

AN EXPLORATORY STUDY OF UNDERGRADUATE
STUDENTS' LEARNING STYLES

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AN EXPLORATORY STUDY OF UNDERGRADUATE
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VITA

The daughter of Mr. Sanjeeva Rao, a retired Bank Manager and Mrs. Lalitha, a retired high school principal, Prasanthi Pallapu was born on 7th November in Eluru, Andhra Pradesh, India. She earned a national academic scholarship upon graduating from highschool. She studied English Literature and earned Bachelor of Arts in 1987 and Master of Arts in 1990 from Andhra University, India. She ranked 6th out of 1000 students for English Literature at the University that year and won a cash award. She served for the Government of India, in the Ministry of Law & Justice for eight months and Ministry of Information & Broadcasting for ten years from May 1989 – July 1999. She moved to Arizona in August 1999 and earned a Master's in Educational Technology from Arizona State University, Tempe, Arizona in December 2001. She moved to Auburn, Alabama in January 2002 as a Distance Learning Specialist in the Auburn University Outreach office to consult with faculty in designing distance education courses and worked with several faculty from various departments and colleges at the University. She became a part-time student in the Adult Education doctoral program and taught an undergraduate Educational Media course as an adjunct faculty. During her time at Auburn she presented at several conferences. She was recognized and awarded the Outstanding Graduate Student Award for the year 2007. She has a younger sister Sheela, brother-in-law John, a niece Deepika, 9 years and nephew Kevin, 7 years. Her younger brother is Pradeep and sister-in-law is Sharmila.

DISSERTATION ABSTRACT
AN EXPLORATORY STUDY OF UNDERGRADUATE
STUDENTS' LEARNING STYLES

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Learning and learning styles have become two major fields that draw the attention of several researchers (Dunn & Dunn, 1986; Keefe, 1987; Kolb & Kolb, 2003; Koch, 1998; Lemire, 2000; Riding & Cheema, 1991). Learning is an ongoing process and occurs in different ways for different people. Some individuals learn by seeing and hearing, for some learning occurs by watching and doing, some learn by visualizing and putting it into action. The different styles that people use to learn are termed as learning styles. James and Blank (1993) defined learning style as “the complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn” (p. 47).

This study examined and explored the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The examination also included gender, ethnicity, age, grade point average (GPA) and grade level. Two research questions were addressed in the study –

1. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles?
2. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level?

The data were analyzed using descriptive statistics, chi-square and ANOVA. The participants were 346 undergraduate students from three different colleges at a large four-year public southeastern university over a period of one semester – Spring 2008. Results from the chi-square analysis indicated that there was a significant difference between sensing and intuitive learners in the College of Education.

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CHAPTER I

INTRODUCTION

“For the things we have to learn before we can do them, we learn by doing them, e.g., men become builders by building and lyreplayers by playing the lyre; so too we become just by doing just acts, temperate by doing temperate acts, brave by doing brave acts” (Ross, 1999, p. 21). Some individuals learn by seeing and hearing. Some individuals learning occur by watching and doing. Some individuals learn by visualizing and some by implementing. Felder and Silverman (1988) indicated that students employ several ways to learn – “by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing and drawing analogies” (p. 674). Kennedy (2002) summarized Confucius’ idea of learning as a purpose “to cultivate oneself as an intelligent, creative, independent, autonomous being” (p. 433). Curry (1983) referred to learning as learning that was intentional as against unintentional learning, where intended learning is considered as a process and also as a product. It is a process because intended learning is adaptive, focuses on future, and affects “an individual’s cognitive, affective, social and moral volitional skills” (p. 2). According to Curry (1983), intended learning is a product in which “a relatively permanent change in behavior, or potential behavior” (p. 2) is observed. Heffler (2001) expressed that Kolb’s experience learning theory considers learning as a process. Cano-Garcia and Hughes (2000) believed that “Learning is related to thinking, and as individual differences intervene we use specific styles when we think

as well as when we learn” (p. 414). Felder and Silverman (1988) mentioned that some learners feel more comfortable when they are learning facts, experiments and data when others prefer to learn theories and principles.

