Cognitive Effect Indicators: The Impact of Student and Teacher Styles on Course Grades

Edward W. McCann, Jr.

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Committee Members

Dr. Thomas Broyles
Dr. Rick Rudd
Dr. William Price

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Abstract

This study was descriptive, correlative and explanatory. It summarized the problem solving and learning styles of students enrolled in the spring 2008 Virginia Polytechnic Institute and State University Agricultural Technology program, identified relationships between problem solving and learning styles, and used problem solving and learning styles to explain students' end of course grades. Ninety-three students and six faculty members elected to participate in the study.

There were differences between degree options in terms of orientation to change. Second year students were likely to be internal processors. There were not significant differences among the population in ways of deciding. However, Agricultural Technology teachers were more task oriented problem solvers, while their students were people oriented. Teachers were more field independent than the students. There were no relationships between problem solving and learning style. There was a high degree of association between student ways of deciding and manner of processing.

Student and teacher problem solving and learning styles were used to explain 11% of the variance in students' end of course grades for the six teachers in the study. Student orientation to change, student manner of processing, teacher manner of processing and teacher ways of deciding scores produced a model that significantly explained end of course grades. Suggestions for further research included identifying other career areas with stylistic trends and further identifying the impact cognitive effect has on student behavior.

Dedication

This paper is dedicated to my best friend Katie.

Acknowledgements

I am grateful for the outpouring of assistance, encouragement, advice, and understanding from many individuals while completing this study. I would like to begin by expressing my sincere thanks to my advisor and friend, Tom Broyles. I respect the many long hours, insistent dedication to students, and passion that he has for agricultural education. I hope that one day I can become a teacher like he has been to me. I also appreciate the assistance, encouragement and suggestions from the other members of my committee, Rick Rudd and Bill Price.

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I conclude this section by expressing my indebtedness to my soon to be wife, Ms. Katie Rebecca Dews. I must agree with the verse 21 in chapter 18 of the book of Proverbs, "He who finds a wife, finds what is good and receives favor from the LORD". I would not have made it through this process without your sincere understanding, listening ear, and kindhearted friendship.

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Chapter 1

Introduction

This study outlines the impact student and teacher cognitive style had on the end of course grades of students enrolled in the Virginia Polytechnic Institute and State University Agricultural Technology Program during the 2006 and 2007 fall semesters. The Virginia Polytechnic Institute and State University Agricultural Technology Program is a two year agricultural associate's degree program at one of Virginia's Land Grant universities. Cognitive style is best described as "a preferred way of thinking" (Grigorenko & Sternberg, 1997, p. 297). Cognitive style, or thinking style, has many different components and this study closely examined problem solving style (orientation to change, manner of processing and ways of deciding) and learning style (field dependence/independence). Problem solving style, a component of cognitive style, is defined as one's personal preferences in regards to novel thoughts and ideas, handling change, and how one effectively manages ill-structured and complex opportunities and challenges (Selby, Treffinger, Isaksen, & Lauer, 2004). Sarasin (1999) described learning style as "as a certain specified pattern of behavior and/or performance according to which the individual approaches a learning experience, a way in which an individual takes in new information and develops new skills, and the process by which the individual retains new information or new skills" (p. 1).

Cognitive style has a significant role in the methods and procedures teachers choose to use in the classroom. Teachers tend to teach content in a manner that is reflective of their personal cognitive style (Dunn & Dunn, 1979; Gregorc, 1979; Raven, Cano, Carton, & Shelhamer, 1993; Witkin, 1973). As instructors become aware of their own and their students' cognitive style, they can make moves to adjust and accommodate each individual's natural

learning tendencies. Keefe (1988) illustrated that most students do not know how they learn or think or how to ensure maximum and efficient learning. A number of researchers drew conclusions that directly tied learning style to academic achievement (Dunn & Dunn, 1979; Gregorc, 1979; Grigorenko & Sternberg, 1997; Sarasin, 1999).

Theoretical Framework

The theoretical framework for this study was based upon the works of Michael Kirton and his Cognitive Function Schema (Figure 1).
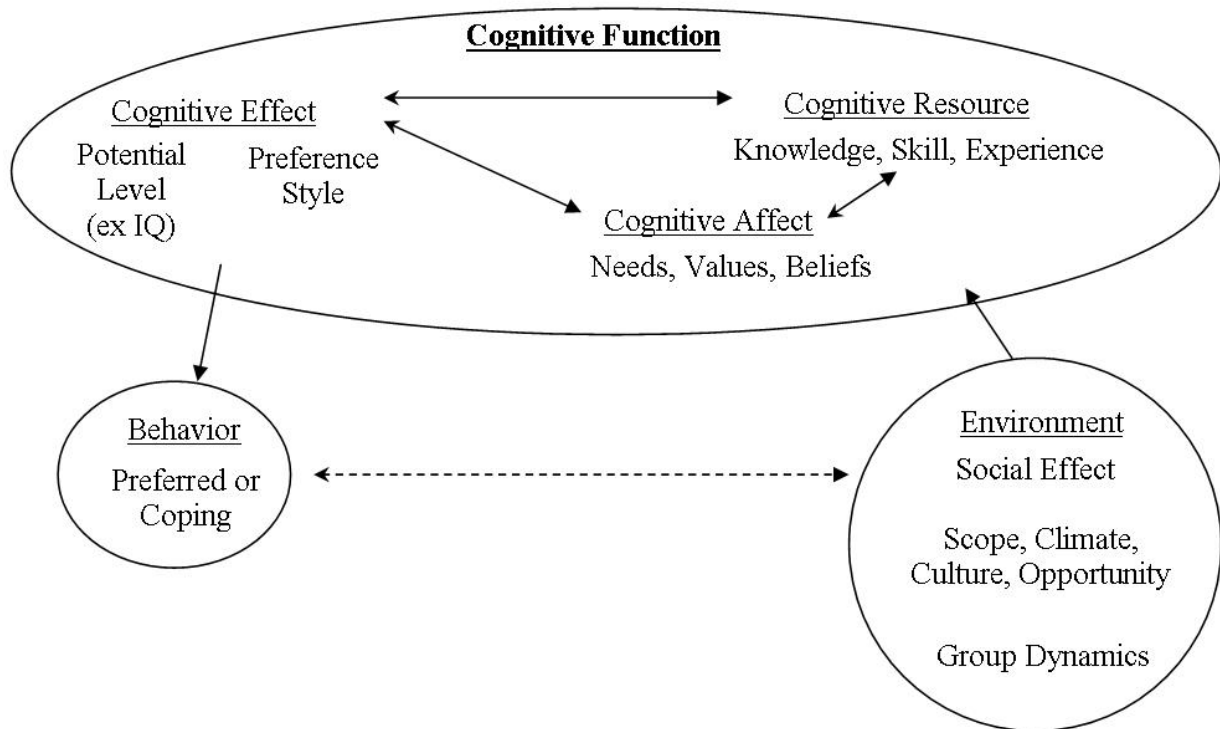
Figure 1. Cognitive Function Schema. (Kirton, 2003, p. 36) Permission granted from publisher in Appendix A.

There are three distinct components of this model: cognitive function, behavior and environment. The environment has a distinct impact on how individuals think. The

environmental impacts are largely situational and difficult to control. Environment influences the way information is interpreted and processed as well as how decisions are made. This component of the model is responsible for both culture and climate and is the domain in which individual decisions are carried out (Kirton, 2003). Climate is influenced by nine factors; (a) challenge and involvement, (b) freedom, (c) idea-time, (d) idea-support, (e) playfulness/humor, (f) debate, (g) conflict, (h) trust and openness, and (g) risk-taking (Isaksen and Akkermans, 2007). Isaksen and Akkermans (2007) consider culture to have five components including: (a) traditions, (b) beliefs, (c) values, (d) history, and (e) customs.

Cognitive function is comprised of three components: cognitive resource, cognitive affect, and cognitive effect. An individual's cognitive resource level is reflective of their unique level of ability. Cognitive resources are accumulated via problem solving processes associated with learning and are retrieved for use by memory (Kirton, 2003). Cognitive resources may be contextual, depending on an individual's knowledge, skills and prior experiences. Attitudes and opinions impact our cognitive function in the affective domain. An individual operates in cognitive affect when under the influence of their motive, they choose a problem to be solved and determine the necessary outputs of the problem solving process (Kirton, 2003). One's belief and value system may play a powerful role in making most choices; subconsciously or consciously. This component of the model is what guides an individual in subconsciously selecting an appropriate type of solution to the perceived problem (Kirton, 2003). Cognitive effect is the process of beginning in the problem solving process while incorporating an individual's style and mental capacity or potential cognitive level into the equation (Kirton, 2003). In other words, cognitive effect is how an individual prefers to think or function at the cognitive level. Cognitive effect is a natural tendency; during which thinking, learning and

problem solving will be a fluid and comfortable process for the individual. Style comes into the equation in this domain. Style is synonymous with preferred thinking methods. It should be noted that an individual's cognitive function is subject to change overtime, however this change must not be rapid or inexistent (Kirton, 2003).

The product of our environment and cognitive function is behavior. Our behavior is largely a result of preference; if the environment is pleasing and an individual's preferred methods of problem solving style and natural thought process have been promoted. A coping behavior is observed when an individual must act outside of their preferred cognitive style (Kirton, 2003). Coping behaviors have the potential to be physically and psychologically damaging if experienced long term. The behavior and environment components interact when feedback is collected and analyzed (Kirton, 2003). The impact of this feedback is only a component of cognitive function when an individual allows to let it be (Kirton, 2003).

This study is specifically focused on the relationship between cognitive effect stylistic preferences and behavior. As previously mentioned, style preferences are a central component of the cognitive effect domain. The relationship between problem solving and learning style is outlined in figure 2.
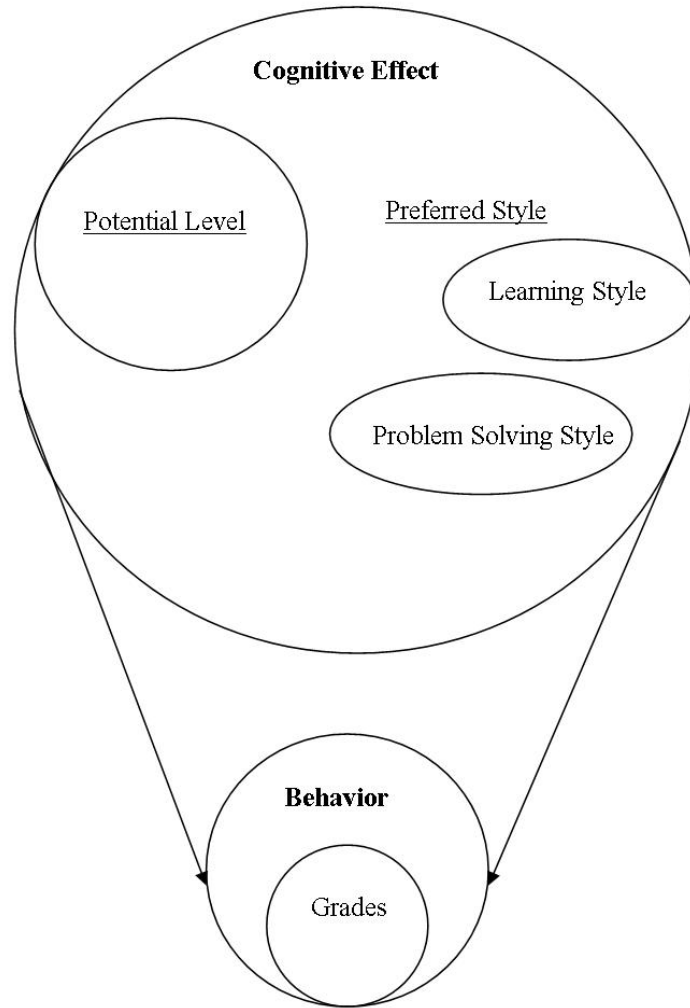
Figure 2. Cognitive Effect and Behavior.

Problem Statement

There are many factors that affect student performance in the classroom and cognitive style is one of them. Studies have evaluated the impact that preferred teacher and student learning styles have on student achievement (Dunn & Dunn, 1979; Gregorc, 1979; Grigorenko & Sternberg, 1997; Sarasin, 1999). The researcher found no literature linking problem solving styles (orientation to change, manner of processing, and ways of deciding) to perceptual learning styles. The researcher did not find literature indicating the impact teacher and student problem

solving or learning styles have on the course grade performance of students enrolled in agricultural associate's degree programs at land grant institutions.

Professional Significance

This study grants an opportunity to provide valuable descriptive knowledge to study participants and the general population of students and teachers involved in the Virginia Polytechnic Institute and State University Agricultural Technology Program. Identifying and explaining the relationship cognitive style has on end of course grades will provide especially valuable information to the program's instructors and administrators. This study will serve as a reminder to program instructors on the importance of cognitive style awareness in the classroom.

Prior researchers have found that the closer the student's learning style was to the instructor; the more probable it was that they would have higher levels of academic achievement. Despite research linking learning style to academic achievement, a significant void exists of literature related to end of course grades and problem solving style (Luk, 1998). This study has the potential to contribute to the body of literature regarding cognitive style. It will also help explain the influence cognitive effect has on behavior. In addition, this study will help meet the National Research Agenda for Agricultural Education and Communication objective RPA-2 by addressing the research question, "What factors are predictive of student success in college?" (Osborne, n.d.).

Purpose

The central focus of this study was to examine and identify student and teacher cognitive style and its relation to students' end of course grades in the Virginia Polytechnic Institute and State University Agricultural Technology Program. Specifically, the researcher sought to:

1. Determine if there is a difference in problem solving styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and grade point averages;

2. Determine if there is a difference in learning styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and grade point averages;

3. Determine if there is a relationship between problem solving style and learning style; and

4. Explain students' end of course grades using problem solving and learning styles.

Limitations

All conclusions and implications drawn from this study were subject to certain confines. Data collections were limited to those obtained from enrolled students and instructors in the 2008 spring semester of the Virginia Tech Agricultural Technology program. Any potential generalizations as a result of this study's outcomes are subject to the degree of similarity that students and teachers have to those in the study.

