EVALUATING INTELLECTUAL DEVELOPMENT OF HORTICULTURAL STUDENTS: The Impact of Two Teaching Approaches Using Perry's Scheme of Intellectual Development as Measured by The Learning Environment Preference

by

CATHERINE CAMILLE LAVIS

B.S., Oklahoma State University, 1986
M.S., Kansas State University, 1993

AN ABSTRACT OF A DISSERTATION

Submitted in partial fulfillment of the

requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Agronomy
College of Agriculture

KANSAS STATE UNIVERSITY

Manhattan, Kansas

2005

ABSTRACT

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collaborative learning, although the voices of several students expressed both benefits and drawbacks of this type of learning. Journal writing did not reveal any changes in students' level of thinking or perception of learning but they did reveal other aspects of student learning and attitudes. An understanding of Perry's Scheme helped the researcher to recognize that student perspective, behavior, and performance is conditioned more by the students' cognitive complexity than by peer interaction or by teaching methodology.

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TABLE OF CONTENTS

LISTS OF FIGURES

LISTS OF TABLES

ACKNOWLEDGEMENTS

Writing my dissertation has been a long, arduous process and without the support of so many people I may never have completed such an undertaking. I have so many people to thank for encouraging me to achieve my goal.

Dr. Tom Warner, my department head, urged me to work toward a doctorate many years ago because he knew the importance of such a worthy goal to my teaching career. I thank you for the suggestion and the encouragement and trust shown to me along the way.

Dr. Jay Ham was instrumental in so many ways; he suggested I perform my research using my passions, teaching and learning; he gave me ideas for my committee members; and he was always available when I had questions, regardless of how ridiculous.

Fortunately, I had excellent guidance and wisdom from my major professor, Dr. Steve Thien, particularly during the final stages of my writing. It was an honor to have such an awarded teacher and scientist as my major professor.

I would like to thank the members of my committee: Dr. Greg Davis, a wonderful friend, fellow educator, and conscientious mentor; Dr. Gerry Posler, a professor whom I've always admired because of his love of learning and I am very thankful to his diligent critique of my writing; and Dr. Jane Fishback, the person responsible for introducing me to William Perry's Scheme of Intellectual Development. Dr. Fishback spent countless hours reading my dissertation and guiding me through the process. She helped me capture my passion for teaching by encouraging me to search for an understanding of student

cognitive complexity, knowing that this understanding would help me become a better educator.

I am blessed to have my fellow faculty members and friends, Dr. Candice Shoemaker and Dr. Kim Williams, who each cheered me on, especially when as my days became longer and more demanding, and I grew more frustrated.

I thank God for my mother, brother and sisters, my close friends, and numerous gardening clients who were all so patient and kind as the demands of my teaching combined with the long hours of writing caused me to reduce the number of hours I spent with them. I know if dad were alive he would be so proud of me. Although my older brother Keith who died before I was awarded my doctorate, I feel I can hear him call me, the professor.

CHAPTER 1

INTRODUCTION

Horticulture has a significant impact on the economy of Kansas according to the Kansas Department of Agriculture (1986). This industry employs approximately 30,000 people, generating three-hundred million dollars annually to the Kansas economy. An evaluation performed by the Department of Agriculture (2005) found the horticultural industry employs 1.04 million people globally. The production of floricultural and woody ornamental plants was the fastest growing sector in United States Agriculture during 2004, generating more than 45 billion dollars. As a result, educated individuals are needed in all facets of horticulture. Kansas State University horticultural graduates are eagerly sought to fill positions in all sectors of this industry.

In 1989 a survey sponsored by the University of Nevada-Reno College of Agriculture asked members of agriculture, agribusiness, and food industries for their opinions of the "ideal agriculture graduate." The responses from those agriculture industries indicate employers earnestly seek college graduates with the skills and ability to solve problems while searching for answers and making decisions. These industry leaders also specified a need to employ individuals with good communication skills, the capacity for teamwork and interpersonal cooperation, and technical skills. As the workforce continues to change globally and technically, horticultural graduates must possess the knowledge and skills required by industry. Universities are being challenged to attain a balance between teaching and research, assessing undergraduate education, globalizing students, diversifying student population, and substantiating education as

their primary focus (W. K. Kellogg Foundation, n. d.).

Horticulture as a subject portrays an image of practicality without a great deal of complexity. Aside from the fact that horticultural specialization curricula involve practical-type skills, horticulture as a field of study combines topics from science, business, communication, and social science (Ingram, Vince-Prue & Gregory, 2002). Horticulture is an integration of art, business, and science (Acquaah, 1999). Horticulture is an art because it embraces manipulative and creative skills in the mastery of working with plants for aesthetic purposes (Acquaah, 1999); and a science because it requires an understanding of soils, chemistry, botany, entomology, plant pathology and physiology, genetics, and mathematics. It is this coalescing of disciplines that makes this branch of agriculture so interesting and it is this blending of topics that come into play when seeking solutions or making decisions. Diagnosing problems in a landscape can be complex and frequently perplexing (Costello, Perry, Matheny, Henry, & Geisel, 2003). Certainly not all plant disorders require an analytical approach (Costello et al., 2003) but the ability to do so is frequently required of a horticulturist. Considering the multitude of plant characteristics and requirements (Greenwood, Halstead, Chase, & Gilrein, 2000), horticultural students must be familiar not only with plants, their problems, and how plants respond to environmental and cultural practices, but they must be able to incorporate this information into numerous scenarios to deal constructively with situations.

A challenge for those teaching upper-division horticultural courses is the diversity of knowledge among students in a typical classroom and many students have different

horticultural skills and experiences than their classmates. Students come together from various horticultural degree specialties (landscape design, greenhouse management, golf course management, turf and landscape management, and horticultural therapy) and different stages in their curricula. Horticultural courses frequently present challenging and complex issues resulting in emotionally charged classroom dynamics. Frequently, individuals with prior experience are reluctant to change incorrectly learned horticultural practices. The beliefs and bias students bring to the classroom, their entrenched ideas and modes of thinking, and their emotional attachments to thought processes rooted in trusted home and prior experiences affect their learning of many horticultural topics. Any instructor who has taught under these diverse situations knows the challenge of facilitating student learning and skill development and as a result of this multiplicity, both the instructor and the students may periodically experience frustration, perplexity, and discouragement (Pascarella & Terenzini, 2005). Theories of cognitive development may help instructors understand and anticipate some of the challenges posed and learning fostered by this diversity.

Theories of cognitive development have been used to illuminate the evolution in college students thinking from simple to complex in many previous studies (Pascarella & Terenzini, 2005). These developmental patterns serve as filters through which students ascribe meaning to their world (Love & Guthrie, 1999). According to William Perry (1970, 1999), the emphasis of higher education should be the development of the individual into an independent thinker. “We believed students who became more complex in their thinking in the classroom could apply that thinking to the complexities

of citizenship in American life" (Perry, 1999, p. xxiv). "One of the hallmarks of a learned and developed person is the use of complex cognitive skills" (Love & Guthrie, 1999, p.1).

To fulfill teaching goals that encourage both a genuine understanding of new information and how to incorporate this new knowledge into the ability for critical analysis, instructors should become familiar with cognitive development theories. An understanding of cognitive development may help instructors design curricula that would encourage critical thinking, a greater openness to conflicting viewpoints during class discussions, and most importantly, the ability to reflect upon one's experiences, prior beliefs, and opinions, from another's perspective. This appreciation of cognitive development may allow instructors to map a students' journey through qualitatively different views of knowledge, from certainty through uncertainty toward relativistic or contextual thought.

Dr. William Perry was the first researcher to study college students' cognitive development (Love & Guthrie, 1999). His theme, like all cognitive-structural theories have their origin from Jean Piaget (1972). These models describe the nature and process of change, focusing on epistemology structures individuals construct to give meaning to their world (Pascarella & Terenzini, 2005). The measurement of intellectual development is cognitive complexity according to the influential cognitive theorist, William Perry's (1970, 1999) scheme of college students (Moore, 1991). Intellectual development, defined by Perry (1970, 1999) refers to the movement a student makes from dualistic meaning making, an objective view of knowledge to a more subjective, relativistic view,

to ultimately a constructivist view of knowledge. Literature supports the importance of complex thinking as a skill necessary for adult life (Love & Guthrie, 1999; Kegan, 1994; King & Kitchener, 1994; Pascarella & Terenzini, 2005; Perry, 1970, 1999). In much of the literature, the term *cognitive development* is used in reference to this movement therefore both this term and intellectual development will be used interchangeably throughout this study.

An awareness of where students are in terms intellectual development may be useful when designing course content with the intent to maximize students' ability to learn not only new information (Allen, 1981), but guiding them in how to use information to draw connections between disciplines and to engage in higher-order thinking, the type of thinking that promotes cognitive complexity.

In order to satisfy both industry requests and the education of students, teachers must recognize that getting students to learn key concepts needed to solve horticultural problems may be more a matter of developing students' brains (Jensen 2000; Leamnson, 1999; Slavkin, 2004) as opposed to instructor performance. The purpose of successful instruction encompasses more than proficiency of subject and the ability to clearly articulate knowledge (Menges, Weimer, & Associates, 1996). Perhaps, developing students to be autonomous may be accomplished by helping students enhance their cognitive complexity through carefully guided challenges and learning experiences that allow the learner to feel good about learning (Duckworth, 1987; Pratt, 2002). Another key educational target should be to help students become independent thinkers. To achieve this, teachers must know what occurs within students' brains when learning

occurs (Fishback, 1998; Leamnson, 1999) and where students are in terms of cognitive complexity. Although an understanding of development theories may be helpful, the difficulty and primary challenge may be the leap required from cognitive development theories to some specific intervention in the classroom (Culver & Hackos, 1988; Stephenson & Hunt, 1977). Sound pedagogy practices, pertinent curriculum materials, activities, and experiences vital to horticultural topics must be included with this knowledge of cognitive development theories.

STATEMENT OF THE PROBLEM

Although there has been extensive research conducted using Perry's scheme of intellectual development of college students (Pascarella & Terenzini, 2005); there has been no research specific to horticultural students. Horticulture as a field of study is rather unique compared with other topics students may encounter during college because there is a strong likelihood that a majority of students had some horticultural experience prior to college. Many students have grown up helping in a family garden or performing yard work alongside parents, while others have experience working on golf courses, or for a landscape maintenance company. Regardless of the experience, many students enroll in horticultural courses with preconceived ideas of course content and a certain amount of confidence in their knowledge base.

It is this very variety of experiences and diversity of horticultural knowledge that are an asset and a challenge to be considered when developing course content or teaching methodologies. The majority of horticultural courses are taught using both lecture and

laboratory. The laboratories provide opportunities to develop skills through hands-on learning. Instructional or curricular approaches selected to encourage these skills may be promoted under both these learning environments.

There is no research to date regarding intellectual development or changes in horticultural students as a result of collaborative learning, specifically inductive questioning and discussions, journal writing, small group work, referred to as consensus groups (Bruffee, 1993), or hands-on projects. According to Pascarella & Terenzini, (2005), "students experiencing instructional interventions designed to increase their intellectual development and skills in addressing ill-structured problems tend to score at more advanced levels on measure of reflective thinking or intellectual development than their counterparts not exposed to the interventions." On a broader base, there are still very few empirically based findings on any one specific technique that encourages higher-order thinking (McMillan, 1987) in college students.

A qualitative study performed by Baxter Magolda (1992) discovered a critical component to encourage higher-order thinking. Baxter Magolda interviewed students throughout their four years in college and discovered the one critical factor that influenced intellectual development was the importance of the teacher defining learning to students as mutually-constructed meaning. When instructors promote mutually-constructed meaning, students engage in thought processes much like critical thinking, of the type required to analyze issues and solve problems (Pascarella & Terenzini, 2005).

PURPOSE OF THIS STUDY

A qualitative phenomenological study was designed using the Learning Environment Preference Inventory (LEP), an instrument based on Perry's (1970, 1999) scheme (Moore, 1987) (Appendix B) as a measure of intellectual development of sixty students enrolled in two undergraduate horticultural courses.

The LEP sought to identify each student's Perry position, i.e., intellectual development, according to the Perry scheme (1970, 1999) at the beginning of the semester versus at the end of the semester and correlate any changes to teaching methodologies. LEP results were then used to identify 18 participants for the semi-structured interviews where they could discuss their learning experiences.

This study was a quasi-experimental design using naturally occurring situations (Keppel & Zedeck, 1989), that is, it used the students enrolled in two courses. The phenomenological approach focuses on exploring how individuals make sense of an experience (Patton, 2002). These experiences must be captured in-depth through interviews to thoroughly describe the phenomenon (Patton, 2002). An objective of this research was to link a student's description of a classroom experience to their Perry position of intellectual development as measured by the Learning Environment Preference Inventory (LEP).

DEFINITIONS OF TERMS

The following definitions are used in this study:

***A*uthority and *a*uthority**: The presumed existence of Absolute truth or knowledge in its own right modifies the perception of the Authority's role, most particularly in an educational institution. The student is there to learn, so they look to the Authority as a mediator between them and truth. Authority is suppose to help them learn, these Authorities consist of many different instructors of varying ages and experiences, it is possible to differentiate between them [to separate those who really know and those who don't] true *A*uthority and fraudulent *a*uthority (Perry, 1999, p. 74).

Brain-based learning: Learning that emphasizes how the brain receives, processes, interprets, connects, stores, and retrieves information (Greenleaf, 2003). Ultimately, brain-based learning is any teaching technique that uses what is currently known about the brain to organize, construct, and facilitate learning.

Capstone Course: An instructor-planned study requiring students to synthesize previously learned information and integrate it to solve simulated or real world problems (Crunkilton Cepia, & Fluker, 1997).

Change: Alterations that occur over time in students' internal cognitive or affective characteristics, can be qualitative or quantitative, it is descriptive and value free (Pascarella & Terenzini, 2005).

Cognition: Cognition is the set of faculties that allow the mind to process inputs from the external world and to determine action in the external world. Cognition comprises perception learning, memory, reasoning and so forth. Basically, we perceive something, we store it in memory, we retrieve related information, we process the whole, we learn

something, we store it in memory, and we use it to decide what to do next. All of these are part of cognition. Cognition deals with acts of thinking that are associated with judgment, reasoning, intuition, perception, and decision-making (Scaruffi, 1998).

Cognitive complexity: The sophistication and depth of one's perceptions as well as how one understands, evaluates, and makes meaning of what is perceived. Specifically, the development of "higher-orders of consciousness" that is, more evolved meaning making (Kegan, 1994). Higher-order of consciousness (or stage of development) determines our relationship to the world in which we live and work. What we perceive as reality—"how things are" or "how I am"—is largely our own construction based on our interpretation of perception.

Cognitive Complexity Index (CCI): The single scoring formula incorporating all the participants' stage scores on the Learning Environment Preferences (LEP) Moore (1987). This single score ranges from 200-500 and measures the complexity of thinking as defined by Perry (1970, 1999) positions two-five.

Cognitive Development: Movement from dualistic, objectivistic view of knowledge to a more subjective, relativistic view to ultimately a constructivist view of knowledge (Hofer & Pintrich, 2002; Perry, 1970, 1999).

Cognitive Structural Theories: Theories that examine the process of intellectual development during college years. These theories focus on how people think, reason, and make meaning of their experiences (Evans, Forney, & Guido-DiBrito, 1998).

Collaborative Learning: An umbrella term encompassing many forms of small group work. A learning situation, or social act of talking which allows two or more students to practice working together when the stakes are low, so they can work effectively together later

when the stakes are high (Bruffee, 1993). This technique emphasizes a shift in authority from teacher to student (Cross & Steadman, 1996).

Constant Comparative: A process of taking information from data collection and comparing it to emerging categories and themes (Creswell, 2002).

Cooperative Learning: Cooperative learning may consist of formal, informal, or base grouping patterns as coined by Johnson & Johnson (1991). Emphasis is on teamwork and individual accountability, teacher may monitor activity, and particularly for formal and base group activities and grades may depend on performance of the group versus the individual in both of these situations. Informal grouping is usually a within class activity requiring a short discussion between two students.

Critical thinking: A pervasive way of being, continually probing and assessing thinking in the pursuit of developing intellectual character, developing a questioning inner voice (Elder & Paul, 1998).

Development: Development involves changes in the organism that are "systematic, [organized, and] successive… and are thought to serve an adaptive function, i.e., to enhance survival" (Learner, 1986, p. 41). Sanford (1967) defined development as "the organization of increasing complexity" (p. 47).

Developmental Instruction: A concept based on cognitive-developmental theory coined by Widick, Knefelkamp, & Parker (1974) that specially designs instruction to promote appropriate educational objectives.

Developmental Theories: Theories or models that address the nature, structure, and processes of individual human growth, these theories focus on intra-individual change, interpersonal experiences are often salient components of these models. (Pascarella & Terenzini,

2005).

Dualism: Position two of Perry's scheme, Multiplicity Prelegitimate. Represents how a person views their world. Knowledge is seen as absolute. Learning is an information exchange between student and teacher (Perry, 1970, 999).

Epistemology: How an individual develops conceptions of knowledge and knowing and subsequently uses these concepts when developing an understanding of the world (Hofer, 2002).

Escape: An alternate experience a student may have in their forward process. Escape is when the student exploits the opportunity for detachment offered by the structures of Positions four and five that may deny responsibility through passive or opportunistic alienation (Perry, 1970, 1999).

Experiential Learning: Specific learning projects designed to provide the opportunities for students develop communication, cooperative, leadership, and technical skills. (Kahn, 1994).

Functional regression: A term coined by Knefelkamp (1999) that describes the backward movement when a student is in a new learning environment and must step back to gain composure of the new knowledge.

Intellectual Development: Involves organized and successive changes in an organism to serve as an adaptive function (Learner, 1986), it also implies that growth is valued and pursued as a desirable educational end (Perry, 1981). Having a highly developed ability to think, reason, and understand especially in combination with wide knowledge.

Intelligence: Intelligence is the ability to solve a problem or generate new problems (Gardener, 1998).

Knowledge: The fact of knowing something gained through experience, association or study (Bransford, Brown, and Cocking, 2000).

Learning Environment Preferences (LEP): An instrument developed by Moore (1987) to objectively assess intellectual cognitive development based on Perry positions two through five of cognitive development (Perry, 1970, 1999). It focuses on five domains and "these domains focus on student preferences for specific aspects of the classroom learning environment shown to be associated with increasing complexity" (Moore, 1987). It is an objective instrument (Appendix B)

Metacognition: "The capacity to think about and examine one's own thinking" (Love & Guthrie, 1999, p. 12)

Multiplicity: The Perry (1970, 1999) positions, three (early multiplicity) and four (late multiplicity), that honor different views when the 'right answer' is not yet known. The student in multiplicity is more receptive to points of view of other students and is becoming better at analytical thinking.

Multiplicity Subordinate: Position three according to Perry (1970, 1999) in which uncertainty is accepted, but there is still a strong desire to find the "true answer."

Perry's Scheme: A theory of intellectual and ethical development that proposes nine hierarchical structures of thought that can be grouped into three distinct ways of thinking (dualism, relativism, and commitment) (Perry, 1970, 1999) (Appendix A)

Position: William Perry's term for his stage theory model of intellectual and ethical development that implies no assumptions about duration and is "happily appropriate to the image or 'point of outlook' or 'position' from which a person views his world" or "positions from which a person views his world." (Perry, 1999, p.54). These positions change, expand,

and become more complex as a person develops and are non-linear. Movement requires motivation to reorganize major personal investments.

Purposeful Sample: A strategy used to select information-rich cases for maximum variation. The identified characteristics selected for this study will be from the LEP results (Lincoln & Guba, 1985). Used primarily with qualitative research to select individuals who will better inform the researcher about the situation being studied.

Problem-Based Learning: A form of instruction that encourages learners to apply problem-solving, critical thinking, and content knowledge to solve real-world problems (Levin, 2001).

Reflective Judgment: A model (King & Kitchener, 1994) that describes cognitive growth from childhood to adulthood focusing on ways that people understand the process of knowing and how they solve ill-structured problems (e.g., global climate change or water quality).

Relativism: In Perry's upper positions (1970, 1999) five, and six [position five on the LEP] (Moore, 1991), students recognize the need to support their opinions and that all opinions are not equally valid, knowledge is viewed more qualitatively.

Relativism Subordinate: Position 4b of Perry's theory (1970, 1999) in which diversity, ambiguity, and differences of opinion are accepted. Ideas can be viewed as better or worse rather than good or bad (Love & Guthrie, 1999)

Retreat: The student entrenches in the dualistic, absolutistic structures of Positions 2 or 3 (Perry, 1970, 1999).

Saturation: "The point of data collection where the information the researcher gets becomes redundant" (Bogdan & Diklen, 2003, p. 258).

Student Development: How a student progresses and grows as a result of enrollment in an

institution of higher educations (Rodgers, 1990).

Temporizing: The student delays in some Position, exploring its implications or explicitly hesitating to take another step (Perry, 1970, 1999).

Triangulation: A research technique that uses multiple methods, data, investigators, or theories to examine a single phenomenon (Lincoln & Guba, 1985).

Upper-Division Course: A college course comprised primarily of juniors or seniors.

LIMITATIONS OF THE STUDY

This study was conducted under the following conditions:

1. This study was limited to one semester of data collection.
2. This study was limited by the use of a paper and pencil instrument, the Learning Environment Preferences Inventory (LEP) (Moore, 1987).
3. This study was limited to semi-structured interviews as opposed to open interviews as used by Perry (1970, 1999) to develop his scheme.
4. The LEP pretest may have raised students' expectations of course outcome.
5. Participants in the interview were selected from their CCI scores according to the Perry scale (1970, 1999). Therefore, any extrapolation of any themes that may develop will be limited in scope, as not all college students function at the same levels found in this sample.
6. In this qualitative study, the researcher is the instrument; therefore, the results depend on the researcher remaining objective and controlling any bias.

ASSUMPTIONS OF THE STUDY

The following assumptions were made for this study:

1. Respondents gave honest and accurate responses on the LEP questions and during interviews.
2. The sample was representative of horticultural undergraduate students at Kansas State University and who, according to the Perry Scheme (1970, 1999), possess the cognitive complexity of Position one.
3. Students classified as juniors and seniors are more likely to have reached higher positions of Perry's scheme (1970, 1999) compared to freshman and sophomores (King & Kitchener, 1994; Moore, 1988).

SUMMARY

This phenomenological study was designed to explore horticultural students' intellectual development as defined by William Perry's Scheme. Perry's theory of intellectual development helps describe the progression in college student thinking from simple to complex. These patterns of development act as filters through which a student ascribes meaning to his or her world. Studies involving intellectual development of college students have been conducted rather extensively, yet there is no research that specifically focuses on horticultural students. Additionally, this study looked at the possible influence of two teaching approaches to intellectual development.

Therefore, this study had the following objectives: 1) explore the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores as a tool to recognize the positions of cognitive complexity of horticultural

students, the nature of this complexity and if gender, age, class status, or previous horticultural experience influence CCI scores; 2) determine if specific teaching methods designed to promote active involvement at a higher level of exchange than traditional lecture would influence scores; 3) describe the effects of the collaborative interactions with classmates and instructor; 4) determine whether student journals can reveal changes in their cognitive complexity or perception of learning as a result of their learning environment and; 5) discover other significant issues that could produce advancement along the Perry scale.

CHAPTER 2

LITERATURE REVIEW

The review of literature contains three sections: the Perry Scheme (1970, 1999); the effects of collaborative/cooperative learning on intellectual growth; trends in teaching methodologies in horticulture; and learning strategies used in this study.

The Perry Scheme: Undergraduate Intellectual Development

William G. Perry, a counselor at Harvard in the 1950s and 1960s, investigated intellectual development in college students, laying the foundation for other cognitive development theories. His research is still relevant for today's college instructors (Moore, 2002), although the scheme was developed more then 30 years ago. Perry's work on early adulthood of college students extended the work of Piaget, Vygotsky, and others whose work focused on children and adolescents (Love & Guthrie, 1999). He is by far one of the most noted theorists of intellectual development in students of higher education (King, 1978; Love & Guthrie, 1999). He was curious to discover how college students reason, think, or make meaning of their experiences. The Perry Scheme (1970, 1999) is a result of extensive qualitative analyses based on epistemological assumptions as a means of describing student experiences and changes that evolved during college. His scheme grew out of intensive longitudinal interviews with college students from 1954-1963 during which he found changes in intellectual development.

Intellectual development as described by Perry (1970, 1999) is the ability to think in more complex ways encouraging the development and practice of metacognition, "the capacity to think about and examine one's own thinking" (Love & Guthrie, 1999, p. 12). Perry's scheme (1970, 1999) outlined how individuals move from right/wrong thinking to the recognition of

multiple viewpoints, to more qualitative thinking. Perry (1970, 1999) developed a model that holds much explanatory power in suggesting how students make sense out of the information, theories, experiences, and opinions that confront them in college classrooms. His theory is comprised of nine different positions. (Appendix A).

Several intellectual development theories (Baxter Magolda, 1992; Belenky, Clinchy, Goldberger, & Tarule; Kegan, 1982; King & Kitchener, 1994; Pascarella & Terenzini, 2005) of college students have grown out of the study performed by William G. Perry at Harvard University during the 1950s and 1960s. Perry's epistemological theory of intellectual and ethical development focuses on how students make meaning in their world and how this may influence further intellectual growth (Evans et al., 1998). A consideration of Perry's Scheme (1970, 1999) may influence curriculum design and assessment. Perry's Scheme has great value to educators who are striving to deal constructively with variations in a student's intellectual development. Perhaps an understanding of this theory can lead educators to strategies for relieving the anxiety and frustrations for those students placed in situations requiring cognitive complexity. Moore (2001, p.7) stated that Perry's work "underscores the notion that the most powerful learning, the learning most faculty really want to see students achieve as a result of their college experiences, involves significant qualitative changes in the learners themselves."

Perry's scheme (1970, 1999) refers to "forms" of intellectual development. These "forms" are the structures that shape how students interpret their learning experiences (Evans et al., 1998), also referred to as, *personal epistemology* (Hofer & Pintrich, 2002); that is, "the beliefs we each hold about knowledge and knowing" (Hofer, 2002, p.3). Personal epistemology shapes how each of us views learning and knowledge and subsequently what we do with this information to develop our own unique understanding of information (Hofer & Pintrich, 2002).

Although his model has weaknesses primarily due to the fact that his interview studies involved only male Harvard undergraduates from white-upper class families, his work on intellectual development helped educators realize there is an evolutionary process of intellectual development, which transpires in college students. The narrow focus of his research on male students caused future research to examine other populations. Perry's model focuses on the connections between individual college students and their process of learning a particular subject. The Perry scheme (1970, 1999) is a representation of both intellectual and epistemological perspectives and how they are interconnected (Moore, 2002).

In Perry's original work, he discovered epistemic assumptions about the nature, limits, and certainty of knowledge. Perry's scheme of intellectual and ethical development postulates that college students move through very distinct positions of intellectual development. As a result of his phenomenological research, Perry identified nine positions that represent a continuum of intellectual development. Perry preferred the use of positions to describe student development because the term implies the "place", or vantage point, from which the student views the world (Love & Guthrie, 1999). In his scheme, and the positions, certain key words are used to describe the fundamental differences in the process of meaning-making; duality, multiplicity, and relativism. In each of these levels, there are three positions. Dualism, multiplicity, and relativism are considered intellectual development positions. The three commitment positions are more emotive in nature since the focus of these positions is on decisions and choices students will eventually make such as, career paths or marriage partners. Perry's theory (1970, 1999) is not concerned with problem solving and the applications of logic as are the concrete and formal operational stages of Piaget's theory (1938). Briefly stated, Perry's model is concerned first with how students move from a *dualistic* (right versus wrong)

view of the universe to a more *relativistic* view, and second, how students develop commitments within this relativistic world.

Perry's scheme tracks the development of student thinking in terms of "the nature of knowledge itself, truths, values and the meaning of life and responsibility" (King, 1978). Most students entering college are not operating in Position one, Strict Dualism. Positions two through five are the focus of this research. Perry's theory suggests that many students enter higher education with rather dualistic sorts of thinking (position two: multiplicity prelegitimate), that is, they view the world in opposites, right or wrong, good or bad, success or failure. In this position, students clutch upon structure and organization. They will be somewhat embarrassed or baffled during classroom discussions or other activities that suggest learning from fellow students (*a*uthority) or contributing their thoughts. They prefer the transfer of knowledge from the teacher (*A*uthority) who is the good Authority on the subject while fellow students or student teachers are viewed as bad authority. They do not like exams or assignments that require unguided, independent learning. They often become frustrated or irritated when confronted with learning situations that require them to determine the correct mode of action to find solutions. In classes where problems have multiple answers, these students have difficulties, and they protest against open-ended problems.

The study by Belenky et al., (1997) found men appear to identify with the authority figure while women do not. The positions within dualism vary as to the degree of uncertainty, either all or nothing, or "maybe we just don't know the answer right now" (Perry, 1970, 1999). Other studies (Moffatt, 1989; Pascarella & Terenzini, 2005) have reaffirmed the importance of residence halls and social interaction in the development of students. Students may start in this position as they enter because of a culturally homogeneous or narrow environment, but they will

quickly lose their innocence at a university.

Transition into multiplicity legitimate (position 3) seems to occur when students encounter cognitive dissonance. Perry (1970, 1999) defines multiplicity as one of honoring several views when a correct answer is not readily known. Students in early multiplicity may begin to question systems of grading or methods of evaluation both to the instructor and fellow peers. The methods for evaluation become a very important issue and students want the amount of effort put into something to count. According to Perry (1970, 1999) students will attempt to find out what an instructor *wants and then try to give* it to them. Education appears to play a significant role in the shift to multiplicity for men, more so than for women (Belenky et al., 1997). From a developmental sense, one problem with some horticultural courses is that there are not many challenges at the lower levels to move the student into position three or four. In horticulture the challenges of multiplicity usually come in upper-division courses. Some lower-level college classes are usually taught as if everything is known (Perry 1970, 1999). This can lead to severe stress for students in upper-division courses where multiple answers are expected and they are suddenly expected to function in a world with multiple answers (Evan et al., 1998). In addition, students who are academically very good can often hide from the challenges of multiplicity through competence.

As students move through position three and into position four they recognize themselves as independent thinkers, shifting from "*what they want*" to "*the way they want us to think*" (Perry, 1970, 1999). Student in this position seem to react in two different ways (Love & Guthrie, 1999). The student tries to retain a dualistic right-versus-wrong position but realizes that there are areas of legitimate uncertainty and diversity of opinion. They may conform to what authority seems to want and learn the forms of independent intellectual thought (Evan et al,

1998). These students learn that *independent-like* thought will earn them good grades. Genuinely independent thought has not yet been achieved or even considered as an issue. Most of the students Perry studied took this route (Perry, 1970, 1999). Women in this position may feel silently alienated from college whereas men fight authority openly (Belenky et al., 1997) such as arguing about exam questions. Some students in this position my elect *escape* temporally (Perry, 1970, 1999).

Position five, relativism, of the Perry scheme finds students becoming more comfortable with their own thoughts and in making decisions and value choices by considering all options available and then arriving at their own conclusions or choices, but this transition takes years, not months (Perry, 1970, 1999). Switching from position four to position five is a rather radical shift (Love & Guthrie, 1999). Individuals see knowledge as contextual and relative. In position five, relativism becomes the common characteristic of everything and absolutes are a special case, students recognize the need to support their opinions (Love & Guthrie, 1999). They begin to realize there can be a difference in opinion of accuracy or correctness. They are not as disturbed to find that Authorities disagree. It is at this point they begin to realize they view the world differently than their peers. They are just beginning to form their own conclusions as a result of personal observation and critical thinking---the development and practice of metacognition. The relativistic thinker tends to roll new ideas around in his/her own head, either accepting or rejecting them by making their own judgments. Students in position five now see a good instructor as a source of expertise, but recognize the teacher may not know all the answers since many answers are unknowable (Perry, 1970, 1999). This professor helps students become adept at forming rules to develop reasonable and likely solutions or solution paths. It is important for the professor to show that good opinions are supported by reasons.