Cassidy (2004) clarified that the one concept that has offered insights into learning is *learning style*. The different styles that people use to learn were termed as learning styles. James and Blank (1993) stated that “The ways individual learners react to the overall learning environment and its various elements are often said to make up the *learning style*” (p. 47). The term learning style describes each individual’s preferred way of understanding experiences and converting the experiences into knowledge (Cuthbert, 2005; Honey & Mumford, 1986; Kolb, 1984). Claxton and Ralston (1978) have identified learning style as “a student’s consistent way of responding and using stimuli in the context of learning” (p. 7).

James and Blank (1993) defined *learning style* as the “complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn” (p. 47). Kolb (1984) defined learning styles as an individual’s preference of methods to perceive and process information. Krätzig and Arbuthnott (2006) indicated that learning styles fundamentally address the memory of an individual for a variety of sensory stimuli when using these components. Curry (1983) used the term learning style to refer to “the general area of interest concerning individual differences in cognitive approach and process of learning” (p. 3). Curry (1991) mentioned that a learning style could be considered as a mixture of an individual’s motivation to learn, engagement in the learning process and processing habits of the content cognitively. Claxton and Murrell (1987) have discussed learning

styles extensively in their research. Baldwin and Sabry (2003) indicated that “Learners are different and approach learning tasks differently and that individual differences can significantly affect an individual’s learning processes” (p. 325).

Heffler (2001) mentioned that “It is advantageous to know your own learning style when approaching a new learning situation to optimize the outcome” (p. 308) and added that awareness of learning styles of the students support the teachers efforts to organize the course content for better learning to occur. Hendry, Heinrich, Lyon, Barratt, Simpson, Hyde, Gonsalkorale, Hyde, and Mgaieth (2005) considered that course coordinators try to match tutorial groups with gender but infrequently any effort is made to match with “students’ knowledge backgrounds or learning styles” (p. 395). A study by Hendry et al. (2005) revealed that students were expressed greater self-awareness of their personal learning and learning styles and showed acceptance of others’ learning styles. Hendry et al. (2005) added that “self-awareness of their learning style would lead to increased confidence in using their study strategies” (p. 397).

Baldwin and Sabry (2003) mentioned that “Learners are different, have different learning styles and approach tasks differently. Some learners require more help than others. Some are more motivated and have clear academic and career goals than others” (p. 337). McLachlan (2006) stated that individual students are driven by different things and that “student learning styles and learning drivers may vary from individual to individual” (p. 1). Felder and Brent (2005) stated as follows:

...some students are comfortable with theories and abstractions; others feel much more at home with facts and observable phenomena; some prefer active learning and others lean toward introspection; some prefer visual presentation of information and others prefer verbal explanations. One learning style is neither preferable nor inferior to another, but is simply different, with different characteristic strengths and weaknesses. (p. 2)

Guild (2001) mentioned that “learners bring their own individual approach, talents and interests to the learning situation” (p. 1). Guild (2001) further added that “an individual learner's culture, family background, and socioeconomic level affect his or her learning. The context in which someone grows and develops has an important impact on learning” (p. 1). Heffler (2001) believed that each individual’s learning style has its strengths and weaknesses based on what has to be learned and how it should be learned. Cassidy (2004) indicated that “There is general acceptance that the manner in which individuals choose to or are inclined to approach a learning situation has an impact on performance and achievement of learning outcomes” (p. 420). Curry (1991), after a study of the use of learning style concepts in medical education, observed significant differences in learning styles between the two practice types of specialists - the university specialists and the community-based specialists. Curry (1991) also observed significant differences between the university and community-based specialists by gender, and years of practice.

As researchers found differences in the way individual learners learn, a need to address individual learning styles and integrate activities to match teaching styles to the learning styles has become a necessity for educators. Hall and Moseley (2005) expressed that course designers and instructors should be attentive to the learning styles of students by investigating their learning styles and encouraging them to think and reflect on their own learning styles. Hall and Moseley (2005) felt that the focus should be shifted from the content to the learner as that has a major effect on the motivation of students to learn.

