johnson, D.W. and Johnson, R.T. (1989). *Cooperation and competition theory and research*. Edina, Minnesota, USA: Interaction Book Co. publishing.

Johnson, D.W., Johnson, R.T. and Holubec, E.J. (1984). *Cooperation in the classroom*. Edina, Minnesota, USA: Interaction Book Co. publishing.

Johnson, D.W., Johnson, R.T., Stanne, M.B. and Garibaldi, A (1990). Impact of group processing on achievement in cooperative groups. *Journal Social Psychology*, 130 (4) 507-516.

Johnson, R.T. and Johnson, D.W. (1994). An overview of cooperative learning, In J., Thousand, A., Villa, & A., Nevin (Eds.), Creativity and collaborative learning (p.2). Baltimore, Maryland, USA: Brookes Publishing.

Johnson, R.T. and Johnson, D.W. (1986). Action research: Cooperative learning in the science classroom. *Journal of Science and Children*, 24 (2), 31-32. |

Johnson, R.T and Johnson, D.W (1985). Relationships between black and white students in intergroup cooperation and competition. *Journal of Social Psychology*, 125 (4) pp. 421–428.

Jones, C., Reichard, C. and Mokhtari, K. (2003). Are students learning styles discipline specific? *Community College Journal of Research Practices,* 27, 363-375.

Kagan, S. and Kagan, M. (1998). *Multiple intelligences: The complete MI book*. San Clemente, California: Kagan Cooperative Learning.

Kagan, S. (1986). Cooperative learning and sociological factors in schooling, In Beyond language: Social and cultural factors in schooling language minority students (pp. 231-98). Los Angeles, CA, USA: Evaluation, Dissemination, and Assessment Center, California State University Publishing.

Keefe, J.W. (1979). Learning style: An overview. *Student Learning Styles: Diagnosing and Prescribing Programs,* National Association of Secondary School Principals, Reston, VA.

Keeton, M.T. (1976). *Experiential learning*. San Francisco: Jossey-Bass.

King, P.M. and Kitchener, K.S. (1994). *Developing Reflective Judgment: Understanding and Promoting Intellectual Growth and Critical Thinking in Adolescents and Adults. Jossey-Bass, San Francisco, CA*

Kolb, D. (1984). Experiential learning experience as the source of learning and development. New Jersey: Prentice-Hall, Inc.

Layman, J.W. (1996). *Inquiry and learning: Realizing science standards in the classroom*. New York: College Entrance Examination Board.

Lazear, D. (1994) Seven pathways of learning: teaching students and parents about multiple intelligences. Tucson, AZ: Zephyr Press.

Lazear, D. (1994) Multiple intelligences approaches to assessment: solving the conundrum. Tucson, AZ: Zephyr Press.

Lee, V.S. (2004). *Teaching and learning through inquiry: A guidebook for institutions and instructors*. Sterling, Virginia: Stylus.

Litzinger, T.A., Lee, S.H., Wise, J.C. and Felder, R.M. (2007). A psychometric study of the index of learning styles. *Journal of Engineering Education, 96*(4), 309-319.

Livesay, G.A., Dee, K.C. and Hites Jr., L.S. (2002). Engineering student learning styles: A statistical analysis using Felder's index of learning styles. Presented at the 2002 AnnualConference of the ASEE, Montreal, Quebec, June 2002.

Lujan, H.L.and DiCarlo, S.E. (2006). First-year medical students prefer multiple learning styles. *Advances in Physiology Education,* 30, 13-16.

Marmah, A.A. (2014). Students' perception about the lecture as a method of teaching in tertiary institutions, views of students from college of technology education, Kumasi (Coltek). *International Journal of Education and Research, 2(6), 601-612.*

Mascolo, M.F. (2009). Beyond student-centered and teacher-centered pedagogy: Teaching and learning as guided participation. *Pedagogy and the Human Sciences.* Vol. 1(1), 3-27.

McCully, K., Zurbrick, C.M. and Ash, D.B. (2013). Innovative teaching strategies for large-enrollment science courses.

McKeachie, W.J. (1985). *Improving undergraduate education through faculty development*. San Fransisco: Jossey-Bass.

McKeachie, W.J. (1986). *Teaching Tips: A guidebook for the beginning College Teacher.* 8th ed. Lexington, Massachusetts; Heath.

Mehlinger, K. (1995). School reform in the information age. Bloomington, Indiana University Center for Excellence in Education.

Michael, J. (2006). Where's the evidence that active learning works? *Advances in Physiology Education.* Vol. 30, 159-167.

Miller, J.E., Groccia, J.E. and Miller, M.S. (2001). *Student-assisted teaching: A faculty-student teamwork*. Boston, Massachusetts: Anker Publishing Company.

Mims, C. (Winter, 2003). Authentic Learning: A Practical Introduction & Guide for Implementation. *Meridian: A Middle School Computer Technologies Journal, 6(1)*, Raleigh, NC: NC State University.

Mintz, S. (2000). The fundamentals of college and university teaching. Columbia University Graduate of Arts & Sciences Teaching Center (handbook).

Moore, D.T. Forms and issues in experiential learning. *New Directions for Teaching and Learning, 124*(Winter 2010) doi:10.1002/tl.415

Nulty, D. and Barrett, M. (1996). Transitions in students learning styles. *Studies in Higher Education,* 21(3), 333-346.