Belenky et al., (1997) noted that men and women may use different logical procedures in position five, which they called “procedural knowledge.” Most men and some women use the traditional logical approach with objective analysis and argument to form opinions. This s*eparate knowledge* or *objective knowledge* (Palmer, 1983) purposefully removes the person’s personal experiences and feelings from the logical analysis. Perry (1970, 1999) describes position five as very powerful.

Unique to Perry’s cognitive development scheme (1970, 1999) in contrast to other developmental theories are the alternatives to growth students may experience in their upward movement, these alternatives are referred to as, *escape, retreat*, and *temporizing* (Love & Guthrie, 1999). Another alternative to growth was identified by Knefelkamp (1999) as, *functional regression*.

Escape describes students who avoid moving beyond relativism to commitment making in a relativistic world. Here students recognize it is easier to remain in this stage than to face the difficulty of making commitments and personal choices. Retreat transpires when the student moves back into the safety and security of dualism, where ambiguity does not exist, this may occur when a student doesn’t understand an instructor’s stance on exams or class discussions. Temporizing occurs when an individual remains in a position, hesitative to make a change even though they may recognize the next position (Perry, 1970, 1999). Functional regression describes when a student is in a new learning situation and regresses until they feel comfortable. Knefelkamp (1999) suggests that this regression is developmentally appropriate because students must move backward in order to get their bearings. Perry as well as other researchers working with the model began to see the journey of development as more fluid and recursive (Moore, 2002).

According to Knefelkamp, Widick, and Stroad (1976), dualistic and relativistic thinkers may resemble each other on the surface. For example, just because a student has a strong opinion doesn't mean they are relativistic thinkers. The distinguishing factor is the degree of examination and reflection of thought supporting his or her opinion.

In Perry's positions six through nine, students begin making choices and decisions in a contextual world, these are the "ethical developmental" positions on Perry's continuum (Evan et al., 1998; Love & Guthrie, 1999). These positions are not the focus of this research and will not be discussed further.

Perry's view is that development does not occur in a linear fashion. Frequently, students experience times of reflection, when movement ceases. Intellectual development may be "put on hold", or there may be times when one retreats back into dualistic modes temporarily, particularly when exposed to new situations or information.

Changes in Perry's position can neither be forced, nor imposed onto students; each student must discover higher-order thinking on his/her own, in their own time (Perry, 1970, 1999). Perry emphasizes movement is slow but a certain amount of dissonance does encourage change. Other literature sources also suggest that teaching techniques that challenge and at the same time support students in a relaxed learning environment may promote upward movement on the Perry scale (Stephenson & Hunt, 1977; Widick et al., 1975). Developmental instruction strategies such as discussions that result from strategically asking questions or working in small groups to solve problems, may help promote the movement into higher positions of intellectual development as described by Perry because these styles of learning promote student involvement and asks students to take responsibility for their own learning.

Essentially Perry's theory emphasizes the learning many college teachers would like to

see students attain as a result of their experiences in class, the learning that involves significant changes in the way learners approach their learning and the topic (Moore, 2002). Perry's scheme helps to define student development so assessment can become more defined and used as a diagnostic tool. It may help in determining how much change can be expected and what causes students to adopt a more complex mode of thinking. Gaining an understanding of intellectual development theories may be useful when devising teaching methods to encourage higher-order thinking, the type of thinking that would moves students into a more relativistic thinking.

The Learning Environment Preferences (LEP) instrument developed by William Moore (1980) (Appendix B) was designed to measure changes in cognitive complexity based on Perry's scheme (1970, 1999). This database can be used to establish legitimate and realistic development goals for students and help teachers with planning learning activities (Rodgers, 1980). Without this information, we are only guessing at the teaching strategies that might work to promote higher-order thinking.

A Background on Collaborative/Cooperative Learning and the Influence on Intellectual Growth

Today's college students are exposed to a multitude of teaching methods as they progress through their college careers (Pratt et al., 1998). Many instructors use strict lectures formats, while some are finding the incorporation of collaborative learning advantageous (Menges et al., 1996). A growing number of courses are offered on-line, with little to no verbal interaction between instructor and student.

In conjunction with how information is disseminated is the quandary of how this information is received and then processed by the learner (Marzano, Pickering, & Pollock,

2001). Some students view new information as a set of facts and are passive receptors of knowledge (Pascarella & Terenzini, 2005). This type of student wants to be told what will be on the exam. A few students are more contextual, integrating new information into what they already know, actively cooperating to construct new knowledge (Love & Guthrie, 1999). According to the Partnership for the 21st Century Skills (2005), students graduating today need "knowing how to learn skills." These types of skills will equip students to acquire new knowledge and skills along with the ability to connect this new information to existing knowledge, to analyze, and to work with others based on the information.

The predominant method of instruction on college campuses is still lecture (Bonwell & Eison, 1991; Fink, 1989; Finkelstein, Seal, & Schuster, 1998; Gardiner, 1996; McKeachie, 1980; Pascarella & Terenzini, 2005). It cannot be denied, there are times when telling students something and having them memorize or learn the facts are still vital pedagogical activities (Bruffee, 1993, McKeachie, 1990; Pascarella & Terenzini, 2005). Presumably lectures have prevailed as a popular format among both new and senior faculty because it is familiar, easy, safe, and well accepted (Eble, 1976). It is also the method a majority of educators experienced as college students. Frequently, foundation courses demand little more then rote learning, particularly when gaining factual knowledge. To most college students, attending lecture, taking notes, then memorizing information for exams is a familiar pattern of learning. Memorizing factual information for exams is commonly practiced at all levels of education, resulting in many students being highly proficient in this format of test taking that only requires basic knowledge and comprehension to succeed (Dale, 1977). Learning the facts is a critical component of learning and in the hands of a skilled teacher, an effective method of delivery of critical aspects of course contents (Pascarella & Terenzini, 2005). Facts are important for thinking and problem

solving (Bradford et al., 2000). Studies clearly show useable knowledge is not just a memorized lists of facts (Bradford et al., 2000).

However, if a person is knowledgeable about plant cells and tissues they know more than just the facts, they understand why each has a particular function. To understand relationships between structure and function of plant cells and tissues, these knowledgeable people are more likely to be able use the facts they know to solve problems and they know how to transfer their knowledge to other contexts. The primary objective of higher education should be the promotion of intellectual development to equip students with the skills and ability to apply their knowledge and problem solving abilities to a variety of circumstances and environments (W. K. Kellogg Foundation, n. d.)

As society continues its technological evolution and fast-pace life style, so too must educators in higher education evolve by using a combination of teaching methods to promote active student involvement that ask more than rote memorization (Kulik & Kulik, 1979; McKeachie, 1990). Educators may need to recognize that lectures may not encourage the type of thinking required to move information from short term to long term memory, nor that lecturing exclusively promotes higher-order thinking (Bonwell & Eison, 1991; McKeachie, 1990; Pascarella & Terenzini, 2005). What ever the format of instruction, teaching should guide students to independent discovery.

Traditional college lectures encourage students to be passive receptors of knowledge because they lack of involvement in their own learning (Frederick, 1989; Pascarella & Terenzini, 2005) other than *taking* notes. Traditional lecture may not teach to each style of learners causing some educators to wonder how the brain works the best to process new information. Eric Jensen (2000, p. xiii) poses this question to educators, “How does the brain learn best?” And, “How do

we create successful learning organizations with the brain in mind?" These questions invite educators to consider not only what works to help students learn, but why particular educational practices work (Jensen, 2000). Francis Crick (1994), the Nobel Prize winning scientist, describes the human brain as "massively parallel", that is, when learning, the human brain understands complexity better when our senses are enriched one way or another, much better than when a topic is read or heard alone (Jensen, 2000).

Students need to be participating to some degree for knowledge to be stored in long-term memory (Bonwell & Eison, 1991). William Perry stated, "students are not potted plants to be watered in some academic hothouse" (Knefelkamp, 1999, p. xiii). Students must to be engaged and interactive with both faculty and peers in order to ensure learning is stored in long-term memory (Bonwell & Eison, 1991). The qualities often required to evaluate, analyze and solve problems and, are not usually learned through passive learning (Chickering & Gamson, 1987) but when the information is used repeatedly the brain synapses become permanent (Leamnson, 1999.)

For students to understand and retain new information, educators must do much more than lecture; students must be involved in the learning process (Chickering & Gamson, 1987) and to teach higher-order thinking, educators must demonstrate high-level thinking (Jensen, 2000). Active learning promotes understanding and retention of knowledge (Bonwell & Eison, 1991; Chickering & Gamson, 1987; McKeachie, 1999). Active learning emphasizes student participation, increasing the effectiveness of teaching and promoting better comprehension and retention of information (Fife, 1991). According to McKeachie, Pintrich, Lin, Smith, and Sharma (1986) discussion, reading, writing, and problem solving are preferred to lecturing for long-term memory storage. When students are actively involved in learning, they are far more likely to

succeed (Dewar, 1995; Hartman, 1995). Although there is little evidence to support that particular teaching methodologies cause students to think more critically (Bok, 1986; Erickson & Strommer 1991), what can be cultivated, is the habit of thinking (Leamnson, 1999). Students involved with faculty in a collaborative fashion create knowledge that "enriches and enlarges them" (Matthew, 1996, p.103). Regardless of the discipline, students who are challenged and exposed to multiple views and interpretations are cultivated for cognitive growth (Kloss, 1994). Perry (1970, 1999) and his colleagues found that as students made the shift from "*what they* (instructors) *want*" to "*the way they* (instructors) *want us to think*," they were beginning to learn to think independently out of desire to please the instructor. Thus, if instructors have high expectations, students tend to rise to the challenge, particularly as they transition to more qualitative thinking. A reminder that instructors cannot lower teaching standards or expectations to gain higher evaluations from students, particularly if increased cognitive complexity is an educational goal.

A study performed by Dressel and Mayhew (1954) demonstrated changes in critical thinking as a result of curriculum alterations. Their research first identified five critical thinking skills. They then conducted research demonstrating how curriculum and teaching strategies could be used to promote critical thinking. Missing from their research were specific teaching methods that encourage higher-order thinking.

Thirty years later, McMillan (1987) reviewed literature that was specific to instructional or curricular interventions on critical thinking. From this critical review of literature, McMillan (1987) could not pinpoint one single instructional variable that consistently enhanced critical thinking, although attending college clearly does heighten these skills (Pascallera & Terenzini, 2005). The college environment that challenges and is bonded with support, does seem to

enhance cognition (Jensen, 2000).

McKeachie et al. (1986) suggests implementing discussions that place explicit emphasis on problem solving practices and techniques may raise critical thinking skills. Moll & Allen, (1982) employed problem solving discussions in a biology course (Moll & Allen, 1982) with some positive responses from students.

In a study performed by Winter, McClelland and Stewart (1981), they showed strong support to the effects of curricula intervention merging two different course topics into discussions. From the results of their research, when students experienced the integration of two or more disciplines at the same time, they saw greater cognitive growth than when students studied the same material in different courses. This is consistent with Forrest (1982) who surmised that integration of general education into curricula influences critical thinking and reasoning skills in college students (Pascarella & Terenzini, 2005). A study by Trank and Steele (1983) investigated how a one-semester course in rhetoric could influence cognitive development by integrating other curricula topics. Their study used an alternate form of ACT called COMP for speech and writing. This test consisted of a pretest and posttest. They found a significant gain in scores that were lower initially.

A correlational study (Karabenick & Collins-Eaglin, 1996) using 1,000 students in 57 classes suggests why there is an increase in cognitive skills using collaborative or cooperative learning. They found students were more likely to use learning strategies of elaboration, comprehension monitoring, and critical thinking when the emphasis is less on grades and more on collaboration. Elaboration is the attempt to integrate ideas in one class to ideas from other courses (Pascarella & Terenzini, 2005). There is an extensive amount of literature supporting higher-order learning strategies lead to higher-order thinking skills (Pascarella & Terenzini,

2005).

Stephenson & Hunt (1977) studied the impact of course-based intervention on twenty-one college freshmen to facilitate changes in cognitive development along the Perry continuum (1970, 1999). Their study showed how course intervention founded on intellectual development theory could influence changes in Perry's positions. The study was carefully designed using engaged learning to advance dualistic students along the Perry continuum. The treatment course was devised to challenge students' cognitive constructs within a positive teaching paradigm while the comparison course was taught using traditional lecture with minor class discussion and little instructor guidance. In the comparison course, the instructor offered little support or direction with class projects, leaving the decisions up to the individual student to tackle on his/her own. The instructor had no knowledge of intellectual development theories and appeared more preoccupied with other duties rather than teaching. Students in both courses took a pretest and posttest using two instruments, KneWi and the Defining Issues Test (DIT), specially designed to measure intellectual development on the Perry continuum. Results of this study indicated an upward movement on the Perry scale as a result of curricula intervention and encouragement. Although the instruments, KneWi, developed by Knefelkamp and Widick (1974) and the Defining Issues Test (DIT) developed by Rest (1973) were used in this study as opposed to the LEP, these instruments were developed to measure development on the Perry scale. The KneWi is composed of ten sentence stems and two paragraph completion items. The DIT is an objective test consisting of ten moral dilemmas. Findings from this study suggest change can occur in the Perry position in a short period of time (11 weeks). The length of their study on the quarter system has been questioned by McMillan (1987), but Kloss (1994) indicates that there can be position movement in one semester, and that is enough, because too much

complexity can back-fire causing *retreat*. Kloss emphasizes “a nudge is better than a shove” (p. 153).

Other studies suggest that “cognitive conflict or dissonance which forces individuals to alter the constructs they have used to reason about certain situations” (Widick et al., 1975, p. 291) can promote changes in higher-order thinking. Widick & Simpson (1978) reported similar findings showing changes in critical thinking as a result of teaching interventions emphasizing challenge to students’ cognitive structure under a supportive learning environment. If an instructor uses applicable and challenging teaching methods and curricula, students will become better with their reasoning and critical thinking skills (Young, 1980).

Collaborative learning and consensus groups (Bruffee, 1993) cause students to depend on one another rather than depending exclusively on the instructor. This type of learning encourages students to construct knowledge as a team. Ultimately, this is a skill students will need and use in their careers.

Trends in Horticultural Teaching Methodologies

Hands-on learning is not a new concept in horticultural instruction; most universities and community colleges implement some experiential learning and sociocultural learning in addition to traditional classroom lectures (Davis, 1999; Stearns, 1995; Trexler, Haynes, & Davis, 2003). “Learning by Building” (Spafford, 2005) is a landscape construction studio that engages students in experiential learning and service work while simultaneously applying knowledge gained during lecture. Instructors in large lectures are creatively incorporating activities that encourage class attendance and participation (Markhart, 2005). A majority of horticultural courses are taught in conjunction with laboratories that are designed to give students the hands-on learning

required to develop particular skills, such as, pruning, site measurement, soil sampling, and tree climbing.

The experiential learning approach is the basis behind the National Future Farmers of America Organization which was established in 1928 to promote learning by doing. Experiential learning projects are designed to give students the opportunity to apply theory to real-life situations (Davis, 1999). These projects help students develop such skills as problem solving, communication, group interaction and the facilitation of life-long learning.

According to Sterns (1995), the experiential landscape construction project he developed for his students, allowed him to serve as a facilitator of knowledge rather than merely delivering information. Real-learning projects can bridge the gap between college and community for students, such as the group of horticultural students who teamed up with Habit for Humanity to design and install a landscape (Davis, 1999). This type of experiential learning benefits students by focusing their attention on not only on their horticultural skills but also on social and civic responsibilities students will face as citizens in a larger community. These types of projects are actual and applicable and especially beneficial to students because of the input from the instructor. The interaction with clients improves the students' education, allows them to implicate what they have learned in the classroom, and ultimately improves their benefit to future employers.

Capstone courses have also gained popularity as a component of many horticultural programs (Rhodus & Hoskins, 1995). Capstone courses provide students the opportunity to demonstrate their acquired abilities in a broad range of professional competencies. Incorporating case studies or a research project into student programs will aid development of critical thinking and problem solving skills. Generally, capstone courses target undergraduate students that are

nearing the completion of their degree program. Capstone projects may help encourage students to draw connections between disciplines and to engage them in higher-order thinking. Incorporating a capstone course near the end of a curriculum allows students to witness and demonstrate the knowledge gained from their horticultural major. The drawback may be that this allows very little additional time to improve or hone their skills prior to graduation.

A 2003 polling of Michigan State agricultural graduates emphasized the need for continued integration of computer use into the curriculum to prepare students for the 21st century workforce (Suvedi & Heyboer, 2004). The use of computers is playing an increasing role in teaching horticulture. Employers are placing more significance on computer skills in the green industry, particularly in areas of inventory control and record keeping. Integrating technology into horticultural courses encourages additional types of interaction for students to facilitate learning while reinforcing what has been learned in previous courses (Davis & Gilman, 1995). Students employed computer aided design (CAD) and other software to create useable plants lists for future use in their designs. In the past, students relied on reference books, plant catalogs, and knowledge gained from previous plant identification courses to make plant selections for their designs. By utilizing computer programs, the student is required to interact with the program by answering questions related to a site as they search for appropriate plants, so the student must use previously learned information to achieve their goal aside from looking at plant photos (Davis & Gilman, 1995).

Another study that examined web-based instruction of horticultural students (Spaw, Williams, & Brannon, 2004) suggests certain advantages to merging traditional lecture with web-based information and case studies. This format of instruction provides both interaction and repetition, equally beneficial to student learning. The findings from this study show test scores

increased when both methods were used simultaneously. The addition of web-based technology as indicated in this study could prove useful encouraging higher-order thinking.

Using alternative teaching environments outside the classroom offers a variety of learning experiences that engage and challenge students, such as the design and installation of a medieval garden at Pennsylvania State. The students surveyed the site, performed general excavation, and other construction skills required to complete the hardscape project. Their work was critiqued throughout the project by the instructors (McGann & Berghage, 2004). This type of hands-on learning not only serves the current class of students but also can be used in future years as an outdoor classroom. Similar projects have been performed at Kansas State University Gardens. Students gain hands-on experience pruning, planting, building hardscapes, and maintaining the gardens. When the gardens are used for the laboratories in Landscape Maintenance class, students overwhelming voiced strong agreement to the value of these hands-on experiences because they reinforce theories learned in the classroom.

LEARNING STRATEGIES IMPLEMENTED IN THIS STUDY

Questioning and Discussion during Lecture

The purpose of using guided discussions in class is to help develop student understanding and reasoning skills that further promote comprehension of a topic and enhance long-term retention (McKeachie, 1990). Guided discussions are informal but their aim is to ask questions and pose problems requiring higher-order thinking (Wilen, 1990). Research indicates it is essential for educators to design questions that call upon prior knowledge to encourage higher-order thinking (Marzano, Pickering, & Pollock, 2001). Questions designed to encourage students to gain a deeper understanding of a concept, eventually increase their interest in that topic

(Alexander et al., 1994).

Gilman (2003) reported some success using discussion formats in a horticultural nursery management class for four consequent years to encourage student interaction. Gilman (2003) found this allowed students to tenaciously discuss their views, leaving the class with a better understanding of the issue, as well as a realization that there might be more than one possible answer or solution to a problem. Questioning students may lead them to critically examine their basic assumptions and recognize the ambiguity and complexity of horticulture (Gilman, 2003).

Studies suggest teachers who ask specific kinds of questions and use discussion strategies necessitating analysis of information have been more successful than others in promoting higher-order thinking (Cunningham, 1971; Hunkins, 1972; Winne, 1979; Redfield & Rousseau, 1981). Questions requiring students to restructure information or apply knowledge in some way are considered higher-order questions (Marzano, Pickering, & Pollock, 2001). Higher-level questions tend to produce deeper levels of learning (Osman & Hannafin, 1994; Pressley, Tenebaum McDaniel, & Wood, 1990). Unfortunately, much of the research indicates a majority of teachers ask lower order questions, of the type asking students to recall or recognize information (Fillippone, 1998; Guszak, 1967). Nixon-Ponder (1995) propose using inductive questioning to lead students into discussions requiring them to think beyond their notes. Asking inductive questions requires more preparation and planning by the teacher to achieve pedagogical objectives. Educative questioning can have a strong influence on learning and may be the single most influential teaching method (Taba, 1966).

Dr. Benjamin Bloom, an educational psychologist, developed a learning taxonomy (Anderson & Krathwohl, 2001) that recognizes six levels of learning or thinking; knowledge; comprehension; application; analysis; synthesis; and evaluation. The levels have a hierarchy

suggesting progression to each level requires achieving success of its predecessor(s). The mastery of the concepts in the learning taxonomy has potential for improving instruction, particularly questioning. Discussion questions designed utilizing Bloom's taxonomy may help students understand how to answer similar questions on exams. Anderson and Krathwohl (2001) revised Bloom's taxonomy to incorporate both the kind of knowledge to be learned (knowledge dimension) and the process used to learn (cognitive process). This allows the instructor to efficiently align objectives to assessment techniques for course content.

A study performed by Ellner and Barnes (1983) determined only 4 percent of classroom time was spent asking questions and only 18 percent of those questions required higher-order thinking, application, analysis, synthesis, or evaluation, while 63 percent of questions asked by teachers required recalling specific facts, such as, defining, describing, labeling or listing. The remaining 19 percent were administrative questions not pertaining to the subject matter.

Well-structured questions should be worded so students know exactly what is being asked and they should fit the curriculum objectives (Marzano et al., 2001). Educators should consider using questioning prior to a new learning experience. A pre-question may help establish a mental state that would help students process the learning experience (Marzano, Pickering, & Pollock, 2001). Good questions should require active and reflective involvement (Sanders, 1990). Students should be told prior to implementing this format what is expected (Dillon, 1990). It is important to ask the question prior to naming a person to respond (Sanders, 1990) and pausing long enough to allow students time to think is essential (Miller & Rose, 1975; Tobin, 1987). Instructor silence is crucial to the questioning process and cannot be overlooked. Pause time demonstrates confidence in students to respond (Dillon, 1990) and may even increase the depth of their answers (Marzano et al., 2001).

If a supportive, encouraging environment has already been established, students are more likely to risk responding (Bonwell & Eison, 1991). An encouraging environment does not guarantee participation by all students; frequently, only a few students consistently answer questions, a problem when trying to promote higher-order thinking (Sadker & Sadker, 1992). The mood and tone an instructor sets in the classroom cannot be understated, and may even influence student development (Cabrera, Colbeck, & Terenzini, 2001). Additionally, be sure to listen and then emphasize the correct answer without embarrassing the student. The teaching environment should respect the uniqueness of each learner (Jensen, 2000). Clarification, asking more probing questions, may be required to broaden their thinking further (Sanders, 1990).

Those instructors who have high expectations may encourage intellectual development (Perry, 1981). Perry (1970, 1999) found that a majority of college students thinking shifted from "what they want" (position 3) to "the way they want us to think" (position 4b) so the paradox that Perry (1970, 1999) discovered was that students were thinking critically and independently out of a desire to play the game to the expectations of Authorities (their instructors). As Perry speculated (1970, 1999), encouraging students to think may possibly be "the lever that will move knowledge from dualistic thinking to qualitative reasoning."

Therefore, teachers should design questions that correspond to respective intellectual positions of their students. If the instructor becomes skilled at asking higher cognitive questions requiring students to mentally manipulate bits and pieces of previously learned information to answer questions or to support an answer with logically reasoned evidence they may encourage independent thinkers, but this still does not assure success in raising all students' intellectual thinking (Samson, Strykowski, Weinstein, & Walberg, 1987; Winne, 1979).

Collaborative and Cooperative Learning

Many classrooms in higher education are using a variety of collaborative learning activities for example, case studies, consensus group work, modified lectures that include demonstrations, or student-generated questions and discussions, each of these examples gives students the opportunity to work together solving problems and constructing knowledge while focusing on critical thinking skills (Bonwell & Eison, 1991; Bruffee, 1993, Menges et al., 1996). Although, there is little concrete evidence supporting the argument that specific cooperative learning methods are more effective than lecture in teaching subject matter content, there is enough evidence to conclude that development of critical thinking can be enhanced by purposeful instruction and practice in critical thinking and problem-solving skills (Pascarella & Terenzini, 2005). Additionally, research does suggest collaborative group practices are more successful when the goal of instruction is higher-order cognitive skills (Pascarella & Terenzini, 2005).

As defined by Bruffee (1993), "collaborative learning is students working on focused but open-ended tasks discussing issues in small consensus groups; planning and carrying out long-term projects in research teams; tutoring one another; analyzing and working problems; puzzling through difficult lab instructions together; reading aloud to one another what they have written, and helping each other edit and revise research reports and term papers." An epistemological perspective, social constructionism, suggests that people gain knowledge better when working with others rather than individually (MacGregor, 1990), an important element of problem solving both during and succeeding college years. Learning will not occur until the learner does something with the new information, so when the learner becomes actively involved connections are made with the learner's personal knowledge structure (Menges et al., 1996). Active learning

does not require a total course overhaul but can be accomplished by inserting it into any instructional template, even the lecture (Menges et al., 1996).

McKeachie's best answer to the most effective teaching method is, "Students teaching students" (McKeachie et al., 1986, p. 81). Collaborative learning is the result of students and teacher working together to create knowledge (Menges et al., 1996). "A class engaged in collaborative learning looks and feels different than a traditional classroom" (Matthews, 1996). This type of learning assumes students bring their experiences and ideas to the learning situations enriching all involved (Matthew, 1996).

A study by Gruber and Weitman (1962) found students performed better on final exams after working in small consensus groups to discover answers rather than hearing solely from lecture. Collaborative learning reduces student competition without reducing motivation (Slavin, 1990; Johnson & Johnson, 1994). A student led discussion in smaller groups appears to be more comfortable and safe, particularly for those students who might otherwise not participate in a larger setting (Webb & Grib, 1967; Johnson & Johnson, 1994). When students know they will be involved in collaborative learning situations that require sharing information with fellow group members, they gain deeper knowledge of the information and are typically better prepared (Bargh & Schul, 1980) than those attending traditional lecture.

Johnson & Johnson (1994) define five defining elements of cooperative learning: positive interdependence; face-to-face promotive interaction; individual and group accountability; interpersonal and small group skills; and group processing. Johnson & Johnson (1999) identified three types of cooperative learning situations; formal, informal, and base group. Formal requires that students work together for enough time to complete an assignment. Informal groups last from a few minutes to possibly the entire class, e.g. are pair-share and turn to your neighbor

activities. Base groups last the entire semester and frequently this is the least desired by some students, primarily due to the difficulty of scheduling time together.

In general, most horticultural courses have a combined lecture-laboratory teaching arrangement. The lecture time is usually fifty minutes, meeting twice or three times a week, while a laboratory generally meets for one hour-fifty minutes. Laboratory is well suited to emphasize problem solving because students usually work in pairs or groups. Laboratory time lends itself to students being able to explore, apply, and practice information, especially with hands-on activities. But, laboratory time may not be any more valuable in terms of problem solving that may encourage higher-order thinking than traditional lecture if students don't understand the information initially (McKeachie et al., 1986). Like any teaching method, it is important not to overuse collaborative or cooperative learning strategies, but these methods do offer flexibility and are powerful learning tools that may promote higher-order thinking (Marzano, Pickering, & Pollock, 2001).

In summary, the literature indicates much progress has occurred during the last 30 years in understanding how learning occurs and how to use this information to help make teachers more effective, but according to Pascarella & Terenzini, (2005), it would be a stretch to say what *causes* effective teaching has now been established This is not suggesting there were not effective teaching strategies prior to this, but teaching is rapidly becoming a science rather than an art (Marzano et al., 2001).

Journal Writing to Encourage Self-Reflection on Learning

The use of journal writing is an unfamiliar practice to most horticulture students. Just the thought of writing, much less about one's own learning is perceived by most students as

unappealing or regarded as just another bothersome or busy-work assignment (Lowman, 1996). Lowman (1996) proposes students dislike writing because independent thinking and the ability to write clearly are difficult for most students.

To achieve the aspired benefits of journal writing, instructors would be wise to explain the objectives and goals of journal writing. The teacher should stress that this type of writing is being used to stimulate students' thinking about course topics, problems, and issues (Boud, 2001: Moon, 1999).

Journal writing allows students to express themselves without having to worry about what they write or how it might sound to the reader. Research has shown that when students write in their journals on a regular basis the course topics are better understood (Boud, 2001: Moon, 1999). To be a useful tool in developing critical thinking skills, instructors should have concrete ideas, especially if used as in-class writing assignment. Bean (1996) has a handy list of twenty-five ideas educators could use to encourage writing. Some of Bean's (1996) more popular ideas are; writing to express confusion; writing at the beginning of class to probe a subject; writing at the end of class to sum up a lecture; exam preparation journals, and what I observed or thought during laboratory notebooks. Many developmental theorists recommend writing assignments with the aim of encouraging critical thinking because they require students to consider multiple points of view, to analyze and evaluate alternative solutions to problems (Bean, 1996). In the creation of writing assignments teachers are creating opportunities for students to reflectively think through a problem, then express their thoughts in their journals.

Once students have been properly introduced to journal writing, particularly the basic objectives and merits, they may find this activity rewarding rather than bothersome. Because journal writing requires just that, writing, this is yet another avenue to encourage improved

communication skills, although this is not the objective. The objectives should be clarified so students know they won't be graded specifically on their writing skills, but more on their ability to express thoughts.

Writing across the curriculum (WAC) is not a new concept (Mahula, 1991). This concept was built on the principle that students need to be active participants in their learning, and writing is an excellent opportunity to learn to express their thoughts while constructing their own knowledge (Fulwiler & Young, 1990; Walvoord & Smith, 1982). Instructors might be wise to acknowledge the extrovert/introvert continuum, especially when it comes to journal writing (Bean, 1996). Extroverts may not prefer journaling to class discussions, whereas introverts prefer protecting their privacy, a bonus of journaling. The value of journaling or personal writing has become confirmed in both WAC and critical thinking literature (Bean, 1996).

"Writing bridges the inner and outer worlds and connects the paths of action and reflection" (Baldwin, 1991, p.9). Journaling may offer students the opportunity to reflect upon their learning; that is, what they understand and how this information might be used in the future (Boud, 2001). Writing gives one the opportunity to express oneself. This form of expression requires reflective thought. Reflection in writing allows for exploration of course content, events or activities and it offers an opportunity to solve problems (Hiemstra, 2001). Writing allows the student to return and examine course context (Boud, 2001). The concern of journal writing, especially when one exposes oneself so intimately is, who will read it. The audience may inhibit true reflection. Boud (2001) suggests that students should be told that they do not have to submit their journals for assessment and unless students feel comfortable, they will not use their journals in a reflective manner.

The many problems that arise in horticulture lend themselves to pedagogy that engages

students in complex thinking about significant problems and the challenges they will face while working with plants and their environments.