Coffield, Moseley, Hall, and Ecclestone (2004) stated that:

There is a strong intuitive appeal in the idea that teachers and course designers should pay closer attention to students' learning styles – by diagnosing them, by encouraging students to reflect on them and by designing teaching and learning interventions around them. (p. 1)

Bacon (2004) agreed that “Although there is an enormous amount of published research on learning styles, relatively few studies have critically evaluated the assumption that learning style affects learning outcomes” (p. 206). Cassidy (2004) argued that “learning style has been the focus of such a vast number of research and practitioner-based studies in the area, there exist a variety of definitions, theoretical positions, models, interpretations and measures of the construct” (p. 420). Cassidy (2004) ascertained that “Whilst educators in all fields are becoming increasingly aware of the critical importance of understanding how individuals learn, it is equally important that any attempts to integrate learning style into educational programmes are made from an informed position” (p. 420).

Purpose of the Study

The purpose of this study was to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The examination also included gender, ethnicity, age, grade point average (GPA) and grade level. Each learner will learn in a specific way depending on their learning styles. These learning style differences affect their learning. Loo (1997) indicated that the learning style characteristics of individuals are comparatively stable with a slight change or development. Cassidy (2004) suggested that

“Learning style may be considered as stable over time or as changing with each experience or situation” (p. 421). If and when addressed appropriately, there is an anticipated improvement in learning and it improves the expectation that learning will occur substantially faster.

“The purpose of examining the learning styles of learners is to better understand the behavior patterns that learners exhibit so that they can be incorporated into interactive learning systems and thus be more effective and efficient in helping learners to learn” (Baldwin & Sabry, 2003, p. 327). Cuthbert (2005) mentioned that “knowledge of the students’ Learning Styles could be important to the teacher since it allows him/her to adjust his/her pedagogic strategies” (p. 246). Gadt-Johnson and Price (2000) indicated that learning styles were meant to symbolize each learner’s distinct inclination to learning certain material and concluded after their study that the research has repeatedly confirmed a powerful relationship between a learner’s unique learning style and their academic achievement. Some researchers have agreed that learners learn better when the content material is provided in a way that matches with their learning style preferences (Kolb, 1984; Gardner, 1985; Slavin, 2000; Woolfolk, 1998). Griggs (1985) agreed with other researchers by stating that “Increased research studies demonstrate the importance of accommodating individual learning style preferences in the learning process” (p. 202).

Statement of the Problem

There is a need to examine the learning style differences between students from different academic programs because research in this area is lacking. A persistent issue in education is the understanding and application of an individual’s unique learning styles. Awareness of the learning styles of the learners’ will aid the teachers, instructors, adult

educators, trainers, course designers, program and training developers to develop a curriculum that addresses individual learning needs. Baldwin and Sabry (2003) mentioned that “research continues to build a strong case for the impact of learning styles in better understanding how learners learn and thus how to support them in their task” (p. 329).

Cassidy (2004) stated that “Learning style was also found to correlate significantly with other academic performance-related factors such as academic self-efficacy and academic locus of control” (p. 439). Teachers, instructors, adult educators, trainers, course designers, program and training developers invest a significant amount of time and effort in designing courses and training to achieve specific objectives and to provide a better learning experience to the learners. Cassidy (2004) suggested that

For those working within an educational setting wishing to utilize learning style to promote more effective learning, whether through individual or group profiling, design of instructional methods, or identifying learner preferences, operationalising learning style is a necessary but highly problematic endeavour. (p. 440)

Research Questions

This study was guided by the following two research questions:

1. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles?
2. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level?

Significance of the Study

Teachers, instructors, adult educators, trainers, course designers, program and training developers have the responsibility to create and develop an effective and efficient learning environment to meet the colossal task of addressing individual learners' learning styles to enhance learning. The results of this study will aid in designing more effective and interactive undergraduate courses and curriculum in academic settings including Colleges of Business, Education and Liberal Arts to enhance undergraduate students' learning. Graf, Viola, Leo, and Kinshuk (2007) indicated that "Incorporating learning styles in teaching plans may make learning easier and leads to better achievement" (p. 79).

Bajraktarevic, Hall, and Fullick (2003) confirmed that "students benefit from the learning materials being adapted to suit their learning preferences. The results revealed that students have obvious different preferences for lesson presentation type" (p. 8).