O'Banion, T. (1997). *A learning college for the 21st century*. Rowman & Littlefield Publishers.

O'Neil, J. (1990). Making sense of style. *Educational Leadership,* 48(2), 4-9.

Pascarella, E.T. and Terenzini, P.T. (2005). *How College Affects Students.* San Francisco, CA: Jossey-Bass.

Piaget, J. and Inhelder, B. (1958). *The Growth of Logical Thinking From Childhood to Adolescence.* New York: Basic Books.

Prashnig, B. (2005). Learning styles vs. multiple intelligences (MI): two concepts for enhancing learning and teaching www.teachingexpertise.com, *9, 8-9.*

Prashnig, B. (1998). *The power of diversity: New ways of Learning and Teaching*. Auckland, NZ: David Bateman Ltd.

Prince, M. (2004). Does active learning work? A review of the research. *Journal f Engineering Education*.93 (3), pp 223-231.

Reichert, A. (2004). Using multiple intelligences to create better (teachers of) writers: A guide To MI theory for the composition teacher. *Teaching English in the Two-Year College,* (32.2), 166-172.

Ryan, J.B., Pierce, C.D. and Mooney, P. (2008). Evidence-based teaching strategies for students with EBD. *Beyond Behavior*, *17*(3), 22-29.

Sarasin, L.C. (1999). *Learning style perspectives impact in the classroom*. Madison, Wisconsin: Atwood Publishing.

Seery, J.E. (2002) *America goes to college: Political theory for the liberal arts.* Albany, New York: State University of New York Press.

Shearer, C.B. (1996). *The MIDAS: A professional manual*. Greyden Press.

Shearer, C.B. (1997). Reliability, validity and utility of a multiple intelligences assessment for career planning. Paper presented at 105th Annual Convention of the American Psychological Association, Chicago, Illinois. August 15, 1997.

Sibley, J. and Parmalee, D.X. (2008). Knowledge is no longer enough: Enhancing professional education with team-based learning. *New Directions for Teaching and Learning, 116*(Winter), 41-53.

Silver, H.F., Strong, R.W. and Perini, M.J. (2000). *So each may learn: Integrating learning styles and multiple intelligences*. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Simeone, W. (1995). Accommodating multiple intelligences in the english classroom. *The English Journal,* (84.8), 60-62.

Slater, J.A., Lujan, H.L. and DiCarlo, S.E. (2007). Does gender influence learning style preferences of first-year medical students? *Advances in Physiology Education,* 31, 336-342.

Soloman, B.A. and Felder, R.M. *Index of learning styles questionnaire.* Retrieved 12/22, 2011, from http://www.engr.ncsu.edu/learningstyles/ilsweb.html

Sternberg, R. (2008). Applying psychological theories to educational practice. *American Educational Research Journal,* (45), 150-165. doi:10.3102/0002831207312910

Tomlinson, C.A. (2005). *The differentiated classroom: Responding to the needs of all learners*. Upper Saddle River, New Jersey: Pearson Merrill Prentice Hall.

Torff, B. (1997). *Multiple Intelligences and assessment: a collection of articles.* Arlington Heights, IL: Skylight Training and Publishing, Inc.

Van Zwanenberg, N. and Wilkinson, L.J. (2000). Felder and Silverman's index of learning styles and Honey and Mumford's learning style questionnaire: How do they compare and how do they predict? *Educational Psychology,* 20(3), 365-381.

Weber, E. (2000). Five-phases to PBL: MITA (multiple intelligence teaching approach) model for redesigned higher education classes. In Penny Little, Tan Seng, Jane Conway, Hee Yin(Ed.), *Problem-based learning: Educational innovation across disciplines* (pp. 65-76). Singapore: Tamasek Center for Problem Based Learning.

Wehrwein, E.A., Lujan, H.L. and DiCarlo, S.E., (2007). Gender Differences in learning style preferences among undergraduate physiology students. *Advances in Physiology Education*, (31), 153-157.

Witkin, H.A. (1962). *Psychological Differentiation*. New York: John Wiley & Sons, Inc.

Witkin, H.A. and Moore, C.A. (1974). Cognitive Style and the teaching-learning process. Paper Presented at Annual Meeting of American Educational Research Association in Chicago, Illinois.

Yates, G.C. (1999). Cognitive styles and learning strategies: understanding style differences in learning and behavior/thinking styles. *Educational Psychology,*19(1), 103-105.

Zirbel, E.L. (2006). *Teaching to Promote Understanding and Instigate Conceptual Change*, Science Education Review, in press.

Zywno, M.S. (2003). A contribution of validation of score meaning for Felder-Soloman's index of learning styles. Proceedings of the 2003 Annual ASEE Conference. Washington DC.

http://www.cirtl.net/print/book/export/html/2509 Planning a course: Teaching and learning styles: the Academic culture

APPENDIX A

LEARNING STYLES

Richard M. Felder
Hoechst Celanese Professor of Chemical Engineering
North Carolina State University

Barbara A. Soloman
Coordinator of Advising, First Year College
North Carolina State University

ACTIVE AND REFLECTIVE LEARNERS

- Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.
- "Let's try it out and see how it works" is an active learner's phrase; "Let's think it through first" is the reflective learner's response.
- Active learners tend to like group work more than reflective learners, who prefer working alone.
- Sitting through lectures without getting to do anything physical but take notes is hard for both learning types, but particularly hard for active learners.