SUMMARY

There is not a single study published associated with measuring cognitive complexity of horticultural students according to the Perry (1970, 1999) scale as measured using the Learning Preference Inventory (Moore, 1991) as a result of implementing collaborative learning compared to traditional lecture. Horticultural students might move into higher positions of thinking when they are in positive learning environments that encourage active learning and collaborative involvement. Critical thinking requires cognitive complexity, the ability to make reflective judgments, and problem solving begins when students are involved with practical problems, questions, or issues (Bean, 1996). Educators need to become more attuned to the fact that as students acquire new knowledge, they must be guided in relating this new information to what they already know or have experienced. This enables them to think critically and solve problems rather then memorizing information for short-term exam disposal. Active involvement requires that students learn to ponder questions and in some cases use analytical thinking. Effective learning is not only performing meaningful use of information, it entails knowing what to do with this information once learned. We would be wise as educators to bear in mind the following thoughts of Robert Kegan, in *In Over Our Heads: The Mental Demands of Modern Life* (1994, p.42):

> "People grow best where they continuously experience an ingenuous blend of support and challenge. Environments that are weighed too heavily in the direction of challenge [cognitive demands too high] without adequate support are toxic; they promote

defensiveness and constriction. Those weighed heavily toward support without adequate challenge are ultimately boring; they promote devitalization from the context. In contrast, a balance of support and engagement leads to vital engagement."

CHAPTER 3

METHODOLOGY

This chapter describes the research questions, selection of methods, population, the protection of human rights, instrumentation, procedures and design analysis. The quantitative component of this study used the LEP pretest and posttest comparison to determine if any cognitive development occurred. The CCI scores from these tests were then used to determine the individuals to be interviewed. The qualitative methods were the student interviews at the conclusion of the experience.

RESEARCH OBJECTIVES

The objectives of this research were to: 1) explore the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores (Moore, 1987) as a tool to recognize the Perry positions (1970, 1999) of cognitive complexity of horticultural students, the nature of this complexity and if gender, age, class status, or previous horticultural experience would influence of CCI scores; 2) determine if specific teaching methods designed to promote active involvement at a higher level of exchange than traditional lecture could influence scores; 3) describe the effects of the collaborative interactions with classmates and instructor; 4) determine whether student journals would reveal changes in their cognitive complexity or perception of learning as a result of their learning environment, and; 5) discover other significant issues or themes that could produce advancement or changes along the Perry scale.

Selection of Methodology

This study used multiple data sources; the (Learning Environment Preference Inventory (LEP) (Moore, 1987) and semi-structured interviews using purposeful sampling (Bogdan & Biklen, 1992). The triangulation research method was used to explore differences in cognitive development on the Perry scale (1970, 1999). Triangulation is the use of multiple data sources, research methods, and theoretical schemes to examine research subjects (Creswell, 1998; Lincoln & Guba, 1995). The rationale for this design was that each data collection form provides strength to offset the weakness of the other form (Creswell, 2002). This was appropriate for two reasons: First, the quantitative instrument, the LEP, based on Perry's scheme, is compatible with qualitative research, as the LEP was formulated using extensive qualitative research (Moore, 1987; Perry, 1970). Second, the quantitative instrument was used to identify subjects for the qualitative research, the interview. Interviewing allows for a richer understanding of the students' learning experience. This is a sequential study (Creswell, 1998) because the researcher generates quantitative data and then gathers qualitative data. Participants were selected from the LEP results for the qualitative research.

POPULATION

This was a quasi-experimental design or a nonequivalent group design (Campbell & Stanley, 1963). In its simplest form it requires a pretest and posttest for a treated and comparison group. The sample for this study consisted of sixty horticultural students enrolled in Arboriculture (HORT 585) and Landscape Irrigation Systems (HORT 550). Both classes are upper-level college courses because they are comprised of juniors and seniors and are traditionally taken during a student's last few semesters in the program. The students in these

two classes work toward horticultural degrees in one of the following options: Golf Course Management, Landscape and Turf Management, Greenhouse Management, Horticultural Therapy, and Landscape Design. Enrollment in Arboriculture was 18, while Landscape Irrigation Systems had 42 students. Table 1 shows the age, gender and class status distribution of the sample.

Students were selected to be interviewed based on their LEP scores (Appendix G) and their population demographics. The researcher selected LEP scores that remained unchanged, or had changed either up or down on the Perry scale (1970, 1999). Although selection of an exact number of interview participants essentially relied on saturation of information (Bogdan & Biklen, 2003; Creswell, 1998; Lincoln & Guba, 1985; Merriam, 1998; Patton, 2002) for this study, eighteen students were purposely selected, nine from each class. Without equal interviews from each delivery method, the results might have been skewed in the direction of the method most represented. Participation was voluntary.

Table 1: Student Age, Gender, and Class Status Distribution of Sample

Age	Arboriculture	Landscape Irrigation Systems
19	0	1 male
20	1 male; 1 female	6 males
21	2 females; 1 male	12 males; 1 female
22	2 males; 2 female	12 males
23	2 males	5 males
24	1 male	2 males; 1 female
25	1 male	1 male
26	2 males	0
27	1 male	0
30	1 female	0
31	1 male	0
43	0	1 male
Class Status:	12 seniors	25 seniors
	5 juniors	14 juniors
	1 sophomore	1 sophomore
	0	1 freshman
	0	1 non-traditional

THE PROTECTION OF HUMAN RIGHTS

This research was conducted in accordance with the Institutional Review Boards of Kansas State University. Permission was granted on August 22, 2002 for the study (Appendix D). Kansas State University's Committee on Research Involving Human Subjects stipulated that certain procedures be followed to ensure the protection of the rights of the participants. It was the researcher's responsibility to ensure each student understood the objective and scope of the research. The Informed Consent Statement (Appendix G) was given to each student who participated in the LEP and the eighteen students interviewed by the researcher. The students signed the form prior to taking the pretest and each student interviewed signed a form prior to being tape-recorded. Specific names of those students interviewed or fellow students, instructors, and institutions were modified to a generic name or word to maintain anonymity.

REARCH PROCEDURES

Arboriculture was taught using traditional lecture during the fifty-minute class period. The instructor delivered course information using slides, overhead transparencies, and notes with minimal interaction (questioning, discussion or sharing of ideas) with the students. In conjunction with the fifty-minute class time, there was a one-and one-half hour laboratory each week. During this time, the instructor strived to reduce collaborative learning situations, at least ten of the thirteen laboratories served as an extended lecture.

Landscape Irrigations Systems was a fifty-minute class taught using a variety of collaborative methods; guided discussions and questioning; cooperative activities such as turn to your neighbor during lecture for brief sharing, consensus small group work, and hands-on skill activities. Each one-and one-half hour weekly laboratory was designed to use hands-on learning

and there were many occasions for interaction between students. During the laboratory, students installed an irrigation system that required them to work in teams of three-to-four throughout this project. Students were also paired to troubleshoot mechanical and electrical problems.

The LEP pretest was administered to sixty students during the second day of class of the 2002 fall semester in both courses. Students were told the LEP was a component of the instructor's research and had no type of impact on them in the class nor were they required to participate. The posttest was given during the last week of the 2002 Fall semester in class. The students were asked to indicate if they would be willing to be interviewed during the following spring semester by putting their names on a sheet of paper that was passed to all students in each class prior to taking the posttest.

The LEP was scored by the Center for the Study of Intellectual Development in Olympia, Washington, where the LEP Score Report Summary was developed. The summary (Appendix E) included a listing by code number for each respondent, a database record listing: (a) demographic data (b) sub-scores broken down by Perry positions two through five that the respondent favored; (c) Cognitive Complexity Index (CCI) scores ranging from 200 through 500. The scoring corresponds to the Perry positions, two through five. Demographic data collected when the pretest LEP was issued included; student gender, age, class status (senior, junior, sophomore, freshmen), and information pertaining to any previous horticultural experience.

Since the research used already existing groups with naturally occurring independent variables and a control group (Creswell, 1994) a pre-experimental design was used: The independent variables were the following classification variables:

- Gender = discrete variable (M, F)
- Class status= freshman, sophomore, junior, or senior

Previous horticultural experience was used as a continuous variable to give a more accurate assessment of experience related change (Kasworm, 1994). The dependent or response variable was the CCI score. Teaching methodology was the blocking variable, traditional lecture versus collaborative learning techniques. This research used a fixed-effects treatment structure in a completely randomized design structure, with a single covariant, previous horticultural experience classified by the number of months of experience. Three months equals one summer of experience.

Students in both courses were asked to maintain a journal throughout the entire semester, ideally making an entry weekly. The researcher described the objectives of the journaling, specifically emphasizing the importance of reflecting upon personal learning. Each student received a copy of an article written by David Boud, *Using Journal Writing to Enhance Reflective Practice* (2001) to further their understanding of the uses and benefits of journal writing. The researcher stressed that each student must complete and submit a journal to receive their final grade; stressing the journal contents would not be reviewed for a grade. Withholding a final grade was used to emphasize the significance of the journaling assignment to the research project and to assure that each student would turn in a journal. The researcher informed the students their journals would not be read until final grades were assigned and submitted to the Registrar Office. Students submitted their journals the day of their final exam.

Quantitative Data Collection: The Learning Environment Preferences Inventory

The Learning Environment Preference (LEP) measures Perry (1970, 1999) positions two through five. The LEP has been used in numerous higher-education institutions (e.g. Alverno College, Kansas State University, Seton Hall University, and University of Maryland-College

Park). The semester frame of this study was consistent with previous research conducted using the LEP. According to Moore (1991), the LEP has been used for quarter-and-semester length experiences using the pre/post test design with positive results. The LEP's validity and reliability studies indicated the LEP accurately measured the Perry (1970, 1999) scheme. There are several advantages to using the LEP to measure cognitive development (Moore, 1988). The LEP was developed from a solid theoretical foundation, based on extensive qualitative research and the time required to complete the test can be completed during a fifty-minute class period.

The LEP designed by William Moore (1987), is a scored instrument that measures differences in intellectual development, specifically, positions two through five on the Perry scale (1970, 1999). Permission to use the LEP was granted by William A. Moore because this instrument is copyrighted.

The LEP describes a consistent pattern of increasing intellectual complexity. "These domains focus on student preferences for specific aspects of the classroom learning environment shown to be associated with increasing complexity of the Perry scheme of intellectual development" (Moore, 1991, p.9). According to Moore (1991), it is important to impress upon the students to answer the questions about *their ideal learning environment* while completing the instrument, rather than a specific class or type of class.

The LEP consists of 65 items divided into five different content domains:

1. View of knowledge/learning
2. Role of the instructor
3. Role of the student/peers
4. Classroom atmosphere/activities, and
5. Role of evaluation/grading

Respondents are asked to rate an item with their perception of its importance in an ideal learning environment. Items within each domain are rated on a Likert scale of 1-4. Respondents then rank the three most significant items to them personally from each domain. The items begin with the least complex and are followed by a mixture of more complex ideas. Completion of the LEP takes approximately 30-45 minutes.

The LEP is grounded in qualitative data collected on the Perry scheme during the past decade (Baxter Magolda, 1989; Moore, 1988). The LEP was derived from another instrument, the Measure of Intellectual Development (MID) at the Center for the Study of Intellectual Development in Olympia, Washington.

Knefelkamp and Widick (1978) designed the original MID instrument, a measure consisting of sentence stems and semi-structured essays tasks, which evolved to the current instrument that focuses exclusively on issues related to classroom learning. Moore (1988) who was interested in Perry's (1970, 1999) positions that could be administered to a large group of participants and objectively scored, started with the MID as a base. Each item was assigned to Perry positions two through five. Raters trained on the Perry scheme are used to score interviews, and items rated more than one position apart were discarded.

In the initial pilot study by Moore (1988), 51 sophomores at a private liberal arts college in the south were administered the MID and the LEP. The Cognitive Complexity Index (CCI) and the R-Index (the score on position five which correlated to relativistic thinking) from the LEP and the MID mean were compared to the students' ACT and Grade Point Average (GPA) scores. The MID and CCI correlated 0.38 with each other, and both about the same with GPA (0.36 and 0.34 respectively). The R-Index correlated poorly with the MID (-0.01), GPA (-0.14), and ACT (-0.06), but well with the CCI (0.46).

Several items were revised and a second pilot study involving 34 undergraduates at a midwestern private liberal arts college was conducted. In this study the R-Index performed better, and the CCI and MID correlation rose to 0.57.

Reliability and validity for the LEP was conducted with 725 undergraduates at several institutions including: a small public college, a small liberal arts college, a medium-sized public research university, a medium-sized selective public university, two medium-sized comprehensive state universities, a large public research university, a public community college, and an honor's program at both a small, liberal arts school and a large university. The students were 47 percent male and 53 female and 38 percent freshmen, 34 percent sophomores, 10 percent juniors, and 18 percent seniors.

Psychometric reliability was assessed for the LEP through internal consistency and test-retest. There is concern of the effect of testing using pretest/posttest design (Campbell & Stanley, 1963). Cronbach's coefficient alpha, the single most important measure of internal consistency for this type of instrument, was used (Moore, 1988). It was computed for each domain of the LEP with alpha reliability coefficients ranging from 0.63 to 0.68 and by position with ranges of 0.72 to 0.84. A one-week retest reliability study with 30 students was conducted, and the CCI showed a correlation of 0.89, indicating a reasonable amount of stability (Moore, 1988).

Validity was assessed for the LEP instrument through construct validity, criterion group differences, and concurrent validity. Construct validity was addressed by using ANOVA for gender and class on the CCI. There were significant differences among class levels, but no significant differences were found due to gender. The interaction of class and gender was not significant. Concurrent validity focused on correlations of the CCI with MID scores and GPAs. The correlation with the MID produced a correlation of 0.36 and with GPA of 0.18.

The CCI score is the primary score of interest for the LEP, reflecting a numerical index along a continuous scale of intellectual development from 200-500, roughly analogous to Perry 2 (200) to Position 5 (500). According to Moore (1991), it is best to consider the CCI score as a more general indicator of increasing cognitive complexity or intellectual development. For this study, the researcher used "loosely defined groupings" using the CCI scores ranges (Moore, 1991).

CCI Score Ranges as Related to Perry Positions

200-240: position 2

241-284: transition 2/3

285-328: position 3

329-372: transition 3/4

373-416: position 4

417-460: transition 4/5

461-500: position 5

Qualitative Data Collection: Semi-Structured Interviews

A phenomenological study explores the meaning of experiences for several individuals about a concept (Creswell, 1998) and the interviews allowed the researcher to gain a better understanding of student experiences. The semi-structured interviews provided the qualitative data. This format of questioning uses open-ended questions (Merriam, 1998); that is, when more information is required, the questions become more structured. Although the interviews were guided by a list of questions, the researcher remained unrestricted with the exact wording or

order. “The interview is used to gather descriptive data in the subject’s own words, so the researcher can develop insight on how the subjects interpret some piece of their world (Bogdan & Biklen, 2003, p. 95).

This method of data collection is regarded by both qualitative researchers and naturalistic inquirers to provide accurate information (King, 1990). In a study of this type, the researcher searches for the underlying meaning from the experiences. Data collection from a phenomenological study must not be influenced by researcher bias or prejudgment, proceeding through reduction of information, analysis for specific statements and themes, and a search for possible meanings. Patton (2002) suggested that “qualitative research allows for ways to find out what people do, think, and feel by observing, interviewing, and analyzing documents” (p.45). Creswell (1998) advises the researcher to rely on intuition and imagination to create a picture of the experiences described. In this type of research, there is an ethical responsibility by the researcher to minimize wrong interpretation of the experience.

All research according to Merriam (1998) is concerned with validity and reliability. Internal validity refers to the match between reality and the research findings. Researchers have an ethical obligation to minimize misrepresentation and misunderstanding. For qualitative researchers, they are observing how people understand their world, their reality. In this type of research, it is important to understand the perspectives of the individuals involved in the phenomenon and to present a holistic interpretation of what is happening (Merriam, 1998). To enhance internal validity, Merriam (1998) suggests the incorporation of six strategies:

1. Triangulation: use multiple sources of information/data to create a holistic understanding of the experience.
2. Interviewee memory checks: having the person read the research interpretations to

check for validity.

3. Persistent data collection: the researcher maintained a journal throughout the study.
4. Peer examinations: receiving comments on research findings as they appear.
5. Participatory or collaborative modes of research: involvement of the participants throughout the study.
6. Researcher bias: clarification of researcher assumptions and theoretical orientation at the beginning of the study (p. 204-205).

The Interview Schedule

To understand the student experience, the semi-structured interview questions were designed to focus objectives of this study. The interviews were guided by those of Perry (1970, 1999) and Kurfiss (1977). The questions pertained to the roles of the learner, teachers, peers, and evaluation in learning; the nature of knowledge; and decision-making. This type of interview gave some guidance but allowed students the freedom to answer each question as it directly related to them.

During the interview selection process, other considerations besides LEP scores were 1) student previous horticultural experiences, 2) horticultural option, 3) student background, and; 4) gender balance.

Prior to the interview, students were provided with a brief explanation of the research and the how the interviews would be used. Participants signed an informed consent form. The first questions were open-ended, allowing participants to focus on issues of importance to them. Personal interviews, lasting one to one and a-half-hours, were conducted one-on-one in the researcher's office on the Kansas State University campus after the end of the fall semester.

Interviews were tape-recorded and then transcribed verbatim.

The interview-questioning format was followed initially, changing slightly as the interviews evolved. An interview protocol was used to log information learned during the interview. This allowed for notes to be taken during the interview about the responses of the participant and provided a way to organize thoughts on items such as headings, information for starting the interview, concluding ideas, information for ending the interview, and thanking the participant. At the end of the interview, participants were asked to contribute any other relevant information that might have not been covered in the interview.

After each interview, field notes were written that included any observations from nonverbal behavior, the emotional state of the participant, researcher thoughts about the interview, and any other pertinent information. Any themes that developed were incorporated into the next interview. As themes emerged, questions for further interviews became more focused.

Reliability of the Interviews

Verbatim transcripts of the interview were given to each student for review. Each student was allowed to make comments to verify the accuracy of account (Merriam, 1998). All interviewees verified that the comments accurately represented their feelings and thoughts. Lincoln and Guba (1985) defined reality as “a multiple set of mental constructions . . . made by humans; their constructions are in their minds, and they are in the main accessible to the human who made them” (p. 295). Therefore, validity depends on how well the researcher demonstrates “that he or she has represented those multiple constructions adequately; that is, that the reconstructions that have been arrived at via the inquiry are credible to the construction of the

original multiple realities" (p. 296).

Transcriptions were then analyzed and coded using the constant comparative method (Glaser & Strauss, 1967). Each transcript was read several times, noting the transcript themes that would be relevant to the research objective. The analysis began with open coding of the interview transcriptions. Data collection and analysis in phenomenological interviewing occurred in phases with increasing interpretation and theme development as the analysis process proceeded. Themes were noted on the transcriptions to facilitate data analysis. Themes demonstrating Perry's (1970, 1999) Positions two through five were highlighted, as well as experiences that facilitated intellectual development. In addition, themes regarding other aspects of student learning were highlighted. Categories were adjusted until they fit into a meaningful ways, with clear definitions between categories (Patton, 1991). Inter-rater reliability was used; that is, a second researcher was given transcribed interviews to code and theme. Themes and meanings were discussed following data analysis until agreement was reached with the coding.

SUMMARY

This study incorporated both quantitative and qualitative research methods to examine the phenomenon of intellectual development. This phenomenon was studied through the experiences and words of the horticultural students in college courses taught using two different teaching formats. The quantitative methods provided the baseline and final level of cognitive complexity for each student and the framework for the selection of the students for interview. The qualitative research methods facilitated the uncovering of student stories and experiences through interviews.

CHAPTER 4

QUANTITATIVE RESULTS

Overview

The quantitative results describe the demographics of the participants in this study and address the first portion of objective one: 1) explore the reliability of using the Learning Environment Preference Inventory (LEP) instruments Cognitive Complexity Indicator (CCI) scores (Moore, 1987) as a tool to recognize the positions of cognitive complexity of horticultural students (the nature of this complexity is discussed in Chapter 5) and statistical analyses of the influence of gender, age, class status, or previous horticultural experience on CCI scores (relationships between these factors will also be discussed further in Chapter 6).

Demographics of the Sample

Demographic information was collected on these variables: (a) gender; (b) age; (c) class status; and (d) previous horticultural experience. Student ages ranged between 19 and 43. There were a total of 36 seniors, 20 juniors, 2 sophomores, 1 freshman, and 1 non-traditional student. Eight of the sixty students were female.

All students in Landscape Irrigation had some horticultural experience prior to enrolling in the course either from an internship or summer job. Four of the nine students interviewed from the Landscape Irrigation Systems class had experience specific to irrigation. One student had worked in horticulture for five years prior to returning to college.

Fourteen of the eighteen students in Arboriculture reported prior horticultural experience through an internship or summer job. One student had worked for a tree care company for several summers.

Gender of the Sample: Arboriculture and Landscape Irrigation Systems

Gender distribution of all 60 students is depicted in Table 2. Gender distribution of sub-sample is depicted in Table 3.

Table 2: Gender Distribution of Sample

Gender	Arboriculture	Landscape Irrigation Systems
Male	12	40
Female	6	2

Table 3: Gender Distribution of Sub-Sample

Gender	Arboriculture	Landscape Irrigation Systems
Male	7	8
Female	2	1

Age of Students in Enrolled in Arboriculture and Landscape Irrigation Systems

Ages ranged between 20 and 31 in Arboriculture with an average age of 23. Student age in Landscape Irrigation Systems ranged between, 19-43. The average age of the students in the class was 22.7. The literature indicates the conventional college student age is 18-22 (Pascarella

& Terenzini, 2005). Table 4 shows the ages of students enrolled in both courses.

Table 4: Age Distribution of Sample

Age	Arboriculture	Landscape Irrigation Systems
19	0	1
20	2	6
21	3	13
22	4	12
23	2	5
24	1	3
25	1	1
26	2	0
27	1	0
30	1	0
31	1	0
43	0	1
Mean	23	22.7

Age of Sub-Sample

The ages of those students interviewed enrolled from the Arboriculture class ranged from 20-30. The average age of the students interviewed was 23. Student ages interviewed from Landscape Irrigation Systems ranged between 19-24. The average age of the students

interviewed was 21. 4. Table 5 depicts the ages of the sub-sample.

Table 5: Age Distribution of Sub-Sample

Age	Arboriculture	Landscape Irrigation Systems
19	0	1
20	2	1
21	3	3
22	1	2
23	0	1
24	0	1
25	1	0
27	1	0
30	1	0
Mean	23	21.4

Class Status of Sample

Arboriculture enrollment was 12 seniors, 5 juniors, and 1 sophomore. Landscape Irrigation Systems was comprised of 24 seniors, 15 juniors, 1 sophomore, and 1 freshman, 1 non-traditional student. Class status of the sample is found in Table 6.

Table 6: Class Status of Sample

Class Status	Arboriculture	Landscape Irrigation Systems
Freshman	0	1
Sophomore	1	1
Junior	5	15
Senior	12	24
Non-traditional	0	1

Class Status of Sub-Sample

Class status of Arboriculture students interviewed was 6 seniors, 2, juniors, and 1 sophomore. Class status of Landscape Irrigation Systems students interviewed was juniors and seniors. Class status of both sub-sample is found in Table 7.

Table 7: Class Status of Sub-Sample

Class Status	Arboriculture	Landscape Irrigation Systems
Freshman	0	0
Sophomore	1	0
Junior	2	5
Senior	6	4

Previous Horticultural Experience of the Sample

Each student was asked for information regarding previous horticultural experience. All students in Landscape Irrigation had some type of horticultural experience prior to enrolling in the course either from an internship or summer job. Fourteen of the eighteen students in Arboriculture reported horticultural experience as an internship or summer job. All eighteen students who participated in the interview process had at least one summer, or three months, of horticultural experience.

Table 8: Horticultural Experience Prior to Fall 2002 Semester

Experience	Arboriculture	Landscape Irrigation Systems
Yes	14	25
No	4	17

Demographic information provided experience related to the specific course topic. Only one student enrolled in Arboriculture had previous tree-related experience, specifically, several consecutive summers of working for a tree company. Twenty students enrolled in Landscape Irrigation Systems had some type of irrigation experience varying from repair of golf course systems to complete residential installation. Table 9 depicts experience as it relates to specific course topics.

Table 9: Previous Horticultural Experience Specific to Course Topic

Experience	Arboriculture	Landscape Irrigation Systems
Yes	1	20
No	17	22

LEP Results

Objective one of this study was to explore the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores as a tool to recognize the positions of cognitive complexity of horticultural students, the nature of this complexity and if, gender, age, class status, or previous horticultural experience would influence CCI scores. This question was answered by the pretest LEP data. Yes, all students enrolled in both courses were no lower than position 2, Multiplicity-Pre-Legitimate.

Student pre-test LEP scores in Arboriculture, the course taught using traditional lecture ranged from 230-413. For Landscape Irrigation Systems, taught collaboratively, pre-test LEP scores ranged from 263-417. The average pre-test LEP score for the students in Arboriculture was 332.2. The average pre-test LEP score for the students in Landscape Irrigation Systems was 332.9. Student post-test LEP scores in Arboriculture ranged from 237-407. The post-test LEP scores for Landscape Irrigation Systems ranged from 230-410. The average post-test LEP score in Arboriculture was 317. The average post-test LEP score in Landscape Irrigation Systems was 310.7 (Table.10).

The students' cognitive complexity in this study ranged from 230 (position 2) to 417 (position 4/5). A closer look at individual scores and the differences between pre-test to post-test scores indicated some scores increased slightly, while others remained reasonably constant, and some decreased. The distribution of the results did not deviate significantly from normality ($p > .25$). The variances of the distributions of the two classes were not different (0.3285 by Levene's test). So, ANOVA is an appropriate method of analysis.

An analysis of variance was performed to determine the differences in the means between the pretest and posttest scores within each class (Table 10.).

Table 10: ANOVA of the Pre-LEP and Post-LEP Scores from Both Classes.

	Arboriculture		Landscape Irrigation Systems	
	Pre-LEP	Post-LEP	Pre-LEP	Post-LEP
M	332.22	317.16	332.92	307.5
N	18	18	42	42
SD	53.80	45.40	37.64	46.39
Std. Error of Mean	12.682	10.702	5.809	7.158

One way analysis of variance was run on the difference between pretest and posttest scores to determine if there was any change (Table 11). An alpha level of .05 was used for all statistical tests. The p-value, .41, indicated there was not a significant difference between the two classes mean difference.

The mean difference in scores for Landscape Irrigation Systems was -24.3 with a standard error ± 6.1. This is significantly different from 0, so there is a significant difference between pretest and posttest scores.

The mean difference in scores for Arboriculture is -15.1 with a standard error ± 9.3. This is not significantly different from 0, so there was not any significant difference between pretest and posttest scores.

Table 11: A Comparison of the Difference in CCI Scores from Both Classes.

	Arboriculture	Landscape Irrigation Systems
Mean	-15.1	-24.3
N	18	42
Std. Error	9.3	6.1

The demographic portion of the study (gender, age, class status, and previous horticultural experience) was used to describe the sample population and to determine if these factors would influence CCI scores. Because of the number of females in the sample was small, the gender portion of the data could not be tested.

Data in Table 12 indicate there is no effect on the change of scores in Landscape Irrigation Systems as a result of class status or experience specific to irrigation.

Table 12: The *p*-values for Previous Experience and Class Status of Students in Landscape Irrigation Systems.

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Irrigation Exp	1	1427.2	1427.2	0.86	0.3603
Class Status	2	430.2	215.1	0.13	0.8786
Hort. Exp	4	788.6	197.2	0.12	0.9747

Data in Table 13 depict irrigation experience between pretest and posttest score differences in Landscape Irrigation Systems.

Table 13: Irrigation Experience as it Relates to the Difference in CCI Scores.

Irrigation Exp.	CCI diff LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 Pr > |t|
no	-20.9	15.0	0.1738	0.3603
yes	-7.7	15.6	0.6247	

Data in Table 14 show the *p*-values for class status on the difference in CCI scores for Landscape Irrigation Systems.

Table 14: A Comparison of Class Status to Changes in CCI Scores for Students in Landscape Irrigation Systems.

Class status	CCI diff LSMEAN	Standard Error	Pr > |t|	
other	-7.7	30.7	0.8038	
junior	-20.3	11.7	0.0917	
senior	-14.9	12.9	0.2547	

Data in Table 15 show the *p*-values for previous horticultural experience on the difference in CCI scores in Landscape Irrigation Systems. Experience in the industry, 3 months to more then 1 year, was not significant factor.

Table 15: A Comparison of Prior Horticultural Experience to Changes in CCI scores.

Hort Exp	CCI diff LSMEAN	Standard Error	Pr > |t|	
None	0.61	42.9	0.9888	
3 months	-21.5	13.6	0.1238	
6 months	-12.9	20.9	0.5409	
1 year	-16.1	20.1	0.4262	
> 1 year	-21.8	13.8	0.1241	

Data in Table 16 show that neither class status nor previous horticultural experience affected CCI scores in the Arboriculture class.

Table 16: The *p*-values of Class Status and Horticultural Experience on Students in Arboriculture.

Source	Type III SS	Mean Square	F Value	Pr > F
Class Status	4916.7	2458.3	1.29	0.3094
Hort Exp	36.5	36.5	0.02	0.8923

Data in Table 17 show that class status did not influence differences in CCI scores for Arboriculture students.

Table 17: The Influence of Class Status and Changes in CCI scores of the Arboriculture Students.

Class Status	CCI diff LSMEAN	Standard Error	Pr > |t|	
other	41.4	45.2	0.3756	
junior	-3.7	18.2	0.8430	
senior	-27.7	14.0	0.0698	

Data in Table 18 show the difference in CCI scores in terms of previous horticultural experience of Arboriculture students in the sample.

Table 18: The Influence of Previous Horticultural Experience on Changes in CCI Scores for Arboriculture Students.

Hort Exp	CCI diff LSMEAN	Standard Error	H0:LSMEAN=0	H0:LSMean1=LSMean2
			Pr > |t|	Pr > |t|
no	1.8	22.6	0.9381	0.8923
yes	4.9	17.9	0.7873	

The *p*-values show there was no difference between previous horticultural experience and changes in CCI scores for Arboriculture, data in Table (19) show an interesting relationship between prior horticultural experience and CCI scores from students in each course. Post CCI scores of students in Landscape Irrigation Systems with previous experience decreased more than the scores of students without experience. With an alpha level of .05, the effect of previous experience was statistically significant, *p*-value, 0.0006. Post CCI scores for some students with previous horticultural experience in Arboriculture decreased less than those without previous experience but was not significant.