Gadt-Johnson and Price (2000) advocated that

an awareness of learning style differences of ethnic populations and accommodating these differences in the classroom may result in better academic achievement for these youth. The particular learning style preferences of students have been found to have a strong impact on achievement in different academic areas. (p. 582)

Curry (1990, 1991) indicated that the key purpose to study and apply learning styles was to develop an instant and long-standing outcome of general learning and teaching processes. Felder (n.d., para. 2) indicated as follows:

When mismatches exist between learning styles of most students in a class and the teaching style of the professor, the students may become bored and inattentive in class, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases change to other curricula or drop out of school. Professors, confronted by low test grades, unresponsive or hostile classes, poor attendance and dropouts, know something is not working. They may become overly critical of their students (making things even worse) or begin to wonder if they are in the right profession. Most seriously, society loses potentially excellent professionals. To overcome these problems, professors should strive for a balance of instructional methods (as opposed to trying to teach each student exclusively according to his or her preferences.) If the balance is achieved, all students will be taught partly in a manner they prefer, which leads to an increased comfort level and willingness to learn, and partly in a less preferred manner, which provides practice and feedback in ways of thinking and solving problems which they may not initially be comfortable with but which they will have to use to be fully effective professionals.

Baldwin and Sabry (2003) found that “variations in learning preferences do exist in the population” (p. 331). Felder and Silverman (1988) suggested that including a small number of activities or techniques in the instruction by the instructors would address or meet the needs of several students with a variety of learning styles.

Assumptions of the Study

The following assumptions were made for the purpose of this study:

1. The ‘Index of Learning Styles’ was a valid instrument to examine the learning styles among undergraduate students' from the Colleges of Business, Education and Liberal Arts.
2. The participants responded honestly to the survey questions.

Limitations of the Study

The study has several limitations. The online learning style instrument Index of Learning Styles (ILS), developed by Felder and Solomon, was selected to identify and examine the relationship of the students' learning styles. Felder and Solomon (1999, para. 3) stated the following:

1. The ILS results provide an indication of an individual's learning preferences and an even better indication of the preference profile of a group of students (e.g., a class), but they should not be over-interpreted.
2. A student's learning style profile provides an indication of possible strengths and possible tendencies or habits that might lead to difficulty in academic settings. The profile does not reflect a student's suitability or unsuitability for a particular subject, discipline, or profession. Labeling students in this way is at best misleading, and can be destructive if the student uses the label as justification for a major shift in curriculum or career goals. (A learning style preference also does not serve as an excuse for a bad grade on the student's last physics test).

Participation in this study was voluntary. The convenience sample was from one of the largest universities in the South which questions the generalizability of the findings to other institutions. The sample selection was limited to a total of 346 undergraduate students from the Colleges of Business, Education and Liberal Arts.

This study surveyed students who were registered for undergraduate courses from only three colleges at one of the largest four-year public universities in the southeast; therefore, it should be considered a convenience sample. Generalization of the results to other universities is not recommended.

Definition of Terms

The following terms used with specific definitions were vital for this study.

1. Active and reflective learning styles - Felder and Solomon (n.d., para. 1) explained that active learners retain and understand information best by doing

something active with it either by discussing/applying/explaining it to others.

Reflective learners prefer to think and work alone about the learning material provided to them.

2. Learning styles - Keefe (1979a) mentioned that learning styles were “characteristic cognitive, affective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (p. 1).
3. Sensing and intuitive learning styles - Felder and Solomon (n.d., para. 5) described that sensing learners like facts and solving problems by well-established methods and intuitive learners prefer discovering possibilities and relationships.
4. Sequential and global learning styles - Felder and Solomon (n.d., para. 11) described sequential learners as those that gain understanding in linear and logical steps and that the global learners learn in large jumps and absorb material randomly without seeing connections.
5. Visual and verbal learning styles - Felder and Solomon (n.d., para. 9) indicated that visual learners remember best what they see in pictures, diagrams, flow charts, time lines, films, and demonstrations and explained that verbal learners get more out of words through written and spoken explanations.

Organization of the Study

An introduction to this research study was provided in this chapter. It addressed the statement of the problem, purpose of the study, research questions, significance and limitations of the study and the definitions of the terms used in this study. A review of

the related literature for this study is provided in Chapter II. It addresses the historical overview of learning and learning styles, previous research on learning styles, learning styles instruments and models and the Index of Learning Styles Questionnaire.