Definitions

Agricultural Associate's Degree Program: an agriculturally based academic postsecondary collegiate level program. Graduates earn an associate's degree.

Cognitive Style: "a preferred way of thinking", also referred to as thinking style (Grigorenko & Sternberg, 1997, p. 297).

Course Grade: an accepted manner for quantitatively assessing an individual's cumulative academic performance during the length of a course. The course grade is on a scale from 0 to 100 points.

Field Dependence: a learning style categorization for an individual, who is extrinsically motivated, learns well in a social environment, emphasizes the value of relationships, view the world globally and need external goals, guidance and assistance (Dunn & Dunn, 1979; Luk, 1998; Raven et al., 1993; Witkin, Moore, Goodenough, & Cox, 1977).

Field Independence: a categorization for an individual who has strong analytic skills, high levels of ambition, is able to organize and restructure difficult material, remains uninfluenced by social trends and relies on assistance and direction from authority figures (Luk, 1998; Raven et al., 1993; Witkin et al., 1977). Field Independent learners are typically high achieving students (Luk, 1998).

First Year Student: a designation for a typical freshmen student enrolled in the Agricultural Technology program at the Virginia Polytechnic Institute and State University. First year students have the same or very similar course schedules and often have very similar life experiences.

Land Grant University: universities founded as a result of the 1862 and 1890 Morrill Acts. The purpose behind these acts was to make education available to the working class by establishing a system for states to appropriate funding and land for state colleges (Gordon, 2003). Virginia Polytechnic Institute and State University is one of Virginia's land grant universities.

Learning Style: a person's instinctive and preferred manner of engaging in learning endeavors; Sarasin (1999) defined learning style as, "a certain specified pattern of behavior and/or performance according to which the individual approaches a learning experience, a way in which an individual takes in new information and develops new skills, and the process by which the individual retains new information or new skills" (p. 1).

Manner of Processing: one component of an individual's overall problem solving style; specifically describes an individual's favored methods of processing and handling information during the problem solving process (Selby et al., 2004).

Orientation to Change: one component of an individual's overall problem solving style; specifically how a person prefers to react to change in their life and to what extent creative means are used to manage that change (Treffinger & Selby, 2004).

Problem Solving: a mental process that an individual uses to arrive at the best possible solution to both conscious and unconscious decisions that is subject to a set of restrictions (Woods, 1987).

Problem Solving Style: representative of one's personal differences in regards to the reaction to novel thoughts and ideas, handling change, and how one effectively manages ill-structured and complex opportunities and challenges (Selby et al., 2004).

Second Year Student: a designation for a student who has completed their first year of course work and continues their enrollment in the Agricultural Technology program at the Virginia Polytechnic Institute and State University. Second year students tend to have a broad range of experiences to draw upon, including coursework and an internship that is traditionally between their first and second year. These students are in their last year of school before graduating.

Ways of Deciding: one component of an individual's overall problem solving style; addresses whether an individual is influenced by the task at hand or other people's opinions and emotions when making decisions (Selby, Treffinger, Isaksen, & Lauer, 2002).

Organization of the Study

Chapter 1 contains the introduction, theoretical framework, problem statement, professional contributions of the study, purpose of the study, research objectives, limits of the study and definitions of key terms.

Chapter 2 includes the review of literature pertinent to this study. It contains information about agricultural associate's degree programs, problem solving, problem solving style, learning style and the impact of problem solving and learning style on academic achievement. This chapter also has information about VIEW: An Assessment of Problem Solving Style [TM] and the Group Embedded Figures Test (GEFT).

Chapter 3 outlines the methods used to conduct this research study. It includes the variables of the study, context in which it takes place, the research design, research questions, and descriptions of the population, subjects, instruments, procedures and data analysis. This section also contains a descriptive analysis of the population and the instruments used in this study.

Chapter 4 offers a means of displaying the results of the study. It includes an analysis of each research objective. The last section, Chapter 5, is a discussion of the findings and implies practical applications for the results of the study and concerns for future research.

Summary

This study sought to determine and explain the relationship between students' and teachers' cognitive style in regard to students' end of course grades while enrolled in the Agricultural Technology Program at Virginia Polytechnic Institute and State University. This chapter provided a descriptive outline of the study.

The reasons that make this study justifiable and significant were in this chapter. Lastly, important definitions were included.

The objectives of this project were clearly outlined. They included:

1. Determine if there is a difference in problem solving styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades;

2. Determine if there is a difference in learning styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades;

3. Determine if there is a relationship between problem solving style and learning style; and,

4. Explain students' end of course grades using problem solving and learning styles.

Chapter 2 provides the theoretical and empirical research relevant to this study.

Chapter 2

Review of the Literature

This chapter describes the theoretical and empirical research relevant to this study. Literature was reviewed in the following areas: (a) associate's degree agricultural programs, (b) problem solving processes and methods, (c) problem solving style, (d) learning style, and (e) student and teacher cognitive style and its relationship to academic performance.

The review of the literature revolved around publications in the education and corporate business literature; doctoral dissertations; proceedings from educational research meetings; ERIC documents; textbooks; and websites.

Associate's Degree Agricultural Programs

This study was concentrated on a highly specified sample of students enrolled in the agricultural associate's degree program at Virginia Polytechnic Institute and State University. There was little literature available to describe students and teachers in similar programs.

In a study conducted by Mykerezi, White, and Crunkilton (2007) the perceptions of directors of agricultural associate's degree programs at land grant universities were measured. These programs are similar in nature to the program on the campus of Virginia Polytechnic Institute and State University. An overwhelming majority of these programs have credits that directly transfer to four year bachelor's degree programs (Mykerezi et al., 2007). Most programs of this nature face excessive demands from agricultural industries for graduates (Mykerezi et al., 2007).

The specific program in this study is located on and has access to many resources at one of Virginia's land grant institutions, Virginia Polytechnic Institute and State University. The

program has six core faculty and a variety of instructors from other departments in the University's College of Agriculture and Life Sciences. Students that are enrolled in the program are in one of two options; applied agricultural management or landscape and turf management. Each option incorporates small business management courses as well as core courses that are domain and career specific.

As postsecondary students, these individuals tend to have certain characteristics of adult learners. Adult learners behave like adults, have adult oriented responsibilities, and consider themselves as an adult (Knowles, 1980). In this particular context, Knowles (1980) classifies adult learners as youthful individuals who are responsible for their behaviors outside of the classroom and claim responsibility for their behavior in school as adult learners. Adult oriented learners will have a high motivation to learn, focus their energies on learning material that is applicable out of school, believe that experiential learning is very effective, and their learning, thinking and problem solving style is likely to have matured as they have aged (Sarasin, 1999). In Knowles' (1984) adragogy model of adult learning, there were six components: (a) adults need to know why they need to learn something, (b) the learner's self concept of being responsible for their choices and livelihood, (c) the learner's experience is valuable in adult teaching, (d) adults are ready to learn something readily applicable to their current life situation, (e) adults possess a life-centered approach to learning, and (f) adults are intrinsically motivated learners. A program with adult learners does need to be sensitive and flexible to student experience in order to accommodate the vast knowledge that students may possess prior to enrollment. The Agricultural Technology program at Virginia Polytechnic Institute and State University does acknowledge that students' experience may be comparable to that of academic courses or credits (Harrington, 1987). Adult centered andragogy can provide an industry

appropriate knowledge base, local and global industry literacy, and facilitate decision making (Flora, 1987).

The population of students enrolled in the Virginia Polytechnic Institute and State University Agricultural Technology program is very unique, especially in comparison to other learners at the University. Students enroll in the program for a variety of reasons. These programs are typically not research centered and have trouble allocating both federal and state financial resources (Mykerezi et al., 2007). Agricultural associate's degree programs tend to have certain pedagogical trends. The content is often more applied and kinesthetically oriented compared to the theoretically based instruction in four year bachelor's degree agricultural programs (Mykerezi et al., 2007). There are six instructors in the Agricultural Technology program with a full time teaching assignment. Other instructors are college faculty that belong to other departments and only teach part-time in the Agricultural Technology program (Mykerezi et al., 2007).

Defining Problem Solving

Problem solving skills are essential to a meaningful life. In order to capitalize on both problem solving methods and strategies, one must be conceptually familiar with problem solving. After a solid foundation is built in problem solving it is possible to better understand and apply problem solving styles in one's daily lifestyle habits. As a result, problem solving and problem based learning have been introduced to educational institutions. Psychological literature has defined problem solving, justified its value to educators and students, and established how to best incorporate problem solving into today's classrooms (Berardi-Coletta, Buyer, Dominowski, & Rellinger, 1995; Reder & Ritter, 1992). Information has been retrieved from cognitive psychologists and combined with work from problem solving experts to develop

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recommendations on integrating problem solving in the best possible manner (Bransford & Stein, 1984; Mayer, 1983; Allen Newell & Simon, 1972).

Despite the overwhelming support for integrating problem solving in the classroom, this teaching method is difficult for instructors to implement (Knowlton, 2003). In fact, the majority of college professors consider their teaching to be effective, despite what contrary evidence they may be provided (Paul, 2005). Problem solving in education is a rapidly changing concept. It has evolved from a universal systematic process in the 1900s to a complex set of steps with different learner specific attitudinal domains (Foshay & Kirkley, 1998). Many instructors avoid problem solving teaching methods because of preconceived notions that it comes at the cost of developing cognitive knowledge. Foshay and Kirkley (1998) discussed how a learner's problem solving ability cannot rise above the level of their declarative knowledge. A student can possess imminent knowledge, yet still lack problem solving skills, but they cannot possess problem solving skills without at least adequate levels of knowledge. At the end of the day, problem solving is more cost-effective for educators because it helps learners adapt better without needing further formal training (Foshay & Kirkley, 1998). Once one agrees that problem based learning is an effective teaching strategy, it is appropriate to explore scientific based processes and methods of solving problems.

Problem Solving Processes

Much of the work in problem solving for this study is grounded in the field of cognitive psychology. A great deal of research within psychology has been concerned with problem solving (Bransford & Stein, 1984; Davis, 1966; Gagne, 1964; Maier, 1970; A. Newell, Shaw, & Simon, 1958; Polya, 1946). After the initial decision to adopt problem solving skills in the learning environment, it is important to develop a model to follow when solving problems. The

literature related to cognitive problem solving processes has addressed multiple models to explain the problem solving process. The models are based on the work of Polya, Pietrasinski, Bransford and Stein, Lockhead and Whimbey. The early literature is based around the principals of artificial intelligence and mathematics; since then, the theories have been transferred to education.

Before explaining the models of problem solving it is imperative that problem solving is defined. From the literature many definitions of problem solving have been identified. Definitions of problem solving have included key concepts such as tasks, goals, mental processes, and attaining goals. Bloom and Broder (1950) defined problem solving as "the process by which the subject goes from the problem or task as he sees it to the solution which he regards as meeting the demands of the problem" (p. 7). Polya (1946) defined problem solving as "finding a way out of a difficulty, a way around an obstacle, attaining an aim that was not immediately attainable" (p. ix). Later, Woods (1987) defined problem solving as "the mental process that we use to arrive at 'best' answer to an unknown or some decision, subject to a set of constraints" (p. 55). Ricketts (1997) simply explained problem solving as a process of initializing corrective actions in order to reach a specified goal.

Problem Solving Models

The literature related to cognitive problem solving process has addressed multiple models to explain the problem solving process. The models are based on the work of Polya, Pietrasinski, Bransford and Stein, Lockhead and Whimbey. Polya (1946) utilized mathematics as the vehicle to develop and describe the problem solving process as four phases the learner must do in order to solve problems. The four phases are: (a) understand the problem, (b) make a plan, (c) carry out

the plan, and (d) look back at the solution. Polya's work was primarily in the field of mathematics and based the theory on making individuals think.

While working on theories of efficient thinking, Pietrasinski (1969) developed a four step problem solving model. His model operated on these four foundational steps; (a) confrontation by a problem, (b) search for the solution, (c) the solution of the problem or the admission of failure, and (d) final checking of and perfecting the solution. Pietrasinski's straightforward model is depictive of a linear approach to solving problems.

Building on the concepts of Polya, Bransford and Stein (1984) developed a very similar model of problem solving, titled IDEAL. The model IDEAL included five steps (a) identify the problem, (b) define and represent the problem, (c) explore possible strategies, (d), act on the strategies, and (e) look back and evaluate the effects of your activities. Bransford and Stein's IDEAL problem solving model paved is one of the most recent models of problem solving.

While very similar to Pietrasinski's model, Lockhead and Whimbey (1987) developed a four step model using research to compare experienced and novice problem solvers. After analysis, the expert problem solver uses these four steps: (a) the expert assembles information from the problem, (b) plans the problem solution, (c) solves the problem, and (d) checks the solution. When this model is applied for novice learners, frequent failure is a result of the lengthy process involved in becoming an expert problem solver (Lockhead & Whimbey, 1987).

Problem Solving In the Classroom

When incorporating problem solving into the classroom, there are approximately nine skills that are directly related to a student's ability to solve problems. Students will develop, contextual knowledge of the problem area, abilities to synthesize data and evaluate it's worth, facilitate learning on their own time, reasoning content in both breadth and depth, motivation and

perseverance to tackle tough issues, skills with handling stress and procrastination, inter-personal and intra-personal skills, communication skills, and the ability to reflect critically on their thinking style and predispositions (Woods, 1987). All of these skills and dispositions are present in the ideal learning environment. Students involved in problem solving are better at self study skills and have a higher level of motivation to succeed than do students who are not enrolled courses with problem solving elements (Savin-Baden & Major, 2004). Courses with problem solving activities often incorporate debates, case-studies, reflective assignments, journals, and class discussions. Due to the nature of the class, learners are no longer able to take a passive role in their learning. In the educational world, passive instruction is inferior to methods that actively engage the students (Paul, 2005). The shift from observer to participant changes the state of learning for students involved in problem solving (Savin-Baden & Major, 2004). Students that are actively engaged are more likely to learn material. By using problem solving in the classroom, teachers help develop key life skills, attitudes and cognitive development of students.