Everybody is active sometimes and reflective sometimes. Your preference for one category or the other may be strong, moderate, or mild. A balance of the two is desirable. If you always act before reflecting you can jump into things prematurely and get into trouble, while if you spend too much time reflecting you may never get anything done.

SENSING AND INTUITIVE LEARNERS

- Sensing learners tend to like learning facts, intuitive learners often prefer discovering possibilities and relationships.
- Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitors like innovation and dislike repetition. Sensors are more likely than intuitors to resent being tested on material that has not been explicitly covered in class.
- Sensors tend to be patient with details and good at memorizing facts and doing hands-on (laboratory) work; intuitors may be better at grasping new concepts and are often more comfortable than sensors with abstractions and mathematical formulations.
- Sensors tend to be more practical and careful than intuitors; intuitors tend to work faster and to be more innovative than sensors.
- Sensors don't like courses that have no apparent connection to the real world; intuitors don't like "plug-and-chug" courses that involve a lot of memorization and routine calculations.

Everybody is sensing sometimes and intuitive sometimes. Your preference for one or the other may be strong, moderate, or mild. To be effective as a learner and problem solver, you need to be able to function both ways. If you overemphasize intuition, you may miss important details or make careless mistakes in calculations or hands-on work; if you overemphasize sensing, you may rely too much on memorization and familiar methods and not concentrate enough on understanding and innovative thinking.

VISUAL AND VERBAL LEARNERS

Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words--written and spoken explanations. Everyone learns more when information is presented both visually and verbally.

In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners, which means that most students do not get nearly as much as they would if more visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.

SEQUENTIAL AND GLOBAL LEARNERS

- Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."
- Sequential learners tend to follow logical stepwise paths in finding solutions; global learners may be able to solve complex problems quickly or put things together in novel ways once they have grasped the big picture, but they may have difficulty explaining how they did it.

Many people who read this description may conclude incorrectly that they are global, since everyone has experienced bewilderment followed by a sudden flash of understanding. What makes you global or not is what happens before the light bulb goes on. Sequential learners may not fully understand the material but they can nevertheless do something with it (like solve the homework problems or pass the test) since the pieces they have absorbed are logically connected. Strongly global learners who lack good sequential thinking abilities, on the other hand, may have serious difficulties until they have the big picture. Even after they have it, they may be fuzzy about the details of the subject, while sequential learners may know a lot about specific aspects of a subject but may have trouble relating them to different aspects of the same subject or to different subjects.

APPENDIX B

THE MIDAS SCALES

Musical: ***To think in sounds, rhythms, melodies and rhymes****. To be sensitive to pitch, rhythm, timbre and tone. To recognize, create and reproduce music by using an instrument or voice. Active listening and a strong connection between music and emotions.*

Vocal Ability: a good voice for singing in tune and in harmony
Instrumental Skill: skill and experience in playing a musical instrument
Composer: makes up songs or poetry and has tunes on her mind
Appreciation: actively enjoys listening to music of some kind

Kinesthetic: ***To think in movements and to use the body in skilled and complicated ways*** *for expressive and goal directed activities. A sense of timing, coordination for whole body movement and the use of hands for manipulating objects.*

Athletics: ability to move the whole body for physical activities such as balancing, coordination and sports

Dexterity: to use the hands with dexterity and skill for detailed activities and expressive moment

Logical-Mathematical: ***To think of cause and effect connections and to understand relationships among action****s, objects or ideas. To calculate, quantify or consider propositions and perform complex mathematical or logical operations. It involves inductive and deductive reasoning skills as well as critical and creative problem-solving.*

Everyday Math: performs well in math at school
School Math: used math effectively in everyday life

Everyday Problem Solving: able to use logical reasoning to solve everyday problems, curiosity

Strategy Games: good at games of skill and strategy

Spatial: ***To think in pictures and to perceive the visual world*** *accurately. To think in three-dimensions and to transform one's perceptions and re-create aspects of one's visual experience via imagination. To work with objects effectively.*

Space Awareness: to solve problems of spatial orientation and moving objects through space such as driving a car

Artistic Design: to create artistic designs, drawings, paintings or other crafts
Working with Objects: to make, build, fix, or assemble things

Linguistic: ***To think in words and to use language*** *to express and understand complex meanings. Sensitivity to the meaning of words and the order among words, sounds, rhythms, inflections. To reflect on the use of language in everyday life****.***

Expressive Sensitivity: skill in the use of words for expressive and practical purposes

Rhetorical Skill: to use language effectively for interpersonal negotiation and persuasion

Written-academic: to use words well in writing reports, letters, stories, verbal memory, reading / writing

Interpersonal: ***To think about and understand another person. T****o have empathy and recognize distinctions among people and to appreciate their perspectives with sensitivity to their motives, moods and intentions. It involves interacting effectively with one or more people in familiar, casual or working circumstances.*

Social Sensitivity: sensitivity to and understanding of other people's moods, feelings and point of view