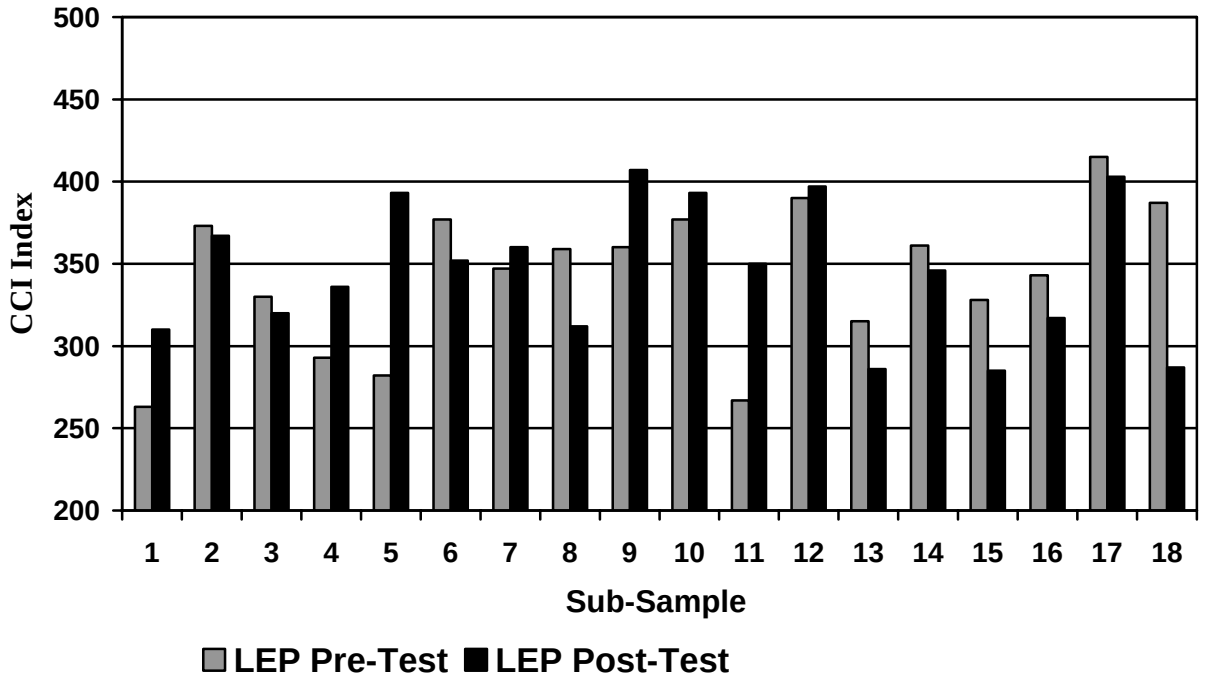
Table 19: A Comparison of Previous Horticultural Experience to Changes in CCI Scores from both Courses.

Class	Hort exp	CCI diff LSMEAN	Standard Error	Pr > |t|
Irrigation	**no**	-12.0	39.6	0.7632
Irrigation	**yes**	-22.9	6.3	0.0006
Arboriculture	**no**	-23.3	14.0	0.1028
Arboriculture	**yes**	-7.8	13.2	0.5584

CCI Index Scores of the Sub-Sample

Figure 1 compares the pretest and posttest CCI index scores of those students selected for one-on-one interviews. Students 1-9 were enrolled in Arboriculture. Students 10-18 were enrolled in Landscape Irrigation Systems.

Figure 1: A Comparison of CCI Scores for Students in the Sub-sample.



Quantitative Results Summary

The quantitative methods provided the baseline and final level of cognitive complexity for the sixty students involved in the study, and served as the framework for selecting eighteen students for interviews. The results of the pretest and posttest LEP scores addressed research objective one which explored the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores as a tool to recognize the positions of cognitive complexity of horticultural students.

In the Arboriculture class Perry positions remained constant for nine students; decreased for eight students; and increased for one student from pretest to posttest. In Landscape Irrigation Systems Perry positions remained constant for eighteen students; decreased for nineteen students; and increased for five students from the pretest to the posttest CCI scores.

No statistical correlation was found between age, gender, class status or previous horticultural experience and CCI scores Arboriculture students. The qualitative results, found in Chapter 5 of the study, do reveal some rousing comments from students possibly illuminating some differences between age, gender, class status and previous horticultural experience not found using the LEP or statistical results.

A statistical difference was seen when overall CCI score differences were compared within classes associated with previous horticultural experience for students in Landscape Irrigation Systems. Students with previous horticultural experience showed a decrease in their scores compared to the scores from students without experience. A more in-depth discussion of this change can be found in the Chapter 6.

CHAPTER 5

QUALITATIVE RESULTS

Overview

The qualitative results examine research objectives one through five as illuminated by students' experiences through the semi-structured interviews and their journals. The interviews allowed the students' voices to be heard, resulting in the analysis of the objectives. Several themes occurred during the interviews which will be discussed along with objective 5.

The objectives of this study were to: 1) explore the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores as a tool to recognize the positions of cognitive complexity of horticultural students and the nature of this complexity; 2) determine if specific teaching methods designed to promote active involvement at a higher level of exchange than traditional lecture would influence scores; 3) describe the effects of the collaborative interactions with classmates and instructor; 4) determine whether student journals would reveal changes in their cognitive complexity or perception of learning as a result of their learning environment and; 5) discover other significant issues (several themes emerged during the constant comparison data analysis) that would produce advancement along the Perry scale.

After the student LEP tests were scored at the Center for the Study of Intellectual Development in Olympia, Washington, a LEP Score Report Summary was used to select students to be interviewed. Students were selected for an interview based on the amount of change or lack of change in intellectual development according to their LEP scores (Appendix C). The students interviewed were in Perry positions two, three, and four. There were no students operating in Perry position five. There were three students in position 2, Multiplicity Pre-

legitimate; six students in position 3, Multiplicity Subordinate; six students were in transition 3/4; and three students were in position 4, Relativism Subordinate. Although only eighteen students were interviewed, the researcher could have obtained more interviews if saturation had not occurred. Saturation occurs when the interviewees add no new information and the information becomes redundant (Creswell, 1998). All interviewees were given pseudonyms to protect their identities.

Objective 1: A critique of the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores as a tool to recognize the positions of cognitive complexity of horticultural students and a look at the nature of this complexity through the students' voices.

In a typical college classroom, an instructor thoughtfully presents information to students who are diligently taking notes. Unfortunately both the instructor and the students have diametrically different objectives for the process of learning (Leamnson, 1996). The instructor is hoping to spark some thought-provoking discussion or question but is disappointingly met by quiet stares. These stares belong to a classroom full of diverse levels of cognitive complexity, "frameworks through which students give meaning to their educational experiences" Perry, 1981).

The dualistic students (Perry position 2), described by Perry (1970, 1999), are primarily concerned with getting the facts because they believe these are the exact facts that should be on any fair exam. Dualistic meaning makers are so caught up in getting the facts they fail to catch the core concepts so carefully presented by the teacher. A majority of these students, except those exceptional few operating in Perry position 4b or 5, typically do not see the relationship of

these newly introduced concepts with concepts they should have learned in an interrelated course. Dualistic thinkers are convinced all good grades are the result of obeying and conforming to what is right and what the teacher (Authority) wants. Basic dualism, as discovered by Perry and associates (1970, 1999), is not the dominant orientation of students after their first year in college, but the expectation associated with dualism is a fundamental key assumption underlying the first four Perry positions. Once students are in Perry position 5, they recognize right answers are the exception rather than the rule.

It is not surprising many instructors become frustrated with such cognitive variability among students and each responds in very individualistic ways (King & Kitchener, 1994). The cognitive pendulum swings between those students who intensely dislike teaching styles that ask them to become involved during class discussions to those students who regard the instructor as a facilitator of knowledge recognizing they might have to construct knowledge within the context in which it was generated (King & Kitchener, 1994). Thoughtfully written exam questions encouraging critical thinking are viewed as “tricky” by a sizable portion of students operating in Perry position two. Unfortunately, this picture is not of inquiring students comprehending and disputing complex ideas. The two diametrically different expectations of educator and student collide, frequently leaving behind overwhelmed, angry students and disappointed, frustrated teachers.

An understanding of Perry's developmental theory (1970, 1999), specifically, the two basic categories that comprise the scheme, is the focal point of interest to this study. Recognition of the characteristics that are found in the Perry positions 2-5 may be an answer for those instructors struggling to understand how their students make sense out of the information, ideas, experiences, and concepts they encounter in a college course. A student’s Perry position does

noticeably shape his/her approach to learning and involvement in a college classroom. Once the educator understands and can recognize cognitive differences, they too, like Perry and his colleagues (1981) may recognize there is "a typical course of development of students' patterns of thought." As Perry (1981, p.77) said, "These comments reflect coherent interpretive frameworks through which students give meaning to their educational experience. These structurings of meaning, which students revise in an orderly sequence from the relatively simple to the more complex, determine more than your students' perspective of you as a teacher; they shape the students' way of learning and color their motives for engagement and disengagement in the whole educational enterprise."

This research summarized here examines cognitive developmental changes among horticultural students. This research established a developmental profile for students in these two courses and it may be used to enable other instructors to redesign classes according to the fit of students to classroom environment; it may help instructors rethink educational goals, reshape their curricula, and plan assessment accordingly. For horticultural educators, this evolution of students from dualism to multiplicity to relativism can be especially challenging because some of the more resistant students may appear firmly entrenched in their current belief systems learned from family or employers and for whom inquiry into different methods or thoughts may pose a startling threat.

Exploring the Nature of Cognitive Complexity: Interview Findings

The following paragraphs contain portions of student interviews. Dualistic students (Position 2: Multiplicity Prelegitmate) view much of their world in absolutes. In the classroom, they want instructors (they remain loyal to Authority, still seeking truth from professors) to give

them the notes to study so they can get the right answers on exams. They prefer to hear from the instructor; their peers are generally not worth listening to (Matthews, 1996). Dualistic thinkers rarely recognize the necessity of substantiating their thinking, typical of thinkers in Position 5: Contextual Relativism. They grow frustrated when instructors do not give them absolute answers. Dualistic thinkers expect teachers to hold their attention, preferring professors who are fun and exciting.

Keith, a graduating senior, had a pretest score of 373 (position 4a) and posttest score of 367 (transition 3/4) (Figure 1: #2). The posttest scores indicate a retreat back to position three. Although Keith's comments portray a dualistic thinker, his CCI scores show him in transition to early multiplicity position three. As noted in the researcher's personal journal, Keith always portrayed himself as a position two thinker, but his CCI scores, placed him higher, Multiplicity Legitimate. "I'm not good at thinking outside-of-the box, like I have a hard time relating new information to previously learned information. I would prefer you to be more straightforward and just tell us the answer, I need to know what you're thinking, I prefer not hearing from fellow peers." Keith's CCI scores indicated he was in transition to early multiplicity according to the Perry scale. Frequently, at this point, students become uncomfortable or alienated and may retreat to an earlier safer position. For example, Keith's comment, "I would prefer you to be more straightforward and just tell us the answer," suggests frustration with the fact I won't tell him the right answer. When students witness good Authorities admitting even they don't have all the answers, they are more comfortable progressing forward with guidance from the Authority. He is not comfortable evaluating or interpreting information for himself. Keith prefers to hear from the instructor (Authority) rather then his fellow peers (authority). Keith would often ask me to "explain in plain English," what the answer was to the problem. He did not like class

discussions and he found them confusing. He did not like discussions that strayed off the course topic to related subjects. Keith's statements are dualistic, in spite of the fact he will graduate in another semester. Many students struggled during class discussions, particularly during the moments of silence after the questions were asked. According to J. T. Dillon (1990), who has probably done the best empirical research on questioning both within and without the classroom, convincingly argues the value of the instructor's silence and of other alternatives to questioning in the classroom.

David, a non-traditional student, still visualizes much of his learning through dualistic lenses. His pretest score was 282 and according to Perry's scheme in transition 2/3.His posttest score was 393 or Perry position 4 (Figure 1: #5). These scores place him in the transition stage between dualism and multiplicity. He still wants to know exactly what is expected of him to get a good grade. David, like many students in this position, "set out on a quest to discover what the Authority wants and then tries to give it to them" (Perry, 1970, 1999). David confessed he frequently lost interest in courses if they did not pertain to his major. "I must be interested in the class and the information, that's the main thing." Although David expressed eagerness to complete his degree by the following spring, he grew very frustrated in Arboriculture. David disliked exam questions that required him to use previously learned information; he felt this was an unfair method of testing. "I like tests to be right from the notes, I can't figure out what you want otherwise, then I miss answers on the exams, I struggle with tricky exams. I prefer exams that are objective; the information should be right from the notes." David told me the only fair way to test was directly from the notes.

Mark, (Figure 1: # 18) a student in the irrigation class had several years of horticultural experience prior to college and said he preferred horticultural courses to general education

courses. Marks's CCI scores, pretest 387 (position 4) and posttest 287 (position 3). He likes instructors that demonstrate relevancy of course content to real world use. During his interview, Mark revealed his realization that he must search for answers on his own rather than always relying on the instructor as he had in the past. He found this to be particularly true because of the collaborative style of teaching used in irrigation. Mark stated, he was frequently confused by the conflicting statements from his job foreman (authority) versus what the instructor (Authority) said in the classroom. Mark wondered who was really correct, his foreman or the instructor? He felt convinced he would hear the one best answer in the college classroom, but instead he grew more bewildered. " I don't really care to have class discussions about what other students think, the teacher is there to teach. I want the information from the instructor, then I should know how to do it. At times I was frustrated by your style of teaching." At another point during the interview, Mark shares how he enjoyed working with fellow students. He found the small group discussion helpful. This may be an indication of early multiplicity, position three. "I like to hear different points of view. Other students might look at things differently. I gain from hearing other students discuss their experiences. But, I still want to hear from the teacher the right way to do it."

Frequently, students confess they are not comfortable working in a large group such as those frequently found in lecture. Most horticultural courses have a laboratory in conjunction with lecture that allows the students to work in smaller groups, sharing information and actually performing class related activities. A comfort zone is established, they don't stand out from the crowd like they do in a large lecture room.

The Perry model helps explain that dualistic students mistakenly judge instructors who "ponder a response" as "not knowing the answer" and it also shows that dualistic thinkers begin

to question the instructors' expertise on the topic in this situation. Perry (1970, 1999) found students in this position "expressed fear and sadness when they realized that the way they have known is at times no longer in evidence."

Neal, a senior during the interview was planning to graduate in May. Neal's CCI scores were pretest 315 (position 3) and posttest 286 (position 3) (Figure 1: #13). Neal acknowledged he had a sense of trepidation entering the irrigation course with his buddies (authority) and a female instructor (Authority). He was concerned that the instructor was not an expert, especially because his friends seemed to know so much about irrigation. Neal confessed that my method of teaching, asking thought provoking questions, caused him to wonder if I really knew the information. His comments made during his interview indicate Neal was in transition to position three. He feared he would not be adequately prepared for his future career if the instructor (Authority) did not have all the answers. "Out of all my friends in the irrigation class, I felt like I knew the least. And then, my learning was somewhat hindered because my buddies made statements about what the instructor said, and this influenced my confidence in you as an instructor. Like maybe you did not know the answers, your style of teaching style was different compared to what I was used to having in other courses."

Additionally, Perry's model sheds some light as to why multiplistic thinkers (position 3: early multiplicity) question why their answer on an exam, which was not adequately substantiated, had points deducted. Students who see the world from position three begin to question systems of grading or methods of evaluations.

Brandon's CCI scores show him in transition, his pretest score was 328 (transition 3/4) and posttest score was 385 (position 4) (Figure 1: #15). Brandon is a junior who prefers to listen during lecture rather than take notes. He would rather not participate during discussions but

enjoys listening to his fellow classmates. Brandon favors instructors who challenge him by bringing different perspectives into issues. He likes instructors that ask questions because he found this helpful in affirming his own knowledge of the subject. But, he struggles with distinguishing between his opinions and the actual facts of the issue. This is in keeping with Perry's position 4a, "as long as ambiguity remains, people have a right to their own opinion, and no one has a right to call anyone wrong." Brandon takes his learning seriously and is personally motivated to learn but expresses his frustration with his exam scores. He wondered just how fair the grading really was on some of his answers. "I want to be able to think for myself and the grading should focus on my argument and the reasoning behind my arguments, but then I still don't get all the points. I think I make connections correctly, but maybe your exams are tricky." Brandon's remarks support his CCI scores because he thinks his answers are well-founded and yet his instructor pinpoints flaws with his perspectives.

Simultaneously, other students operating in Perry's position 4b comprehend and enjoy the challenge of interlinking ideas, fully realizing how to integrate their existing knowledge into the solidification of new concepts. These students find class discussions stimulating; they seem to enjoy challenging the instructor or their fellow peers "just so long as they don't get trapped by their own argumentativeness" (Perry 1970, 1999).

Darrell, enrolled in Landscape Irrigation Systems during his last semester in college had a pretest score of 361(transition 3/4) and posttest scores of 346 (transition 3/4) (Figure 1: #14), Perry's relativism subordinate position. A view of the world from this position recognizes diversity, ambiguity and differences of opinion. Rules of evidence are incorporated into thinking. Darrell made the following statement during his interview. "Instructors shouldn't have to hold your hand and guide you through it all the time, I think there usually is more than one right

answer, no body is really wrong, it may depend on the situation, I mean, I feel if I understand the concept than I can make a right decision according to the context of the situation I am in at that particular time." Darrell was anxious to enter the green industry realizing the importance of considering the "big picture" when solving horticultural problems. He enjoyed the challenge of "figuring things out," and yet seemed to need direction from the instructor with unfamiliar situations. Students in position 4b when challenged, strive to think the way they anticipate the Authority would like them to think (Perry 1970, 1999). Darrell frequently responded to questions with sound reasoning. "I like to think for myself. I like to try to elevate all the possibilities when determining solutions. I like books that reveal other theories. This helps me to widen my thinking."

Ellen, a twenty-four year old sophomore, prefers demonstrating her ability to think. Ellen demonstrates by her comments her cognitive thinking is in position 4b (Figure 1: #17). Her pretest score was 415(position 4) and her posttest score was 403 (position 4). These scores concur with her upper level multiplicity responses in the following statements. She feels strongly that instructors should give some guidance, but many instructors fail to give her enough feedback and practical suggestions. Ellen shared the fact that most of them (Authorities) are quick to give me the answer, "It's like they don't really want to take the time to share their thinking or defend their own thought." During her interview, Ellen demonstrated she had the ability to look at a situation and then evaluate it to come up with her answer. According to Perry (1970, 1999), a student moving into position five recognizes differences of opinion and knows how to pool previously learned information to substantiate their answers. "I like to make connections between what I am currently learning to the information I learned elsewhere. I'm more concerned about how to apply the information after I graduate, I expect my instructor to know their subject really

well; some instructors can't answer my question immediately which leaves me wondering if they really know the information."

A fellow classmate of Ellen's in Landscape Irrigation was a junior named, Charles (Figure 1: #12). Charles and Ellen share some commonalities in terms of learning preferences; that is, they preferred to be challenged. Charles's CCI scores, pretest 390 (position 4) and post-397 (position 4), placed him in a balancing act between multiplicity and relativism, position 4b. Ellen and Charles both liked the peer interaction as a result of instructor questioning, they both demonstrated abilities to analyze and evaluate, but their approach was strikingly different. Belenky et al. (1997) found men and women may use different logical procedures in position five. During his interview Charles declared his feelings about many of his classes, "I'm easily bored." He believes learning should be interactive. Charles is comfortable questioning the instructor, consistently probing deeper into the problem looking for a valid solution. A passage from the researcher's journal made note that during a discussion on irrigation hydraulics, Charles strongly disputed the fact that water pressure decreased with a decrease in pipe size. Belenky et al. (1997) found that men may openly question Authority. Charles immediately set about thinking through the physics of pressure and pipe size. He began to madly work problems on his note pad. About five minutes later, Charles raised his hand, in front of forty students proclaiming he was wrong, and had figured it out. Students in this position actually enjoy the game of solving problems (Perry, 1970, 1999). The "Ah-Ah moment" so many instructors strive for in a college class. Charles demonstrated he could "think independently and critically out of the desire to conform to the expectations of Authorities." Students in position four are quite creative and witty in solving problems (Perry, 1970, 1999). "Okay, you are right. I just worked it out using what I

learned in Physics, now I see; you do lose pressure when pipe size is decreased. But until then, I really thought it was the opposite."

During his interview, Charles shared his feelings about fellow peers (authority). While Charles prefers to take quality time during laboratory projects, anxious to explore the problem or situation, his lab partner usually wants to hurry so he can leave. Charles voice seems to come from position 5 meaning-making. He recognizes he has the capacity to think and examine his own thinking---the practice of metacognition (Perry, 1970, 1999) "Most students have a high school mentality, they don't know how to think, they want the easy way out. To me, the easiest day is the day of an exam, you just go in there, say what you know, how easy is that? My fellow students are my competitors the way I see it." Charles grows impatient during lecture discussions because most students don't enjoy challenging each other while figuring out solutions to problems. " If there isn't some good class discussion during lecture, I'll shut down after about fifteen minutes and start writing stuff in my notes because there's no interaction. I like to share ideas and hear from other students. I like to see how my instructors think and figure things out; I want to be at their level."

Summary of the of the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores as a tool to recognize the Perry positions of cognitive complexity of horticultural students and the nature of this complexity.

Perry's Developmental Theory (1970, 1999) helps to describe how students make sense of their experiences in a college classroom. Perry's *Forms of Intellectual and Ethical Development in the College Years* has inspired many teachers in higher education (Stephenson &

Hunt, 1977; Widick et al., 1975) to explore the use of Perry's Theme as a reference guide for how students perceive knowledge in the college environment.

The challenge to instructors is balancing the pendulum of intellectual development in a diverse classroom atmosphere such as typically found in horticulture. Designing learning to gradually encourage and guide dualistic thinkers to a higher level without causing retreat, while engaging multiplicity or transitioning 4a or 4b students in an atmosphere that stimulates the formation of their own opinions and beliefs is a daunting task. But the findings from this research are abundantly suggestive to instructors. The results show there are dualistic thinkers in upper-division horticultural courses. Therefore, it is important to provide clear objectives and guidelines for activities and other course requirements, emphasizing the concrete before the abstract. Dualistic students must be given time to ask questions and clarify confusion. This study does suggest that cognitive development according to Perry's scheme offers an illuminating framework for the special challenges and opportunities that occur in horticultural education.

Although it is wishful thinking, it is a mistake to presume students in upper division courses are operating in Perry positions 4 or 5 of intellectual development. The LEP is indeed a useful point of reference, expressing a central tendency in the way a student makes meaning about knowledge according to the Perry theme (1970, 1999). By utilizing an instrument such as the LEP, educators may realize, "it is more than your student's perspective of you as an instructor that rules their thinking." In truth, it is difficult to promote intellectual development, especially when educators are unaware of cognitive complexity or how to determine the "interpretive frameworks through which students making meaning" Perry (1970, 1999). At the very least, the utilization of a reliable instrument could help account for some of the perplexing incidents that often occur in a college classroom.

By utilizing such a source as a point of reference, instructors could learn to develop their courses to specifically guide students to move to higher levels of thinking. In addition, instructors could find comfort knowing that what frequently transpires in a college classroom may be motivated more by where students are in their intellectual development rather than by what is said or done by the instructor.

Frequently, as demonstrated by the student voices heard during the interviews, these experiences could indeed make learners uncomfortable, perplexed, or even excited and motivated. Instructors would be able recognize the successive changes in how students think and the increasing complexity with which they make meaning of their new knowledge with the use of Perry's theory and the ability to use CCI scores as a guide. Student learning objectives could be developed to encourage changes from dualistic thinking to relativism, an aspiring target for both instructor and student within a department.

An evaluation of objectives 2 and 3: The influence of specific teaching methodologies used in this study to promote active involvement at a higher level of interchange than traditional lecture on CCI scores and the effects of the collaborative interactions with classmates and instructor.

A goal of collaborative learning is for the instructor to engage students in subject matter conflicts and then focus discussions around these conflicting views. In a collaborative classroom the instructor talks less while striving to engage students to puzzle out the answers cooperatively (Matthews, 1996). Using this technique requires the instructor to devise learning situations that encourage students to ride smoothly over the learning bumps rather then bucking and kicking through these awkward periods of passage (Matthews, 1996).

As discovered during the interview process, it is important that teachers not become impatient with students who struggle with the obvious. Frequently what the instructor finds obvious is better called familiar. Instructors would do well to bear in mind that content of complexity becomes familiar with repeated use. If frustration sets in during teaching, the teacher should remember that the student's brain circuitry might not be as developed as his or her own (Leamnson, 1999). This is just one of the challenges with educational collaboration methods, as revealed in the next section of student interviews.

Interview Findings: A look at collaborative instruction, the implications of this type of interaction as discovered through the interviews and that may correlate to CCI scores.

Most students expressed a desire for passivity during class as opposed to actually doing something. "I like to sit back and listen to the instructor. I like the teacher to tell me what is important. I'm a lazy learner, I would much rather sit there and have a teacher give me handouts and tell me everything, besides half the time I'm totally confused, it's like some of the stuff she says, I never heard in Botany." (Figure 1: #5). Repeatedly students voiced a preference to contribute very little if anything to class time, particularly during lecture. Especially if they don't see the relevancy of the topic to their future career. Dualistic (position 2) students, in particular, do not recognize the significance of taking courses that have no apparent relationship to their career goals. " As far as my role as a learner, it all depends on my interest level, but I usually like to sit and listen. But, if it's not related to my major, I get bored." Another student voiced this comment during the interview. "I must be interested in the topic to get involved. Being interested in the class is the main thing. Mostly, I expect the instructor to be knowledgeable, organized, and entertaining." (Figure 1: #11).

Some students do not like collaborative learning, at least, initially. Frequently, this is because of the familiarity and ease of lecture formats (McKeachie, 1980). Students might struggle with granting authority to their peers, rather than the teacher (Authority), for information. The idea of collaborating with other students (authority) in search of answers may even teeter on the brink of cheating; after all, throughout their educational career they have been told, it's not fair to get answers from your neighbors or friends. Collaboration is all about sharing opinions, ideas, values, and solutions. This next statement was from a student whose pre CCI score was 373 and their post CCI score was 367 (Figure 1: #2). These scores correspond to transitioning into Perry position 3/4. "I don't like instructors that bounce around on different topics and ideas. They should be clear and stay on track and not all over the place. I don't like instructors that encourage class discussions, I only get confused and bored. Besides what do those other students know, and how do I know what they say is reliable?" These students are clearly demonstrating dualistic thinking. Dualistic thinkers tend to be wary of peer opinions, preferring to rely on the instructor. It is a challenge for an instructor to motivate this line of thinking while encouraging multiplistic/relativistic thinkers in the same classroom. Student-centered learning holds a promising future to integrate these thinkers to benefit each other, if well orchestrated by the instructor (Matthews, 1996).

In this study, collaborative learning proved to be more successful during laboratory settings. Enrollment in the laboratory sections ranges between 15-20 students. This number of students lends itself to the opportunity to become acquainted. Students seem to be less skeptical of each other in small peer learning groups. They are more at ease examining new methods and experimenting together (Cross & Steadman, 1996). "I am more apt to learn from fellow students who know something about the topic. I would be more apt to say this person is worth talking to

because they know what they are talking about. During lab I find out more about them." One student voiced appreciation for collaboration. "I like discussion formats in labs, I enjoy participating and hearing from my peers." Students seemed to find peer opinions interesting because they raised new ideas and because they help students better understand themselves as distinct from others.

Some students enjoy guided challenges during collaborative learning activities. "I like it when an instructor throws something out and students discuss it, the instructor seems to be guiding more than answering, it triggers more thought for me."

Many students enjoy working with other students, especially when they think on a similar level. "I like to work with people that have an open mind to ideas and opinions; some students are stubborn and stuck on what they have been told elsewhere. I find it difficult to learn with those students, they don't seem to care about expanding their knowledge. I found it distracting." This next statement also affirms a positive reaction from hearing from fellow students, specifically in smaller groups. "I like to hear different points of view. Other students might look at things differently. I gain from hearing other students discuss their experiences, but I prefer doing this in small groups, it feels safer. The best for me is when the instructor gives us clear, concise objectives or directions. This saves time. We get right to the problem; we aren't trying to guess what they want."

One student shared the fact he was more comfortable making mistakes after the instructor demonstrates, especially when working in small groups. This comment came from a position 3 student. "I'm more of a watcher, listener, and observer, only when I'm confident, then I'll step in and complete the task."

A summary of collaborative learning as discovered through student voices.

There are many models of collaborative learning and no one optimal method can be prescribed, because what is most favorable for one student may not be for another (Pratt et al., 1998). The class atmosphere and size, the course content, and the collective personality of the students and instructor must all be considered when searching for teaching methods that may increase cognitive complexity (Cross & Steadman, 1996).

For this research study, the instructor used two specific types of collaborative learning methods; the classroom consensus group (Bruffee, 1993) and placing students in groups of three to four to work together performing specific skills during laboratory. In this small-group setting students tend verbalize their questions and ideas more so than in a room of forty-five (MacGregor, 1992). The consensus group method asks students to work together to solve a limited but open-ended task, usually in groups of four then reconvening as a large class to hear from other small groups, with the instructor evaluating the quality of student work, as both referee and judge (Bruffee, 1993). Cooperative learning groups require positive interdependence among group members, each is responsible for not only their own learning but of fellow members (Cross & Steadman, 1996). Cooperative learning emphasizes teamwork; instructors tend to pay keen attention to students' social interaction (Cross & Steadman, 1996)

Educators interested in collaborative techniques require the instructors to stand back to allow the students to work out the issues (Cross & Steadman, 1996). Collaborative learning is not just another tool to be pulled from a pedagogical bag of tricks. Collaborative learning is structured conversation among students (Bruffee, 1993), a social community of learners. Students working together in small groups especially outside the classroom were one of the most common traits among successful students (Astin, 1993) because learning is a social event. As

pointed out by Bruffee (1995), cooperative and collaborative are similar in their attributes because they each encourage learning by sharing, but they differ in their liabilities. A difference between these two techniques is that cooperative learning guarantees accountability because of the teacher governing the situation, whereas collaborative learning promotes students governing each other at the expense of accountability (Bruffee, 1995).

Consensus groups may be used to clarify concepts, allowing students to work together to solve problems, and ultimately allow individual students to hear what fellow students are thinking. Students begin to depend on each other rather than the instructor exclusively for knowledge (Bruffee, 1993). Perry's (1970, 1999) work suggests that learning does not involve people's absorption of knowledge; rather, it involves people's integration into communities of knowledgeable peers.

It may be helpful to include an in-class practice when working in small groups, although it may seem intuitive, to some students, particularly dualistic thinkers, it is not easy (Cross & Steadman, 1996). Students need to know the instructor is there to help, not criticize. The student and teacher relationship is pedagogically important (Leamnson, 1999), especially when breaking into small groups. Just don't become obsessive with the small group work or allow it to become standard practice, students recognize a repetition for dealing with course content, and dislike too much of any one type of learning method. Students will view small group work as another invariant method for dealing with content, different than lecture, but routine. Be sure the learning objectives match the goals most importantly different learning goals usually require different means.

Collaborative learning, like any good assignment, should be carefully designed and thought out (Bruffee, 1985). The goals and activities necessary for student achievement must be

worked out in advance of the learning. Regardless of the exercise, give students a reason for the activity then step aside to let them work through the issues (Bruffee, 1985). Students need to know the learning objectives to instill in their minds, "what is this suppose to teach me, or what should I be doing?" It is helpful to distribute a written description of the activity to be read out loud within each group. Be specific, students tend not to take an instructor or assignment seriously if the specifics are not comprehensible, a few will take the work seriously, while a majority will see the activity as busy-work, words frequently voiced during the student interviews.

Students seem to work best in small groups during class time when they address a definite problem or achieve a known goal (Cooper, Robinson, & McKinney, 1994; Cross & Steadman, 1996). Dualistic thinkers want to know what the correct procedure is while multiplistic students want to do it the *way* they anticipate the instructor wants the exercise performed. Relativistic thinkers will set about designing their own way to do the exercise (Perry, 1970, 1999). Less experienced, dualistic students dwell inordinately on how they will be evaluated, so provide an estimate of how each exercise will influence grades so the focus can be on the learning. When activities are clear and detailed allow sufficient time for students to discuss the work and ask questions. Some of the students will see collaborative work as serious learning opportunities (Cross & Steadman, 1996). Dualistic students in particular may become flustered working in small groups, so be patient, mingle, but not aggressively, offer advice or lead in questions but for the most part, let the students do the thinking. It may be important for dualistic thinkers to work cooperatively rather than collaboratively initially because the authority of the classroom still rests with the instructor.