Problem Solving Style

Problem solving style is representative of one's personal differences in regards to their reaction to novel thoughts and ideas, handling change, and how one chooses to effectively manage ill-structured and complex opportunities and challenges (Selby et al., 2004). When working alone or in groups, people tend to typically attempt to solve problems in one of two ways. People tend to either attempt to modify the problem and make it better by enhancing parts of the problem or they tend to drop what has been done in the past and develop novel solutions (Treffinger & Selby, 2004). No matter which venue is chosen, successful problem solving will likely resort if an individual consciously or subconsciously chooses to follow strategies or

models outlined previously. Treffinger, Selby, Isaksen, and Crumel (2007) described problem

solving style by defining exactly what problem solving style is and is not, as outlined in Table 1.

Table 1

Problem Solving Style

Problem solving styles are:	Problem Solving Styles are NOT:
• Natural (everyone has a style)	• Fixed, inflexible (people can adapt)
• Neutral (no "right or wrong style")	• Measures of one's ability
• Ways you prefer to behave	• Excuses for not doing well
• Comfortable (the way one really is)	• Ways people expect others to behave
• Stable (does not change rapidly)	• Rules for how one has to behave
• Strengths (how one is at their best)	• "Faults" (things one cannot do well)

Note: This table was reproduced with permission from Treffinger et al. (Appendix B), as seen in

An Introduction to Problem-Solving Style (2007, p. 3).

VIEW: An Assessment of Problem Solving Style [TM] attempts to quantify a person's

problem solving style in three independent domains; orientation to change, manner of processing

and ways of deciding. Each domain classifies an individual on a numerical continuum. No style

typology is more preferable or less desirable than the next.

VIEW: An Assessment of Problem Solving Style [TM]

The VIEW: An Assessment of Problem Solving Style [TM] instrument is grounded in the

literature. An example of the instrument can be found in Appendix C. The instrument's

theoretical framework is pictured in figure 2.
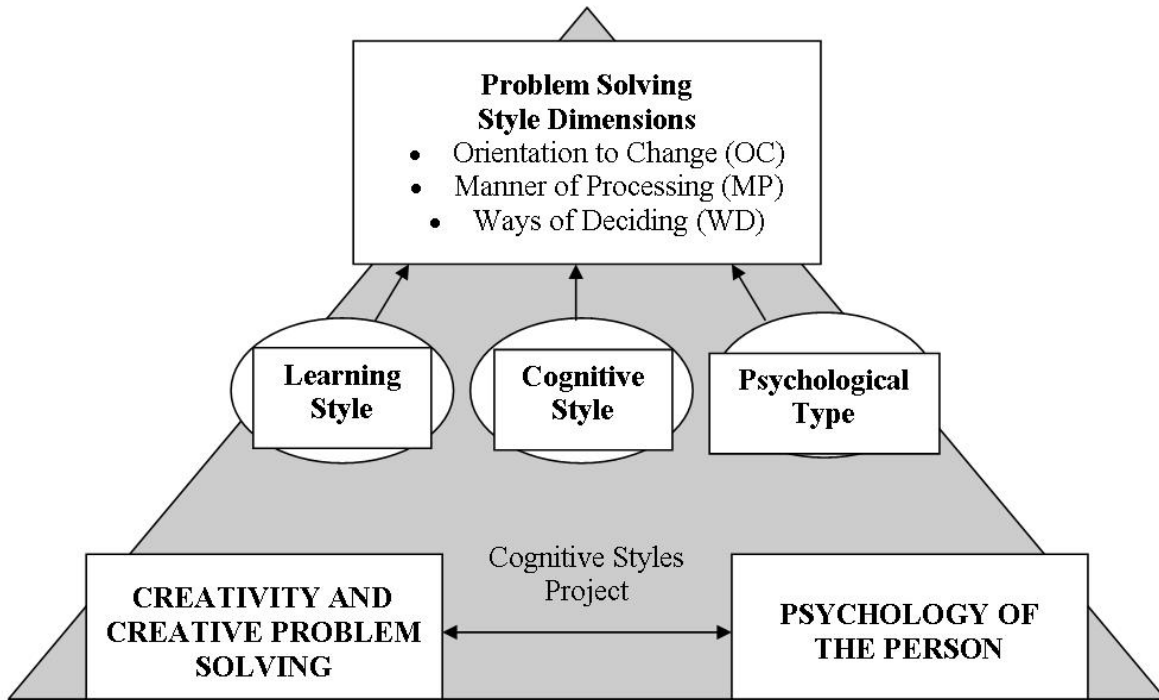
Figure 3. VIEW: An Assessment of Problem Solving Style [TM] Theoretical Framework. This

figure was reproduced with permission from Treffinger et al. (Appendix B), as seen in *An*

Introduction to Problem-Solving Style (2007, p. 3).

Before discussing problem solving style in great detail, it is important to first review the

foundational concepts this theory is built upon. Learning style plays a vital role in one's problem

solving style. Many researchers, including Rita and Kenneth Dunn, agree that learners typically

prefer structure or are limited by it; they may need authority figures in close proximity during

learning while others prefer that authority be distant (Selby, Treffinger, & Isaksen, 2007).

Literature indicates that learning is subject to many elements. Learning can happen with or

without certain elements present. However, to maximize learning potential, preferred elements

will be present during learning (Selby et al., 2007).

In regards to the problem solving model, cognitive style is based on the concept of the

independent constructs of personality and cognition domains actually intersecting (Selby et al.,

2007). In a study by Isaksen, Lauer and Wilson (2003), a significant correlation was found between the Kirton Adaption Innovation Inventory (KAI) and the Myers-Briggs Type Indicator (MBTI) personality assessment. The MBTI area of Sensing-Intuitive accounts for 30% of KAI variance. The Judging-Perceiving domains explain 19% of KAI variance (Isaksen et al., 2003).

The third foundational concept of problem solving style is built upon the personality type work of Carl Jung. Jung theorized that personality could be measured on several different degrees; sensation-intuition, thinking-feeling, and judging-perceiving (Selby et al., 2004). Lawrence (1993) indicated that learning style and personality type overlap; in a similar manner to that of learning style and cognitive style's overlapping relationship. Lawrence (1993) reported that over 80% of researchers studying learning style and personality style have linked various aspects of the MBTI to a certain learning style. With solid empirical evidence, problem solving style evolved from work in the distinct fields of learning style, cognitive style, and personality type. These three components interact together within the cognitive arena.

The developers of VIEW: An Assessment of Problem Solving Style [TM] based their work on research done by Cattell, Dunn and Dunn, Gough, Jung, Kirton, Costa and McCrae, Eysenck, "Five Factor" personality theorists, and on creativity literature (Selby et al., 2007). An instrument was developed to indicate ones' personal preference for problem solving styles called VIEW: An Assessment of Problem Solving Style [TM]. It identifies problem solving style in three dimensions; orientation to change, manner of processing and ways of deciding.

An individual's problem solving style, in regards to their orientation to change, specifically revolves around their preferences for handling change and what creative solutions are used to manage it (Treffinger & Selby, 2004). Selby et al. (2007) define this dimension as

one's "disposition and preferences for responding to and managing structure, novelty, and authority, when you are dealing with change or solving problems" (p. 24). Based upon the assessment results, an individual will lie somewhere on a continuum, between Explorers and Developers. Explorers, which fall below the mean, are adventurous individuals who enjoy chasing possibilities and take pleasure in novel and indistinct problems with original, raw and revolutionary solutions (Selby et al., 2004). Developers prefer a systematic manner of solving problems, they automatically collect data and synthesize problems in an organized manner that creates solutions that are deemed valuable and helpful by others (Treffinger & Selby, 2004).

While orientation to change deals with a person's method of handling change, manner of processing describes an individual's preferred methods of handling information during the process of solving a problem (Selby et al., 2004). Selby et al. (2007) define this dimension as one's "dispositions and preferences for how and when you use your own inner energy and resources, the energy and resources of others, and the environment; and for different ways of handling information when managing change or solving problems" (p. 27-28). External problem solvers' scores fall below the mean and tend to indicate an individual who is extroverted, finds energy from others, enjoys discussing problems and constructing solutions in groups, and leans on authority figures for direction and advice (Treffinger & Selby, 2004). Those who score below the mean on the manner of processing continuum are referred to as external problem solvers. The opposite of external methods of processing information is internal methods of processing information. Internal processers tend to be introverted; looking inwards for a solution by personally reflecting quietly and at a self directed pace (Treffinger & Selby, 2004).These individuals tend to evaluate their ideas before expressing them publicly, spend considerable time in reflection and enjoy learning in solitude (Treffinger & Selby, 2004).

The final dimension of the VIEW: An Assessment of Problem Solving Style ™ assessment quantifies an individual's ways of deciding. This continuum between people or task directed decisions is indicative of how a person tends to make decisions and evaluate options (Selby et al., 2002). Selby et al. (2007) define this dimension as one's "dispositions and preferences for balancing and emphasizing task concerns and personal or interpersonal needs when focusing your thinking and moving toward decisions and action" (p. 30). People that tend to habitually consider a decision's outcomes in terms of the potential impact on other individuals and their emotions are identified as focusing on people (Selby et al., 2002). When people do habitually base their decisions on other people's opinions and emotions, their score on the ways of deciding continuum tends to be below the mean. When an individual falls above the mean, they are identified as task motivated and tend to rely on logical, sound and easily justifiable decisions that will easily direct them to an emotion free and defendable solution (Treffinger & Selby, 2004).

In summary, the VIEW: An Assessment of Problem Solving Style ™ instrument identifies three independent dimensions of problem solving style. The explorer/developer continuum indicates a person's orientation to change. The second continuum, external/internal, estimates an individual's preferred means of processing a problem. This is indicative of how a person habitually solves problems. The ways of deciding, or otherwise known as the people/task continuum assesses an individual's attention towards emotional or logical outcomes.

Learning Styles

There is no magic formula for predicting student academic success. Nearly all researchers indicate that everyone has preferred ways to engage in learning (Cano & Garton, 1994; Dunn & Dunn, 1979; Grigorenko & Sternberg, 1997; Luk, 1998; Sarasin, 1999; Witkin et al., 1977). In

addition, many educational psychologists and researchers also readily identify a student's ability as a large contributor to individual academic success (Cano & Garton, 1994; Dunn & Dunn, 1979; Grigorenko & Sternberg, 1997; Sarasin, 1999). Dunn and Dunn (1979) suggest a number of different factors can cause any individual to react differently to an environment, including: age, ability, socioeconomic status, or achievement level. In an attempt to explain other variables contributing to academic achievement, researchers have explored cognitive style (Grigorenko & Sternberg, 1997). Cognitive style or thinking style is defined as "a preferred way of thinking" (Grigorenko & Sternberg, 1997, p. 297). Research indicates that style is derived from both genetic predispositions and the environment and culture in which an individual develops (Gregorc, 1979).

Learning Style Defined

Learning style is one component of cognitive style. There are many definitions of learning style. Gregorc (1979) illustrated learning style as, "distinctive behaviors which serve as indicators of how a person learns from and adapts to his environment" (p. 234). Garger and Guild (1984) defined learning style as the, "stable and pervasive characteristics of an individual, expressed through the interaction of one's behavior and personality as one approaches a learning task (p. 11). Cano and Garton (1994) wrote that learning style can be simply defined as "the manner in which learners sort and process information" (p. 6). Dunn (1996) explains that learning styles are complex reactions to stimulus including emotions, events, and routines. For the purpose of this study, Sarasin's (1999) working definition will be used. Sarasin (1999) defined learning style "as a certain specified pattern of behavior and/or performance according to which the individual approaches a learning experience, a way in which an individual takes in new information and develops new skills, and the process by which the individual retains new

information or new skills" (p. 1). It is commonly accepted that every individual has a unique way of learning and mastering material (Dunn, 1996; Dunn & Dunn, 1979; Gregorc, 1979; Raven et al., 1993).

Teaching and learning styles are relatively steadfast and resistant or difficult to change (Dunn & Dunn, 1979; Grigorenko & Sternberg, 1997; Witkin et al., 1977). However, individuals can cope and adjust learning styles on a situational basis (Gregorc, 1979). Grigorenko and Sternberg (1997) illustrated that there are no styles that are superior; the focus is to uncover and develop certain styles for certain circumstances. Despite their relative steadiness, learning styles are subject to small changes in either direction over time (Dunn & Dunn, 1979). It has been documented that at between 24 years of age and old age, individuals do tend to become more field independent (Witkin, Oltman, Raskin, & Karp, 1971).

Field dependence and field independence are the most widely studied aspects of learning style (Cano & Garton, 1994; Witkin et al., 1977). These indications of learning style only reflect an individual's tendency to perceive a stimulus as discrete from its surroundings using passive global or active and analytical cognitive processes (Luk, 1998; Raven et al., 1993; Witkin et al., 1977; Witkin et al., 1971). Field dependence and field independence lie on two ends of the learning style continuum. It should be noted that learning style is not an indicator of learning ability or skill (Dunn, 1996; Gregorc, 1979; Grigorenko & Sternberg, 1997; Witkin et al., 1977; Witkin et al., 1971).

Field Dependence

Researchers have clearly defined the identifying characteristics of field dependent and field independent learners. Field dependent learners tend to be less independent people who seek extrinsic motivation, rely heavily on authority figures, and have difficulties constructing personal

learning experiences (Luk, 1998). Field dependent learners' beliefs and actions are strongly

influenced by their social experiences (Luk, 1998; Raven et al., 1993; Witkin et al., 1971). Field

independent and field dependent learners value social relationships differently. Many individuals

can learn in a host of sociological structured activities, but some may only reach acceptable or

optimal performance when specific relationships are fostered (Dunn & Dunn, 1979). These

individuals learn well from social interaction and can selectively remember materials that have

social connotations (Raven et al., 1993; Witkin et al., 1977). Field dependent learners are likely

to need externally defined goals whereas field independent learners readily set their own goals

(Luk, 1998; Witkin et al., 1977; Witkin et al., 1971). These individuals tend to have global

perspectives and will require explicit guidance and instruction in the classroom (Raven et al.,

1993). Field dependent teachers characteristically provide very little negative feedback to their

classroom community or individual students (Garger & Guild, 1984). These teachers also tend to

naturally create a welcoming classroom environment (Raven et al., 1993). In regards to problem

solving ability, field dependent learners typically lack the inherent ability to solve problems

without prior training in problem solving (Witkin et al., 1977). This does not mean that they lack

problem solving styles; it is rather an indicator of ability. Field dependent students tend to be

attracted to vocational areas in education (Witkin et al., 1977).