Social Persuasion: ability for influencing other people

Interpersonal Work: interest and skill for jobs involving working with people

Intrapersonal: ***To think about and understand one's self.*** *To be aware of one's strengths and weaknesses and to plan effectively to achieve personal goals. Reflecting on and monitoring one's thoughts and feelings and regulating them effectively. The ability to monitor one's self in interpersonal relationships and to act with personal efficacy.*

Personal Knowledge / Efficacy: awareness of one's own ideas, abilities; able to achieve personal goals

Calculations: meta-cognition "thinking about thinking' involving numerical operations

Spatial Problem Solving: self awareness to problem solve while moving self or objects through space

Effectiveness: ability to relate oneself well to others and manage personal relationships

Naturalist: ***To understand the natural world including plants, animals and scientific studies.*** *To recognize, name and classify individuals, species and ecological relationships. To interact effectively with living creatures and discern patterns of life & natural forces.*

Animal Care: skill for understanding animal behavior, needs, characteristics

Plant Care: ability to work with plants, i.e., gardening, farming and horticulture

Science: knowledge of natural living energy forces including cooking, weather and physics

APPENDIX C

Introduction Letter to Instructors

Dear Instructor;
My name is Crystal Allen and I am a graduate student working with Dr. Walter Hurley in Animal Sciences at the University of Illinois. I am currently working on a research project to explore the capabilities of university animal science students and how they process information as well as how they prefer to learn. We are asking for your assistance by participating in two online evaluations and possibly two personal interviews as well as having the students in your class complete the two online evaluations.
The online evaluations will take no more than 10 minutes each to complete and then a result page should be printed off to be returned to us. Possibly your students could receive a few points or extra credit for completing the evaluations. In addition to the evaluations, interviews will be conducted to acquire additional data from instructors. The interviews will be scheduled at a mutually agreed upon time and place for your convenience. You may choose to do one, two, or no interview. You may also participate by completing the evaluations and choose not to do the interviews.
The data from your evaluations and your students' evaluations will be very important for our research as well as my dissertation. We are attempting to compare the capabilities and preferences of the students to how they are perceived by instructors, and how the instructors teach accordingly. I strongly encourage you to participate and have your students participate also. This research will be integral in assessing the correlation between students' learning and instructors' teaching methods and may create discussions among all involved for continued improvement in University of Illinois animal science courses.
If you are interested, please contact me at callen@illinois.edu and I will send the links to the two online evaluations and the consent forms. I must have signed consent forms for everyone who completes the evaluations, both instructors and students. Please, if you have any questions email me or call (217) 265-8497.
Sincerely,
Crystal A. Allen
PhD Student
Animal Sciences
University of Illinois

APPENDIX D

Instructor Consent Form

Animal Sciences-University of Illinois

Learning Capabilities and Preferences of Students in Animal Science Courses

You are being asked to participate in a research project conducted by faculty at the University of Illinois at Urbana-Champaign. Please read the information below and indicate if you are willing to participate by filling out the blanks on the last page of this form.

Research Investigators: The research investigators for this project are UIUC faculty or research assistants, Dr. Walter Hurley and Crystal Allen. Dr. Hurley is a professor in the Department of Animal Sciences at the University of Illinois, Urbana-Champaign. Dr. Hurley is also the instructor of the ANSC 438 course. Crystal Allen is a graduate student in the Department of Animal Sciences.

Project Background: This project involves gathering data from instructors and students of select Animal Science courses at the University of Illinois. Data will be based upon two online evaluations completed by the instructors and two online evaluations completed by each student. In addition, participating instructors will have the opportunity to volunteer for up to two interviews during the semester. Interviews may be audio recorded and transcribed.
Any instructor names will be eliminated and transcriptions will be coded in order to obscure identities. Materials, information, and data gathered by this project may be used to develop journal articles, teaching essays, book or book chapters, conference presentations, and may be used as part of a PhD dissertation.

Purpose: The purpose of this study is to determine how students prefer to learn and their capabilities within the context of animal science courses at the University of Illinois in comparison to the instructors of such courses.

Participation: Participants for this project will come from instructors teaching selected Animal Science courses at the University of Illinois and the students enrolled in such courses during the Spring 2012 semester.. You must be at least 18 years of age to participate. Participation in this study is entirely voluntary. You may withdraw at any time and may request that your data not be used without any negative consequences. Instructors or students who may wish to withdraw should contact Crystal Allen at callen@illinois.edu and request to sign a new consent form to supersede the initial form. Your decision to participate, decline, or withdraw from participation will have no effect on your status at or future relations with the University of Illinois. Your participation in this project will involve two online evaluations. This consent relates to your agreement to allow the researchers to use the data generated from these activities for research purposes. Participation will begin upon your signature of this consent form and end in May, 2012 at the end of the Spring semester. The participating instructors will also be asked to partake in up to two interviews.

Benefits/Risks: Your participation in this project will enrich the information base in understanding the relationship of student learning capabilities and preferences compared to the instructors of the courses. This project does not involve any risks greater than those encountered in everyday life.