An advantage to well-prepared group work is that it demands procedural thinking. Having students switch to a procedural way of knowing requires a cognitive change, so it cannot be done without a small jolt (Leamnson, 1999) to their thinking. The simplest way to change a students' thinking procedure is to ask him/her for answers that require more than declaring facts, request information demanding those truths to new or hypothetical situations (Leamnson, 1999). Deriving these types of questions is not easy and answering them is particularly challenging to "memory dumping" thinkers. When a question requires students to perform hypothetical-deduction reasoning demanding procedural knowledge, dualistic thinkers may balk at this type of questioning, referring to them as "tricky and/or unfair." Design questions that have more than one answer, use controversial questions (Cooper et al., 1994). If students are requested to generalize, have students support their generalizations with particulars. Students seem to become empowered when thinking together; confidence tends to grow with fellow student verification.

A key benefit of collaborative learning is forcing verbalization of thought, the type requiring reflection (Bruffee, 1993). Collaborative methods require instructor patience and persistence in order to break through to the actual benefits of learning (Cooper et al., 1994). No matter how effective the method of instruction, a few students will be neither empowered nor enticed to learn at more than their current cognitive capacity. A few students, with encouragement from the instructor, will realize and become eager knowing their thoughts and questions dramatically affect the classroom atmosphere and learning (Cross & Steadman, 1996), while some will resist this type of learning, content to sit and listen.

As a result of this research and listening to the students during the interview process, it is apparent that a majority of students prefer teachers who vary their approach and their methods during each class period. Using the Perry scheme during this study helped the researcher explore

the objectives of using collaborative learning while designing course topics and assessment approaches. By reflecting upon Perry's model the research discovered the importance of guiding students to become risk-takers when sharing ideas, solving problems, and exploring how to use newly learned information.

This research also found that by trying to move students out of their cognitive comfort zone caused dissonance for some students, leading to a cognitive retreat rather than moving forward along the Perry scale, confirming there are some die-hard dualistic thinkers in upper-division courses who will struggle with new ideas.

Objective 4: Discover any other significant issues that could produce advancement or changes along the Perry scale.

An examination and analysis of the themes that developed during the interviews as voiced by the students as significant issues to their learning.

Overview of the Theme Development

The qualitative portion of this research was conducted using the constant comparative method. The researcher uses constant comparative analysis to look for statements and signs of behavior that occur over time during the study (Janesick, 1994). The process of constant comparison "stimulates thought that leads to both descriptive and explanatory categories" (Lincoln & Guba, 1985, p. 341). In this method, data are analyzed as it emerges from each interview, and new themes are incorporated into subsequent interviews. Initial questions were open-ended allowing each student's interview to develop themes that were relevant to their particular experiences. As a result, several majors themes emerged from the data that were not reflected in the original research questions. These themes frequently overlapped, reinforcing and

clarifying one another. This following section will allow the voices of the learners to be heard as they illuminate the major themes from this study.

Themes that Developed During the Interviews

1. Students prefer courses that include *hands-on learning* or formats that include learning by experience. Student motivation, particularly when working collaboratively, is increased when they can take information introduced during lecture and make it a tangible experience during laboratories or other collaborative activities.
2. A majority of the students (dualistic meaning-makers) regarded *learning as the responsibility of the instructor*, that is, they should teach the subject satisfactorily so that they, the student, can learn the information. Exams should be straightforward and objective. Many learners do not like to attract attention toward self, preferring to speak only when spoken to, and articulating as little as possible. In large classrooms in particular, students prefer remaining anonymous, and rarely desire developing any kind of relationship with the instructor.

Theme One: Hands-on Learning

A prominent and persistent theme was the emphasis placed on hands-on learning or active, collaborative or cooperative involvement. Students like to “see, feel, and experience” the learning process. Learning horticulture by implementing well-planned group activities, particularly those that occur during the laboratory sessions, proved to be a quality instructional approach from the student’s perspective. Students expressed enjoyment in being outdoors during

laboratory. They like the freedom from indoor classes. Learning as a behavior is a function of the interaction a person has with their environment (Bandura, 1976), learning is a social event (Merriam & Caffarella, 1999). “Learning, as defined by Leamnson (1999, p. 5) is stabilizing, through repeated use, certain appropriate and desirable synapses in the brain.” Learning that uses hands-on experiences and sensory interactions with the environment promote and stabilize neuronal connections (Leamnson, 1999). Therefore, when instructors incorporate learning experiences requiring repeated use of new information, this repetition helps stabilize new and weak neuron synapses. Things get easier with practice and use as a result of the brain’s ability to “make a good path” (Leamnson, 1999).

Laboratory activities require students to rely more on their own decision-making skills and observations rather than on the instructor or the textbook (Lowman, 1996). Bandura (1976), who focused most of his study on cognitive processes involving observation, postulated one can learn from observation, without imitating what was observed. The laboratory experience is so much a part of teaching horticulture because it is a science and is based on empirical investigations and the application of those principles to real-life situations (Lowman, 1996).

It is also important to provide horticultural students with direct experiences with equipment, circumstances, and phenomena in order to establish meaning, particularly with those students who have no prior knowledge (Jason Rothwell, Owner, Rothwell Landscape, personal conversation (2003).

While information can be remembered if taught during lecture, true understanding and the ability to use the information in new situations requires learning that is founded in direct experience and collaboration with fellow peers (Bruffee, 1985). To truly benefit student learning, instructors need to discuss the objective of the activity beforehand and afterwards allowing them

the opportunity to ask questions. This will also affirm to the students the connection between the activity and the lecture (Meyers, 1986). Activities requiring integrating experiences intelligently with course content should encourage students to evaluate, synthesize, and analyze course content (Lowman, 1996). When lecture and laboratory are blended thoroughly they can enrich learning (Lowman, 1996), something for instructors to bear in mind when scheduling lecture topics and lab activities.

Abe, a senior in Landscape Irrigation Systems, had a pretest score of 377 and a posttest score of 393 (Figure 1: #10). These scores place him in Perry position four. Abe frequently dropped by my office to ask questions. He was very concerned with the wording of exam questions, especially if a lecture topic had not actually been performed as an activity in lab. Abe preferred instructors who used slides or Powerpoint during lecture. He confessed to experiencing difficulty grasping abstract topics or making links between information without some concrete experience. “I am very much a hands-on learner. When I’m out in lab doing stuff is when I learn the most. Brent was in my group, out in lab, he always knew what to do because he had irrigation experience, he kind of instructed me, and it was great. I learned bunches working with him. I enjoyed thinking through problems with fellow students.”

Charles had a pretest score of 390 and posttest score of 397. These scores indicate he is in transition to position 4b (Figure 1: #12). Charles said he prefers hands-on learning. Charles doesn’t hesitate to ask questions during lecture, so he was particularly inquisitive once outside actually installing an irrigation system. “To see how something really helps, seeing is like a light bulb for me. Oh, so that’s how that works. I like hands-on activity.”

John, a student in Arboriculture, majoring in Park Resource Management had a pretest score of 330 and a posttest score of 320 (Figure 1: #3). These scores place him in Perry position

three. He frequently volunteered answers during laboratory, but admitted he preferred being lazy during lecture. During his interview, he said he preferred taking notes, so he likes instructors who provide good ones. He also admitted he preferred just listening; he did not like reading assignments or busy work. But, John expressed an appreciation for the outdoor experiential learning activities. “Going outdoors with the hands-on learning, being able to view and see what you were actually talking about with the trees, really helped me learn and understand. I wanted to learn more, I liked trying to figure out what happened then.”

Mel, a student in Arboriculture, was specializing in Horticultural Science in preparation for a graduate degree. Mel’s CCI pretest score was 347 and her posttest score was 360 (Figure 1: #7). These scores indicate she is currently operating in position 3 transitioning to 4a. Mel expressed a strong dislike of tricky exams. She preferred objective exam questions with clear right or wrong answers. Mel shared the fact she always takes notes using colored pens because she is a visual learner and found the various colors are more exciting when taking notes. Her comments suggest she wants more guidance from her instructors. Some of her remarks reflect the desire to think independently but a slight reluctance to cut the apron strings completely from the instructor. “Going outside was the best, I mean, I didn’t know trees like everyone else, because I haven’t taken Woody Plants yet, but seeing what you were talking about really helped. I’m very much a hands-on, visual learner. I just like learning for the sake of learning, but, I think instructors should still be organized and guide us, even when we are doing activities outside.”

David was another Arboriculture student. His pretest score was 282, his posttest score was 293 (Figure 1: #5). David articulated that he never really understood a new concept until he could see or do it first-hand. David needed to be able to mastermind his own reality for learning new ideas. He enjoys any class that has a lab, especially the type requiring involvement. “I’m big

on visual aids, it really helps when we pass stuff around, then I can see and feel what you mean. Hands-on is a major learning experience, until you actually go out and do it, you don't really understand what it's all about."

Science is a major component of horticulture when solving plant and soil problems (Ingram et al., 2002). Therefore, learning by doing or observing plants helps students to think and make sense of what they heard during lecture. Laboratory sessions allow students to learn with understanding and, at the same time, engage in a process of building knowledge by doing science as it relates to horticulture. This is particularly useful when students are learning to solve tree-related issues, they must be able to get out and investigate problems first hand.

Jenny, a non-traditional student, worked for the forestry department during her summer internship. Jenny's CCI pretest score was 360, her posttest score was 407 (Figure 1:#9).These scores place her in Perry's upper level position four. She said she felt fairly comfortable comprehending most of the lecture topics but really enjoyed the labs. Women operating in upper positions may seem more confident and see themselves as an equal with men (Belenky et al., 1997). Jenny said she found lab time to be helpful because it was somewhat challenging to diagnose tree-related problems, but once she was able to see the whole picture and collaborate with fellow students solving problems, learning seemed to happen for her. Jenny voiced confidence in her abilities. "I like instructors who challenge me by presenting ideas and problems. In lab, when we were given problems dealing with trees I could remember what you told us in class about methods and procedures to use. It was rewarding to figure things out on my own. I liked working with other students to solve problems. I'm feeling more confident to speak up in class about what I know."

During a class period some information sounds simple, such as adjusting sprinklers particularly to those students who have some experience performing this activity, but to students with no experience, the directions are often confusing. Now, take these same students out to the field, turn on a system whose sprinklers need adjusting, and watch the activity. What was said in lecture suddenly makes sense. Once students actually play around with the various sprinkler adjustments, they become comfortable working together. Neal (Figure 1: #13) concurred with Jenny's thoughts about hands-on learning, in that, it reinforces and aids in the learning process so much more so than just hearing it in lecture. "I felt like I knew the least of all my buddies, but once I was actually able to physically perform the stuff you talked about in class, it all made sense. After playing with the sprinkler adjustments, I felt far more confident."

Instinctively instructors realize the benefits of hands-on learning, but hands-on learning gives students the power to take control of their learning helping them see the correlation between course content and real-world usage (Lowman, 1996). If an activity requires each student to perform a specific task, they find out very quickly if they need further clarification to complete a task correctly. Students actually assess their own performance and abilities when they are allowed to perform or observe an experience.

Although Arboriculture lecture did not include any collaborative activities, the labs included many opportunities for hands-on experiences or observations. During the interviews students expressed their preference for this type of learning. The educational process is enriched when students can incorporate experiences into what they are learning.

Theme Two: Learning is the Responsibility of the Instructor

There are many definitions of an effective teacher. The National Board for Professional Teaching Standards (1998) uses the following two quotations to describe an effective teacher. “Effective teachers display skills at creating curricula designed to build on students' present knowledge and understanding and move them to more sophisticated and in-depth abilities, knowledge, concepts, and performances.” “Effective teaching necessitates making difficult and principled choices, exercising careful judgment, and honoring the complex nature of the educational mission.” If students were asked to describe effective teaching, the answers would vary tremendously among individuals, and most likely not sound anything like the two descriptions just mentioned.

Teachers should be aware of how students learn so they can guide students to increase their cognitive complexity gently but with persistence (Perry, 1970, 1999). Instructors should help their students see the connection between what is being taught and its future application (Bradford et al., 2000; Merriam & Caffarella, 1999). It is critical that educators recognize they should not be the sole providers of knowledge as many dualistic and transitioning multiplistic students believe. When learning is thought of as a process rather than an end product, learning is more apt to occur (Merriam & Caffarella, 1999).

Effective educators should be able to draw out and work with students’ previous understanding or experience of a subject, building upon this knowledge (Merriam & Caffarella, 1999) to learn new information. Drawing upon what students already know in combination with new concepts is exactly what Dewey (1938, p.13) suggested sixty-seven years ago, “All genuine education comes about through experience.” Dewey was also careful to note, “Not all experiences educate.”

During the interview process students frequently suggested it was “the teacher’s fault if students didn’t learn the information or if they preformed poorly on exams.” There were several similar comments made by students in Arboriculture. The following interview comment came from an Arboriculture student with a pre-CCI of 282, and a post-CCI score of 293, a Perry position three (Figure 1: #5). "The instructor’s role is to teach me the facts and information. I want to study and learn what is expected from me, the teacher is the expert and their job is to teach. I prefer instructors who are organized and have a well-planned lecture with a lot of detail and guidance.” While a number of the comments from students in Landscape Irrigation Systems who were taught using a combination of collaborative methods seemed to take more responsibility for their learning. This next statement indicates this student’s ability to integrate information to solve problems; clearly this student has recognized knowledge is not black and white. Their pre and posttest scores placed them in Perry position 4b. “I enjoy the challenges in your class. Your style of teaching makes me think. Your format of questioning allows me to think through the problem. I use information I learned in other courses or from my own experiences to help me come up with the answers to your questions. You often leave me with the feeling that I might have to determine the answer as it pertains to each individual situation. I think this is the type of thinking I’ll use on a job.”

Many students think it is the role of instructors to make their learning effective. These same students prefer to sit back and take notes or to simply idly listen. The next few statements were from students in Perry position three who were in Arboriculture. “The instructor should put gobs of effort into making the class interesting and worthwhile for me, they should help me see the practical side of the stuff they teach.” The following statements also indicate dualistic modes of thinking. "I want to get all the information from the instructor who should be emphasizing the

relevant use of what is being taught.” This next statement expresses very high expectations of instructors. "Instructors should understand the way we think, I would hope the instructor is always trying to find new ways to teach.” The following comment depicts yet another perception of what an instructor’s job is in the eyes of some students. "I expect to come out knowing something, the instructor should teach me how to do stuff, one instructor made me figure stuff out on my own, it was frustrating, but it made me feel good that I could figure it out for myself, I cussed her all semester, but I ended up learning.”

Many students operating in dualistic positions expect the instructor to know everything, because they are considered the Authority. “An instructor shouldn't have to use a book to teach, if a college professor is really educated in that area, they should be able to teach you how they learned and what they want you to know without a book, that's kind of the way I see it.” Instructors are expected to be organized and extensive research finds organization to be a component of effective teaching (Pascarella & Terenzini, 2005). "I expect instructors to be organized and not jump around, just teach me the stuff.”

The next four statements were from students in Perry position two initially, making a slight transition to 2/3 at the end of the semester. "I expect the instructor to be clear and on-track, they must be funny and entertaining, and I must like them. Instructors I don't like, I have a hard time listening to.” Hearing these words could put much stress on instructors without an understanding of cognitive development theories as well as those who don’t consider themselves entertaining. "I don't like professors who can't answer my questions. They should be an expert and know their subject really well. I like to have instructors discuss the information with me; many don't seem to like it when I take their time.” These words clearly express the Authority should be all knowing and without flaws. "I expect the information to be given clearly and

accurately, they should know when students aren't grasping. They should show humility.” Some students expect the instructor to deliver all the knowledge a student will need. "I want clear directions and guidance. They should be able to teach me what I need to know.” Some statements place instructors in a very high position of Authority and knowledge. "They should be excited about the topic.” “I like a more formal, professional instructor who delivers a straight lecture. The teacher should be in control, they should teach, I don't think peers should.”

The next statement was made by a student whose pretest and posttest CCI scores placed them in Perry position two. This student was graduating the following spring semester. "Instructors should have real life experiences. I have more confidence in them. I must have confidence in my professor to want to learn from them.” Some students express a desire for slower-paced instruction and a sense of connection is important. "Communication is important, they should go at my pace, and they should write on the board, they should get to know me.” The next comment was from a student with a pre CCI score of 343 and a post CCI score of 263. These scores indicate a retreat from position 3/4 to 2/3. "One of my favorite instructors wrote over-heads with us, I felt like, he's writing it all, so I'll write it all.” The challenge many instructors face in a typical college classroom is the cognitive variability among the students as heard through the voices during the interviews.

The value of using an instrument like the LEP would be to help educators recognize the cognitive variability in their classrooms. Cognitive variability identified by Perry’s scheme illustrates why certain teaching techniques cause frustration to students, especially dualistic thinkers; however, this is not how intellectual growth occurs (Perry, 1970, 1999). The instructor must provide enough challenge for students’ prior mode of thinking while providing structure and support for development of new ones (Brookfield, 1987). According to Wlodkowski &

Westover (1999) this type of support is referred to as the “zone of proximal development”; the phase in learning where students need assistance. It is only through challenging students that they transition into higher levels of cognitive thinking (Brookfield, 1987; Kegan, 1994; King & Kitchener; Perry, 1970, 1999), but educators would be wise to provide gentle guidance, a nudge rather than a push. Evidence from the literature indicates that specific attempts to manipulate learners toward more complex thinking can have a paradoxical effect having them take on a more regressive dualistic approach (Marton & Saljo, 1984).

The following quotes are indicative of dualistic thinkers who are not comfortable with any other style of teaching especially those that ask them to become involved. “Instead of asking the class questions, you should tell us the answers, you’re the teacher. We can learn a lot more if you just tell us the answer. Discussion is a waste of time, especially since there’s only one right answer, it’s stupid to listen to what other students have to say, the ones that talk just want to look smart.” Some students have a difficult time moving into collaborative modes of learning. “You need to avoid answering a question with a question. To prove your knowledge on a subject, give us straightforward answers without having class inputs, you lose your credibility; just tell us the right answers.”

It is very clear from these remarks that students want their catch-cans filled with information that leads to correct answers on exams. Scattered among the “catch-can fillers,” are students who become irritated when they hear conflicting answers from different teachers. This next statement from a student expresses annoyance when thrown into the pits of educational delusion. This student does not realize there might be two correct answers or two Authorities, depending on the context. “You were wrong when stating how *you* thought something should be done with turf; your answer differed from what I had learned from the turf professor.”

Another point of interest heard during the interviewing was that many students from this generation, coined the Nexters or Internet Generation (Zemke, Raines, & Filipczak, 2000), expect or at least want to be continually entertained. This generation is all-encompassing of digital technology (Zemke et al, 2000). "The instructor should be entertaining so I don't get bored."

The challenge to educators who are striving to get students to examine and think critically without causing frustration that leads to cognitive dissonance might be to provide an "evolutionary bridge" as referred by Kegan (1994). That is, instructors connect to where their students are in their thinking, then create the support system that facilitates the student crossing to more complex ways of thinking (Kegan, 1994). In spite of what students say about wanting to sit back comfortably so they can be fed the information to memorize for an exam, if educators allow their students to remain in their intellectual comfort zone, they are unlikely to develop higher cognitive complexity.

Summary of the Themes

Hands-On Learning

Johnson & Johnson (1986) proponents of cooperative learning suggest that when students are allowed opportunities to exchange ideas and learn from each group members while being guided by the instructor, not only is there an increased interest level among participants, but this type of interaction encourages independent and critical thinking. Working in small groups uses diversity of knowledge and individual experiences and this should contribute positively to the learning process (Cross & Steadman, 1996).

According to Vygotsky (1978), students typically perform at higher intellectual levels when they work and think together to solve problems or learn new information. Experiential learning requires instructors to view their role in developing a students' higher-order thinking as a process (Gokhale, 1995). The instructor should create learning experiences that stimulate a students' thinking using real world problems or examples that call upon a students' prior knowledge (Merriam & Caffarella, 1999). If neural connections are to be made, students must be able to connect new information with information already stored in memory (Leamnson, 1999; Slavkin, 2004). If the educator strives to help students become aware of how new information is related to prior knowledge, there is a greater opportunity to retain new concepts and skills (Merriam & Caffarella, 1999). From a cognitive perspective, hands-on activities that involve small groups allow students to rehearse and relate course material into contextualized levels of understanding so the content that makes sense (Cross & Steadman, 1996; Kurfiss, 1988). The types of hands-on activity used during the Landscape Irrigation Systems laboratories allow students to work together and receive explanations from each other. Students actually are teaching other students. Hands-on learning whether it be of the collaborative or cooperative type acknowledges the fundamental influence of John Dewey (1938) and his belief that education should be viewed "as a social enterprise in which all individuals have an opportunity to contribute and to which all feel a responsibility."

Although hands-on learning does by no means guarantee learning has occurred, getting students involved does remove students them the typical ultra-linear, structured lecture by encouraging involvement rather than passivity (Jensen, 2000). Just going through the motions of an activity does not mean students were really in the moment (Leamnson, 1999). Studies have shown that unless the "thinking" modules of the brain are in communication with the "activity"

modules of the brain, hands-on activities don't facilitate learning (Leamnson, 1999). Educators should use hands-on activities to motivate and capture students' attention, but it is not in itself a sufficient cause for learning to occur. Learning is influenced by external agents (Jensen, 2000; Leamnson, 1999) thus how educators choose to reinforce the learning is indeed critical.

Learning is the Responsibility of the Teacher

During the interviews several students expressed a preference for lectures. In fact, they stressed it was the responsibility of the instructor to teach and give good notes. These student voices affirm what Perry's scheme describes as dualistic meaning-makers. "Authorities process Absolute Truth; a students' job is to listen to the Authorities, receiving the right answer---the Truth. All problems are solvable by obeying and conforming to what is right and what Authorities want" (Perry, 1970, 1999).

Another point illuminated during the interviews was that students don't like to be the center of attention as answering questions and illustrating reflective judgment among their peers can be intimidating. It might be argued that many students prefer sitting back and listening to being "put on the spot." Responding to the instructor's questions takes lots of confidence. Many students are far more comfortable being passive during a class discussion. Different teaching styles and topics may promote different approaches from each learner. High levels of anxiety brought on by teaching strategies that encourage collaboration are frequently associated with students' desires to remain passive during learning (Pratt et al., 1998). Students are concerned with how they will be perceived by both the instructor and fellow students. This is an important source of extrinsic motivation leading them to adopt a passive approach to learning (Pratt et al., 1998). "The most significant influence on student learning is their perception of assessment and

evaluation" (Ramsden, 1998, p. 24). During class discussions students may be more concerned with how they will be perceived by the instructor of their fellow classmates (Ramsden, 1998). This is an important consideration when offering constructive critique to students.

Objective 5: Journal writing encouraged self-reflection but did not reveal any changes in cognitive complexity.

Journal writing was viewed by a majority of the students as another tedious exercise to be completed for a course grade. Although objectives and goals were discussed and each student was given a copy of *Using Journal Writing to Enhance Reflective Practice* (Boud, 2001) to read, many student journal entries contained only a sentence or two. It was obvious many students put very little thought or time into their writing. Journal after journal found students writing about what happened during lecture or lab, but within many entries, a sentence or two did reveal some personal thoughts. Students confessed having written their thoughts regarding a class so they found the task initially difficult. Since this was a new experience students seemed uncomfortable using it as a tool to reflect or express feelings or personal opinions directed toward the class. Several journal entries seemed to be random reflections obtained during class time, but other comments expressed their hopes or fears life, relationships, or exams. A few students appeared to use their journals to recapture or highlight information obtained during class. These students viewed journaling as an opportunity to go over their notes, a good use of reflected thought. Several student journals expressed a growing understanding of a particular topic or concept as the semester evolved, specifically during hands-on activities.

Reading student journals can be enlightening and affirming. Students write about why they could not or did not focus during class. Many students view attending class as something

they need to do, many do not like attending class. A few students will share what they learned while attending class, voicing surprise that attendance really did lead to learning.

Journal Entry Findings

Maintaining a journal during their semester experience produced a mixture of responses. A male student in the Arboriculture class, whose scores indicate he is operating in Perry's position three, wrote the following passage. "Although the teacher talked about tree branch structure in an interesting manner, I quite frankly had my mind on my suffering relationship, and I'm ready for a nap." This verifies students have far more going on in their minds during lecture than paying attention. The following week this passage appeared in his journal. "Well this week is much better, school, that is, maybe because my relationship has come through and is better then ever. Isn't it strange how sometimes my relationship affects my schooling?"

A different male student writes about his feelings toward school. Although the entry is brief, the student still expressed a personal feeling. "This week was a bad week for me and I really was not paying attention in class."

Several journal entries from the irrigation course expressed the feeling they didn't think there was so much to know about irrigation. Students tend not to really think about details, or the importance of performing a task correctly. A few students expressed that they may actually have learned more than they thought by taking the class, they thought they knew all there was to know after working at a golf course. Learning something new and different and then reflecting on what it means affirms the merits of journaling. The student who wrote the following had a pretest CCI score of 390, and a post CCI score of 397 corresponding to Perry position four. "I think I have a pretty good grip on this class in general. Wow, I found on Monday there is a lot more to pipe and

different type of pipe than I thought. It is true that I have more to learn than I previously thought?" He continues his thoughts with this statement. "I am learning a lot about irrigation I didn't know or even think of. Piping is a serious consideration when designing a system." His next passage is a strong indicator the collaborative methodology implemented in Landscape Irrigation Systems was causing some "cognitive case rattling" for this student. "I question your ability to teach this class, just about everything I learned from by boss about irrigation is different than what you say, and irrigation is really a male-dominated field anyway." Another male student was candid expressing how he felt about maintaining a journal. His pretest CCI index score placed him in Perry position 2/3 his posttest score indicated a retreating to position two at the conclusion of the semester. "The journal itself is a pain in the ass, although I think it is a noble idea. Frankly nobody has time, or the ambition (especially the guys) to write in a journal every week that isn't required for a grade. I would rather have some stupid assignment for a grade. Anyway that is the only negative points I had about this class, I find you to be a thorough teacher which I appreciate and respect more than a lot of others on this campus."

A female in Arboriculture wrote this next entry. She expresses some interesting thoughts about how students view class time and their fellow students. Her pretest was CCI 347, her post CCI score was 360, transition 3/4. Female students, according to Belenky et al. (1997) may feel silently alienated during college struggling as "internal multiplists." "The first day of class! Blah! Is it bad that my 8:30 classes I have every day are already bringing me down? First day in Arboriculture, I sit at my desk surrounded by a sea of testosterone. Another one of those classes where the boys rule and no one notices me. But to my surprise a woman walks to the front of the class. My bad thoughts go out the window. At last, a women who will show the boys their place.

Not just another dull female instructor, this one has on boots with huge biceps. Wow, am I impressed, now I'm thinking I am going to like this class."

The next student journal entries express the desire to use the information learned in lecture. The student expresses her thoughts about my exams. This student is planning on pursuing a master's degree in plant pathology, her pretest CCI index score placed her in Perry position three, her posttest showed a retreat to 2/3. "This week in lab we went outside to prune, I'm glad because I was totally lost listening to her talk about pruning in lecture. I am a visual learner." Her next entry describes her feelings about an exam. "We had another test this week, I did really poorly. I always think the instructor is trying to trick me, I can usually find more than one right answer and I never choose the right one. This semester has been really tough for me, my grades have not been as good as I would like, what is worse is that I almost have a 100% in calculus." Her final entry expresses her continued concern about grades. "Well this is my last journal entry, next week is finals. I'm really worried about this exam. No matter what, I feel I am walking away with twenty-times more knowledge about trees than I knew before this class. I have a ton of respect for you and as much as I hate your exams, you made me think."

Several journal entries, from different students, expressed the value of working in small groups, especially when they had the hands-on learning experiences. The comfort from working with other students may help reduce the feeling of inadequacy. "During lab this week we learned how to audit a system. Am I glad we worked in groups I would have been lost without my partners. The hands-on in lab really helps with the specifics, the stuff that's hard to visualize. It clarifies the concepts and ideas we have been studying in class."

The following entry affirms a few students would rather interact during lecture versus just taking notes. This statement verifies journaling helps students realize what they gained by

the learning activity. This student's CCI scores placed him in Perry position four initially and at the conclusion of the semester. "I agree with your teaching methods, it makes me think, although I'm too chicken to answer many questions, it makes me think through stuff. Thinking is important, especially in irrigation because you have to think about the whole system, not just one part. Working in groups really made me think and find meaning in what we were doing."

Although rarely expressed in many of the journals, this students' final entry illustrates the benefit of writing in his journal. This student apparently realized he actually experienced periods of personal growth by taking the opportunity to personally reflect upon what he wrote. This student's pre CCI scores placed him in Perry position, 3/4, and a post CCI score of position three. "I think this journal has helped me somewhat. It caused me to think about class more than the night before the exam. I just wish I had put more thought into this a few weeks ago. My problem was I had heard you were a hard teacher and your exams suck, so my attitude was lousy from the start."

Only one student commented on taking the pretest. This student's pre CCI scores placed him Perry position two/three, remaining unchanged at the end of the semester. "That was kind of weird taking the pretest for your research. Some of that stuff I had never even thought of before. It was hard to figure out what I liked about learning, one thing I know, I hate tricky exams and teachers that don't tell me what I need to know."

In the following journal entries, student statements indicate rather clearly the Perry position from which each student makes meaning. This entry was written by a student whose CCI scores placed him in position two at the beginning and again at the end of the semester. "I approached this class thinking I would be given lots of information that I could read-over, study, and then memorize so I could do well on the test, boy was I wrong." Another dualistic student

wrote, “I would like to be given more specific guidance to the best answer. I should be tested on what was taught in irrigation, not on what might happen in a certain situation. You told us to know the steps of trouble shooting but then you ask us something that required me to disregard those steps.”

During early multiplicity, position 3, students still display characteristics of dualism, but they begin to recognize that the answer may not be known yet. These students think that given the right argument, they might receive good exam grades because all opinions are equally valid. Each of these statements were written by students whose pretest CCI score placed them in position two or in transition to three where they remained unchanged at the conclusion of the semester. “I seem to do better on essays exams because I can write more about what I think.” Another reflection on evaluations concerns. “I thought if I focused on the problems we did in lab, I would do okay on the exam. Even though you say I should be able to work these problems knowing the information, they are not the same.” This next statement expresses dislike for exam format. “I find your method of testing unfair because I think my answers make since, but I get counted off if I don’t say exactly what you want.”

As students transition to position 4, they begin to think more independently. They see fellow classmates and peers as legitimate sources of knowledge and their own thinking is improving analytically. A student whose CCI scores placed him in transition to position 4a both pre and post LEP wrote this sentence. “I understand why my answer differed from what you told me was correct, once I hear what your thoughts are on my answer, I see where I can improve next time.”

The student that wrote this comment in his journal had CCI scores placing him in position 4b. This students’ posttest CCI shows movement from position 3 to 4b. “I like your style

of testing, I am able to think through the problems, relate it to what I know, then substantiate my thinking. You seem to want me to have to think and reason through what I know about irrigation to answer your questions."

Summary on Journal Writing

Although there is potential for growth and learning through journal writing, many students do not enjoy the task or appreciate being required to maintain one during a semester. In spite of sharing the many benefits with students prior to asking them to maintain a journal, it was difficult to convince reluctant students that journaling deserves a serious try. The conditions upon which journal writing takes place will have an influence as to what takes place and the extent to which writers will express their thoughts. If journal writing is used, care must be taken to distinguish how they will be assessed, whom the reader will be, and when they will be read. The idea of students writing their thoughts, knowing the teacher would read what they had to say, most likely influenced what was expressed.