Field Independence

Field independent learners are typically characterized as analytical, logic oriented, and

capable of restructuring problems. They rely on direction, assistance and knowledge from others

yet remain less influenced by social circumstances than field dependent learners (Luk, 1998).

These individuals perceive items as being distinctly separate from the surrounding field (Raven

et al., 1993). Field independence is considered to be a significant predictor for student

achievement. Field independent students constantly perform better academically than field

dependent students (Luk, 1998). Field independent learners tend to automatically organize,

master, and interpret learning materials that are void of clear internal structure (Witkin et al.,

1977). Teachers that are field independent focus their attention on content material, emphasize

cognitive development during instruction, and tend to guide students instead of directly

delivering material to learners (Cano, Garton, & Raven, 1992; Raven et al., 1993; Witkin et al.,

1971).

Learning Style Implications

There is some controversy over cognitive styles between genders. Witkin et al. (1977)

indicated that beginning at adolescence; there are slight significant differences in field

dependence and field independence of males and females. Witkin et al. (1971) also found distinct

differences between genders. Females are generally more field dependent than men (Witkin et

al., 1977). However, Grigorenko and Sternberg (1997) studied the thinking styles of high school

gifted students and found that the learning styles did not differ across gender, ability levels or

grade level. Dunn (1996) indicated that gifted students were readily capable of performing at

high levels without using their learning style, whereas average or low achievers can perform

significantly better when using their preferred style. Raven et al. (1993) found that preservice

female agricultural teachers tended to be more field independent than the general population of

females.

Students' learning styles are predictive of their school success (Grigorenko & Sternberg,

1997). As teachers become aware of their learning style and the learning style of each student,

they are better able to prepare individualized instruction, utilize different teaching strategies,

promote different learning strategies, and enhance the likelihood of student success regardless of

learning style (Gregorc, 1979; Witkin et al., 1977). Recognizing style and ability will allow the instructor to strategically plan appropriate learning engagements that will strengthen each individual's ability to learn using different styles.

Learning Style and Teaching

Academic success is an issue on nearly every educator's radar. When students are unsuccessful academically, many begin to immediately reason that time on task, motivation, and content material difficulties are partial causes for failure. However, oftentimes teaching strategies may directly affect students' success. Acknowledging the impact that teaching methods and learning styles have on achievement may promote more effective teaching and learning. Other than cases of psychological damage, most students do not know learning operations and procedures or how to manipulate and control them (Keefe, 1988).

There is a direct correlation between teaching style and learning style (Dunn & Dunn, 1979). Researchers suggest that teachers teach in the same manner in which they learned because they often believe that the means they used to learn material is the most efficient or correct manner for learning (Dunn & Dunn, 1979; Sarasin, 1999). Other researchers have also found that an instructor's learning style correlates with their habitual teaching style (Gregorc, 1979; Raven et al., 1993; Witkin, 1973). The relationship between teaching style and learning style plays a role in the success of students at the postsecondary level (Sarasin, 1999).

The impression a teacher has of their own style and the style and behavior of their students plays an important role in a student's success. Teachers often overrate the extent to which their students share similar thinking styles (Grigorenko & Sternberg, 1997). It is necessary that when planning and delivering instruction, teachers consider learning styles and their impact on student achievement (Dyer & Osborne, 1996). For example, Dyer and Osborne (1996) found

that field independent learners respond better to problem solving based teaching methods. Qualitatively speaking, teachers tend to appear to value students who have the same or similar thinking styles as they have (Grigorenko & Sternberg, 1997). Periodically assessing and varying the type of assessment will serve more students (Grigorenko & Sternberg, 1997). Diverse teaching strategies are necessary to accommodate diverse learning styles in every classroom.

Knowledge of teacher and student learning styles is extremely beneficial for both parties in terms of assessing knowledge and skills. When instructors develop their own assessments, it is possible to develop a testing tool that lends itself towards one thinking style over another. In a study by Grigorenko & Sternberg (1997) gifted students performed better on assessments that matched their preferred thinking style. When taught in a style that compliments theirs, students not only achieve higher academically, but tend to be more motivated (Dunn & Dunn, 1979; Gregorc, 1979). In addition to higher academic achievement, at the postsecondary level, students should know their styles because it can produce positive psychological benefits; including higher self esteem and confidence as well as an appreciation of diversity (Sarasin, 1999).

Certain career fields tend to attract individuals with certain learning styles (Luk, 1998). Different career fields require different skills and dispositions for success. It was found that preservice agricultural instructors tend to be more field independent but tend to teach in a learner centered manner; a characteristic more typical of field dependent teachers (Raven et al., 1993). Despite that some fields may attract less style diverse clientele; learners should be exposed to different learning styles in order to foster the development of thinking skills and appreciation for diverse cognitive styles.

At the bottom line, "teachers may be knowledgeable, charismatic, dramatic, hardworking, caring, and dedicated, and still not be effective with students whose learning styles are not complemented by their teaching styles" (Dunn & Dunn, 1979, p. 241). Positive transfer is more likely to occur in students when the instructor is aware of and acts upon their students' learning styles (Sarasin, 1999). Students will perform better when allowed to learn in their preferred style.

Group Embedded Figures Test

There are a number of methods available to designate learning style via field dependence and field independence (Witkin et al., 1977). The Group Embedded Figure Test (GEFT), developed by Witkin et al. (1971), is the most frequently used tool for identifying field independence and field dependence (Luk, 1998). The GEFT was developed to replace the Embedded Figures Test (EFT) because group testing was not possible with the EFT (Witkin et al., 1971). The concept developed out of the idea that both perceptual and intellectual tasks can be used to assess very broad domains of an individual's daily life (Dyer & Osborne, 1996). It has been described as measuring an individual's level of abstractness or concreteness on a scale of 0 to18 (Witkin et al., 1971). GEFT has three individual sections. The first section has seven straightforward items. The second and third sections have nine items that are more complex. The number of correctly identified simple shapes in the second and third sections is the total GEFT score (Witkin et al., 1971). Scores that are below the national mean are field dependent while scores above the national mean are field independent (Luk, 1998; Raven et al., 1993; Witkin et al., 1971).

GEFT is recognized as a standard test for measuring field dependence and field independence (Dyer & Osborne, 1996; Witkin et al., 1971). The GEFT has reliability of .82 for makes and .79 for females (Witkin et al., 1971).

Learning Style and Problem Solving Style

The literature indicates that learning style has an impact on students' academic achievement, teachers' methods of teaching and learning and interactions that take place between students and teachers (Cano & Garton, 1994; Dunn & Dunn, 1979; Gregorc, 1979; Witkin et al., 1977). There was no research found on the influence student and teacher problem solving style and academic performance. There is also very little research exploring the relationship between field dependence and field independence to problem solving style in terms of orientation to change, manner of processing, and ways of deciding. However, these two indicators are part of the larger realm of cognitive style.

Summary

This chapter was meant to review literature related to the cognitive style, specifically including problem solving and learning style in regards to students and teachers in the Agricultural Technology Program at Virginia Polytechnic Institute and State University. Problem solving style and learning style were put into context with cognitive function and behavior in the Cognitive Function Schema (Kirton, 2003). An extensive background of the cognitive problem solving and a historical review of problem solving methods were included in this chapter. Problem solving style was broken down into its three constructs: orientation to change, manner of processing and ways of deciding. The literature about learning styles and field dependence and field independence was analyzed and related to student achievement and instructor pedagogy.

Chapter 3 will introduce the methodology used to conduct this study.

Chapter 3

Methodology

This chapter details the methods that were used to address the proposed research objectives. The research context, design, population demographics, instruments, and procedures for data analysis are also included in this section.

Variables

The quantitative research methods used in this study were descriptive, correlational and explanatory. For objectives one and two, the variables were problem solving style (orientation to change, manner of processing, ways of deciding – VIEW: An Assessment of Problem Solving Style [TM]) and learning style (field dependence, field independence – GEFT). Each variable was compared between groups of the sample for students and teachers, student degree options, academic years, ages, and GPA ranges.

For objective three, the variables were problem solving style (orientation to change, manner of processing, ways of deciding – VIEW: An Assessment of Problem Solving Style [TM]) and learning style (field dependence, field independence – GEFT). Correlations were made between problem solving and learning styles for students and teachers, student degree options, academic years, ages, and GPA ranges.

Objective four's independent variables were student and teacher problem solving styles (orientation to change, manner of processing, and ways of deciding – VIEW: An Assessment of Problem Solving Style [TM]) and learning styles (field dependence, field independence – GEFT). The dependent variable was overall course grades.

Context of the Study

  Institutional Review Procedures. Virginia Polytechnic Institute and State University

Institutional Review Board (IRB) policies were followed. The consent form, grade release,

contact and thank you letters and the IRB approval letter are included in Appendix E, F, and G,

respectively.

  Place. The entire study was conducted on the Blacksburg campus of Virginia

Polytechnic Institute and State University. The data were collected two different times, one

session for students and one for instructors. Student data were collected in the Personnel

Management Course: AT 0224 (Course Reference Number 10709). Permission from the

Personnel Management instructor was received prior to completing the study (Appendix I).

Instructor data were collected during a bi-weekly faculty meeting. The VIEW: An Assessment of

Problem Solving Style ^{TM} was given in an electronic format to all research participants. An

online format for this test was chosen for this study because all students and teachers in the

Virginia Polytechnic Institute and State University Agricultural Technology program are

required to own and have a functional tablet laptop in their possession during every course.

There is a high correlation between the online and paper version of the VIEW: An Assessment of

Problem Solving Style ^{TM}; .92 for orientation to change, .92 for manner of processing, and .98

for the ways of deciding construct (Selby et al., 2007). The learning style data were collected in a

hand scored booklet.

  Time. The study was conducted on Thursday, February 22 and Friday, February 23, 2008.

Both students and instructors received the same information regarding the study. The first

announcement was sent over email on Monday, February 4, 2008. On Monday and Wednesday

of February 11-13, 2008, a letter was delivered to all prospective participants. Two email

reminders were sent out again during the week of the study. A make-up date was scheduled for subjects who were absent during data collection. Three individuals did not consent to participating in the study. One individual's problem solving and learning style scores were omitted from data analysis due to failure to comply with instrument instructions. Cumulative numerical end of course grade data were obtained from instructor records for the fall 2006 and fall 2007 semesters. Only courses taught by all six full time faculty members were collected. Grade data were only collected from students who received a final course grade and those students were enrolled during initial data collection in the spring 2008 semester.

Research Design

This study was descriptive, correlational, and explanatory. Descriptive research only describes or tells about an event without explaining why or how it came to its present state (Reaves, 1992). Correlational research attempts to utilize one variable to predict the value of another variable (Shaughnessy, Zechmeister, & Zechmeister, 2006). Explanatory research utilizes a regression analysis of independent quantitative variables to predict dependent quantitative variables (Ott & Longnecker, 2001).

VIEW: An Assessment of Problem Solving Style [TM] has been completed by over 16,141 individuals (Treffinger, 2008). There is no relationship between age and the manner of processing and ways of deciding continuums. There is a statistically significant, but very weak and negligible correlation between age and the orientation to change continuum of problem solving style (Selby et al., 2007). The relationship lacks practical significance because of the extremely large sample size. The results from this instrument are considered to be an accurate indicator of the population regardless of the participants' age differences.

Research Objectives

This research categorized the cognitive style of students and teachers in the Virginia

Polytechnic Institute and State University Agricultural Technology program and sought to

explain the relationships that student and teacher problem solving and learning styles have on

students' end of course grades by answering the following objectives:

1. Determine if there is a difference in problem solving styles between the Virginia
   Polytechnic Institute and State University Agricultural Technology Program students and
   teachers, student degree options, academic years, ages, and academic course grades;

2. Determine if there is a difference in learning styles between the Virginia Polytechnic
   Institute and State University Agricultural Technology Program students and teachers,
   student degree options, academic years, ages, and academic course grades;

3. Determine if there is a relationship between problem solving style and learning style; and,

4. Explain students' end of course grades using problem solving and learning styles.

Population

Teachers and students enrolled in the Virginia Polytechnic Institute and State University

Agricultural Technology program during the 2008 spring semester were the population for this

study. Those students enrolled in and the instructors who were teaching in the program were

readily accessible for the researcher.

Participants

There were 99 participants in the study, 93 students and six teachers. The student sample

was 84% male (n=78) and 16% female (n=15). Of the six teachers, 67% (n=4) were male and

33% were female (n=2). There were no respondents (n=0) who chose not to indicate their

gender.

Instrumentation

Two instruments were used during this study. The VIEW: An Assessment of Problem Solving Style ™ instrument served as an indicator for the three constructs of problem solving style, orientation to change, manner of processing, and ways of deciding for the students and teachers in the Virginia Polytechnic Institute and State University Agricultural Technology program. The second instrument was the Group Embedded Figures Test (GEFT). The GEFT was used to interpret learning style in terms of field dependence or field independence.

VIEW: An Assessment of Problem Solving Style ™. The participant's problem solving style preferences were found using the VIEW: An Assessment of Problem Solving Style ™ instrument. The VIEW: An Assessment of Problem Solving Style ™ instrument serves as an indicator for three independent dimensions of problem solving style. The explorer/developer continuum specifies a person's orientation to change. The second continuum, external/internal, estimates an individual's preferred means of processing information during problem solving processes. The ways of deciding, or otherwise known as the people/task continuum, assesses an individual's rationale and basis for decisions; towards emotional or logical outcomes.