Confidentiality: Although you will need to supply your name on the evaluations, at the end of the semester Crystal Allen will copy the evaluations to be used as data in the research; your name will be erased from the copies, and an identifier number will be used to encode the copies. Only these coded copies will be used in data analysis. Your name will not appear in any resulting publication or other presentation of this research study. The data will only be reported in aggregate or thematic form. Any representative quotes that may be used in summaries of the research findings (presentations or publications) would be attributed to an unnamed subject in the research subject pool. All data will be secured in a locked cabinet in the researcher's office and will be kept for a period of 3 years after the study for future reference. Further, the instructor/researchers will not perform any data evaluation prior to the time final course grades are submitted.

If you should have any questions about this research project, please feel free to contact Walter Hurley at 430 ASL, MC-630, 1207 W. Gregory Dr., Urbana, IL 61801, email wlhurley@illinois.edu or phone 217-333-1327, or Crystal Allen at callen@illinois.edu or 217-265-8497.

If you have any general questions about your rights as a participant in this research, please contact the University of Illinois Institutional Review Board via email at irb@illinois.edu or by phone at (217) 333-2670 (you may call collect).

You may want to keep a copy of this consent form for your files.

Research Project Participation:

- o Yes, you may use both of my online evaluations for research.
- o No, I do not wish to participate in the research project.

Voluntary Interview Participation

- o Yes, I am willing to participate in at least one interview for this research during this semester. I understand that these interviews may be audio recorded.
- o No, I am not willing to participate in any interview for this research.

I, (print your name) _____, understand the above information and consent to participate in this research project.

Signature: _____ Date: _____

APPENDIX E

Instructor Interview Questions

Participating instructors will be asked to contribute more data via one or two personal interviews. The interviews (lasting 30 minutes each) will be scheduled at a convenient time and location mutually agreed upon by the instructor and graduate student researcher. Interviews may be recorded (with permission) and transcribed. Any identifiable names will be removed from the transcriptions and everyone will remain confidential. They recordings will be destroyed before May 13, 2013.

Interview #1 Questions- Prior to completing online surveys

1. How many years have you taught at the University of Illinois?

2. How many years have you taught science courses?

3. How many hours do you teach per year?

4. What gets you excited about teaching in your courses? How do you do that?

5. If you have the "perfect student" in your class, what are they doing? Why do you say that?

6. What do you do to teach students with diverse learning styles in your courses?

7. Tell me about the assignments in your courses.

8. In your opinion, what makes an excellent scientist? How do you help prepare an excellent scientist?

Interview #2 Questions- After instructor and students complete both online surveys

1. What do you do in your courses? What are your students doing?

2. To what would you compare your students? (ANALOGY)
   block of clay conduit empty pitcher fallow field sponge

3. Were you familiar with Multiple Intelligences before this research project? If so, to what extent?

4. Were you familiar with Learning Styles before this research project? If so, to what extent?

Discuss results of Instructor LS/MI assessments:

5. What Multiple Intelligences were more prevalent in your online evaluation?

6. Were you surprised at the outcome or was it as you expected?

7. What seems to be your Learning styles from the online evaluation?

8. Were you surprised at the outcome or was it as you expected?

9. How do you think the surveys of most college students compare with yours?

10. How do you think your students' surveys compare with yours?

SHOW RESULTS OF STUDENTS' MULTIPLE INTELLIGENCE SURVEYS
SHOW RESULTS OF STUDENTS' LEARNING STYLES SURVEYS

11. Do the student results surprise you?

12. How do you teach your course(s) according to the MI and LS of your students?

13. What changes could be made in teaching science courses to encompass more Multiple Intelligences and Learning Styles to enhance student learning?

14. Do you intend to change anything in your courses to address MI/LS?

15. Are there any obstacles that might keep you from making such changes?

APPENDIX F

Student Consent Form

Animal Sciences-University of Illinois

Learning Capabilities and Preferences of Students in Animal Science Courses

You are being asked to participate in a research project conducted by faculty at the University of Illinois at Urbana-Champaign. Please read the information below and indicate if you are willing to participate by filling out the blanks on the last page of this form.

Research Investigators: The research investigators for this project are UIUC faculty or research assistants, Dr. Walter Hurley and Crystal Allen. Dr. Hurley is a professor in the Department of Animal Sciences at the University of Illinois, Urbana-Champaign. Dr. Hurley is also the instructor of the ANSC 438 course. Crystal Allen is a graduate student in the Department of Animal Sciences.

Project Background: This project involves gathering data from students enrolled in select Animal Science courses at the University of Illinois. Data will be based upon two online evaluations. Materials, information, and data gathered by this project may be used to develop journal articles, teaching essays, book or book chapters, conference presentations, and may be used as part of a PhD dissertation.

Purpose: The purpose of this study is to determine how students prefer to learn and their capabilities within the context of animal science courses at the University of Illinois in comparison to the instructors of such courses.

Participation: Participants for this project will come from students enrolled in Animal Science courses during the Spring 2012 semester. You must be at least 18 years of age to participate. Participation in this study is entirely voluntary. You may withdraw at any time and may request that your data not be used without any negative consequences. Students who may wish to withdraw should contact Crystal Allen at callen@illinois.edu and request to sign a new consent form to supersede the initial form. Your decision to participate, decline, or withdraw from participation will have no effect on your grades at, status at, or future relations with the University of Illinois, including your enrollment in the animal science course. Your participation in this project will involve two online evaluations. This consent relates to your agreement to allow the researchers to use the data generated from these activities for research purposes. Participation will begin upon your signature of this consent form and end in May, 2012 at the end of the Spring semester.