A bonus to the reader, perhaps the instructor of the course, who understands Perry's Scheme of Intellectual Development, is a better understanding of where the journal author may be according to Perry's positions. This understanding of intellectual development may ease the pains of frustration felt by the teacher who attempts to promote higher-order thinking, or it just may soften the blow from some of the harsh comments students can make regarding the instructor.

Many of the student remarks consistently correspond to their individual CCI scores. The study found that those students who preferred to sit and listen, getting all the answers from the instructor, were in Perry's position two or in transition to position three. While those students

who desired a learning environment that required additional reflection, discussion, and the power to arrive at their own conclusions, were in position four. Of sixty-one students given the LEP, only two scores indicated position five of the Perry scheme.

Journal writing was viewed by a majority of students as a required, laborious assignment. Although numerous journal entries were recaps of lecture or lab activities, this "forced" writing requires reflection. Any skilled writer finds composing an essay a tortuous process (Bean, 1996), as writing theorist Peter Elbow (p. 15, 1973) said "meaning is not what you start out with but what you end up with…think of writing then not as a way to transmit a message but as a way to grow and cook a message." The aim of journal writing in this study was to help students become more productive and more focused thinkers, regardless of whether the writer realizes this at the time of writing, it can deepen students' thinking about their course subjects because it causes them to look at the topic with speculation and investigation rather than simply a new body of information.

Summary of Qualitative Research

The interviews served as a platform to address the qualitative portion of this research, specifically describing the nature of cognitive complexity and the significant issues that influence the learning environment for this group of horticultural students. According to their CCI scores, these upper-division students are operating in Perry positions two through four.

The voices of the students during the interviews suggest the nature of this complexity. Students expressed a wide range of feelings about their learning, their instructors, and fellow students. The Perry Scheme clearly demonstrates students each interpret their learning differently and each is engaged or disengaged differently in their learning as a result of the nature of their

complexity. These differences are strongly impacted by the cognitive complexity platform from which they view their knowledge and progress can be slow (Perry, 1970, 1999). Pavelich and Fitch (1988) measured engineering students' progress through Perry's positions and concluded that it is slow. Culver and Hackos (1988) discussed the redesign of engineering courses and curricula to aid the progress of students on Perry's model. If growth along the Perry scale is a desired then educators may have to change their teaching approach by developing techniques that appeal to several positions of cognitive complexity to encourage intellectual growth.

The females who participated in the interviews made a few statements suggesting there may be clear differences in how they operate cognitively as opposed to their male counterparts in the same positions. Studies by Belenky et al. (1997) suggest similar findings. Although there were only three females interviewed, some of their responses seemed to indicate they were more comfortable with instructors who used a questioning format during course instruction. Whereas, several of the males interviewed indicated they preferred to sit back and listen. These findings indicate the importance of careful planning when developing a questioning format.

Horticultural students showed little progress to higher Perry positions, and may have actually regressed as seen by some of the posttest scores from Landscape Irrigation Systems. Many of these students seem comfortable operating in position two and three. The concern is that they are not able to see the bigger picture which may influence their career advances. These students in this study are not going to be graduating in positions 7 and 8 as Perry found in his study (1970). Horticultural students in this study are likely to be graduating in positions three and four, similar to the engineering students (Pavelich & Fitch, 1988). The results of the LEP may be conservative as frequently the comments made by some students during the interview seemed to indicate they may be operating at a slightly higher position. However, an understanding of Perry's Scheme (1970,

1999) in conjunction with the ability measure cognitive complexity using an instrument such as the LEP can serve as a platform, or “an interpretive framework” from which instructors can use to develop their curricula to encourage higher-order thinking.

Instructor techniques and the interactions that students have with them can have a positive or negative influence on a students’ ideal learning environment. Specifically, the themes that developed indicate many students view learning as the responsibility of the instructor; they prefer hands-on learning; and are easily bored in courses that do not pertain to their field of interest.

The CCI scores did not reveal upper movement as a direct result of collaborative learning although the voices of several students expressed both benefits and drawbacks of this type of learning.

Any changes in Perry position or perceptions of learning were not reflected in student journals. Rather, other aspects of student learning and attitudes were discovered.

CHAPTER 6

IMPLICATIONS, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Overview

This chapter contains a review of the research objectives, implications of the study, discussion of the findings, and conclusions. Recommendations for further research will be discussed.

RESEARCH OBJECTIVES

To: 1) Explore the reliability of using the Learning Environment Preference Inventory (LEP) instrument's Cognitive Complexity Indicator (CCI) scores (Moore, 1987) as a tool to recognize the Perry positions (1970, 1999) of cognitive complexity of horticultural students, the nature of this complexity and if gender age, class status, or previous horticultural experience would influence CCI scores; 2) determine if specific teaching methods designed to promote active involvement at a higher level of exchange than traditional lecture would influence scores; 3) describe the effects of the collaborative interactions with classmates and instructor; 4) determine whether student journals would reveal changes in their cognitive complexity or perception of learning as a result of their learning environment, and; 5) discover other significant issues that could produce advancement along the Perry scale.

Implication of Results

Objective 1: Explore the reliability of using the Learning Environment Preferences instrument's Cognitive Complexity Indicator (CCI) scores (Moore, 1987) as a tool to recognize

the Perry positions (1970, 1999) of cognitive complexity of horticultural student.

All sixty students enrolled in both courses during the fall 2002 semester involved in this study began their experiences no lower than Perry position two, Multiplicity Pre-Legitimate and ranged as high as position four, Late Multiplicity. There were no students operating in Perry position five, Contextual Relativism, in this study.

Analysis of the forty-two pretest and posttest CCI scores from Landscape Irrigation Systems taught using collaborative learning found ten student scores increased; seven remained approximately the same; while twenty-five decreased. The pretest scores ranged from 263-417. The posttest CCI scores ranged from 230-410. Seventeen students shifted to a lower Perry position; five students showed upward movement on the Perry scale; twenty of the students remained in the same position. Five of the seventeen scores showing a decrease in CCI scores dropped by one Perry position. For example, one student's pretest CCI score was 336 (in transition from position 3 to 4) and their final CCI score was 257 (in transition from position 2 to 3). Moore (1987) reminds us while the CCI scores are not designed to be converted to grouping variables it is possible to define loose groupings using CCI score ranges. This does help clarify how CCI scores translate to Perry positions.

The range of CCI scores from Arboriculture, taught using traditional lecture, also found some shifts in Perry positions. A look at the CCI scores show eight decreased; one increased; and nine remained constant. The pretest CCI scores ranged from 230-413. The posttest CCI scores ranged from 237-407. Of the eighteen students, eight moved back to a lower Perry position; seven stayed in the same position; and three made an upward position change by one position.

What is the nature of this complexity?

The first researcher to solely focus on intellectual development of college students was William Perry (1970, 1999), and his work was rooted in Jean Piaget's. Perry felt it necessary to understand how students made meaning from multiple frames of reference. From his research, he found that students differed in their developmental process. This research confirmed, as has the expansive reviews of cognitive development by Pascarella and Terenzini (2005) that lots of students graduate from college developmentally untouched by classroom experiences. Many still operate from dualistic positions of meaning making at graduation. Movement from one position to the next may not happen as a direct result of a particular teaching method or in-class experience (Pascarella & Terenzini, 2005; Perry 1970, 1999). Perry's work notes upward movement, particularly from dualistic to multiplicity, may be influenced more by social factors that occur outside the classroom and interpersonal relationships among students than by the instructor. As Vygotsky (1978) suggests, cognitive skills are not just determined by innate factors but are products resulting from interaction with friends and family. As Perry suggests (1970, 1999), it is this interaction with peers, fellow classmates, and instructors that is imperative to intellectual development. As pedagogical methods change by tying brain-based instructional methods to everyday instruction, so too will intellectual development of college students Leamnson (1999).

Highly structured lectures seem to promote lower position thinking (Pratt et al, 1998). Students from this study voiced a preference for courses that were less structured. Students prefer instructors and courses with flexibility and variety of learning approaches. Many students like concrete experiences, for example, going outside to observe or learn a skill. The female

students in the study seemed to need more support during their learning than to the male students, a point noted by Belenky et al. (1997).

Students are also very aware of their teachers, what they say, and how they act in response them. How instructors respond to students should be seriously considered when instructing (Leamnson, 1999). The weight of evidence from extensive research indicates a relationship linking the positive interaction between students and instructors for general intellectual development during college (Kitchener et al, 1999; Pascarella & Terenzini, 2005). According to Duckworth (1987), the essence of intellectual development is students having good ideas and the positive reinforcement of these ideas. Then the essence of effective teaching must be to provide opportunities for students to have great ideas subsequently allowing them to feel good about their contribution to their learning (Pratt et al., 1998). Teacher and student relationships and interactions are pedagogically important, students tend to work much harder to please an instructor they respect and who challenges them to think independently (Perry, 1970, 1999). Perry describes this as an interesting paradox, on the path to conform to the expectations of the instructor these students are actually learning to think independently and critically (Love & Guthrie, 1999). If that is the case, than perhaps the interaction that occurs in the class as a result of collaborative learning may cause students to realize there may be more than one right answer, opinion or view, and each student might have a good idea to share. Thus collaborative or cooperative learning may either promote movement along the Perry scale or functional regression could occur as a direct result of pluralism.

Some of the students with previous irrigation experience showed a decrease in their CCI scores, a few actually declined in their Perry position. Perhaps these students were experiencing *functional regression* as described by Knefelkamp (1999). When faced with ambiguity, students

retreat to dualism where right and wrong are clear. Possibly the retreat seen in this study resulted from the discrepancy students experienced when hearing different answers or ways of doing things from two different Authorities, the instructor and their bosses, causing cognitive dissonance leading to this a temporary retreat.

Interestingly, the petty tyrants in the class who consistently argued about grading and tricky exam questions were those students whose posttest scores showed a backward movement in Perry positions. Students in Early Multiplicity (position 3) begin to question modes of evaluation (Love & Guthrie, 1999). The multiplistic student who squabbles enough with the instructor during class discussion will begin to realize their argument needs to be justified with evidence (Perry, 1970, 1999), the advent of relativistic thinking, or this bickering may lead to a temporary retreat. Research with engineering students (Culvar & Hackos, 1988) using Perry's scheme found movement into higher positions was gradual, if at all. Many of these students showed retreat, but most of these students were operating in position three. Gains in cognitive complexity are not entirely linear, Perry himself identifies periods of "temporary suspension" in development (Perry, 1970; Pascarella & Terenzini, 2005, p. 34).

Some cognitive developmental theories emphasize the importance of discontinuity and discrepancy for intellectual development (Evans et al., 1998). Cognitive growth is fostered when individuals encounter experiences and demands that they cannot completely understand or meet, and thus must work to comprehend and master the new and discontinuous demands. Piaget (1972) called this optimal learning situation one of *disequilibrium*. Drawing on this theory, Ruble (1994), a developmental psychologist, theorized that cognitive growth (and other developmental changes) will be stimulated by developmental transitions, such as going to college, enrolling in challenging courses, or starting a new job. Transitions are significant

moments for student intellectual development because these new situations involving uncertainty that requires new knowledge content encourage growth.

Collaborative learning, when carefully designed, and implemented in a supportive environment of peers and instructor, may stimulate this type of disequilibrium. As students move through position three with hints of uncertainty and periods of retreat, learning opportunities that provide challenge must do so with encouraging support. Studies by Culvar and Hackos, (1988) with engineering students found the importance of a supportive environment especially for female students. Belenky et al. (1997) discovered a noteworthy paradox involving female students and male professors. Female students are frequently distrustful of compliments from male professors. “Female students worried when professors praised their work, they really desired their bodies” (p. 197). Even when the learning situations are well designed and occur in motivating, enriched environments with the hope of making appreciable cognitive changes, students may experience periods of retreat until they feel comfortable in a new situation or with relativistic thought.

When students are required to substantiate their answers as they might be required to do during collaborative or cooperative learning, Perry (1981) discovered an interesting paradox. Students in position 4b would “think more independently and critically out of desire to conform to the expectations of their instructors.” Consequently, instructors might consider thinking out loud rather than using well-rehearsed speeches. Several students in this study voiced a desire to know what instructors were thinking. If the instructor hopes to promote higher-order thinking, they must provide the tools that will encourage a more qualitative response.

The concluding portion of objective 1: Determine if age, gender, class status, or previous

horticultural experience would influence CCI scores.

There was no significant statistical correlation between student age, gender, or class status. With an alpha level of .05, the effect of previous horticultural experience was statistically significant for some students enrolled in Landscape Irrigation Systems. The qualitative portion of the study did reveal some rousing comments from students possibly illuminating the influence of age, gender, class status and previous horticultural experience not found using the LEP or statistical results.

The average age of the sixty students in this study was 22. The few students older than the traditional-aged college student, 19-22 (Pascarella & Terenzini, 2005), had CCI scores of 400 or slight above, but there was no statistical correlation between age and Perry position. The following comment from a 26-year old male student with a CCI post score of 293 is an example of an older student still operating in dualistic modes of thinking, also reflective of his CCI scores. "I do not like instructors who give tricky exams. I like questions that are objective. I don't like instructors who won't tell me the exact answer."

The next statement is from a 30-year-old female student with a posttest CCI score of 407. Her comment is more in-line with what many people may think that older students operate in upper Perry positions. "In Arboriculture, I learned there is an organized methodology to solving tree-related problems. The instructor demonstrated a rational way to think more effectively. I learned how to integrate information to solve problems better then I ever had before, plus I realized sometimes, you just can't solve every tree problem, but you can make sound speculations." There have been a few studies with non-traditional or older students. Some of these findings on adult learners are contradictory (Merriam & Caffarella, 1999). A study performed by Lavallee, Gourde, and Rodier (1990) found that a majority of their respondents

were operating in Perry position three or four. Another study by Cameron (1983) found adult subjects were primarily operating in position two. Other studies suggest educational background and social class influence intellectual development (Merriam & Caffarella, 1999).

The next remark expressing the thoughts of a 22-year-old female, final CCI score of 346 also supporting Belenky et al. (1997) research, women seem to prefer experiences to abstract concepts. “I appreciate instructors who encourage thinking and really want to know what I think. In irrigation, the fun is trying to figure out what the problem is. I enjoy coming up with an answer, especially after I see what is happening.”

Perry (1970, 1999) found most students in college experience consciously striving toward maturity and suggested many students show signs of higher-order thinking as they moved from freshman to senior year. Moore (1991) used the written measure of Perry’s scheme, the Measure of Intellectual Development (MID) and found little change as 18 year-olds became 21-year olds.

Baxter Magolda’s (2002) longitudinal study of college students had similar findings, 32% of freshman, 53% of sophomores, 83% of juniors, and 80% of seniors were in transitional modes of knowing. Transitional knowers maintain their beliefs that certain subjects, mathematics and science, have specific answers, whereas, subjects such as humanities or social science, are more ambiguous (Baxter Magolda, 2002). In new learning situations or those of uncertainty, there are various reactions from students that appear to be in response to where they are in terms of intellectual development (Perry, 1970, 1999) rather than class status. Students in new learning situation are concerned with: a) understanding the information; b) expecting teachers to facilitate their understanding of the topic and explain how to use this knowledge; c) prefer examinations that require understanding versus memorization; and; d) find information from fellow students

supportive in their comprehension of new information.

The influence of gender on cognitive development has been of interest to many researchers over the years (Love & Guthrie, 1999). Perry describes some critical differences in position four, particularly with relationship and identification with authority. Baxter Magolda's (1992) study included a mixture of female and male students and she did find differences in cognitive development based on gender. Baxter Magolda clearly states these are gender-*related* rather than gender *dictated* patterns (Love & Guthrie, 1999). Females tend to focus on communication over the actions to accomplishment, the path males tend to follow. In advance positions of intellectual development both Baxter Magolda (1992) and Gilligan (1982) discovered gender-related patterns of knowing disappear.

In this study of sixty students, only eight were female, therefore the data can make no connection between gender and intellectual development. Research findings do suggest that education appears to play a significant role in the shift to multiplicity for men (Belenky et al., 1997). Whereas, formal education for women is relatively unimportant for the shift into "subjectivism," the term Belenky et al. (1997) used for multiplicity. Women appear to shift into subjectivism "after some crisis of trust in male authority in their daily lives, coupled with some confirmatory experience that they, too, could know something for sure" (Belenky et al., 1997, p. 58).

Previous studies (Belenky et al., 1997) indicate men appear to identify more with authority figures than do women. Perhaps this may influence male students' opinions toward female instructors, an aspect voiced during this study's interviews. Two gender-related patterns surface within transitional knowing, interpersonal and impersonal. Women, it seems, are more interpersonal. They seem to benefit from uncertainty, building their knowledge by connecting to

others and tend to use personal judgment when making decisions and focus more on sharing views with fellow students. Impersonal *knowers*, mostly males, tend to defend their views, learn more from being challenged and prefer to logically resolve uncertainties (Belenky et al., 1997).

In dualistic positions, men and women use language differently. In general, men tend to talk while women listen. Since listening to authorities is the primary focus of women in dualistic position, Belenky et al. (1986) called these positions "received knowledge." In their study they found women had a more difficult time recognizing their own authority. Their study defined epistemological development occurring in five stages: silence, received knowing, subjective knowing, procedural knowing, and constructed knowing. What these researchers determined was women are comfortable starting a college education with what they know, calling upon their experiences (Belenky et al., 1986). Most women are drawn to actual experiences, as opposed to abstract concepts, especially those that were not preceded by their experiences to aid in making sense of the concepts. Women prefer instructors that welcome diversity of opinions during class discussions. To develop cognitive complexity, instructors need to "emphasize connection over separation, understanding and acceptance over assessment and collaboration over debate" (Belenky et al., 1997, p. 229). Follow-up studies by Clinchy (2002) involving both genders demonstrated that these differences may be gender-*related* rather than gender-*specific*.

The few statements made by the females interviewed suggest their lack of understanding of irrigation was based on the fact they had no previous experience, but, according to Perry (1970, 1999) it may be women avoid abstract thought devoid of experience. The females in Landscape Irrigation Systems were apprehensive initially but once paired with male students with some experience, and once they gained confidence, they were eager to perform other skills used to install an irrigation system. One female repeatedly voiced the following "I gained so

much by working with other students, especially the guys who weren't cocky and arrogant."

A senior male student raised his hand during a class discussion about irrigation pipe sizing to argue what was just said about pipe size and pressure loss. Was he questioning authority in general, or that of a female instructor? Perhaps he was seeking to understand on a higher level. "I don't believe you are correct, I think you have this backwards." Moments later this same student raised his hand and said, "I stand corrected. After working through what I remembered in physics I now understand the hydraulics of pipe-sizing." Not surprisingly, this student had a post CCI score placing him in transition 4b/5.

The findings from this study found no statistical correlation between class status in college and Perry positioning. Although, intuitively people may think students who are ready to walk the graduation stage to receive their diploma, soon to leave their college days behind would surely have more cognitive complexity than freshmen. But the many comments made by students in this study would suggest otherwise. Many students in upper-division courses do not see the big picture. They don't seem to have the ability to weave their knowledge from previous courses into addressing different types of problems. Operating in lower positions may have significant negative influence on advancement in their future careers.

Many of the students in this study voiced how important it was to develop close bonds with fellow peers, especially because they take many of the same courses. These students socialize and study together on a frequent basis. Students spend a great deal of out-of-class time learning collaboratively which may indeed inspire dualistic thinkers to make a transition to a higher cognitive level. The time spent together studying and working on projects may be more of a thrust for increased cognitive complexity than anything that occurs in the classroom, regardless of class status. Vgotsky (1978) believed social interactions and interpersonal

communication were vital for cognitive development. These social connections certainly include pedagogical interactions (Good, 1987).

Research findings on cognitive development suggest students' assumptions and learning structures are more influenced by social interactions that occur outside of class (Pascarella & Terenzini, 2005) than in the classroom. Essentially the meaning an individual makes of their experiences will a) depend upon where they are in terms of cognitive complexity, b) how the individual is influenced by a difference of opinion as a result of the interaction with instructors and peers c) and to some extent, the social environment in which these differences occur (Baxter Magolda, 2002). Learning may indeed be more social in nature (Baxter Magolda, 2002; Love & Guthrie, 1999). Perry's study (1970, 1999) revealed that students were more likely to move to upper positions as a result of coexisting and stimulus with other students.

Kuhn's research (1991) found after interviewing 169 people ranging in age from teenage to 60-year-old people that epistemological level and educational background were positively correlated. Only those people with advanced degrees demonstrated the highest level, evaluative reasoning (Kuhn, 1991). The comprehensive review on the impact of graduating from college concludes there is a discerning influence. Attending college increases the ability to look at evidence and solve problems, but it is less effective facilitating the ability to derive conclusions from facts or premises (Pascarella & Terenzini, 2005).

Nineteen students in Landscape Irrigation Systems reported to have had some previous irrigation experience. There was statistical evidence supporting a relationship between experience and CCI scores, a review of initial scores to final scores of these nineteen students does show a slight decrease in scores of eight students. Several dropped close to100-points in their scores.

Perry (1970, 1999) identified three alternatives to forward progress through the positions of his scheme: *temporizing*, *retreat* and *escape*. In 1999, Knefelkamp added, *functional regression*. Frequently when students are exposed to information that differs from knowledge gained from another source, such as employer versus instructor, they may move back to the relative safety and security of dualism---a world where right and wrong are clear and ambiguity does not exist. This occurs often in reaction to the complicated nature of pluralism (Perry, 1970, 1999). Students with previous experience frequently question the knowledge of the instructor, they initially believe the difference in opinion between what they've been told and what the instructor says is that the "instructor is book-smart, but doesn't live in the real world like the foreman." Until they gain more experience or have the opportunity to see why one method is more optimal, or that both methods are legitimate, they become frustrated in their learning environment, frequently becoming the "class-know-it-all" or rebel. These students tend to argue about grades and evaluation methods.

Another possible answer to the decrease in CCI scores of those students with some previous experience may be what Knefelkamp (1999) calls, *functional regression*. This may occur when an individual is learning new information in a new learning environment and "functionally" regresses to a previous position until becoming more comfortable. This type of regression is seen as "developmentally" appropriate; to progress cognitively, the student moves back to a previous level of meaning-making to regain composure to the new learning. For example a student who worked on a golf course may have learned the difference between a sound solenoid and a bad solenoid, they may know exactly how to change one out, but they have no idea why the solenoid stopped operating initially, so when placed into a new learning environment that requires them to actually understand the working concept of solenoid

operation, they become frustrated. These students may have “lost their confidence” so to speak, discovering there was much more to irrigation trouble-shooting than being told by the golf course superintendent to change a bad solenoid. Until a student is able to “get their bearings” in a new learning environment with a new Authority, they regress until they are comfortable and recognize there can be more than one Authority.

Objective 2: Determine if specific teaching methods designed to promote active involvement at a higher level of exchange than traditional lecture would influence scores.

Analyzes of the interviews revealed that instructor techniques can have a positive or negative influence on a students’ ideal learning environment. The students operating in Perry position 2 or 2/3 preferred instructors who were organized. These students expressed the desire to have the information presented similar to how it would be used on exams. The dualistic thinkers in this study said they lost confidence with instructors who ask questions during lecture. These students were not able to recognize discussion as a constructive way to learn how to evaluate or analyze problems; rather they grew insecure with the instructor’s ability to teach the course. A comment during a discussion such as, “Don’t you know the answer, why are you asking us?” may cause an instructor unfamiliar with intellectual development to lose their balance during the class discussion. Perhaps once instructors understand cognitive development, they may be better equipped to recognize that such a statement comes from a dualistic thinker who views them as the authority not their fellow classmates. This example should also serve to reinforce the importance of using techniques that encourage moderate cognitive dissonance while attempting to move a student to the next Perry position.

Instructors able to recognize the vast variation of cognitive complexity of their students

can strive to achieve teaching critical thinking that challenges the students' old modes of thinking and provide structure and support for the development of new ones (Brookfield, 1987). As observed in this study, educators can have powerful influence over learners. The challenge is to help dualistic thinkers learn when to use existing knowledge in new situations (Pratt et al., 1998).

There appears to be a relationship between a students' Perry position and their attitude toward the teaching methodology. This research revealed the challenges faced by the instructor who would like to promote movement along the Perry scale, together with the frustrations felt by the students who were uncomfortable with a style of teaching that urged upward movement.

At least one of the goals of higher education, especially in upper level courses, ought to be fostering student development of higher-order thinking skills. This research used William Perry's scheme of cognitive development (Perry, 1970, 1999) because it is a descriptive theory concerning students' changing attitudes toward knowledge as they progress through college. This research affirms the use of Perry's theory because it has implications for encouraging a students' development of critical thinking skills, particularly when the instructor has an understanding of cognitive growth.

The interviews with students did serve as an excellent format to gain further insight into learning environments that promote reasoning and thinking skills. The researcher maintained a journal throughout the research process. This served as invaluable reference tool particularly during the reflection of student interviews. Frequently, student comments overwhelmingly correlated to their CCI scores and their voices during the interviews reinforced what their CCI scores indicated.

This research also found dualistic students will not understand, or will not be able to make sense out of instruction that is designed for higher Perry positions, they will be in cognitive dissonance; in contrast, students in higher Perry positions tend to be bored when instruction is intended for dualistic meaning-makers. This is specifically true of exam questions. Dualistic and early multiplistic thinkers are intimidated when exam questions are not objective (Perry, 1970, 1999). Their reaction is one of anger and frustration toward the instructor. They do not like exam questions that are not objective. These types of questions are frequently described as tricky. Dualistic thinkers view the instructor as the good and all knowing Authority and collaborative learning asks them to consider the thinking of fellow peers as bad authority.

Consider if an instructor presents a question and then supplies several possible answers rather than one, or urges students to come up with their own possible answer. The dualistic student becomes aggravated and uneasy if the instructor does not give the right answer. Some even wonder why there is any discussion; after all, doesn't the instructor know the answer? On the other hand, the multiplistic student will think, heck, my answer seems much better than the Authority or other students, but the instructor implies my answer needs some "fine tuning." To add to the mix in a typical upper level course, the contextual relativistic student is wondering how to best support their answer, and maybe even trying to decide which of the teacher's answers is more appropriate to the situation.

To further illustrate these points are a few comments from two male students in Landscape Irrigation Systems. "The teacher doesn't seem sure of what she says, because she's always asking questions, like maybe she doesn't really know the answer," implies an objection by dualistic meaning makers to questioning and discussion. Or, "I hate your exam questions. You try to trick us constantly."

Questioning and discussion sessions were accepted more positively by students operating in upper Perry positions 4a and 4b. They liked to be challenged, this was apparent in this remark. “Your teaching methods are superb, you do a good job of compensating for the pace of all students but at the same time teach the materials in ways students will retain the information, I love the way you challenged my thinking by asking questions that precipitated discussion.”

Perry (1970, 1999) points out many students entering college are of the dualistic mindset. This research found many of the graduating students interviewed were indeed leaving college still operating in positions two or in transition to three. This presents the likelihood that most are ill-prepared to address open-ended problems (King & Kitchener, 1984; Wolcott & Lynch, 1997) or to solve problems such as those they will face in the green industry. Simply put, many college seniors may be able to supply evidence and reasons for their opinions, but very few can thoroughly examine an issue from multiple views while considering how other factors may influence interpretation of the body of information (Wolcott & Lynch, 1997).

If educators in upper-division courses strive to incorporate higher-order thinking into their courses to foster cognitive development along the Perry scheme, they should be prepared to run into tribulations in this ego-threatening process. Consequently, how can an instructor challenge students in order to promote movement of Perry positions without threatening them, especially when each student responds differently to diverse teaching methodologies? Work by Culver & Hackos, (1988); Knefelkamp (1974); and Wolcott & Lynch (1997) suggest the creation of assignments that appeal to students at different cognitive levels. It is important that instructors build a bridge between new knowledge and old as assignments are created (Kegan, 1994). Assignments must be understandable to different learning levels (Knefelkamp, 1974). Consider the following assignment questions that might be given to students in Arboriculture.

Select one of the following to answer.

A. Discuss the vascular structure of the tree when describing how a branch is attached to the trunk

B. Determine the role branch size plays in decay prevention and strength of attachment to the trunk

C. Evaluate branch unions and forks, expound on the factors you think contribute to branch union strength. Support your answer.

Option A is objective. This type of question appeals to a dualistic thinker, at the same time it forces them to do more then dump the information on to the page. Option B is somewhat more challenging for the multiplistic thinkers, who are beginning to feel more confident with their ability to construct their own meaning. The final option, C, asks the student to evaluate and expound when answering the statement. This requires more contemplation and resourcefulness. This type of question also asks the student to not only evaluate but to defend their answer. Assignments such as this will allow students to select the question that corresponds to their Perry position. This reduces the possibility of a student feeling threatened when given an assignment that may be too difficult. For the next assignment, the choices could be slightly more challenging. This should encourage students to challenge themselves, perhaps beginning their move to the next Perry position. Instructors who teach students with a wide range of cognitive levels need to learn how to challenge students with the appropriate method that encourage growth but in a manner that will not discourage development (Rapaport, 1984).

This type of questioning can be used when creating exams by utilizing the cognitive process dimension. To keep the importance of Bloom's work relative to today's theories, Anderson and Krathwohl (2001) revised the original Bloom's taxonomy of Bloom combining both the cognitive process, and knowledge dimensions. This new expanded taxonomy can help instructors write and revise learning objectives, assignments, and exam questions. The revised taxonomy (Anderson & Krathwohl, 2001) incorporates both the kind of knowledge to be learned (knowledge dimension) and the process used to learn (cognitive process), allowing for the instructor to efficiently align objectives to assessment techniques.

Objective 3: Describe the effects of c*ollaborative learning interactions with classmates and instructor.*

Although the LEP scores did not indicate upper movement as a direct result of collaborative learning, the voices of several students expressed both the benefits and drawbacks of this type of learning. The stimulus of other students appears to be influenced by their Perry positions. Students operating in position 2, multiplicity pre-legitimate, expressed during their interviews that "learning was the responsibility of the instructor." The instructor is viewed as the Good Authority. Some students grew impatient listening to fellow students' answers (bad authority). These same students consistently remained silent during consensus group work.

As the semester progressed, one student interviewed did begin to value fellow students' opinions, acknowledging a growing awareness that he could learn from his peers. In Perry's scheme (1970, 1999) as students begin the process of transition to position 3, they begin to see their friends and fellow peers as sources of knowledge.

Those students operating in position three like the interaction with other classmates.

Witnessing fellow group members performing successfully seems to motivate each member to perform at a higher level of achieve.

A student whose CCI scores placed him in upper Perry position 4b expressed annoyance with fellow group members who acted like "high schoolers." The group member this student was referring to had LEP scores in position 2, Multiplicity Pre-legitimate. Comments such as this may indicate that consensus groups may be more beneficial to some students if fellow group members are close to the same position of intellectual development to avoid frustration for upper position thinkers. Unfortunately, the benefits derived for the students operating in lower Perry positions may not be realized in this type of pairing. Working together sharing information, solving problems and expressing thoughts provides fertile ground for students to reflect. As students listen to peers, they learn to form their own legitimate ideas, and how to relate these ideas to larger pools of knowledge (Bruffee, 1993). Several comments from students during the interviews support this idea, especially for those students in positions 2 and 3. Through struggle and disagreement with others (Bruffee, 1993), students may develop more complex ways of thinking. Because as they learn to merge this incongruity in their thinking, they may make a gradual shift to higher cognitive thought (Perry, 1970, 1999).