Chapter III describes the methods used for this study. It includes the design of the study, research questions, variables – the independent and dependent variables, the instrument – Index of Learning Styles, reliability and validity, population sample, data collection, procedure and analysis, results and a summary. Chapter IV presents the findings of the study and describes the participants' demographic characteristics and the analytical and statistical procedures. Chapter V summarizes the findings of the study and includes suggestions for future research.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The first chapter described the purpose, statement of the problem, research questions, definitions of terms, significance, assumptions, limitations and the organization of the study. The second chapter - literature review - discusses andragogy, pedagogy, adult learners, historical review and background of learning styles, learning style models, learning style as a tool, the instrument – index of learning styles survey, the visual and verbal, active and reflective, sensing and intuitive, and sequential and global learning styles.

Learning and learning styles are two important fields that draw the attention of major researchers in the field of education. In order to understand learning and learning styles better, a review of ‘pedagogy’ and ‘andragogy’ is necessary. Knowles (1973) defined pedagogy as the art and science of teaching children and Knowles (1970) defined andragogy as the “art and science of helping adults learn” (p. 38). Jarvis (1985) observed that, for Knowles, education from above is pedagogy and education of equals is andragogy. After careful review of literature, it was understood that adult learning involves both pedagogy and andragogy. Adult learners are diverse and possess different learning styles. Hence, depending on the learners learning styles and the content to be

learned, principles of pedagogy and andragogy may be conjunctively used to create an effective learning experience.

Learning styles have become a significant learning consideration in the past three decades. As diverse definitions were given to learning styles, learning styles instruments have come into existence. As research continues, additional learning style instruments are being developed and the current effort is to incorporate learning styles into the learning process.

Purpose of the Study

The purpose of this study was to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The study also examined the relationship between the learning styles and the demographic information of gender, ethnicity, age, grade point average (GPA) and grade level.

Research Questions

This study was guided by the following two research questions:

1. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles?
2. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level?

Pedagogy

Bedi (2004) stated that “the word ‘pedagogy’ is derived from the Greek words ‘paid’ meaning ‘child’ and ‘agogus’ meaning ‘leader of’” (p. 94). Holmes and Abington-Cooper (2000) indicated that pedagogy evolved in the monastic schools of Europe between the 7th and 12th centuries. Marshak (1983) described pedagogy as teacher centered in which the goals for learning were set, the learning process was directed and results evaluated by the teacher. Holmes and Abington-Cooper (2000) mentioned that monks’ observations in teaching children simple skills paved the way to pedagogical assumptions about learners and learning. These assumptions were adopted and incorporated into teaching in North America and Europe during the 18th and 19th centuries.

Marshak (1983) considered that pedagogy is appropriate to educate and train children and, at times, adults too. In a pedagogical model, teachers are responsible for deciding what, how and when of learning occurs and added that a teacher has complete responsibility to make all decisions regarding a learning experience (Bedi, 2004; Conner, 2004). Bedi (2004) implied that the learning takes place from a teacher centered point of view and the learner is submissive in the process. Clark (1999) clarified that in pedagogy, a content plan is important for content to be taught, how it can be chunked into smaller modules, what the delivery options are to deliver the content in a logical sequence, and to find out the most effective way to teach the content. Yoshimoto, Inenaga, and Yamada (2007) mentioned that teachers are expected to teach and take care of young and immature students’ learning needs.

Andragogy

The notion of andragogy has been around for nearly two centuries. The term andragogy was originally formulated by Alexander Kapp, in 1833 (Nottingham Andragogy Group, 1983). Kapp used the term to describe the educational theory of Plato. Zmeyov (1998) determined that the theory of adult education called andragogy is a new field of human sciences, one of the new sciences of education that was in full evolution. Holmes and Abington-Cooper (2000) mentioned that initially the term was disapproved by a fellow German, John Frederick Herbert, and subsequently disappeared from use for almost a century. Davenport (1987) and Sherow (2006) observed that the term had reappeared in Europe by the year 1921 and was used in France, Holland and Yugoslavia during the 1960s. Davenport and Davenport (1985) indicated that the term was first introduced in the United States by Martha Anderson and Eduard Linderman in the year 1927.