As of 2007, 16,141 subjects had completed the VIEW: An Assessment of Problem Solving Style ™ assessment (Treffinger, 2008). Treffinger (2008) also reported that 45.1% of the VIEW: An Assessment of Problem Solving Style ™ users are male, 53.9% are female and 1.0% declined to indicate gender. The mean age for VIEW: An Assessment of Problem Solving Style ™ is 37.7 with a standard deviation of 12.9 and an age range from 11 to 90 years (Treffinger, 2008). Using Cronbach's coefficient alpha for the 2007 data, the current sample had coefficient results of .87 for orientation to change, .86 for manner of processing and .82 for ways of deciding (Treffinger, 2008). Table 2 describes summary statistic data for data through 2007.

Table 2

2007 VIEW: An Assessment of Problem Solving Style[TM] Descriptive Statistics (N=16,141)

Statistic	Orientation To Change	Manner of Processing	Ways of Deciding
M	73.9	29.6	35.0
SD	15.9	9.2	8.5
SE	5.7	3.4	3.6

Note: Orientation To Change has a minimum score of 16 a maximum score of 126. Manner of Processing and Ways of Deciding have a minimum score of 8 and a maximum score of 56. These statistics were taken from the *VIEW: An Assessment of Problem Solving Style[TM] Technical Update* by Treffinger (2008, p. 1).

The theoretical means for orientation to change, manner of processing, and ways of deciding are 72, 32, and 32, respectively. Some of the problem solving style constructs are slightly correlated with each other. Table 3 describes some of the intercorrelations among the constructs of VIEW: An Assessment of Problem Solving Style [TM], Age and Gender from the international database.

Table 3

Intercorrelations of VIEW Dimensions, Age and Gender (N=10,151)

Variable	Manner of Processing	Ways of Deciding	Age	Gender
Orientation To Change	.10**	.10**	-.11*	.14*
Manner of Processing	---	.08*	.03	.06
Ways of Deciding		---	-.04	.31*
Age			**---**	.06

Note: The source of these statistics was taken from the *VIEW: An Assessment of Problem Solving Style Technical Manual*, *2nd ed.* by Selby et al. (2007, p. 40).

* $p < .01$. **$p < .001$.

      Group Embedded Figures Test. Learning style was assessed using the Group Embedded Figures Test (GEFT). The GEFT is recognized as a standard instrument for identifying individual preferences for field dependence and field independence (Dyer & Osborne, 1996; Witkin et al., 1971). GEFT has a reliability of .82 for males and .79 for females (Witkin et al., 1971). Table 4 describes more reliability data about the GEFT instrument.

Table 4

Number Correct: GEFT

Quartiles	Men	Women
1	0-9	0-8
2	10-12	9-11
3	13-15	12-14
4	16-18	15-18
n	155	242
M	12.0	10.8
SD	4.1	4.2

Note: GEFT has a minimum score of 0 and a maximum score of 18. The source of these statistics was taken from the Group Embedded Figures Test Manual by Witkin et al. (1971, p. 26).

This instrument was timed. The GEFT has three individual sections. The first section has seven straightforward items and two minutes were allowed for completion. The participant had five minutes to complete the second and third sections that have nine items each and are more complex (Witkin et al., 1971). The number of correctly identified simple shapes in the second and third sections is the total GEFT score. Scores that were below the national mean are field dependent while scores above the national mean were field independent (Luk, 1998; Raven et al., 1993; Witkin et al., 1971).

Procedures

Students and teachers received written notification in advance four times prior to the study. The first contact was a letter was that was delivered during class time for the students and

delivered through campus mail to the faculty. A subsequent and similar electronic notice was delivered the next week. The third and fourth contacts were emails delivered the week of the study. After the data were collected, participants received a "Thank you" email. Additional oral announcements were made during the three weeks prior to the study. An alternative date was scheduled for students and instructors who were absent during the days when data were collected. One-hundred percent of the faculty (*n*=6) responded to the instruments and 96% (*n*=93) of the students responded to both instruments.

Data Analysis

Data from the VIEW: An Assessment of Problem Solving Style ^{TM} instrument were collected electronically and converted to an Excel file. It was then analyzed in the JMP 7.0 for Windows ^{TM} statistical package. GEFT and academic grade data were entered into JMP 7.0 by the researcher. A significance level of 5% was set for all research objectives *a priori*. A 5% level is considered to be an acceptable level for Type I error (Zar, 1999).

Objective one was accomplished by reporting the following for each dimension of VIEW: An Assessment of Problem Solving Style ^{TM}: mean and standard deviation for first year and second year students, student degree options, student grade point averages, as well as the descriptive statistics for the student sample age range, total cumulative student sample and the total cumulative instructor sample. An analysis of variance for all variables was conducted.

Objective two was accomplished by reporting the following in accordance to the total GEFT score: mean and standard deviation for first year and second year students, student grade point averages, student degree options, student sample age range, and descriptive statistics for

the total cumulative student sample and all teacher samples. An analysis of variance for all variables was conducted.

Objective three was met by using a bivariate correlation to compare each construct of VIEW: An Assessment of Problem Solving Style ^{TM} and GEFT for the following groups: first year and second year students, student degree options, student grade point averages, student ages, the total student sample, and the sample of instructors.

Objective four was assessed by conducting a multiple linear regression to produce a grade explaining equation. The factors included in the regression analysis were student orientation to change, manner of processing, ways of deciding, and learning style scores and the teachers' orientation to change, manner of processing, ways of deciding, and learning style scores. A backward stepwise regression with a 5% *a priori* alpha level was used to identify a statistically sound model.

Summary

This chapter highlighted the methods used by the researcher in this study of the cognitive style of students and teachers at the Virginia Polytechnic Institute and State University Agricultural Technology program in regards to academic performance. This study was descriptive, correlational, and explanatory. This chapter also described the study's variables and the context in which the study was conducted. Cognitive style was assessed within the context of the Virginia Polytechnic Institute and State University Agricultural Technology program faculty and students enrolled in the Personnel Management course. The VIEW: An Assessment of Problem Solving Style ^{TM} and GEFT instruments were used to assess learning and problem solving styles. Data were collected online and on paper, respectively. Data analysis procedures

and statistical analyses including means, standard deviations, bivariate correlational analyses, multiple sample analyses of variances, and a multiple linear regression were described in this chapter.

Chapter 4 will report the results of this study.

Chapter 4

Results

Chapter 4 highlights the results from this study. It is organized in terms of the four specific research objectives that were identified in Chapter 1. This chapter first reports differences in problem solving and learning styles for groups students and teachers, student degree options, academic years, ages, and grade point averages (GPA). Then the relationship between problem solving styles and learning style was identified. Lastly, Chapter 4 recognizes the explanatory nature of students' end of course grades as a result of student and teacher problem solving and learning styles.

Objective One: Determine if there is a difference in problem solving styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and grade point averages.

Descriptive statistics were first identified within the population. Table 5 describes the teacher sample problem solving style.

Table 5

Teacher Problem Solving Style Summary Statistics (n=6)

Statistic	Orientation To Change	Manner of Processing	Ways of Deciding
M	81.67	31.17	40.00
SD	14.47	12.58	10.22
SE	5.90	5.13	4.17

Note: Orientation To Change has a minimum score of 16 and a maximum score of 126. Manner of Processing and Ways of Deciding have a minimum score of 8 and a maximum score of 56.

The instructor manner of processing mean score is close to the national and theoretical mean of for this domain. Table 6 describes the student sample's problem solving style in greater detail.

Table 6

Student Problem Solving Style Summary Statistics (n=93)

Statistic	Orientation To Change	Manner of Processing	Ways of Deciding
M	77.35	32.03	33.72
SD	14.45	9.53	7.63
SE	1.50	0.99	0.79

Note: Orientation To Change has a minimum score of 16 and a maximum score of 126. Manner of Processing and Ways of Deciding have a minimum score of 8 and a maximum score of 56.

The student manner of processing and ways of deciding means were close to the national and theoretical mean for these domains. Table 7 outlines the orientation to change scores for specific groups of the study's student sample.

Table 7

Orientation to Change Summary Statistics (N=99)

Variable	*n*	*M*	*SD*	*Range*	*F*	*p*
Type					0.50	.48
Student	93	77.35	14.45	40-118		
Teacher	6	81.67	14.47	57-93		
Student Degree Option					6.07	.02*
Applied Agricultural Management	45	81.07	14.20	41-118		
Landscape and Turf Management	48	73.88	13.95	40-100		
Academic year					0.05	.82
First Year	50	77.86	13.79	41-118		
Second Year	43	76.98	15.35	40-103		
Age					0.57	.64
18	13	80.08	18.16	40-108		
19	39	79.13	12.44	54-118		
20	22	74.82	14.77	41-98		
21+	19	74.79	15.48	47-103		
GPA (Quartiles)					2.04	.11
0.00-2.26	24	75.46	15.60	40-118		
2.27-2.90	24	72.71	16.12	41-103		
2.91-3.45	23	79.52	11.81	59-108		
3.46-4.00	22	82.23	12.61	54-103		

Note: Orientation to Change has a minimum score of 16 and a maximum score of 126.

* $p < .05$.

A series of ANOVA tests were conducted between different groups of students and teachers. A 5% Type I error rate was set *a priori*. There was a statistically significant difference between orientation to change scores for students in different degree programs ($p = .02$). Landscape and Turf Management students were more likely to be more explorer oriented than the Applied Agricultural Management students.

Table 8 is outlines the manner of processing scores for different groups of the student sample.

Table 8

Manner of Processing Summary Statistics (N=99)

Group	n	M	SD	Range	F	p
Type					0.04	.83
Student	93	32.03	9.53	8-54		
Instructor	6	31.17	12.58	17-47		
Student Degree Option					0.02	.89
Applied Agricultural Management	45	31.89	8.51	13-54		
Landscape and Turf Management	48	32.17	10.48	8-51		
Academic year					4.32	.04*
First Year	50	30.16	10.11	8-54		
Second Year	43	34.86	8.40	13-51		
Age					1.02	.39
18	13	35.46	4.24	29-42		
19	39	30.13	9.18	12-49		
20	22	29.82	11.37	8-51		
21+	19	36.16	9.12	18-47		
GPA (Quartiles)					1.22	.31
0.00-2.26	24	30.5	9.66	8-51		
2.27-2.90	24	31.04	8.43	13-49		
2.91-3.45	23	31.48	8.13	16-49		
3.46-4.00	22	35.36	11.52	12-54		

Note: Manner of Processing has a minimum score of 8 and a maximum score of 56.

* $p < .05$.

Manner of Processing scores were reviewed to determine differences between students and teachers, degree programs, ages, and GPA ranges. The Landscape and Turf Management student sample did have more variability than the Applied Agricultural Management students in the manner of processing domain. There was a statistically significant difference between first and second year students' manner of processing scores ($p = .04$). Second year students were more likely to have internal methods of processing problems. In terms of variability, the 20 year old student's manner of processing scores varied the most with a standard deviation of 11.37, while 18 year old students were tightly arranged with a standard deviation of 4.24.

Table 9 breaks down different student group scores for the ways of deciding problem solving style continuum.

Table 9

Ways of Deciding Summary Statistics (N=99)

Variable	*n*	*M*	*SD*	*Range*	*F*	*p*
Type					3.67	.06
Student	93	33.72	7.63	15-49		
Instructor	6	40.00	10.22	28-53		
Student Degree Option					0.10	.75
Applied Agricultural Management	45	33.98	7.06	15-49		
Landscape and Turf Management	48	33.48	8.19	17-49		
Academic year					1.80	.18
First Year	50	32.74	8.08	15-48		
Second Year	43	34.86	6.98	21-49		
Age					2.03	.11
18	13	35.46	8.59	21-49		
19	39	32.87	8.26	15-49		
20	22	33.50	6.38	19-44		
21+	19	34.53	7.21	18-47		
GPA (Quartiles)					0.54	.66
0.00-2.26	24	35.40	7.33	18-46		
2.27-2.90	24	33.17	6.09	19-49		
2.91-3.45	23	32.87	7.77	19-48		
3.46-4.00	22	33.36	9.35	15-49		

Note: Ways of Deciding has a minimum score of 8 and a maximum score of 56.

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The last component of problem solving style, ways of deciding, was also compared among students and teachers, degree programs, ages, and GPA ranges. There were no significant differences between students and teachers, degree programs, ages, and GPA ranges for the ways of deciding domain of problem solving style. Although it was not a statistically significant relationship, teachers were more task oriented than the student sample.

Objective Two: Determine if there is a difference in learning styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and grade point averages.

Learning style was indicated using the Group Embedded Figures Test (GEFT) instrument. Scores could range from a minimum score of 0 to a maximum score of 18. Table 10 identifies learning style summary statistics for the study's population.

Table 10

Learning Style Summary Statistics (N=99)

Variable	*n*	*M*	*SD*	*Range*	*F*	*p*
Type					2.80	.10
Student	93	10.57	4.66	1-18		
Instructor	6	13.83	3.92	8-18		
Student Degree Option					3.89	.05
Applied Agricultural Management	45	9.60	4.57	1-18		
Landscape and Turf Management	48	11.48	4.61	2-18		
Academic year					0.92	.34
First Year	50	10.14	5.01	2-18		
Second Year	43	11.07	4.22	1-18		
Age					1.38	.25
18	13	9.31	4.52	3-17		
19	39	10.72	4.65	3-18		
20	22	10.64	4.77	1-18		
21+	19	11.05	4.89	2-17		
GPA (Quartiles)					0.95	.42
0.00-2.26	24	9.58	4.65	1-17		
2.27-2.90	24	10.29	4.80	3-17		
2.91-3.45	23	10.65	4.37	2-18		
3.46-4.00	22	11.86	4.83	3-18		

Note: The GEFT has a minimum score of 0 and a maximum score of 18.

An ANOVA test was conducted between the different groups. A 5% Type I error rate was predetermined for levels of statistical significance. There were no statistically significant differences between the learning styles of students and teachers, degree programs, ages, and GPA ranges.