In summary, collaborative learning groups can influence cognitive complexity, as expressed by several students in positions 2 and 3, while at the same time causing some frustration to those students operating in upper positions 4 and 5 who already possess a more complex way of thinking.

Objective 4: Determine whether student journals would reveal changes in their level of thinking or perception of learning as a result of the learning environment? Journal writing did

not reveal changes in student level of thinking or perception of learning as a result of the learning environment. Rather, the journals served to reveal other aspects of student learning and attitudes.

The portion of this research using student journals for the purpose of discovering if student perceptions of learning changed as a result of the learning environment achieved mixed results. This may be because a majority of these students had never maintained a journal and perceived this assignment to be another form of academic busywork. There was immediate resistance to maintaining a journal because it asked the students to perform a task that would not be graded. This produced initial frustration because students appear to be motivated to perform only when a grade results.

Many students wrote comments in their journals or in the end of the semester course evaluations, that they disapproved and even resented being required to maintain a journal. But many of the journals revealed hidden clues suggesting a few students' journaling did encourage a proactive approach to their learning. The idea of maintaining a learning journal is to record thoughts, reflections and personal opinions (Hiemstra, 2001). Many of the comments came from stimulation received from the instructor or fellow students during class time. Even though such comments as "your exams are tricky" may not seem enlightening, they do reveal the vantage point from which this writer views knowledge. Another advantage of journaling was it allowed a few students to integrate their life experiences with new knowledge and stimulate mental development.

Using journal writing in learning can have several objectives. "To deepen the quality of learning, to enable learners to understand their own learning, to encourage personal ownership of learning, and to provide another means of expressing one's thoughts" (Moon, 1999, pp.188-194). The process of expressing personal thoughts through writing is learning (Boud, 2001). If journals

are to be used to promote reflection in horticulture, great care must be taken to introduce the journaling process in ways that avoid the obstacles to expressing ones thoughts through this unfamiliar exercise.

Objective 5: Discover other significant issues (themes) that could produce advancement along the Perry scale.

This research did reveal some significant issues that influence ideal learning environments: 1) a preference for learning relevant information; 2) the benefits of hands-on learning and; 3) the influence of the instructor and teaching techniques.

Students expressed a preference to learn information that is relevant to their degree program. A majority of those interviewed articulated a dislike of taking courses that "didn't seem to apply" to their horticultural curriculum. This group of students, as demonstrated by their CCI scores, was still operating in Perry positions two and three. These students found those other courses to be boring and totally unrelated to their interests. Horticultural instructors need to help students find the relationship of their courses to other university courses by using examples in classes. Instructors need to encourage ownership of knowledge by demonstrating how they intertwine their knowledge in solving problems. As stated by Thien (2003), "it is important to be a model of the learning process, showing how doubt, intellectual curiosity, and uncertainty are essential complements to knowledge." Perhaps by changing the way students view required courses, those not specifically related to horticulture may also change the way they think. When students are able to personalize new information, it is thought to make neural connections in the brain stronger (Brandt, 1997) than if they remain unconnected to new knowledge. Students must be able to take ownership of their learning by realizing how this information may relate to their

own lives. If this can be accomplished; the likelihood of retaining the new information is increased (Slavkin, 2004). Hardwiring in the brain depends upon the learning environment, interest in subject, and prior experience of the student (Slavkin, 2004). When the learning environment is enhanced, the area of the brain responsible for higher-order thinking grows (Diamond, 1988). The importance of enriching the learning environment can not be overstated because, when provided, instructors give students the opportunity to think in more complex ways, improve their metacognitive skills, and increase their ability to think for themselves rather than relying on the instructor to tell them the right answer (Diamond, 1988).

Students also expressed preference to be actively involved in the learning experience. Their voices expressed partiality for hands-on, skill type activities. This involvement seems to motivate students reduce their likelihood of boredom, and increase their retention of knowledge. This is congruent with literature findings (Burke, 1997; Dozier, 1992). The more meaningful the learning experience, the greater the likelihood of the growth of neural pathways in the brain (Slavkin, 2004). Hands-on learning uses the stimulations of several senses, mind, body, and the hands, increasing the probability the information will be remembered. This type of learning is not accomplished during traditional lecture.

John Dewey's book (1958) states, "Education, in order to accomplish its end both for the individual learner and for society, must be based upon experience---which is always the actual life experience of some individual" (p. 113). Piaget stressed the importance of learning by doing, especially in science related areas (Piaget, 1972). The principal component of Piaget's developmental theory of learning and thinking is that knowledge can be verbally communicated to the learner but, to be realized, the learner must be able to construct and reconstruct that knowledge. Involvement, he states, is the key to intellectual development, because the focus is

on how meaning is made and structured for the learner. The learner must be active in order to clearly understand the learning. Therefore, the justification for hands-on learning is that it allows students to build an understanding that is reclaimable and to develop their ability to inquire. In other words, this type of learning helps a student to become a more independent learners or higher Perry position thinker.

Recommendations for Future Research

The limits of this research caused the researcher to question whether students would achieve higher levels of cognitive complexity over a longer period of time especially if fellow horticultural teachers were exposed to Perry's scheme of intellectual development. An understanding and awareness of how college students make meaning, depending upon where they are in cognitive complexity, may help illuminate how instructors could modify their individual curriculums so the entire department could attain the shared goals of the horticultural curriculum. A more in-depth departmental-wide study could be preformed using the LEP as a measure and guide to determine if students are increasing in cognitive complexity as they progress through college.

In addition, further study may help determine if this information could be valuable when assessing horticultural students for not only what they learn while in college but useful in assessing whether students have the skills to transfer this knowledge to their future life situations. If an academic program only assesses with straightforward questions about said knowledge, what happens when a student is standing on a client's property attempting to determine why a 30-year old red oak died? Will they assume the death is a result of the current hot, dry summer or will it occur to them to evaluate and analyze all environmental circumstances

and events leading to the tree's death?

The fundamental objective of university assessment programs is to have an effective means for assessing student learning outcomes (SLOs), effective assessment procedures, and methods for feedback and change based on the assessment process. An effective assessment program would help educators find out what their students are learning and how well they are learning it.

Assessment is context-specific (Angelo & Cross, 1993), so what works for one instructor in their class may not work across the entire horticultural curriculum. Each class has its own personality and individual dynamics. Anyone who has taught two sections of the same course in a given semester has recognized the different chemistry. Individual students bring unique experiences and backgrounds to the course. Their socio-economic class, cultural background, attitudes and values, individual elements of emotional involvement with the course content, level of academic preparation, learning strategies and skills, and previous knowledge of the subject matter can influence their performance (Angelo & Cross, 1993). Anyone who has taught for a period of time recognizes these complex interactions and responds by fitting their teaching to the context. The obvious and most appropriate person to assess student learning is the instructor of the individual course, but by collaborating with colleagues in assessing student development, learning may be enhanced throughout the curriculum.

The most widely accepted and used method of assessing cognitive abilities is still "Bloom's taxonomy" (Bloom, Hastings, & Madaus, 1971). This guide for assessment makes an assumption that cognitive abilities can be measured along a continuum of simple to complex. Assessing the capacity to analyze ideas and generate new information, this type of higher-order capacity of thinking is a perennial challenge.

The question of how to measure gains in cognitive complexity has been a subject of study for decades. Further research is needed to develop better techniques to measure and assess cognitive complexity. Researchers Segal, Chipman, and Glaser (1985, p. 7) state, "As yet, however, there is no comprehensive and universally accepted theory capturing complex human intellectual functions in a single conceptual framework. But, as more and more educators learn about pedagogy in addition to their own unique areas of expertise they have a responsibility to promote their students' intellectual development by having an understanding of the useful theories and taxonomies that exist side by side. Each day educators have the opportunity to become astute observers of student learning and as assessment becomes more a part of university protocol, they will contribute greatly to their own teaching and student learning."

A further study of how gender may influence cognitive develop of horticultural students may illuminate more answers to some of the questions that arose from this study. Belenky et al. (1997) explored gender-related issues in cognitive development. Their epistemological study revealed differences relating to such factors as age, gender, race, sexual orientation, and physical ability came into play in cognitive development (Love & Guthrie, 1999). As pointed out by Belenky et al. (1997), different paths of knowing are more the result of socialization than hard-wired gender issues. Tarule (1997) makes the distinction their findings were gender-related not gender-specific.

Perry's study shows men tend to align themselves with Authority and it may be interesting to study how this alignment may change when the Authority is female, particularly when the topic is considered "male dominant" by some dualistic thinkers. Are female students more likely to benefit when the instruction is more in tune to their way of thinking or when more technical courses are taught by a female instructor?

As seen in the Landscape Irrigation Systems course, some students with previous experience had lower posttest scores than those students without experience. A speculative thought might be that these students experienced retreat into a lower position until they become comfortable with the idea of ambiguity. Further studies might uncover specific reasons this occurred in this study.

Closing Thoughts

Although the value of this research may depend upon individual situations and circumstances, the benefit to this researcher has been profound. To summarize the rewards of this study, the researcher shares the following quotes from William Perry (1981, p. 77).

"This was the most disorganized course I've ever taken." Or, "The only improvements made to my learning were due entirely to my own efforts." These statements may give cause to a good laugh with fellow faculty receiving similar comments, but comments such as this "threaten not only ones' vanity but ones' very sanity." And finally, "It took my colleagues and me twenty years to discover that such comments reflect coherent interpretive frameworks through which students give meaning to their educational experience. These structuring of meaning, which students revise in an orderly sequence from the relatively simple to the more complex, determine more than your students' perception of you as teacher; they shape the students' ways of learning and color their motives for engagement and disengagement in the whole educational enterprise."

While many educators may have sensed this and tried to teach accordingly, an

understanding of how students progress intellectually utilizing Perry's scheme of intellectual development certainly improved the sanity of this researcher, resulting in the confidence and reassurance to continue teaching college students.

Effective teaching is not just organizing and skillfully presenting the information, rather it is finding and using whatever means to inspire students to focus on the content by becoming engaged and to have some intensity of emotional involvement with the content (Leamnson, 1999). To be truly effective, with hopes of increasing cognitive complexity, learning is all about encouragement, reinforcement and inspiring the emotional involvement of the learner. So if it's hands-on learning for some it must be that they are not only physically involved with the tasks, but their brains are in communication with the hands. As Leamnson (1999) points out "getting the brain involved is the effective way to set off the signals that focus attention." If an educators' goal is to encourage cognitive complexity an awareness of individual students' cognitive position (according to the Perry Scheme) and a desire to "key into what turns students on to learn is vital."

REFERENCES

Acquaah, G. (1999). Horticulture: Principles and practices. *Introduction: What is horticulture?* (pp. xxix-xl). Prentice-Hall, Inc.: Upper Saddle River, NJ.

Alexander, P. A., Kulikowich, J. M., & Schulze, S. K. (1994). How subject-matter knowledge affects recall and interest. *American Educational Research Journal*, *31*(2), 313-337.

Allan, R. D. (1981). Intellectual development and the understanding of science: Applications of William Perry's theory to science teaching. *Journal of College Science Teaching, 11*(2), 94-97.

Anderson, L. W., Krathwohl, D. R, & Airasian, P. W. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives*. New York: Longman.

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

Astin, A. W. (1993). *What matters in College*? Four critical years *revisited*. San Francisco: Jossey-Bass.

Baldwin, C. (1991). *Life's companion: Journal writing as a spiritual quest*. New York: Bantam Books.

Bandura, A. (1976). Modeling Theory. In W. S. Sahakian (Ed.), *Learning: Systems, Models, and Theories.* (2nd ed.). Chicago: Rand McNally.

Bargh, J. A. & Schul, Y. (1980). On the cognitive benefits of teaching. *Journal of Educational Psychology, 72,* 593-604.

Baxter Magolda, M. B. (1992). *Knowing and reasoning in college: Gender related patterns in students' intellectual development.* San Francisco: Jossey-Bass.

Baxter Magolda, M. B. (2002). Epistemological reflection: The evolution of epistemological assumptions from age 18-30. In Hofer, B.K., and Pintrich, P.R. (Eds.), *Personal Epistemology: The Psychology of Beliefs about Knowledge and Knowing*. (pp. 89-102). Mahwah, NJ: Erlbaum.

Bean, J. C. (1996). *Engaging ideas: The professor's guide to integrating writing, critical thinking, and active learning in the classroom.* San Francisco: Jossey-Bass.

Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1997). *Women's ways of knowing.* (10th anniversary edition). New York: Basic Books.

Bloom, B. S., Hastings, J. T., & Madaus, G. F. (1971). *Handbook on formative and summative evaluation of student learning.* New York: McGraw-Hill.

Bogdan, R.C., & Biklen, S.K. (2003). *Qualitative research in education: An introduction to theory and methods* (4th ed.). Boston: Pearson.

Bok, D. (1986). *Higher learning*. Cambridge: Harvard University Press.

Bonwell, C. C., & Eison, J. A. (1991). *Active learning*: *Creating excitement in the classroom*: ASHE-ERIC Higher Education Report No. 1. Washington, DC: ERIC Clearinghouse on Higher Education and the Association for the Study of Higher Education.

Boud, D. (2001). Using journal writing to enhance reflective practice. In L. M English & M. A. Gillen (Eds.) *Promoting journal writing in adult education*. New Directions for Adult and Continuing Education, No.90. (pp. 9-17). San Francisco: Jossey-Bass.

Bradford, J. D., Brown, A. L., & Cocking R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school.* National Academy Press: Washington, D. C.

Brainerd, C. (1978). *Piaget's Theory of Intelligence*. Englewood Cliffs, NJ: Prentice-Hall.

Brookfield, S. (1987). *Developing critical thinkers*. San Francisco: Jossey-Bass.

Bruffee, K. A. (1993). *Collaborative learning: Higher education, interdependence, and the authority of knowledge*. Baltimore, MD: John Hopkins University Press.

Bruffee, K. A. (1995). Sharing our toys: Cooperative learning versus collaborative learning. *Change,* 27(19), 12-18.

Burke, P. (1997). Where do the learning theories overlap? *Educational Leadership*. 46(2), 30-31.

Cabrera, A. F., Colbeck, C. L., & Terenzini, P. T. (2001). Developing performance indicators for assessing classroom teaching practices and student learning: A case in engineering. *Research in Higher Education,* 42(3), 327-352.

Cameron, S. W. (1983). The Perry scheme: A new perspective on adult learners. *Proceedings of the Adult Education Research Conference,* no. 24. Montreal: Université de Montreal.

Campbell, D. & Stanley, J. (1963). *Experimental and quasi-experimental designs for research*. Dallas, TX: Houghton Mifflin.

Chickering, A. W., & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin* 39 (7)3-7.

Clinchy, B. (2002). Revisiting *women's ways of knowing*. In B.K. Hofer & P.R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing*. (pp.63-87). Mahway, NJ:Erlbaum.

Cooper, J., Robinson, P., & McKinney, M. (1994). Cooperative learning in the classroom. In D. Halpern & Associates (Eds.), *Changing college classrooms; New teaching and learning strategies for an increasingly complex world* (pp.74-92). San Francisco: Jossey-Bass.

Costello, L. R., Perry, E. J., Matheny, N. P., Henry, J. M., & Geisel, P. M. (2003). *Abiotic disorders of landscape plants: A diagnostic guide*. Regents of the University of California Division of Agriculture and Natural Resources: Oakland, CA.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks: Sage Publications.

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Columbus, OH: Merrill Prentice Hall.

Crick, F. (1994). *The astonishing hypothesis: The scientific search for the soul*. New York: Charles Scribner and Sons.

Cross, K. P., & Steadman, M. H. (1996). *Classroom research: Implementing the scholarship of teaching*. San Francisco: Jossey- Bass.

Crunkilton, J. R., Cepia, M. J., & Fluker, P.L. (1997). *Portfolio of capstone courses in colleges of agriculture.* (USDA award # 94-38411-016). Washington DC: US. Department of Agriculture.

Culver, R. S. & Hackos, J. T. (1988). Perry's model of intellectual development. E*ng. Educ.*, (pp. 73-221).

Cunningham, R. T. (1971). Developing question-asking skills. In J. E. Wiegand (Ed.), *Developing teacher competencies*. Englewood Cliffs, NJ: Prentice-Hall.

Dale, E. (1977). Introduction in: *The heart of instruction: Psychology of learning*. Ohio Department of Education. Curriculum Materials Service. Ohio State University.

Davis, G. L. (1999). Landscape design courses provide opportunities for service learning. *NACTA Jour*. *43*(1), 23-25.

Davis, G. L. & Gilman, E. F. (1995). Computer assisted design as a plant materials teaching tool in a landscape design course. *Proc. Fla. State Hort. Soc*. *108*, 418-420.

Dewar, T. (1995). Adult Learning Online. Retrieved March, 2002, from http://www.cybercorp.net~tammy/lo/oned2html.

Dewey, J. (1958). *Experience and education*. New York: Collier.

Diamond, M. C. (1988). *Enriching heredity: The impact of the environment on the anatomy of the brain.* New York: Free Press.

Dillon, J. T. (1990). *The practice of questioning*. London: Routledge.

Dozier, R. (1992). *Codes of evolution: the synaptic language revealing the secrets of matter, life and thought.* New York: Crown.

Dressel, P. L., & Mayhew, L. B. (1954). *General education: Explorations in evaluation.* Westport, TL Greenwood Press.

Duckworth, E. (1987). *'The having of wonderful ideas' and other essays on teaching and learning*. New York: Teachers College Press.

Eble, K. E. (1976). *The craft of teaching: A guide to mastering the professor's art*. San Francisco: Jossey-Bass.

Elbow, P. (1973). *Writing Without Teachers*. New York: Oxford University Press.

Elder, L., & Paul, R. (1998). Critical thinking: Developing intellectual traits. *Journal of Developmental Education*, 21(3), 34-35.

Ellner, C. L., & Barnes, C. P. (1983). *Studies of college teaching*. Lexington, Mass.: D.C. Health & Co.

Erickson, B. L. & Strommer, D. W. (1991). *Teaching college freshmen*. San Francisco: Jossey-Bass.

Evans, N., Forney, D., & Guido-DiBrito, F. (1998). *Student development in college: Theory, research, and practice.* San Francisco: Jossey-Bass.

Fife, J. D. (1991). (Ed.). *Teaching tips: A guide for beginning college teachers*. D.C. Lexington, Massachusetts/Toronto: Heath and Company.

Fillippone, M. (1998). *Questioning at the elementary level.* Master's thesis, Kean University. (ERIC Document Reproduction Service No. ED. 417-431).

Fink, L. D. (1989). The lecture: Analyzing and improving its effectiveness. In A. F. Lucas (Ed.). *The department chairperson's role in enhancing college teaching*. New Directions for Teaching and Learning, No. 37. San Francisco: Jossey-Bass.

Finkelstein, M. J., Seal, R. K., & Schuster, J. H. (1998). *The new academic generation: A profession in transformation*. Baltimore: John Hopkins University Press.

Fishback, S. J. (1997). *The cognitive development of adult undergraduate students*. (Doctoral dissertation, Kansas State University, 1997). *Dissertation Abstracts International*, 58, 4523.

Fishback, S. J. (1998). Learning and the brain. *Adult Learning*. 10:18-22.

Forrest, A. (1982). *Increasing student competence and persistence: The best case for general education*. Iowa City, IA: American College Testing Program.

Frederick, P. J. (1989). Involving students more actively in the classroom. In A. F. Lucas (Ed.). *The department chairperson's role in enhancing college teaching*. New Directions for Teaching and Learning, No. 37. San Francisco: Jossey-Bass.

Fulwiler, T. & Young, A. (Eds.) (1990). *Programs that work: Models and methods for writing across the curriculum.* Portsmouth, NH: Boynton/Cook Publishers.

Gardner, H. (1993). *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books.

Gardiner, L.F. (1994). *Redesigning higher education: Producing dramatic gains in student learning.* Report 7. Washington, DC: Clearinghouse on Higher Education, George Washington University.

Gilligan, C. (1982). *In a different voice: Psychological theory and women's development.* Cambridge, MA: Harvard, University Press.

Gilman, J. H. (2003). A discussion format for improving critical thinking on issues affecting nursery management. *NACTA Jour*. *47* (4), 40-42.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine.

Gokhale, A. A. (1995). *Collaborative learning enhances critical thinking*. Retrieved January 2004, from http://scholar.lib.vt.edu/ejournals/JTE/jte-v7n1/gokhale.jte-v7n1.html

Good, T. (1987). Two decades of research on teacher expectations: Finding and future directions. *Journal of Teacher Education*, *38*(6), 9-15.

Greenleaf, R. K. (2003). Motion and emotion. *Principal Leadership* 3(9), 14-19.

Greenwood, P., Halstead, A., Chase, A. R., & Gilrein, D. (2000). *American Horticultural Society: Pests & Diseases* (pp. 66-96). Dorling Kindersley Publishing, Inc.: NY.

Gruber, H. E., & Weitman, M. (1962). *Self-directed study: Experiments in higher education* (Report No. 19). Boulder: University of Colorado, Behavior Research Laboratory.

Guszak, F. J. (1967). Teacher questioning and reading. *The Reading Teacher*, *21*, 227-234.

Hartman, V. F. (1995). *Teaching and learning style preferences: Transitions through technology.* VCCA Journal 9. No. 2 Summer: 18-20. Retrieved January 2004, from http://www.xo.cc.va.us/vcca/hart1.htm

Hiemstra, R. (2001). Uses and benefits of journal writing. In L. M. English, & M. A. Gillen (Eds.). *Promoting journal writing in adult education.* New Directions for Adult and Continuing Education, No. 90. (pp. 19-26). San Francisco: Jossey-Bass.

Hofer, B. K. (2002). Personal epistemology as a psychological and educational construct: An introduction. In B. K. Hofer & P. R. Pintrich (Eds.), *Personal Epistemology: The psychology of beliefs about knowledge and knowing*. (pp.3-13). Mahwah, NJ: Erlbaum Associates.

Hunkins, F. P. (1972). *Questioning strategies and techniques*. Boston: Allyn & Vacon.

Ingram, D. S., Vince-Prue, D., & Gregory, P. J. (2002). Science *and the Garden: The scientific basis of horticultural practices.* (pp. 1-34) Blackwell Science Ltd:Malden, MA.

Janesick, V. J. (1994). The dance of qualitative research design: Metaphor, methodology, and meaning. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 209-219). Thousand Oaks, CA: Sage.

Jensen, E. (2000). *Brain-based learning: The new science of teaching and learning*. San Diego: The Brain Store.

Johnson, D. W, & Johnson, R.T. (1994). *The new circles of learning: Cooperation in the classrooms and schools.* Alexandria, VA: Association for Supervision and Curriculum Development.

Johnson, D.W., & Johnson, R. T. (1999). *Learning together and alone: Cooperative, competitive, and individualistic learning*. Boston: Allyn & Bacon.

Kahn, A. 1994. Soil fertility evaluation of private farms: Provides students with hands on learning experience. *NACTA J. 38*(1), 23-25.

Kansas Department of Agriculture, Kansas Agricultural Statistics. (1996). *The impact of horticulture on the Kansas economy.* Kansas State University. Special Projects Unit: Department of Communications.

Kasworm, C. (1994). *Adult undergraduate learning: Implication for practice*. Paper presented at the American Association of Adult and Continuing Education.

Kegan, R. (1994). *In over our heads: The mental demands of modern life*. Cambridge, MA: Harvard University Press.

Keppel, G., & Zedeck, S. (1989). *Data analysis for research designs*. New York: W. H. Freeman.

King, P. M. (1978). William Perry's theory of intellectual and ethical development. In L. Knefelkamp, C. Widick, and C.A. Parker (Eds.), *Applying New Developmental Findings*: New Directions for Student Services, No. 4. San Francisco: Jossey-Bass.

King, P.M. (1990). Assessing development from a cognitive-development perspective. In D. Creamer (Ed.), *College student development: Theory and practice for the 1990's*. Alexandria, VA.: American College Personnel Association.

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

King, P. M. (2000). Learning to make reflective judgments. In M. B. Magolda (Ed.). *Teaching to promote intellectual and personal maturity: Incorporating students' world views and identities into the learning process.* New Directions for Teaching and Learning, No. 82. (pp.15-26). San Francisco: Jossey-Bass.

Kitchener, K. S. (1983). Cognition, meta-cognition, and epistemic cognition. *Human Development*: *26*, 222-232.

Kloss, R. J. (1994). A nudge is best: Helping students through the Perry scheme of intellectual development. *College Teaching*, 42(4), 151-158.

Knefelkamp, L. L. (1974). *Developmental instruction: Fostering intellectual and personal growth in college students*. Doctoral dissertation, University of Minnesota, Minneapolis. (Dissertation Abstract 36, 3:1271A. 1975).

Knefelkamp, L. L., Widick, C., & Stroad, B. (1976). Cognitive-developmental theory: A guide to counseling women. *Counseling Psychologist*, *6*(2), 15-19.

Knefelkamp, L. L. (1999). Introduction. In Williams G. Perry, Jr. *Forms of intellectual and ethical development in the college years: A scheme. (pp. xi-xxxviii).* San Francisco: Jossey-Bass

Knowles, M. S. (1984). *The adult learner: A neglected species* (3rd ed.). Houston: Gulf.

Kohlberg, L. (1972). The cognitive-developmental approach to moral education. *Humanist*, 6, 13-16.

Kuhn, D. (1991). *The skills of argument*. Cambridge University Press, Cambridge.

Kulik, J., & Kulik, C. L. (1979). College teaching. In P. Peterson & H. Walber (Eds.), *Research on teaching: Concepts, findings, and implications*. (pp. 70-93). Berkley, CA: McCutcheon.

Kurfiss, J. P. (1977). Sequentiality and structure in a cognitive model of college student development. *Developmental Psychology*, *13*, 565-571.

Kurfiss, J. P. (1988). *Critical thinking: Theory, practice, and possibilities* (ASHE ERIC Higher Education Report No. 2). Washington, DC: Mathematical Association of America.

Lavalle, M., Gourde, A., & Rodier, C. (1990). The impact of lived experience on cognitivoethical development of today's women. *International Journal of Behavioral Development*, *13*(4), 407-430.

Leamnson, R. (1999). *Thinking about teaching and learning: Developing habits of learning with first year college and university students.* Stylus: Sterling, VA.

Learner, R. (1986). *Concepts and theories of human development*. (2nd ed.). New York: Random House.

Levin, B. R. (Ed.). (2001). *Energizing teacher education and professional development with problem-based learning*. Alexandria, VA: Association for Supervision and Curriculum Development.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Thousand Oaks, CA: Sage.

Love, P., & Guthre, V. (1999). *Understanding and applying cognitive development theory*. *New Directions for Student Services*, No. 88. (pp. 1-15). San Francisco: Jossey-Bass.

Lowman, J. (1996). *Assignments that promote in integrate learning*, in Teaching on Solid Ground: Using scholarship to improve practice. (pp. 203-233). Jossey-Bass: San Francisco.

MacGregor, J. T. (1992). Collaborative learning: Reframing the Classroom, In A, Goodsell, M. Maher, and V. Tinto (Eds.), *Collaborative Learning: A sourcebook for higher education*. University Park, PA.: National Center on Postsecondary Teaching, Learning, and Assessment.

MacGregor, J. (1990). Collaborative learning: Shared inquiry as a process of reform. In M. D. Svinicki, (Ed.). *The changing face of college teaching*. (pp. 19-30). New Directions in Teaching and Learning, No. 42. San Francisco: Jossey-Bass.

Mahala, D. (1991). Writing utopias: Writing across the curriculum and promises for reform. *College English, 53*(7), 773-789.

Markhart, A. H. (2005). *America's funniest home videos and the lottery come to plant propogation: Using technology to promote learning*. Paper presented at the annual meeting of the American Society of Horticulture Science. Las Vegas, Nevada.

Marton, F., & Saljo, R. (1984). Approaches to learning, In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *The experience of learning* (pp. 36-55). Edinburgh: Scottish Academic Press.

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Danvers, MA: McRel.

Matthews, R. S. (1996). Collaborative learning: Creating knowledge with students. In R. L. Menges & M. E. Weimer, and Associates (Eds.), T*eaching on solid ground: Using scholarship to improve practice*. (pp. 101-124). San Francisco: Jossey-Bass

McGann, M. R., & Berghage, R. D. (2004). The Pennsylvania state university medieval garden: Using a specialized garden as an alternative teaching and learning environment. *HortTechnology, 14*(1), 155-160.

McKeachie, W. J. (1980). Improving lectures by understanding students' information processing. In W. J. McKeachie, (Ed.). *Learning, cognition, and college teaching*. New Directions for Teaching and Learning, No.2. San Francisco: Jossey-Bass.

McKeachie, W. J. (1990). Research on college teaching: The historical background. *Journal of Educational Psychology*, *82*(2), 189-200.

McKeachie, W. J. (1999). *Teaching tips: McKeachie's teaching tips: strategies, research, and theory for college and university teachers*. Boston: Houghton Mifflin Co.

McKeachie, W. J., Pintrich, P. R., Lin, Y. G., Smith, D. A. F., & Sharma, R. (1986). *Teaching and learning in the college classroom: A review of the research literature.* Ann Arbor: National Center for Research to Improve Post-Secondary Teaching and Learning, University of Michigan.

McMillan, J. (1987). Enhancing college students' critical thinking: A review of studies. *Research in Higher Education, 26*, 3-29.

Menges, R. J., Weimer, M., & Associates. (1996). *Teaching on solid ground: Using Scholarship to improve practice.* (pp. 1-19). San Francisco: Jossey-Bass

Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.

Merriam, S. B., and Caffarella, R. S. (1999). *Learning in adulthood: A comprehensive guide* (2nd ed.). San Francisco: Jossey-Bass.

Merriam-Webster's collegiate dictionary (10th ed.). (2002). Springfield, MA: Merriam-Webster.

Meyers, C. (1986). *Teaching students to think critically: A guide for faculty in all disciplines.* San Francisco: Jossey-Bass.

Miller, W. R. & Rose, H.C. (1975). *Instructors and their jobs* (3rd ed.) Chicago: American Technical Society.

Moll, M., & Allen, R. (1982). Developing critical thinking skills in biology. *Journal of College Science Teaching, 12*, 95-98.

Moon, J. (1999). *Reflection in learning and professional development*. London: Kogan Page.

Moore, W. (1987). *The learning environment preferences inventory*. Center for the Study of Intellectual Development/The Perry Network. Olympia, WA.

Moore, W. S. (1988). The learning environment preferences: Exploring the construct validity of an objective measure of the Perry scheme of intellectual development. *Journal of College Student Development, 30*(6), 505-514.

Moore, W. S. (1991). *The measure of intellectual development: An instrument manual*. Center for the Study of Intellectual Development/The Perry Network. Olympia, WA.

Moore, W.S. (2001). *My mind exploded: Intellectual development as a critical framework for understanding and assessing collaborative learning*. Retrieved July 4, 2005, from http://www.evergreen.edu/washcenter/resources/acl.iia.html.

Moore, W. S. (2002). Understanding learning in a postmodern world: Reconsidering the Perry scheme of intellectual and ethical development. In B. K. Hofer & P. R. Pintrich (Eds.), Personal Epistemology*: The psychology of beliefs about knowledge and knowing*. (pp. 17-36). Mahwah, N.J.: L. Erlbaum Associates.

National Board for Professional Teaching Standards (1998). Washington, DC: Available: http://www.nbpts.org

Nixon-Ponder, S. (1995). Using problem-posing dialogue in adult literacy education. *Adult Learning, 7*(2), 10-12.