Benefits/Risks: Your participation in this project will enrich the information base in understanding the relationship of student learning capabilities and preferences compared to the instructors of the courses. This project does not involve any risks greater than those encountered in everyday life.

Confidentiality: Although you will need to supply your name on the evaluations, at the end of the semester Crystal Allen will copy the evaluations to be used as data in the research; your name will be erased from the copies, and an identifier number will be used to encode the copies. Only these coded copies will be used in data analysis. Your name will not appear in any resulting publication or other presentation of this research study. The data will only be reported in aggregate or thematic form. Any representative quotes that may be used in summaries of the research findings (presentations or publications) would be attributed to an unnamed subject in the research subject pool. All data will be secured in a locked cabinet in the researcher's office and will be kept for a period of 3 years after the study for future reference. Further, the instructor/researchers will not perform any data evaluation prior to the time final course grades are submitted.

If you should have any questions about this research project, please feel free to contact Walter Hurley at 430 ASL, MC-630, 1207 W. Gregory Dr., Urbana, IL 61801, email wlhurley@illinois.edu or phone 217-333-1327, or Crystal Allen at callen@illinois.edu or 217-265-8497.

If you have any general questions about your rights as a participant in this research, please contact the University of Illinois Institutional Review Board via email at irb@illinois.edu or by phone at (217) 333-2670 (you may call collect).

You may want to keep a copy of this consent form for your files.

Research Project Participation:

- o Yes, you may use both of my online evaluations for research.
- o No, I do not wish to participate in the research project.

I, (print your name) _____, understand the above information and consent to participate in this research project.

Signature: _____ Date: _____

APPENDIX G

NC STATE UNIVERSITY

Index of Learning Styles Questionnaire

Barbara A. Soloman
First-Year College
North Carolina State University
Raleigh, North Carolina 27695

Richard M. Felder
Department of Chemical Engineering
North Carolina State University
Raleigh, NC 27695-7905

Directions

Please provide us with your full name. Your name will be printed on the information that is returned to you.

Full Name

For each of the 44 questions below select either "a" or "b" to indicate your answer. Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

1. I understand something better after I
   - **(a)** try it out.
   - **(b)** think it through.
2. I would rather be considered
   - **(a)** realistic.
   - **(b)** innovative.
3. When I think about what I did yesterday, I am most likely to get
   - **(a)** a picture.
   - **(b)** words.

4. I tend to
   - **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - **(b)** understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   - **(a)** talk about it.
   - **(b)** think about it.
6. If I were a teacher, I would rather teach a course
   - **(a)** that deals with facts and real life situations.
   - **(b)** that deals with ideas and theories.
7. I prefer to get new information in
   - **(a)** pictures, diagrams, graphs, or maps.
   - **(b)** written directions or verbal information.
8. Once I understand
   - **(a)** all the parts, I understand the whole thing.
   - **(b)** the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   - **(a)** jump in and contribute ideas.
   - **(b)** sit back and listen.
10. I find it easier
    - **(a)** to learn facts.
    - **(b)** to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
    - **(a)** look over the pictures and charts carefully.
    - **(b)** focus on the written text.
12. When I solve math problems
    - **(a)** I usually work my way to the solutions one step at a time.
    - **(b)** I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
    - **(a)** I have usually gotten to know many of the students.
    - **(b)** I have rarely gotten to know many of the students.
14. In reading nonfiction, I prefer
    - **(a)** something that teaches me new facts or tells me how to do something.
    - **(b)** something that gives me new ideas to think about.

15. I like teachers
    - **(a)** who put a lot of diagrams on the board.
    - **(b)** who spend a lot of time explaining.
16. When I'm analyzing a story or a novel
    - **(a)** I think of the incidents and try to put them together to figure out the themes.
    - **(b)** I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
    - **(a)** start working on the solution immediately.
    - **(b)** try to fully understand the problem first.
18. I prefer the idea of
    - **(a)** certainty.
    - **(b)** theory.
19. I remember best
    - **(a)** what I see.
    - **(b)** what I hear.
20. It is more important to me that an instructor
    - **(a)** lay out the material in clear sequential steps.
    - **(b)** give me an overall picture and relate the material to other subjects.
21. I prefer to study
    - **(a)** in a study group.
    - **(b)** alone.
22. I am more likely to be considered
    - **(a)** careful about the details of my work.
    - **(b)** creative about how to do my work.
23. When I get directions to a new place, I prefer
    - **(a)** a map.
    - **(b)** written instructions.
24. I learn
    - **(a)** at a fairly regular pace. If I study hard, I'll "get it."
    - **(b)** in fits and starts. I'll be totally confused and then suddenly it all "clicks."
25. I would rather first
    - **(a)** try things out.
    - **(b)** think about how I'm going to do it.