Objective Three: Determine if there is a relationship between problem solving style and learning style.

The third objective was to determine if there was a relationship between problem solving styles and learning styles. The next table identifies correlations between each construct of problem solving and learning style. Pairwise comparisons were calculated to determine the level of statistical significance for each correlation. Table 11 outlines the correlations between problem solving and learning styles for students and teachers.

Table 11

Students and Teachers Problem Solving and Learning Styles Intercorrelations

Variable	Orientation to Change	Manner of Processing	Ways of Deciding	Learning Style
Students (*n* = 93)				
Orientation To Change	---	.17	.11	-.17
Manner of Processing		---	.36*	.08
Ways of Deciding			---	-.07
Learning Style				---
Teachers (*n* = 6)				
Orientation To Change	---	-.15	.15	-.48
Manner of Processing		---	.34	.56
Ways of Deciding			---	.48
Learning Style				---

* *p* < .05.

In the student sample, there was a statistically significant correlation between the manner of processing and ways of deciding continuums (*p* = <.01). Students who were task oriented decision makers were also likely to be internal processers of information. There were no other statistically significant correlations between students and teachers. Table 12 describes the problem solving style and learning style correlation matrix for Agricultural Technology degree programs.

Table 12

Degree Program Problem Solving and Learning Styles Intercorrelations

Variable	Orientation to Change	Manner of Processing	Ways of Deciding	Learning Style
Applied Agricultural Management (*n* = 45)				
Orientation To Change	---	.28	.29	-.17
Manner of Processing		---	.34*	-.18
Ways of Deciding			---	-.07
Learning Style				---
Landscape and Turf Management (*n* = 48)				
Orientation To Change	---	.10	-.05	-.09
Manner of Processing		---	.36*	.28
Ways of Deciding			---	-.05
Learning Style				---

* *p* < .05.

In the Applied Agricultural Management degree program, there was a statistically significant correlation between the manner of processing and ways of deciding continuums (*p* = .02). In the Landscape and Turf Management degree program, there was a statistically significant correlation between the manner of processing and ways of deciding continuums (*p* = .01). Students in both degree programs who were task oriented decision makers were also likely to be internal processers of information. There were no other statistically significant correlations

between students and teachers. Table 13 describes the problem solving style and learning style

correlation matrix for first and second year students.

Table 13

Academic Year Problem Solving and Learning Styles Intercorrelations

Variable	Orientation to Change	Manner of Processing	Ways of Deciding	Learning Style
First Year Students (*n* = 50)				
Orientation To Change	---	.24	.10	.02
Manner of Processing		---	.35*	.04
Ways of Deciding			---	-.18
Learning Style				---
Second Year Students (*n* = 43)				
Orientation To Change	---	.10	.14	-.41*
Manner of Processing		---	.32*	0.10
Ways of Deciding			---	.07
Learning Style				---

* *p* < .05.

Manner of processing and ways of deciding were significantly correlated for first year

students (*p* = .01). For second year students, there was a statistically significant correlation

between the manner of processing and ways of deciding continuums (*p* = .04). There was also a

statistically significant correlation between orientation to change and learning style (*p* = <.01).

Both first and second year students who were task oriented decision makers were likely to also

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be internal processers of information. There were no other statistically significant correlations between students and teachers. Table 14 describes the problem solving style and learning style correlation matrix for the different age groups in the study's sample.

Table 14

Problem Solving and Learning Styles Intercorrelations Between Age Groups

Variable	Orientation to Change	Manner of Processing	Ways of Deciding	Learning Style
	18 Years (*n* = 13)			
Orientation To Change	---	-.18	-.71*	-.28
Manner of Processing		---	.62*	.07
Ways of Deciding			---	.02
Learning Style				---
	19 Years (*n* = 39)			
Orientation To Change	---	.23	.38*	-.09
Manner of Processing		---	.31	-.01
Ways of Deciding			---	-.26
Learning Style				---
	20 Years (*n* = 22)			
Orientation To Change	---	-.01	.01	-.38
Manner of Processing		---	.39	.08
Ways of Deciding			---	.09
Learning Style				---
	21 Years and Older (*n* = 19)			
Orientation To Change	---	.62*	.29	-.06
Manner of Processing		---	.19	.23
Ways of Deciding			---	-.15
Learning Style				---

* *p* < .05.

In the 18 year old students, there was a statistically significant correlation between the manner of processing and ways of deciding continuums ($p = .02$). Eighteen year old students who were task oriented decision makers were also likely to be internal processers of information. There was also a statistically significant correlation between orientation to change and ways of deciding ($p = <.01$). Students who were 18 years old who are task oriented decision makers are also likely to be explorer oriented in their orientation to change. In the group of students who were 19 years old, there was a statistically significant correlation between orientation to change and ways of deciding ($p = .02$). Nineteen year old students who were task oriented decision makers were more likely to be developer oriented in their orientation to change. There was a statistically significant correlation between the manner of processing and orientation to change continuums for students that were at least 21 years of age ($p = <.01$). Students in this age range who were internal processers of information were likely to be developer oriented in their orientation to change. Table 15 describes the problem solving style and learning style correlation matrix for students with similar GPAs.

Table 15

Problem Solving and Learning Styles Intercorrelations Between GPA Groups

Variable	Orientation to Change	Manner of Processing	Ways of Deciding	Learning Style
GPA 0.00-2.26 (*n* = 24)				
Orientation To Change	---	.29	.26	-.27
Manner of Processing		---	.03	.33
Ways of Deciding			---	.16
Learning Style				---
GPA 2.27-2.90 (*n* = 24)				
Orientation To Change	---	.38	.36	-.10
Manner of Processing		---	.06	.12
Ways of Deciding			---	.05
Learning Style				---
GPA 2.91-3.45 (*n* = 23)				
Orientation To Change	---	-.03	.13	-.11
Manner of Processing		---	.47*	-.42
Ways of Deciding			---	-.37
Learning Style				---
GPA 3.46-4.00 (*n* = 22)				
Orientation To Change	---	-.18	-.23	-.42
Manner of Processing		---	.74*	.05
Ways of Deciding			---	-.06
Learning Style				---

* *p* < .05.

In the third quartile of GPAs, 2.91-3.45, there was a statistically significant correlation between the manner of processing and ways of deciding continuums ($p = .02$). There was also a statistically significant correlation between manner of processing and ways of deciding in the upper GPA quartile, 3.46-4.00 ($p = <.01$). Students in the upper half of the GPA range who were internal processers of information were also likely to be task oriented decision makers.

Objective Four: Explain students' end of course grades using problem solving and learning styles.

In order to determine if student and teacher problem solving and learning styles could explain end of course grades, a multiple linear regression was conducted on grade data from all Agricultural Technology fall courses from 2006 and 2007. Data from students that took both instruments were used in the regression. A backward stepwise regression with a 5% *a priori* alpha level was used to determine a model that explained grades based on student and teacher cognitive styles. Each domain in the VIEW: An Assessment of Problem Solving Style [TM] (orientation to change, manner of processing, and ways of deciding) and GEFT (field dependence/ independence) were used as preliminary variables in the model. Table 16 describes the regression analysis.

Table 16

Regression Analysis to Explain End of Course Grades (N = 440)

Variable	*β*	*SE*	*t*	*p*
Intercept	84.24	4.31	19.56	<.01*
Student Orientation to Change	0.12	0.04	3.02	<.01*
Student Manner of Processing	0.14	0.06	2.26	0.02
Teacher Manner of Processing	-0.19	0.05	-3.72	<.01*
Teacher Ways of Deciding	-0.30	0.06	-4.73	<.01*

* p <.05

A regression analysis showed that a combination of student orientation to change, student manner of processing, teacher manner of processing, and teacher ways of deciding scores significantly explained student's end of course grades, $F(14.54)$ and significance of $p = <.0001$. R^2 for this model was .12 and adjusted R^2 was .11. This model explained 11% of the variance (adjusted) in final course grades for all fall courses taught by the six faculty members in the Agricultural Technology program.

Summary

This chapter outlined the results according to each objective of the study. The results were organized by objective. The objectives of the study were:

1. Determine if there is a difference in problem solving styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades;

2. Determine if there is a difference in learning styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades;

3. Determine if there is a relationship between problem solving style and learning style; and,

4. Explain students' end of course grades using problem solving and learning styles.

Chapter 5 will provide conclusions and recommendations based on the findings.

Chapter 5

Discussion of Findings, Conclusions and Implications

This chapter contains a summary and discussion of the findings from this study. Study conclusions and recommendations for practice and further research were also included.

Human behavior is difficult to assess because it is largely a function of many distinctly different facets; including the environment, cognitive resource, cognitive affect, and cognitive effect (Kirton, 2003). The central focus of this study was to examine and identify student and teacher cognitive style and its relation to students' end of course grades in the Virginia Polytechnic Institute and State University Agricultural Technology program. It is important to remember that the results of this study cannot be generalized beyond the specific sample. The results and implications contained herein are framed within the context of the study's sample.

The specific research objectives of this study were:

1. Determine if there was a difference in problem solving styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades;

2. Determine if there was a difference in learning styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades;

3. Determine if there was a relationship between problem solving style and learning style; and,

4. Explain students' end of course grades using problem solving and learning styles.

Discussion of the Findings

   Objective One: Determine if there was a difference in problem solving styles between the

Virginia Polytechnic Institute and State University Agricultural Technology Program students

and teachers, student degree options, academic years, ages, and academic course grades.
Problem solving style is broken down into three domains: orientation to change, manner of processing, and ways of deciding. The discussion for this objective is organized by each domain of problem solving style. The landscape and turf management students were more explorer oriented in the orientation to change domain, as compared to the applied agricultural management students. Students in the two different degree programs will be entering into very distinct and different career fields. Selby et al. (2007) have found distinct differences between other broader occupational careers as well.

There were relatively few distinctions between group classifications among the manner of processing continuum. Second year students were more likely to have more internal methods of processing information as compared to their first year counterparts. It is important to acknowledge that problem solving style remains relatively steadfast and resistant to change (Treffinger, Isaksen, & Stead-Dorval, 2005). Therefore, the distinction between these groups of students is only a factor of the students who self selected into the specified entry year of the program. However, the distinction between first and second year students' manner of processing scores is important to notice for maintaining quality teaching practices. It serves as a quantitative reminder that each class may be different than the last. Practically speaking, younger individuals tended to have more external methods of processing information. Again, problem solving style does not typically change a great deal over time (Treffinger et al., 2005). This difference is likely a result of the students who happened to elect into the program at a younger age. In terms of practical significance, students with a GPA in the 3.46-4.00 range were different from students with a GPA between the ranges of 0.00-3.45. Students with a high GPA were more likely to be

classified as strong internal processors. All other groups of students and teachers were not statistically different.

There were a few important traits to bring attention to in the ways of deciding domain of problem solving style. Agricultural Technology program teachers were likely to be more task-oriented problem solvers than all students enrolled in the program. The student sample was largely more people oriented than the teacher sample. It should be noted that second year students tended to have slightly more task oriented outlooks. This is yet another distinction between different class types. Instructors must continue to acknowledge differences between their style preferences as well as differences within their students.

Objective Two: Determine if there is a difference in learning styles between the Virginia Polytechnic Institute and State University Agricultural Technology Program students and teachers, student degree options, academic years, ages, and academic course grades. The mean GEFT score for Agricultural Technology program students was 10.57, indicating field dependent students. However, in a study by Rudd, Baker and Hoover (2000) the mean GEFT score for students in a four year degree program was 12.88, indicating field independent students. This difference is another important distinction between the types of students that may be attracted to one type of program over another. There were two important learning style distinctions within the population. Agricultural Technology program teachers were more field independent than the student body. It was also apparent that there were slightly higher levels of field independence as students got older. These findings align with the findings from Witkin et al (1971), in that after 24 years of age, individuals will tend develop more field independent tendencies. Students enrolled in the landscape and turf management degree program were also more likely to be more field independent than students in the applied agricultural management degree option. Cano

(1999) suggested that freshmen entering into horticulture, agronomy, animal sciences and management degree programs were field independent. Students in the upper quartile of the GPA distribution also had the highest levels of field independence. This finding concurs with a study by Luk (1998) in that field independence was associated with higher levels of academic achievement.

Objective Three: Determine if there is a relationship between problem solving style and learning style. Agricultural Technology students' ways of deciding scores were significantly correlated with their manner of processing scores. Task oriented problem solvers were very likely to also be internal processors. In comparison to the VIEW: An Assessment of Problem Solving Style [TM] database, this correlation is much higher than the .08 correlation cited by Selby et al. (2007). Other problem solving style intercorrelations did not differ largely from the VIEW: An Assessment of Problem Solving Style [TM] database.

There were small correlations between learning style and problem solving style. However there was only one correlation that was statistically different from zero. Therefore, it is reasonable to conclude that there is only a weak correlation between GEFT and VIEW: An Assessment of Problem Solving Style [TM]. In other words, field dependence and field independence are not directly tied to the problem solving style constructs orientation to change, manner of processing and ways of deciding in this specific population.

Early work in the three problem solving style constructs was based in research by learning style theorists such as Dunn and Dunn. The researcher found no literature supporting a link between work by Dunn and Dunn and Witkin. The GEFT learning style instrument has traditionally been regarded as an analytical and perceptual instrument, whereas Dunn and Dunn's work encompasses broader spectrums of learning style. A review of the literature pertaining to

problem solving style describes learning style as a component of nearly all three dimensions of problem solving style. This may make it difficult for any one problem solving style domain to have a significant correlation with the GEFT's version of learning style.

Objective Four: Explain students' end of course grades using differences in student and teacher problem solving and learning styles. An equation was developed that explained 11% of the variance in students' end of course grades. There were four important factors in the equation; student orientation to change, student manner of processing, teacher manner of processing, and teacher ways of deciding. Style is only one component of cognitive effect, which in turn is only a one factor of an individual's cognitive function. Identifying components that explain behavioral outcomes is essential in explaining, evaluating, and studying human behaviors.