Osman, M., & Hannafin, M. J. (1994). Effects of advance organizing questioning and prior knowledge on science learning. *Journal of Educational Research, 88*(1), 5-13.

Palmer, P. J. (1983). *To know as we are known: A spirituality of education*, Harper Collins: San Francisco.

Pascarella, E.T., & Terenzini, P.T. (2005). *How college affects students: A third decade of research.* San Francisco: Jossey-Bass.

Patton, M. J. (1991). Qualitative research on college students: Philosophical and methodological comparisons with the quantitative approach. *Journal of College Student Development, 32*(5), 389-396.

Patton, M. J. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Pavelich, M. and Fitch, P. (1988). Measuring students' development using the Perry model. Proceedings ASEE Annual Conference, ASEE, Washington, DC, 668-672.

Perry, W.G. (1970). *Forms of intellectual and ethical development in the college years: A scheme.* San Francisco: Jossey-Bass.

Perry, W.G. (1981). Cognitive and ethical growth: The making of meaning. In A. W. Chickering & Associates, (Eds.), *The modern American college*. (pp.76-116). San Francisco: Jossey-Bass

Perry, W.G. (1999). *Forms of intellectual and ethical development in the college years: A scheme.* San Francisco: Jossey-Bass.

Piaget, J. (1972). *To understand is to invent*. New York: The Viking Press, Inc.

Pratt, D. D. and Associates. (1998). *Five perspectives on teaching in adult and higher education*. Malabar, FL: Kieger Publishing Company.

Pressley, M., Tenenbaum, R., McDaniel, M., & Wood, E. (1990). What happens when university students try to answer prequestions that accompany textbook material? *Contemporary Educational Psychology, 15*, 27-35.

Ramsden, P. (1988). Studying learning: Improving teaching. In P. Ramsden (Ed.), *Improving learning: New perspectives* (pp. 13-31). London: Kogan Page, Ltd.

Rapaport, W. J. (1984). *Critical thinking and cognitive development*. In Proceedings and Addresses of the American Philosophical Association. Vol. 57 (5): 610-615. Retrieved March 2005, from http://www.cs.buffalo.edu/~rapaport/perry.positions.html

Redfield, D. L. & Rousseau, E. W. (1981). A meta-analysis of experimental research on teacher questioning behavior. *Review of Educational Research, 51*(2), 237-245.

Rest, J. (1973). Development psychology as a guide to value education: A review of Kohlbergian programs. *Review of Educational Research, 44*(2), 10-15.

Rodgers, R. F. (1990). Recent theories and research underlying student development. In D. Creamer & Associates, *College student development: Theory and practice for the 1990's* (pp. 27-79). (Media Publication No. 49). Alexandria, VA: American College Personnel Association.

Ruble, D.N. (1994). A phase model of transitions: Cognitive and motivational consequences. In M. Zanna (Ed.), Advances in Experimental *Social Psychology, 26,* 163-214.

Sadker, M., & Sadker, D. (1992). Ensuring equitable participation in college classes. In L. Border & N. Chism (Ed.), New Direction for Teaching and Learning: No. 49. *Teaching for diversity* (pp. 89-103). San Francisco: Jossey-Bass.

Samson, G. E., Strykowski, B., Weinstein, T., & Walberg, H. J. (1987). The effects of teacher-questioning levels on student achievement: A quantitative synthesis. *Journal of Educational Research, 80,* 290-295.

Sanders, R. E. (1990). The art of questioning. In M. W. Galbraith (Ed.), *Adult learning methods: A guide for effective instruction*. Malabar, FL: Krieger Publishing.

Sanford, N. (1967). *Where colleges fail: A study of the student as a person*. San Francisco: Jossey- Bass.

Scaruffi, P. (1998). Cognition: In: *Thinking about Thought*. Retrieved March 3, 2005, from http://www.thymos.com/tat/cognitio.html

Slavin, R. (1990). *Cooperative learning theory, research, and practice*. Englewood Cliffs, NJ: Prentice-Hall.

Slavkin, M. L. (2004). *Authentic learning: How learning about the brain can shape the development of students.* Scarecrow Education: Lanham, MD.

Spafford, A. (2005). *Learning by building: How a landscape construction studio enriches horticulture education*. Paper presented at the annual meeting of the American Society of Horticulture Science, Las Vegas, NV.

Spaw, M., Williams, K.A., & Brannon, L. A. (2004). Summary lecture versus web-based method for instruction of site-planning for protected environmental structures. *NACTA Journal, 48*(4):45-50.

Stearns, D. T. (1995). On-site instruction for landscape contracting students. *HortTechnology, 5*(1), 78-80.

Stephenson, B., & Hunt, C. (1977). Intellectual and ethical development: A dualistic curriculum intervention for college students. *Counseling Psychologist,* 6(4), 39-42.

Suvedi, M., & Heyboer, G. (2004). Perceptions of recent graduates and employers about undergraduate programs in the college of agriculture and natural resources at Michigan State University: A follow-up study. *NACTA Jour*., *48* (1), 22-27.

Svinicki, M. D. (1991). Practical implications of cognitive theories. In R. J. Menges & M. D. Svinicki (Eds.), *College teaching: From theory to practice*. New Directions for Teaching and Learning: No. 45. (pp.27-37). San Francisco: Jossey-Bass.

Taba, H. (1966). *Teaching strategies and cognitive functioning in elementary school children.* San Francisco: Jossey-Bass.

Tarule, J. M. (1997). A letter to Paulo Freire. In P. Freire (Ed.), *Mentoring the mentor: A critical dialogue with Paulo Freire.* New York: Lang.

The National Future Farmers of America Organization (FFA): Retrieved February 12, 2005, from http://www.ffa.org/about_ffa/index.html

Thien, S. J. (2003). A teaching---learning trinity: Foundation to my teaching philosophy. *J. Nat. Resour. Life Sci. Educ.* 32: 87-92.

Tobin, K. G. (1987). The role of wait time in higher cognitive learning levels. *Review of Educational Research*, *57*, 69-95.

Trank, D., & Steele, J. (1983). Measurable effects of a communications skills course: An initial study. *Communication Education, 32*, 227-236.

Trexler, C. J., Haynes, C., & Davis, L. (2003). Helping future educators learn to teach through horticulture: A case study of an experimental interdisciplinary course. *NACTA Jour*., *47* (4): 43-50.

United States Department of Agriculture. (2005). Information retrieved August 3, 2005 from http://www.ers.usda.gov/briefing/floriculture

University of Nevada-Reno. (1989). *Searching for the ideal agriculture graduate ─A survey of the agriculture, agribusiness, and food industries.* A special study sponsored by the College of Agr., Univ. Nev., Reno, conducted by the Helming Group, Overland Park, Kansas.

Upcraft, M. L. (1996). Teaching and today's college students. In R. J. Menges, M. Weimer and Associates (Eds.), *Teaching on solid ground*. (pp. 21-42). San Francisco: Jossey-Bass.

Vygotsky, L. (1978*). Mind in society: The development of higher psychological processes.* Cambridge: Harvard University Press.

Wadsworth, B. J. (1996). *Piaget's Theory of Cognitive and Affective Development*. Longman Publishers: USA.

Walvoord, B. F. & Smith, H. L. (1982). Coaching the process of writing. In Griffin, C. W. (Ed.). *New dimensions for teaching and learning: Teaching writing in all disciplines*. San Francisco: Jossey-Bass.

Webb, N. J., & Grib, T. F. (1967). *Teaching process as a learning experience: The experimental use of student-led groups* (Final Report, HE-000-882). Washington, DC. Department of Health, Education, and Welfare.

White, R. W. (1999). Foreword in: *Forms of intellectual and ethical development in the college years: A Scheme*. (pp. xxxix-xli). San Francisco: Jossey-Bass.

Widick, C., Knefelkamp, L. L., & Parker, C. A. (1975). The counselor as developmental instructor. *Counselor Education and Supervision, 14*, 286-296.

Widick, C., & Simpson, D. (1978). Developmental concepts in college instruction. In C. Parker (Ed.), *Encouraging development in college students*. Minneapolis: University of Minnesota Press.

Winne, P. H. (1979). Experiments relating teachers' use of higher cognitive questions to student achievement. *Review of Educational Research, 49,* 13-50.

W. K. Kellogg Foundation. n.d. *Visions of change in higher education*. Available on-line at: <http://wkkf.org/knowledgebase/Pubs/>

Wlodkowski, R. & Westover, T. (1999). Accelerated courses as a learning format for adults. *Canadian Journal for the Stud of Adult Education, 13*(1), 1-20.

Wolcott, S.K. & Lynch, C. L. (1997). Critical thinking in the accounting classroom: A reflective judgment developmental process perspective. *Accounting Education: A Journal of Theory, Practice and Research, 2*(1), 59-78.

Wilen, W. W. (1990). Forms and phases of discussion, In W. Wilen (Ed.), *Teaching and learning through discussion: The theory, research, and practice of the discussion method*. Springfield, IL: Charles C. Thomas.

Winter, D., McClelland, D., & Stewart, A. (1981). *A new case for the liberal arts: Assessing institutional goals and student development.* San Francisco: Jossey-Bass.

Young, R. E. (Ed.). (1980). *Fostering critical thinking*. San Francisco: Jossey-Bass.

Zemke, R., Raines, C., & Filipczak, B. (2000). *Generations at work: Managing the clash of veterans, boomers, Xers, and nexters in your workplace*. (pp. 127-150). NY: AMACOM

Appendix A

PERRY'S SCHEME OF

INTELLECTUAL DEVELOPMENT

Perry's Scheme of Intellectual and Ethical Development

Position 1:	Authorities know, and if we work hard, read every word, and learn Right Answers, all will be well.
Transition:	But what about those Others I hear about? And different opinions? And Uncertainties? Some of our own Authorities disagree with each other or don't seem to know, and some give us problems instead of Answers.
Position 2:	True Authorities must be Right, the others are frauds. We remain Right Others must be different and Wrong. Good Authorities give us problems so we can learn to find the Right Answer by our own independent thought.
Transition:	But even Good Authorities admit they don't know all the answers *yet*!
Position 3:	Then some uncertainties and different opinions are real and legitimate *temporally*, even for Authorities. They're working on them to get to the Truth.
Transition:	But there are *so many* things they don't know the Answers to! And they don't for a long time.
Position 4a:	Where Authorities don't know the Right Answers, everyone has a right to his own opinion; no one is wrong!
Transition (and/or)	But some of my friends ask me to support my opinions with facts and reasons.
Transition:	Then what right have They to grade us? And what?
Position 4b:	In certain course Authorities are not asking for the Right Answer; They want us to *think* about things in a certain way, *supporting* opinion with data. That's what they grade us on.
Transition:	But this "way" seems to *work* in most course, and even outside of them.
Position 5:	Then *all* thinking must be like this, even for Them. Everything is relative but not equally valid. You have to understand how each context works. Theories are not truth but metaphors to interpret data with. You have to think about your thinking.
Transition	But if everything is relative, am I relative too? How can I know I'm making the Right Choice?
Position 6:	I see I am going to have to make my own decisions in an uncertain world with no one to tell me I'm Right.
Transition:	I'm lost if I don't. When I decide on my career (or marriage or values) everything

will straighten out.

Position 7: Well, I've made my first Commitment!

Transition: Why didn't that settle everything?

Position 8: I've made several commitments. I've got to balance them---how many, how deep? How certain, how tentative?

Transition: Things are getting contradictory. I can't make logical sense out of life's dilemmas.

Position 9: This is how life will be. I must be wholehearted while tentative, fight for my values yet respect other, believe my deepest values are right yet be ready to learn. I see that I shall be retracing this whole journey over and over---but, I hope, more wisely.

Note: Chickering, A. W. & Asssociates. (1982). Cognitive and ethical growth: The making of meaning, William G. Perry, Jr., in *The Modern American College*, p. 79. San Francisco: Jossey-Bass.

Appendix B

THE LEARNING ENVIRONMENT PREFERENCE INSTRUMENT

LEARNING ENVIRONMENT PREFERENCES

This survey asks you to describe what you believe to be the most significant issues in you **IDEAL** LEARNING ENVIRONMENT. Your opinions are important to us as we study hov students think about teaching and learning issues. We ask, therefore, that you take this task seriously and give your responses some thought. We appreciate your cooperation in sharing you find most important in a learning environment.

The survey consists of five sections, each representing a different aspect of learning environments. In each section, you are presented with a list of specific statements about that particular area. Try not to focus on a specific class or classes as you think about these items; focus on their significance in an *ideal* learning environment *for you.*

> We ask that you do two things for each section of the instrument:
>
> 1. Please **rate** each item of the section (using the 1-4 scale provided below) in terms of its significance or importance to your learning.
> 2. Review the list and **rank** the three most important items to you as you think about your *ideal learning environment* by writing *the item numbers* on the appropriate spaces at the bottom of the answer sheet.

Please mark your answers on the separate answer sheet provided, and be sure to indicate bo your ratings of individual items **and** *your ranking of the top 3 items in each section.* It is ve important that you indicate your top three choices for each question area by writing the ITE NUMBER in the spaces provided (1st choice, 2nd choice, 3rd choice).

Rating Scale:

1	2	3	4
Not at all significant	**Somewhat significant**	**Moderately significant**	**Very significant**

Before you begin, we ask that you provide us with the background information requested at top of the answer sheet. This information will be used to examine group differences; your n or social security number may be used at some point in the future if a follow-up survey is required. ALL RESPONSES WILL BE KEPT CONFIDENTIAL. Again, thank you very m for sharing with us your ideas about learning.

LEARNING ENVIRONMENT PREFERENCES--
DOMAIN ONE: COURSE CONTENT/VIEW OF LEARNING

MY IDEAL LEARNING ENVIRONMENT WOULD:

1. Emphasize basic facts and definitions.
2. Focus more on having the right answers than on discussing methods or how to solve problems.
3. Insure that I get all the course knowledge from the professor.
4. Provide me with an opportunity to learn methods and solve problems.
5. Allow me a chance to think and reason, applying facts to support my opinions.
6. Emphasize learning simply for the sake of learning or gaining new expertise.
7. Let me decide for myself whether issues discussed in class are right or wrong, based on my own interpretations and ideas.
8. Stress the practical applications of the material.
9. Focus on the socio-psycho, cultural and historical implications and ramifications of the subject matter.
10. Serve primarily as a catalyst for research and learning on my own, integrating the knowledge gained into my thinking.
11. Stress learning and thinking on my own, not being spoon-fed learning by the instructor.
12. Provide me with appropriate learning situations for thinking about and seeking personal truths.
13. Emphasize a good positive relationship among the students and between the students and teacher.

PLEASE BE SURE TO REVIEW THE ABOVE LIST AND MARK YOUR THREE MOST SIGNIFICANT ITEMS (BY ITEM NUMBER) IN THE LINES PROVIDED ON THE ANSWER SHEET.

Rating Scale:

1	2	3	4
Not at all significant	Somewhat significant	Moderately significant	Very significant

ROLE OF INSTRUCTOR

IN MY IDEAL LEARNING ENVIRONMENT, THE TEACHER WOULD:

1. Teach me all the facts and information I am supposed to learn.
2. Use up-to-date textbooks and materials and teach from them, not ignore them.
3. Give clear directions and guidance for all course activities and assignments.

Center for the Study of Intellectual Development

4. Have only a minimal role in the class, turning much of the control of course content and class discussions over to the students.
5. Be not just an instructor, but more an explainer, entertainer and friend.
6. Recognize that learning is mutual--individual class members contribute fully to the teaching and learning in the class.
7. Provide a model for conceptualizing living and learning rather than solving problems.
8. Utilize his/her expertise to provide me with a critique of my work.
9. Demonstrate a way to think about the subject matter and then help me explore the issues and come to my own conclusions.
10. Offer extensive comments and reactions about my performance in class(papers, exams, etc.)
11. Challenge students to present their own ideas, argue with positions taken, and demand evidence for their beliefs.
12. Put a lot of effort into the class, making it interesting and worthwhile.
13. Present arguments on course issues based on his/her expertise to stimulate active debate among class members.

PLEASE BE SURE TO REVIEW THE ABOVE LIST AND MARK YOUR THREE MOST SIGNIFICANT ITEMS (BY ITEM NUMBER) IN THE LINES PROVIDED ON THE ANSWER SHEET.

Rating Scale:

1	2	3	4
Not at all significant	Somewhat significant	Moderately significant	Very significant

ROLE OF STUDENT/PEERS

IN MY IDEAL LEARNING ENVIRONMENT, AS A STUDENT I WOULD:

1. Study and memorize the subject matter--the teacher is there to teach it.
2. Take good notes on what's presented in class and reproduce that information on the tests.
3. Enjoy having my friends in the class, but other than that classmates don't add much to what I would get from a class.
4. Hope to develop my ability to reason and judge based on standards defined by the subject.
5. Prefer to do independent research allowing me to produce my own ideas and arguments.
6. Expect to be challenged to work hard in the class.
7. Prefer that my classmates be concerned with increasing their awareness of themselves to others in relation to the world.
8. Anticipate that my classmates would contribute significantly to the course learning through their own expertise in the content.
9. Want opportunities to think on my own, making connections between the issues discussed in class and other areas I'm studying.
10. Take some leadership, along with my classmates, in deciding how the class will be run.
11. Participate actively with my peers in class discussions and ask as many questions as necessary to fully understand the topic.
12. Expect to take learning seriously and be personally motivated to learn the subject.
13. Want to learn methods and procedures related to the subject--learn how to learn.

PLEASE BE SURE TO REVIEW THE ABOVE LIST AND MARK YOUR THREE MOST SIGNIFICANT ITEMS (BY ITEM NUMBER) IN THE LINES PROVIDED ON THE ANSWER SHEET.

Rating Scale:

1	2	3	4
Not at all significant	Somewhat significant	Moderately significant	Very significant

CLASSROOM ATMOSPHERE/ACTIVITIES

IN MY IDEAL LEARNING ENVIRONMENT, THE CLASSROOM ATMOSPHERE AND ACTIVITIES WOULD:

1. Be organized and well structured--there should be clear expectations set (like a structured syllabus that's followed).
2. Consist of lectures(with a chance to ask questions) because I can get all the facts I need to know more efficiently that way.
3. Include specific, detailed instructions for all activities and assignments.

4. Focus on step-by-step procedures so that if you did the procedure correctly each ti
answer would be correct.
5. Provide opportunities for me to pull together connections among various subject a
then construct an adequate argument.
6. Be only loosely structured, with the students themselves taking most of the respor
what structure there is.
7. Include research papers, since they demand that I consult sources and then offer m
interpretation and thinking.
8. Have enough variety in content areas and learning experiences to keep me interest
9. Be practiced and internalized but be balanced by group experimentation, intuition,
comprehension, and imagination.
10. Consist of a seminar format, providing an exchange of ideas so that I can critique
perspectives on the subject matter.
11. Emphasize discussions of personal answers based on relevant evidence rather tha
and wrong answers.
12. Be an intellectual dialogue and debate among a small group of peers motivated t
the sake of learning.
13. Include lots of projects and assignments with practical, everyday applications.

PLEASE BE SURE TO REVIEW THE ABOVE LIST AND MARK YOUR THREE
SIGNIFICANT ITEMS (BY ITEM NUMBER) IN THE LINES PROVIDED ON TH
ANSWER SHEET.

Rating Scale:

1	2	3	4
Not at all significant	Somewhat significant	Moderately significant	Very significant

EVALUATION PROCEDURES

EVALUATION PROCEDURES IN MY IDEAL LEARNING ENVIRONMENT WO

1. Include straightforward, not "tricky," tests, covering only what has been taught and
else.
2. Be up to the teacher, since s/he knows the material best.
3. Consist of objective-style tests because they have clear-cut right or wrong answers.
4. Be based on how much students have improved in the class and on how hard they h
worked in class.
5. Provide an opportunity for me to judge my own work along with the teacher and le
the critique at the same time.
6. Not include grades, since there aren't really any objective standards teachers can us
evaluate students' thinking.
7. Include grading by a prearranged point system(homework, participation, tests, etc.)
think it seems the fairest.

8. Represent a synthesis of internal and external opportunities for judgement and learning enhancing the quality of the class.
9. Consist of thoughtful criticism of my work by someone with appropriate expertise.
10.Emphasize essay exams, papers, etc. rather than objective-style tests so that I can shov much I've learned.
11.Allow students to demonstrate that they can think on their own and make connections made in class.
12.Include judgments of the quality of my oral and written work as a way to enhance my in the class.
13.Emphasize independent thinking by each student, but include some focus on the qualit one's arguments and evidence.

PLEASE BE SURE TO REVIEW THE ABOVE LIST AND MARK YOUR THREE MC SIGNIFICANT ITEMS (BY ITEM NUMBER) IN THE LINES PROVIDED ON THE ANSWER SHEET.

Rating Scale:

1	2	3	4
Not at all significant	Somewhat significant	Moderately significant	Very significant

LEARNING ENVIRONMENT PREFERENCES ANSWER SHEET

NAME or CODE: _____

DATE: ____ / ____ / ____ AGE: ____

GENDER (check one): Male ___ Female ___

Rating Scale:	1 Not at all significant	2 Somewhat significant	3 Moderately significant	4 Very significant

DOMAIN: COURSE CONTENT/VIEW OF LEARNING (INDICATE RATING, 1-4)

1.____ 2.____ 3.____ 4.____ 5.____ 6.____ 7.____

8.____ 9.____ 10.____ 11.____ 12.____ 13.____

DOMAIN: ROLE OF INSTRUCTOR (INDICATE RATING, 1-4)

1.____ 2.____ 3.____ 4.____ 5.____ 6.____ 7.____

8.____ 9.____ 10.____ 11.____ 12.____ 13.____

DOMAIN: ROLE OF STUDENT/PEERS (INDICATE RATING, 1-4)

1.____ 2.____ 3.____ 4.____ 5.____ 6.____ 7.____

8.____ 9.____ 10.____ 11.____ 12.____ 13.____

DOMAIN: CLASSROOM ATMOSPHERE (INDICATE RATING, 1-4)

1.____ 2.____ 3.____ 4.____ 5.____ 6.____ 7.____

8.____ 9.____ 10.____ 11.____ 12.____ 13.____

DOMAIN: EVALUATION PROCEDURES (INDICATE RATING, 1-4)

1.____ 2.____ 3.____ 4.____ 5.____ 6.____ 7.____

8.____ 9.____ 10.____ 11.____ 12.____ 13.____

INDICATE TOP THREE CHOICES IN EACH AREA (MARK ITEM NUMBER)

COURSE CONTENT	ROLE OF INSTRUCTOR	ROLE OF STUDENT/PEERS	CLASSROOM ATMOSPHERE	EVALUATION PROCEDURES
1ST____	1ST____	1ST____	1ST____	1ST____
2ND____	2ND____	2ND____	2ND____	2ND____
3RD____	3RD____	3RD____	3RD____	3RD____

Appendix C

LEP SUMMARY DATA:

Pretest and Post LEP Scores

Kansas State Univeristy

LEP Data Summary

Cathie Lavis

CODE	AGE	SEX	POS2	POS3	POS4	POS5	CCI	PPOS2	PPOS3	PPOS4	PPOS5	P CCI
1	22	M	40	30	7	23	313	30	30	0	10	260
2	23	M	40	37	13	10	293	63	17	7	13	270
3	24	M	43	40	7	10	283	54	11	21	14	296
4	22	M	25	43	25	7	314	27	23	50	0	323
5	22	M	50	11	21	18	307	67	23	10	0	243
6	22	M	37	43	7	13	297	33	37	20	10	307
7	20	M	45	41	3	10	279	26	37	33	4	315
8	21	M	10	47	20	23	357	63	13	0	23	283
9	43	M	40	27	10	23	317	47	20	30	3	290
10	21	M	15	38	0	46	377	7	31	24	38	393
11	23	M	50	43	0	7	263	30	50	0	20	310
12	20	M	23	27	10	40	367	33	13	23	30	350
13	21	M	14	17	34	34	390	0	37	30	33	397
14	22	M	7	37	26	30	378	33	33	7	27	327
15	22	M	47	37	0	17	287	37	50	0	13	290
16	20	M	40	23	13	23	320	24	34	38	3	321
17	22	M	43	25	14	18	307	53	37	0	10	267
18	23	M	37	43	13	7	290	52	38	0	10	269
19	23	M	37	33	13	17	310	61	32	7	0	246
20	21	M	7	47	20	27	367	17	40	43	0	327
21	21	M	19	38	31	12	335	30	50	10	10	300
22	20	M	0	40	47	13	373	20	30	13	37	367
23	21	M	10	28	34	28	379	50	30	13	7	277
24	20	M	21	36	29	14	336	57	37	0	7	257
25	21	F	3	60	30	7	340	7	67	10	17	337
26	20	M	7	24	14	55	417	14	46	18	21	346
27	22	M	30	33	30	7	315	50	21	21	7	286
28	22	M	27	60	10	3	290	30	47	13	10	303
29	22	M	40	27	23	10	303	77	17	7	0	230
30	21	M	20	57	13	10	313	34	48	0	17	300
31	21	M	14	43	14	29	357	10	13	33	43	410
32	21	M	40	37	0	23	307	27	53	7	13	307
33	22	M	0	61	18	21	361	0	61	32	7	346
34	21	M	7	39	32	21	368	3	43	33	20	370
35	19	M	32	28	20	20	328	48	26	19	7	285
36	21	M	0	75	7	18	343	27	47	10	17	317
37	21	M	3	43	17	37	387	53	27	0	20	287
38	24	F	0	22	41	37	415	0	21	55	24	403
39	25	M	37	37	7	20	320	37	37	10	17	307
40	22	M	23	43	27	7	317	47	27	23	3	283
41	24	M	23	33	30	13	333	47	13	30	10	303
42	23	M	23	37	27	13	330	18	36	29	18	346
43	23	M						33	37	11	19	315
1	21	M	33	30	10	27	330	23	40	30	7	320
2	22	M	17	47	0	37	357	50	23	10	17	293
3	31	M	17	13	13	57	410	27	57	3	13	303
4	24	M	45	21	28	7	297	29	36	18	18	325
5	23	M	77	20	0	3	230	83	3	7	7	237
6	26	M	3	0	77	20	413	0	23	67	10	387
7	22	F	7	36	21	36	386	13	30	43	13	357
8	20	M	38	45	3	14	293	18	54	4	25	336
9	26	M	70	20	3	7	247	60	17	3	20	283
10	27	M	46	36	7	11	282	43	30	17	10	293
11	23	M	48	41	10	0	262	60	33	7	0	247
12	25	M	14	18	45	23	377	11	37	41	11	352
13	21	F	22	19	30	30	367	30	37	10	23	327
14	21	F	23	40	3	33	347	27	27	7	40	360
15	22	F	23	53	3	20	320	37	37	10	17	307
16	22	M	19	15	56	11	359	38	15	42	4	312
17	20	F	17	40	27	17	343	63	20	7	10	263
18	30	F	20	27	27	27	360	0	29	36	35	407

Appendix D

RIGHTS OF HUMAN SUBJECTS

Kansas State University
University Research
Compliance Office
1 Fairchild Hall
Manhattan, KS 66506-1107
785-532-3224
Fax: 785-532-3235
http://www.ksu.edu/research/

Proposal Number: 2574

TO: Catherine Lavis
Horticulture, Forestry, and Recreation Resources
2021 Throckmorton

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: August 22, 2002

RE: Proposal Entitled, "Enhancing Reasoning and Thinking Skills in Horticulture Students: Applying the William Perry Theory to Horticulture."

The Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is exempt from further review.

This exemption applies only to the proposal currently on file with the IRB. Any change affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Exemption from review does not release the investigator from statutory responsibility for obtaining the informed consent of subjects or their authorized representatives, as appropriate, either orally or in writing, prior to involving the subjects in research. The general requirements for informed consent and for its documentation are set forth in the Federal Policy for the Protection of Human Subjects, 45 CFR 46.116-117, copies of which are available in the University Research Compliance Office and online at http://ohrp.osophs.dhhs.gov/humansubjects/guidance/45cfr46.htm#46.116. In cases of remote oral data collection, as in telephone interviews, oral consent is sufficient and the researcher is required to provide the respondent with a copy of the consent statement only if the respondent requests one. The researcher must, however, ask the respondent whether he or she wishes to have a copy. The initiative in requesting a copy must not be left to the respondent. Regardless of whether the informed consent is written or oral, the investigator must keep a written record of the informed consent statement, not merely of the fact that it was presented, and must save this documentation for 3 years after completing the research.

The identification of a human subject in any publication constitutes an invasion of privacy and requires a separate informed consent.

Injuries or any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

Appendix E

PRE-QUESTIONAIRE

And

DEMOGRAPHIC INFORMATION

Student Questionnaire

The purpose of this study is to help me better understand what college students seek in their learning environment. Your perspective is critical to my understanding. Please help me by completing the attached instrument as well as answering the following questions.

Thank you for your help.

In this section, I would like you to answer the following questions.

A. Your gender:

Female _____ Male _____

In this section, I would like you to tell me about your work experiences as they relate to agriculture of horticulture.

B. Have you worked during the summer or performed an internship during the summer months?

Yes _____ No _____

If yes, how many months? _____

C. Have you been employed on a full time basis in either of these field?

Yes _____ No _____

If yes, for how long? _____

If there is anything else you would like to tell me about your learning preferences. Please use this space for this purpose.

Your contribution to this effort is greatly appreciated.

The final section of this study relates to your ideal learning environment. The Learning Environment Preferences (LEP) is an instrument that will be used to give me this information. Please read the directions included with the instrument and provide your answers on the following pages supplied with the LEP text.

Appendix F

INTERVIEW SCHEDULE

1. Tell me about the most significant aspect of your learning experience this past semester.
2. As you think about yourself as a learner in the classroom, what role do you prefer to play to make learning more effective?
3. In terms of instructors, what do you expect from them to help you learn effectively? What type of relationship do you think instructors and students should have to make learning effective?
4. What kinds of experiences have you had with fellow classmates that help you learn?
5. Discuss your perspective on the value of the things you have learned this past semester. What things have you learned that you think are important? What concerns have you had about some of the things you learned?
6. Would you change the learning environment you experienced this past semester? Is there anything else you would like to share with me to help me understand your perspective on the learning you experienced last semester?

Appendix G

INFORMED CONSENT STATEMENT

Informed Consent Statement

You are asked to be part of a study that examines your experience as an undergraduate learner. I hope to learn more about intellectual development of undergraduate students in horticulture.

If you consent to be in this study, you will be asked to complete an instrument called the Learning Environment Preferences (LEP). It is designed to identify your ideal learning environment. This instrument takes approximately 30 minute to complete.

A subsample of participants from this study will be asked to participant in an interview that will explore learning preferences. The interview will take approximately on hour. There are no hidden treatments and no expected discomforts or risks to you from this study. The interview will be taped recorded but your confidentially will be protected in the following ways:

a. no identifying information will appear on the transcript of the tape
b. access to the interview will be limited to the researcher conducting the interview
c. if any portion of the interview is used in an article or report, you will be shown the portion used to make sure it has adequately been disguised

Not only will you understand yourself better as a learner, but also you will increase the knowledge about undergraduates that can be used to create better environment for learning. All data will be reported as group data, and confidentiality of your replies is guaranteed by the researcher.

_____

I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participant in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I have read the above statements and have been fully advised of the procedure to be used in the study. I verify that my signature indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of the consent form.

If you have additional questions, please contact: Cathie Lavis, 3736 Throckmorton Hall, KSU, Manhattan, KS 66506, or call me at: 532-1433

_____
Participant Name

_____ _____
Participant Signature Date

_____ _____
Witness to Signature: Date