26. When I am reading for enjoyment, I like writers to
    - **(a)** clearly say what they mean.
    - **(b)** say things in creative, interesting ways.
27. When I see a diagram or sketch in class, I am most likely to remember
    - **(a)** the picture.
    - **(b)** what the instructor said about it.
28. When considering a body of information, I am more likely to
    - **(a)** focus on details and miss the big picture.
    - **(b)** try to understand the big picture before getting into the details.
29. I more easily remember
    - **(a)** something I have done.
    - **(b)** something I have thought a lot about.
30. When I have to perform a task, I prefer to
    - **(a)** master one way of doing it.
    - **(b)** come up with new ways of doing it.
31. When someone is showing me data, I prefer
    - **(a)** charts or graphs.
    - **(b)** text summarizing the results.
32. When writing a paper, I am more likely to
    - **(a)** work on (think about or write) the beginning of the paper and progress forward.
    - **(b)** work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
    - **(a)** have "group brainstorming" where everyone contributes ideas.
    - **(b)** brainstorm individually and then come together as a group to compare ideas.
34. I consider it higher praise to call someone
    - **(a)** sensible.
    - **(b)** imaginative.
35. When I meet people at a party, I am more likely to remember
    - **(a)** what they looked like.
    - **(b)** what they said about themselves.

36. When I am learning a new subject, I prefer to
    - **(a)** stay focused on that subject, learning as much about it as I can.
    - **(b)** try to make connections between that subject and related subjects.
37. I am more likely to be considered
    - **(a)** outgoing.
    - **(b)** reserved.
38. I prefer courses that emphasize
    - **(a)** concrete material (facts, data).
    - **(b)** abstract material (concepts, theories).
39. For entertainment, I would rather
    - **(a)** watch television.
    - **(b)** read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
    - **(a)** somewhat helpful to me.
    - **(b)** very helpful to me.
41. The idea of doing homework in groups, with one grade for the entire group,
    - **(a)** appeals to me.
    - **(b)** does not appeal to me.
42. When I am doing long calculations,
    - **(a)** I tend to repeat all my steps and check my work carefully.
    - **(b)** I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
    - **(a)** easily and fairly accurately.
    - **(b)** with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to
    - **(a)** think of the steps in the solution process.
    - **(b)** think of possible consequences or applications of the solution in a wide range of areas.

When you have completed filling out the above form please click on the Submit button below. Your results will be returned to you. If you are not satisfied with your answers above please click on Reset to clear the form.

APPENDIX H

MIDAS SCALES AND SUB-SCALE ITEMS

MUSICAL

Appreciation

1: As a child, did you have a strong liking for music or music classes?
6: Do you spend a lot to time listening to music?
8: Do you drum your fingers or sing to yourself?
9: Do you often have favorite tunes on your mind?
10: Do you often talk about music?
12: Do you have a strong liking for the SOUND of certain instruments or music?

Vocal Ability

3: Can you sing in tune?
4: Do you have a good voice for singing with other people in harmony?
11: Do you have a good sense of rhythm?

Instrumental Skill

2: Did you ever learn to play an instrument?
5: As an adult, have you ever you played an instrument, play with a band or sing with a group?

Composing

7: Do you ever make up songs or write music?
63: Have you ever written stories, poetry or words to songs?

KINESTHETIC

Athletics

5: In school, did you generally enjoy sports or gym class more than other school classes?
6: As a teenager, did you often play sports or other physical activities?
18: Do you or other people (like coaches) think you are coordinated, graceful, a good athlete?
20: Have you ever joined teams to play a sport?
21: As an adult, do you often do physical work or exercise?

Dexterity: Working with Hands & Expressive Movement

17: Did you ever perform in a school play or study acting or dancing?
22: Are you good with your hands at card shuffling, magic tricks or juggling?
23: Are you good at doing precise work with your hands such as sewing, typing or handwriting?
24: Are you good with your hands at mechanics, making things, fancy food, sculpture?
25: Are you good at using your body or face to imitate people like teachers, friends or family?
26: Are you a good dancer, cheerleader or gymnast?

LOGICAL-MATHEMATICAL

Strategy Games

32: Are you good at playing chess or checkers?
33. Are you good at playing or solving puzzle-type games?
34: Do you often play games such as Scrabble or crossword puzzles?
52: How easily can you put things together like toys, puzzles or electronic equipment?

Everyday Skill with Math
35: Do you have a good system for balancing a checkbook or figuring a budget?
37: How are you at figuring numbers in your head?
39: Are you good at inventing systems for solving long or complicated problems?
42: Are you good at jobs or projects where you have to use math a lot or get things organized?
43: Outside of school, do you enjoy working with numbers like figuring baseball averages?

Everyday Problem Solving
38: Are you a curious person who likes to figure out WHY or HOW things work?
47: How well can you design things such as arranging, decorating rooms, building furniture, etc.?
65: How are you at bargaining or making a deal with people?

School Math
28: As a child, did you easily learn math such as addition, multiplication & fractions?
29: In school, did you ever have extra interest or skill in math?
30: How well did you do in advanced math classes such as algebra or calculus?

SPATIAL

Spatial Awareness
45: As a child, did you often build things out of blocks, cardboard boxes, etc.?
48: Can you parallel park a car on the first try?
49: Are you good at finding your way around new buildings or city streets?
50: Are you good at reading road maps to find your way around?
56: Do you have a good sense of direction when in a strange place?

Artistic Design
46: As a teenager, how well could you do any of these: mechanical drawing, hair styling, woodworking, art projects, auto body, or mechanics, etc.?
47: How well can you design things such as arranging, decorating rooms, building furniture, etc?
53: Have you ever made your own plans or patterns for projects, i.e., sewing, carpentry, crochet?
54: Do you ever draw or paint pictures?
55: Do you have a good sense of design for decorating, landscaping or working with flowers?