Conclusions

After an analysis of the results and findings from this study, there are several central themes that have emerged. These conclusions are:

- Some individuals may be more likely to have certain cognitive effect style dispositions relative to their degree program and year in school;

- The VIEW: An Assessment of Problem Solving Style [TM] and Group Embedded Figures Test are not highly related in this population.

- Both student and teacher problem solving style contribute to explaining students' end of course grades.

Recommendations

As a result of this study, several recommendations have been developed that will impact educational institutions, teaching practices and shape further research in this area. These recommendations are organized by recommendations for practice and for further research.

Recommendations for practice. One recommendation of this study is that educators be made aware of the stylistic differences in their classroom and the impact it may have on their students' academic success. Effective teachers need to differentiate their instruction techniques in order to best accommodate the variety of learners in their classroom. As evidenced in this study, class style composition may be extremely diverse. A well versed educator will anticipate these differences in their classroom and design instruction that strengthens style awareness and prompts all learners to interpret and evaluate the implications of their own preferences as well as those of others. There are definite relationships between students' end of course grades and the style preferences of students and teachers. It must be recognized that cognitive styles do contribute to how individuals and groups approach novel situations and how we think creatively, but they do not completely control human behavior. This reiterates work by Selby *et al.* (2007), in that problem solving styles are not fixed, expectations for behavior, or excuses for exceptional performance.

Recommendations for research. Longitudinal research tracking student academic performance and style scores would enhance the knowledge in this field. The sample of students enrolled in the spring 2008 semester are not representative of all agricultural students or students enrolled in agricultural associate's degree programs. A study that examines the style preferences of other agricultural associate's degree program students and teachers would be beneficial. In this study, the class enrollments were random. More research should be done that tracks student performance in different courses in order to fully identify the effect of cognitive style on individual academic performance. Research that takes years of teaching experience into account in combination with styles to explain grades may find interesting results. This study could easily

be expanded to determine the effects and interactions between student and teacher style and course content areas.

The VIEW: An Assessment of Problem Solving Style [TM] instrument is grounded in Dunn and Dunn's learning style work. More research is necessary that examines and explains VIEW: An Assessment of Problem Solving Style [TM] using the Group Embedded Figures Test (GEFT) as well as other learning style instruments. This experimental design could be easily expanded to include critical thinking, decision making, personality, and affective measures of human function.

End of course grades are only one measure of a student's success. Qualitative research that assesses an individual's perceptions of courses, program administration, and teachers would be beneficial in explaining both problem solving style and end of course grades. This may lead to further work examining and identifying coping behaviors and their relationship with cognitive function, perception, and performance.

As a result of this study, stylistic differences were identified in college degree fields. It would be both pedagogically important as well as valuable to identify other degree programs in agriculture that may attract individuals with specific style preferences. Further research should be done to explain why and how individuals with specific style preferences are successful in specific career fields.

For the most part, the population in this study was not different from the national population's problem solving or learning styles. More research should be done to investigate the role that parents have on their children's stylistic preferences. Understanding the role that peers, authority figures, role models, caregivers and teachers have on the style preference development of youth will have a significant impact on educational trends, career placement and workforce

development in the future. Individuals should be closely monitored during adolescent, early adult, and adult time periods to determine if, why, and how key events, individuals or experiences shift style preferences.

Group dynamics play a key role in workplace, career and community success. Problem solving and learning style awareness and appreciation activities may be incorporated into youth leadership organizations for agriculture, such as the FFA or 4-H. The role individuals have in groups, in comparison to their style preferences, should be researched further. It would also be interesting to determine how, when, and why students move into coping behaviors due to stylistic differences and the impact it has on their academic achievement.

Summary

An individual's preferences for solving problems and learning are evidenced in routine mannerisms and unique personal behavior identifiers. Acknowledging an individual's different stylistic outlooks is a primary step for educators in ensuring all students an equal chance to quality education. There are and will be distinct differences in problem solving and learning styles that impact our daily lives. Cognitive preferences have profound implications on behavior. In order to best meet individual needs, these personal style traits must be acknowledged, addressed, and accepted by our peers, teachers, and the world.

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Appendix A

From: Sanders, Helen (CLPubSrvUK)
Sent: 11 March 2008 16:17
To: 'Permissions Mailbox'
Subject: RE: Reprint Figure from Kirton 2003

Dear Ed McCann,

Re: Adaption-Innovation, In The Context of Diversity and Change" by Michael Kirton'

Further to your recent emails permission is granted for use of the above material in your forthcoming Thesis, subject to the following conditions:

1. The material to be quoted/produced was published without credit to another source. If another source is acknowledged, please apply directly to that source for permission clearance.

2. Permission is for non-exclusive, English language rights, and covers use in your Thesis only. Any further use (including storage, transmission or reproduction by electronic means) shall be the subject of a separate application for permission.

3. Full acknowledgement must be given to the original source, with full details of figure/page numbers, title, author(s), publisher and year of publication.

Yours sincerely,

Helen Sanders
Taylor and Francis Books UK
Please Note: My email address has changed to helen.sanders@contractor.cengage.com
Helen Sanders
Permissions & Subsidiary Rights Administrator
Taylor and Francis Books UK
Tel: + 44 (0) 1264 343090
Fax + 44 (0) 1264 342792

Appendix B

March 31, 2008

Dr. Don Treffinger
Center for Creative Learning, Inc.
4921 Ringwood Meadow
Sarasota, FL 34235

Dear Don:

I am now drawing near to the completion of my master's research work. As you may already be aware, I am using VIEW and the Group Embedded Figures Test (GEFT) to predict student's grades. As I approach my final preparation phases, I would like your permission to reprint in my thesis excerpts from the following:

Treffinger, Selby, E. C., Isaksen, S. G., & Crumel, J. H. (2007). *An Introduction to Problem-Solving Style*. Sarasota, FL: Center for Creative Learning.

The excerpts to be reproduced are:

- The VIEW theoretical framework that was published on page 3; and
- The table that is also on page 3 of *An Introduction to Problem Solving Style* (2007). The table describes what problem solving is and is not in clear detail.

The requested permission extends to any future revisions and editions of my dissertation, including non-exclusive world rights in all languages, and to the prospective publication of my dissertation by UMI Company. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that you own [or your company owns] the copyright to the above-described material.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me in the enclosed return envelope. Thank you very much.

If you have any questions, please feel free to call or email me.

Sincerely,

Ed McCann
Virginia Tech AEE

PERMISSION GRANTED FOR THE
USE REQUESTED ABOVE:

_____   Date: _____
Dr. Donald J. Treffinger

Appendix C

VIEW

An Assessment of Problem Solving Style

Please read these directions before you answer the questions on the other side of the page.

There are 34 sets of statements that ask you about your preferences when you are solving problems. Read both sides of each line. Then, blacken one of the circles between the pair of statements. Blacken the circle closer to the left or right, so it will be nearer to the statement that best describes your personal preference. Your preference is the way you usually do things when you're solving problems. It is the way of working that is most comfortable and natural for you. Your preference or style is the way you are, *not* the way you might wish you could be, or the way others want you to be!

If *both* statements seem accurate to you, but at different times and to different degrees, blacken a circle on or near the center of the row that best describes how you prefer to balance the two. For each item, think about both phrases, at the left and right, before blackening the circle that describes you best; think carefully about the full range of circles when you are deciding where to mark your response.

Example: When I am solving problems, I am a person who prefers…

1. Working in the early morning	○ ○ ◉ ○ ○ ○	1. Working late at night
2. Working at the last minute	○ ○ ○ ○ ○ ○ ●	2. Working well in advance of deadlines
3. Working on a computer	○ ● ○ ○ ○ ○	3. Working with pencil and paper
4. Working in bright light	○ ○ ○ ● ○ ○	4. Working in soft or low light

Item #1 The person prefers balance between working in the morning and working late at night.
Item #2 The person *strongly* prefers to work with plenty of time, not waiting until the last minute.
Item #3 The person *usually* prefers working on a computer, rather than working with pencil and paper.
Item #4 The person *slightly* prefers to work in soft or low light rather than in bright light.

When you make your choice, blacken the circle completely. Please be sure to mark all 34 items. The statements on one side are not "better" than the statements on the other side, but one might be more accurate in describing your own style.

Be sure to enter your name and complete the other information at the bottom of the page. Once you are finished please turn in the completed form. Please do not open the booklet. Thank you!

Please read the directions on the other side of the page before making your choices.

When responding to these questions, please keep in mind the following:

"When I am solving problems, I am a person who prefers…"

Left		Right
1. To work with the guidance of a clear structure	○○○○○○	1. To work without boundaries
2. To follow ideas wherever they lead	○○○○○○	2. To direct ideas toward the task at hand
3. To let my ideas flow freely	○○○○○○	3. To search for practical ideas
4. Quiet concentration	○○○○○○	4. Involvement with others
5. Drawing energy from within	○○○○○○	5. Drawing energy from talking with others
6. Looking first at feelings	○○○○○○	6. Looking first at evidence
7. Outcomes that are well-reasoned	○○○○○○	7. Outcomes that maintain harmony
8. To develop and improve what exists	○○○○○○	8. To explore new directions
9. To assume approval and go ahead	○○○○○○	9. To seek approval before going ahead
10. To change gradually and carefully	○○○○○○	10. To go in fresh new directions
11. Taking time alone for reflection	○○○○○○	11. Forming ideas through discussion with others
12. Talking through my ideas with a group	○○○○○○	12. Writing down my ideas in a quiet place
13. To recognize people's needs first	○○○○○○	13. To recognize logical flaws first
14. To put step-by-step directions aside	○○○○○○	14. To look for and use step-by-step directions
15. To define the problem my own way	○○○○○○	15. To work on the problem as given
16. Thinking aloud about ideas	○○○○○○	16. Thinking quietly about ideas
17. Making decisions in a caring, personal way	○○○○○○	17. Making decisions in a cool, analytic way
18. Weighing the evidence	○○○○○○	18. Weighing the impact on people
19. To improve on the familiar	○○○○○○	19. To seek change that leaves the familiar behind
20. To know and follow the rules	○○○○○○	20. To modify or change the rules
21. To be seen as cautious	○○○○○○	21. To be seen as spontaneous
22. Following a familiar routine	○○○○○○	22. Making my own path
23. Finding solutions to work on with others	○○○○○○	23. Finding solutions to work on by myself
24. To be persuaded more by emotions	○○○○○○	24. To be persuaded more by logic
25. Ideas that are original	○○○○○○	25. Ideas that are workable
26. To explore without limits	○○○○○○	26. To work creatively within limits
27. To search widely, following my hunches	○○○○○○	27. To search efficiently for realistic possibilities
28. To do the job as directed	○○○○○○	28. To do the job my own way
29. Generating options with a group	○○○○○○	29. Generating options on my own
30. Fair and just decisions	○○○○○○	30. Sympathetic and caring decisions
31. Finding better ways to do the job	○○○○○○	31. Finding different ways to do the job
32. To develop my plan as I go	○○○○○○	32. To develop my plan before I begin
33. To clarify my thinking by myself	○○○○○○	33. To clarify my thinking by talking with others
34. Appreciating careful analysis	○○○○○○	34. Appreciating people's feelings

Please press firmly and fill the circle completely. Please do not open the booklet.

Name: _____ Date: _____

Appendix D

GROUP EMBEDDED FIGURES TEST
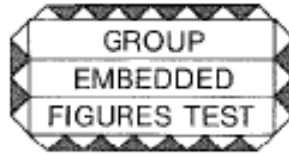
By Philip K. Oltman, Evelyn Raskin, & Herman A. Witkin

Name _____ Sex _____

Today's date _____ Birth date _____

INSTRUCTIONS: This is a test of your ability to find a simple form when it is hidden within a complex pattern.

Here is a simple form which we have labeled "X":

X

This simple form, named "X", is hidden within the more complex figure below:
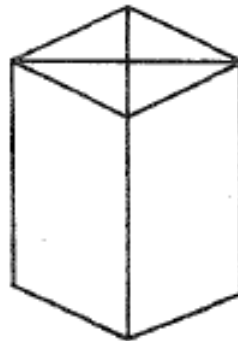
Try to find the simple form in the complex figure and trace it *in pencil* directly over the lines of the complex figure. It is the SAME SIZE, in the SAME PROPORTIONS, and FACES IN THE SAME DIRECTION within the complex figure as when it appeared alone.

When you finish, turn the page to check your solution.

83

This is the correct solution, with the simple form traced over the lines of the complex figure:
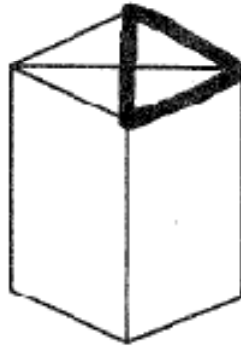
Note that the top right-hand triangle is the correct one; the top left-hand triangle is similar, but faces in the opposite direction and is therefore *not* correct.

Now try another practice problem. Find and trace the simple form named "Y" in the complex figure below it:
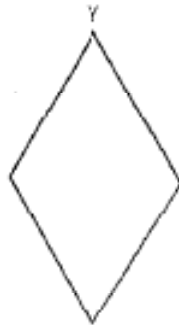
Look at the next page to check your solution.

2

Solution:

In the following pages, problems like the ones above will appear. On each page you will see a complex figure, and under it will be a letter corresponding to the simple form which is hidden in it. For each problem, look at the BACK COVER of this booklet to see which simple form to find. Then try to trace it in pencil over the lines of the complex figure. Note these points:

1. Look back at the simple forms as often as necessary.

2. ERASE ALL MISTAKES.

3. Do the problems in order. Don't skip a problem unless you are absolutely "stuck" on it.

4. Trace ONLY ONE SIMPLE FORM IN EACH PROBLEM. You may see more than one, but just trace one of them.

5. The simple form is always present in the complex figure in the SAME SIZE, the SAME PROPORTIONS, and FACING IN THE SAME DIRECTION as it appears on the back cover of this booklet.

Do not turn the page until the signal is given

Appendix E

Virginia Polytechnic Institute and State University

**Informed Consent for Participants
in Research Projects Involving Human Subjects**

Title of Project: Cognitive Effect Indicators: The Impact of Student and Teacher Styles On Course Grades

Investigators: Mr. Edward W. McCann, Jr., Master's Degree Student, Virginia Tech
Dr. Thomas W. Broyles, Assistant Professor, Virginia Tech

I.   Purpose of this research

This research will help explain the many different personality preferences and traits that contribute to course grades. Specifically, the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. This new knowledge will help to promote better teaching practices in the greater educational community. Participants will be the 94 students and 6 teachers in the Virginia Polytechnic Institute and State University Agricultural Technology Program.

II.   Procedures

You will be invited to complete an online survey and a paper based exercise using VIEW: An Assessment of Problem Solving Style ™ and the Group Embedded Figures Test (GEFT). Each of these instruments only requires 5-10 minutes to complete. Students will participate during the Personnel Management Course (AT 0224) and the instructors will participate during a bi-weekly faculty meeting. The students' grade data will be secured via an online database that the Agricultural Technology program uses. At no time will your individual information or scores be released to anyone other than the researchers involved in the project without your written consent.

III.   Risks

This study has been reviewed and approved by the Virginia Tech Institutional Review Board. It received the "Exempt" status which means that it is seen as the safest of all possible research. Individual answers and identities of the participants will be protected at all times.

(Continued)

IV. Benefits

This research will help uncover how problem solving style and learning style may impact students' academic end of course grades. It will also help to promote better teaching practices in the educational community. By participating in this study you will receive feedback from both the VIEW: An Assessment of Problem Solving Style [TM] and the Group Embedded Figures Test (GEFT). These instruments are indicators of your preferences for problem solving style and learning style. They are NOT indicative of your abilities. They help to depict your preferences for learning and interacting with others. No promise or guarantee of benefits have been made to encourage your participation.

V. Extent of Anonymity and Confidentiality

Protecting your identity is a top priority of this study. By participating in this research project, your information will be kept strictly confidential. At no time will information be released that allows an individual to be identified. At no time will the researchers release the results of the study to anyone other than individuals working on the project, without your written consent. Only the research team, Mr. Ed McCann, Jr. and Dr. Tom Broyles will have access to your data.

It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

There is no compensation for participating in this study.

VII. Freedom to withdraw

Participants are free to withdraw from the study at any time without penalty. Subjects are free to not answer any questions without penalty.

VIII. Subject's responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:

- Answer each question on the VIEW: An Assessment of Problem Solving Style [TM] and the Group Embedded Figures Test (GEFT) instruments as honestly as possible per the researcher's instructions.

(Continued)

IX.   Subject's permission

I have read and understand the Informed Consent and conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent:_____ Yes   _____No.

_____ Date_____
Signature

Should I have pertinent questions about this research, I may contact:

Dr. Thomas Broyles   Mr. Edward McCann
Assistant Professor   Master's Degree Student
tbroyles@vt.edu   emccann1@vt.edu
(540) 231-8188   (540) 231-0994

Mr. David M. Moore
IRB Chairperson
moored@vt.edu
(540) 231-4991

Appendix F

Virginia Polytechnic Institute and State University

**Release of Information for Participants
in Research Projects Involving Human Subjects**

Title of Project: Cognitive Effect Indicators: The Impact of Student and Teacher Styles On Course Grades

Investigators: Mr. Ed W. McCann, Jr., Master's Degree Student, Virginia Tech
                        Dr. Thomas W. Broyles, Assistant Professor, Virginia Tech

I _____ do hereby give permission to Mr. Ed McCann,
                    Print name
Jr. and Dr. Thomas W. Broyles to review my educational records and use them for this research project. I acknowledge that my records are completely confidential and will not be shared with anyone other than the research team without my written consent.

        I realize that the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. It will help will help explain the many different personality preferences and traits that contribute to course grades. The knowledge gained will help:

- Understand student and teacher relationships,
- Develop better teaching methods, and
- Improve teaching strategies in the Agricultural Technology program.

        The participants will be the 94 students and 6 teachers in the Virginia Tech Agricultural Technology Program.

_____

Signed   Date

        Should I have pertinent questions about this research, I may contact:

Dr. Thomas Broyles   Mr. Ed McCann
Assistant Professor   Master's Degree Student
tbroyles@vt.edu   emccann1@vt.edu
(540) 231-8188   (540) 231-0994

Mr. David M. Moore
IRB Chairperson
moored@vt.edu
(540) 231-4991

Appendix G

LETTER 1 – HANDED OUT DURING CLASS (STUDENTS)/CAMPUS MAIL (FACULTY)

Mr. Ed McCann, Jr.   Dr. Tom Broyles
Master's Degree Candidate   Assistant Professor, Virginia Tech
1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Dear Participant:

We are a research team in the Agricultural and Extension Education Department here at Virginia Tech. Mr. Ed McCann is currently working to fulfill his research requirement for his master's degree programs. This research will help explain the many different personality preferences and traits that contribute to course grades. Specifically, the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. This new knowledge will help to promote better teaching practices in the greater educational community.

This research will help uncover how problem solving style and learning style may impact students' academic end of course grades. The knowledge gained will help:
- Understand student and teacher interactions,
- Develop better teaching methods, and
- Improve teaching strategies in the Agricultural Technology program.

Faculty and students in the Virginia Tech Agricultural Technology program are eligible to participate. Your participation in this study is voluntary. This study will take place in late February.

There are several benefits that you will receive by participating in this study. By participating in this study you will receive free feedback from both the VIEW: An Assessment of Problem Solving Style ™ and the Group Embedded Figures Test (GEFT). These instruments are indicators of your problem solving style and learning style. They are **NOT** indicative of your abilities but help to depict your preferences for learning and interacting with others.

Should you have any questions about this study, please feel free to contact us. Our contact information is:

1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Sincerely,

Ed McCann, Jr.   Tom Broyles

EMAIL 2

From: Mr. Ed McCann, Dr. Tom Broyles
Subject: Research Participants Needed

Mr. Ed McCann   Dr. Tom Broyles
Master's Degree Candidate   Assistant Professor
1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Dear Participant:

We are a research team in the Agricultural and Extension Education Department here at Virginia Tech. Mr. Ed McCann is currently working to fulfill his research requirement for his master's degree programs. This research will help explain the many different personality preferences and traits that contribute to course grades. Specifically, the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. This new knowledge will help to promote better teaching practices in the greater educational community.

This research will help uncover how problem solving style and learning style may impact students' academic end of course grades. The knowledge gained will help:
- Understand student and teacher interactions,
- Develop better teaching methods, and
- Improve teaching strategies in the Agricultural Technology program.

Faculty and students in the Virginia Tech Agricultural Technology program are eligible to participate. Your participation in this study is voluntary. This study will take place in late February.

There are several benefits that you will receive by participating in this study. By participating in this study you will receive free feedback from both the VIEW: An Assessment of Problem Solving Style ™ and the Group Embedded Figures Test (GEFT). These instruments are indicators of your problem solving style and learning style. They are **NOT** indicative of your abilities but help to depict your preferences for learning and interacting with others.

Should you have any questions about this study, please feel free to contact us. Our contact information is:

Ed McCann   Tom Broyles
1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Sincerely,

Ed McCann, Jr.   Tom Broyles
Virginia Tech AEE   Virginia Tech AEE

EMAIL 3 AND 4: WEEK OF STUDY - STUDENTS

From: Mr. Ed McCann, Jr., Dr. Tom Broyles
Subject: Research Reminder!

Mr. Ed McCann, Jr.   Dr. Tom Broyles
Master's Degree Candidate   Assistant Professor, Virginia Tech
1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Dear Participant:

     During this week, a research project will be carried out in AT 0224: Personnel Management. This research will help explain the many different personality preferences and traits that contribute to course grades. Specifically, the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. This new knowledge will help to promote better teaching practices in the greater educational community.

     This research will help uncover how problem solving style and learning style may impact students' academic end of course grades. The knowledge gained will help:

- Understand student and teacher interactions,
- Develop better teaching methods, and
- Improve teaching strategies in the Agricultural Technology program.

     Faculty and students in the Virginia Tech Agricultural Technology program are eligible to participate. Your participation in this study is voluntary. This study will take place this week in Personnel Management Class! Please be sure to bring your computer.

     Faculty and students in the Virginia Tech Agricultural Technology program are eligible to participate. Your participation in this study is voluntary. This study will take place this week! If you would like to participate, please attend your regularly scheduled class meeting for more information.

     There are several benefits that you will receive by participating in this study. By participating in this study you will receive free feedback from both the VIEW: An Assessment of Problem Solving Style ™ and the Group Embedded Figures Test (GEFT). These instruments are indicators of your problem solving style and learning style. They are **NOT** indicative of your abilities but help to depict your preferences for learning and interacting with others.

     1320 Litton Reaves Hall   268 Litton Reaves Hall
     Blacksburg, VA 24060   Blacksburg, VA 24060
     ed.mccann@vt.edu   **tbroyles@vt.edu**
     (540) 231-0994   (540) 231-8188

     I look forward to meeting you during the Personnel Management course this week.

Sincerely,

Ed McCann, Jr.   Tom Broyles
Virginia Tech AEE   Virginia Tech AEE

From: Mr. Ed McCann, Jr., Dr. Tom Broyles
Subject: Research Reminder!

Mr. Ed McCann, Jr.   Dr. Tom Broyles
Master's Degree Candidate   Assistant Professor, Virginia Tech
1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Dear Participant:

  During this week, a research project will be carried out in the faculty meeting. This research will help explain the many different personality preferences and traits that contribute to students' course grades. Specifically, the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. This new knowledge will help to promote better teaching practices in the greater educational community.

  This research will help uncover how problem solving style and learning style may impact students' academic end of course grades. The knowledge gained will help:

- Understand student and teacher interactions,
- Develop better teaching methods, and
- Improve teaching strategies in the Agricultural Technology program.

  Faculty and students in the Virginia Tech Agricultural Technology program are eligible to participate. Your participation in this study is voluntary. This study will take place this week in the faculty meeting! Please be sure to bring your computer.

  Faculty and students in the Virginia Tech Agricultural Technology program are eligible to participate. Your participation in this study is voluntary. This study will take place this week! If you would like to participate, please attend your regularly scheduled class meeting for more information.

  There are several benefits that you will receive by participating in this study. By participating in this study you will receive free feedback from both the VIEW: An Assessment of Problem Solving Style ™ and the Group Embedded Figures Test (GEFT). These instruments are indicators of your problem solving style and learning style. They are **NOT** indicative of your abilities but help to depict your preferences for learning and interacting with others.

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  Blacksburg, VA 24060   Blacksburg, VA 24060
  ed.mccann@vt.edu   tbroyles@vt.edu
  (540) 231-0994   (540) 231-8188

  I look forward to seeing you at the faculty meeting this week.

Sincerely,

Ed McCann, Jr.   Tom Broyles
Virginia Tech AEE   Virginia Tech AEE

EMAIL THANK YOU FOLLOW UP

From: Mr. Ed McCann, Dr. Tom Broyles
Subject: Thank You!

Mr. Ed McCann   Dr. Tom Broyles
Master's Degree Candidate   Assistant Professor
1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   tbroyles@vt.edu
(540) 231-0994   (540) 231-8188

Dear Participant:

I want to thank you for participating in the recent research project regarding problem solving and learning style. This research will help explain the many different personality preferences and traits that contribute to course grades. Specifically, the purpose of this study is to closely examine student and instructor personal problem solving and learning style preferences. This new knowledge will help to promote better teaching practices in the greater educational community.

This research will help uncover how problem solving style and learning style may impact students' academic end of course grades. The knowledge gained will help:
- Understand student and teacher interactions,
- Develop better teaching methods, and
- Improve teaching strategies in the Agricultural Technology program.

Faculty and students in the Virginia Tech Agricultural Technology program were eligible to participate. Your participation in this study was voluntary. You participated in this study in late February. If you would like to discuss the results from the two assessments, please contact us.

I hope that you found the free feedback from both the VIEW: An Assessment of Problem Solving Style[TM] and the Group Embedded Figures Test (GEFT) beneficial. These instruments are indicators of your problem solving style and learning style. They are **NOT** indicative of your abilities but help to depict your preferences for learning and interacting with others.

Should you have any questions about this study, please feel free to contact us. Our contact information is:

1320 Litton Reaves Hall   268 Litton Reaves Hall
Blacksburg, VA 24060   Blacksburg, VA 24060
ed.mccann@vt.edu   **tbroyles@vt.edu**
(540) 231-0994   (540) 231-8188

Sincerely,

Ed McCann, Jr.   Tom Broyles
Virginia Tech AEE   Virginia Tech AEE

Appendix H

VirginiaTech

Office of Research Compliance
Carmen T. Green, IRB Administrator
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24061
540/231-4358 Fax 540/231-0959
e-mail ctgreen@vt.edu
www.irb.vt.edu
FWA00000572(expires 1/20/2010)
IRB # is IRB00000667

DATE: February 5, 2008

MEMORANDUM

TO: Thomas W. Broyles
             Edward McCann

FROM: Carmen Green

SUBJECT: **IRB Exempt Approval:** "Cognitive Effect Indicators: The Impact of Student and Teacher Styles on Course Grades" , IRB # 08-050

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status.   Approval is granted effective as of February 5, 2008.

As an investigator of human subjects, your responsibilities include the following:

1.   Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2.   Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE UNIVERSITY AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

Appendix I

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

Agricultural Technology

College of Agriculture and Life Sciences
1060 Litton Reaves Hall
Blacksburg, Virginia 24061-0334 USA
(540) 231-7649 Fax: (540) 231-6741

January 31, 2008

Mr. Joe Guthrie
Instructor, Agricultural Technology Program
1310 Litton Reaves Hall
Blacksburg, VA 24060

Mr. Ed McCann
1320 Litton Reaves Hall
Blacksburg, VA 24060

Dear Mr. McCann:

I am the instructor for ATO224, Personnel Management. I agree to let you collect data for your research study in my class. I acknowledge that it will take approximately 20 minutes to complete. I look forward to working with you as you progress towards completing your study.

Sincerely,

Joe Guthrie