Working with Objects
32: Are you good at playing checkers or chess?
51: How are you at fixing things like cars, lamps, furniture, or machines?
52: How easily do you put things together like toys, puzzles, electronic equipment?
57: Are you good at playing pool, darts, riflery, archery, bowling?

LINGUISTIC

Rhetorical Skill

64: Are you a convincing speaker?
65: How good are you at bargaining or making a deal with people?
66: Can you talk people into doing things your way when you want to?
68: How good are you at managing or supervising other people?
69: Do you have interest for talking about things like the news, family matters, religion, sports?
70: When others disagree, are you able to say what you think or feel?
72: Are you asked to do the talking by family or friends because you ware good at it?
73: Are you good at imitating the way other people talk?

Expressive Sensitivity
60: Do you enjoy telling stories and talking about favorite movies or books?
61: Do you play with the sounds of words like making up jingles or rhymes?
62: Do you use colorful words or phrases when talking?
63: Do you often write stories, poetry, or words to songs?
64: Are you a convincing speaker?
71: Do you enjoy looking up words in dictionaries or arguing with people about the right word?
67: Do you often do public speaking or give talks to groups?
74: Are you good at writing reports for school or work?

Written/Academic Ability
74: Are you good at writing reports for school or work?
63: Do you ever write a story, poetry or words to songs?
75: Can you write a good letter?
76. Do you like to read or do well in English classes?
77: Do you write notes or make lists as reminders of things to do?
78: Do you have a large vocabulary?

INTERPERSONAL
80: Do you have friendships that have lasted for a long time?
81: Are you good at making peace at home, at work or among friends?
83: In school, are you usually part of a particular group or crowd?
92: Are you an easy person to get to know?
93: Do you have a hard time coping with children?
97: Are you able to come up with unique or imaginative ways to solve problems between people or settle arguments?

Social Sensitivity
84: Do you easily understand the feelings, wishes or needs of other people?
85: Do you often help other people such as the sick, the elderly or friends?
86: Do family members come to you to talk over personal troubles or to ask for advice?
87: Are you a good judge of character?
88: Do you usually take extra care to make friends feel comfortable and at ease?
89: Are you good at taking the good advice of friends?
91: Are you good at understanding your (girl/boy friend's or spouse's) ideas / feelings?

Social Persuasion
66: Can you talk people into doing things your way when you want to?

82: Are you ever a leader for doing things at school, among friends or at work?
90: Are you generally at ease around men/women your own age?

Interpersonal Work
94: Do you ever have interest in teaching or coaching or counseling?
95: Do you do well working with the public, i.e., sales, receptionist, promoter, police?
96: Do you prefer to work alone or with a group?

INTRAPERSONAL

Personal Knowledge/Efficacy
98: Do you have a clear sense of who you are and what you want out of life?
100: Do you plan and work hard toward personal goals, i.e., at school, work or home?
101: Do you know your own mind and do well at making important personal decisions?
102: Do you choose jobs or projects that match your skills, interests and personality?
103: Do you know what you are good at doing and try to improve your skills?
105: Do you have any interest in self-improvement? For instance, did you attend classes...?
106: Are you able to find unique or surprising ways to solve a personal problem?

Self/Other Efficacy
68: How are you at managing or supervising other people?
69: Do you have interest for talking about things, i.e., news, family matters, religion, or sports?
70: When others disagree are you able to say what you think or feel?
80: Have you had friendships that have lasted a long time?
87: Are you a good judge of character?

(METACOGNITION)
Calculations
29: In school, did you ever have extra interest or skill in math?
30: How well did you do in advanced math classes such as algebra or calculus?
35: Do you have a good system for balancing a checkbook or figuring your budget?
37: How are you at figuring numbers in your head?
43: Outside of school, do you enjoy working with numbers like figuring baseball averages, etc.?

Spatial Problem-Solving
31: Do you have any interest in studying science or solving scientific problems?
49: Do you find your way around new places and buildings easily?
50: Are you good at reading road maps to find your way around?
52: How easily do you put things together like toys, puzzles or electronic equipment?
48: Do you parallel park a car on the first try?

NATURALIST

Animal Care
107: Have you ever raised pets or other animals?
108: Is it easy for you to understand and care for an animal?
109: Have you ever done any pet training, hunting or studied wildlife?

110: Are you good at working with farm animals or thought about being a veterinarian or naturalist?
111: Do you easily understand differences between animals, e.g., personalities, traits or habits?
112: Are you good at recognizing breeds of pets or kinds of animals?

Plant Care

55: Do you have a good sense of design for decorating, landscaping or working with flowers?
114: Are you good at growing plants or raising a garden?
115: Can you identify or understand the differences between types of plants?
118: Have you taken photographs of nature or written stories or done artwork?

Science

31: Do you have any interest in studying science or solving scientific problems?
40: Are you curious about nature like fish, animals, plants or the stars & planets?
113: Are you good at observing and learning about nature, for example, types of clouds, etc.?
116: Are you fascinated by natural energy systems such as chemistry, electricity, engines, etc.?
117: Do you have a concern for nature and do things like recycling, camping, hiking, etc.?