The term was based on the Greek word 'andr' which means 'man/adult' and 'agogus' which means 'leader of'. In the 1960s, Malcolm Knowles who is considered as the father of adult education has further developed the concept of andragogy (Sherow, 2006). In the 1970s and 80s, Malcolm Knowles, who was a theorist of adult education and a renowned American practitioner, R.M. Smith, an American researcher, and P. Jarvis, a British researcher created the theory of adult learning – an androgogical model of learning based on the fundamentals of andragogy (Zmeyov, 1998). The model became particularly popular in North America and Great Britain as a way of describing adult learning through the work of Malcolm Knowles. Draper (1998) indicated that today the term andragogy is used in Poland, Germany, the Netherlands, Czechoslovakia,

Russia, Yugoslavia, and other central and eastern European countries to refer to what the British and Americans call adult education.

Smith (2005) confirmed that many in the adult education field considered that the name Malcolm Knowles and the term andragogy have become inextricably linked.

Marshak (1983) described andragogy as learner centered where the learner was responsible for achieving his or her own learning goals through self-direction and evaluation, aided by a 'facilitator' rather than a 'teacher'. Knowles' theory of andragogy was an attempt to develop a theory specifically for adult learning. He emphasized that adults were self-directed and were expected to take responsibility to make decisions. His definition focuses on the role of a teacher and his theory of andragogy was based on adult learner characteristics.

According to Knowles (1984), andragogy was based on four different and vital assumptions about the characteristics of adult learners and child learners. They were self-concept, experience, readiness to learn, and orientation to learning. A fifth one, motivation to learn, was added later (Jarvis, 1995; Knowles, 1984; Smith, 2005). It was assumed that as a person grows older their self concept moves from being a dependent personality to one of being an independent personality, their accumulation of experiences become a resource for learning, their willingness to learn becomes oriented increasingly to their social roles, and their time perspective changes from one of postponed application of knowledge to immediacy of application (Darkenwald & Merriam, 1982; Davenport, 1987; Knowles, 1973, 1980).

Knowles (1980) described andragogy as follows:

Andragogy is premised on at least four crucial assumptions about the characteristics of adult learners that are different from the assumptions about child learners on which traditional pedagogy is premised. These assumptions are that, as a person matures, 1) his self-concept moves from one of being a dependent personality toward one of being a self-directed human being; 2) he accumulates a growing reservoir of experience that becomes an increasing resource of learning; 3) his readiness to learn becomes orientated increasingly to the developmental tasks of his social roles; and 4) his time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his orientation toward learning shifts from one of subject-centered to one of problem-centeredness. (p. 39)

Knowles (1984) indicated that as a person matures, the fifth element of 'motivation to learn' was internal. According to Darkenwald and Merriam (1982), these characteristics of adult and child learners' assumptions indicate that it was important to know about adult learning and development. Conner (2004) indicated that the term defined an alternative to pedagogy and referred to learner-focused education for people of all ages. Marshak (1983) mentioned that andragogy was considered as appropriate for the education and training of adults.

Bedi (2004) summarized that andragogy is an instrument to understand the behavior of a student in a teaching relationship, supports the reason for the way a teacher behaves in the relationship, and guides the teaching philosophy of how to manage the learning environment to make a learning situation effective. The University of Central Florida Literacy and Reading Excellency Center (FLaRe) (n.d.) concluded that andragogy was considered as an alternate model for instruction and it caught the attention of several adult educators and was considered one of the models that could be used to teach adult learners. The FLaRe (University of Central Florida Literacy and Reading Excellency

Center, n.d.) program extended the notion that since the evolution of the term andragogy, the use of “it has taken on a wider meaning and now more often refers to learner-focused education for people of all ages” (p. 1). WAVE (n.d., para. 17) in a white paper on *Adult Education in the Information Age* stated that andragogy

refers to learner-focused education for people of all ages. The andragogic model asserts five issues to be considered and addressed in formal learning; letting the learner know why something is important to learn, showing learners how to direct themselves through information, relating the topic to the learners experiences, recognizing people will not learn until ready and motivated to learn, often this requires helping them overcome inhibitions, behaviors, and beliefs about learning.

Pedagogy and Andragogy

Knowles (1970) believed that an andragogical approach to teaching adults was essential to take into account the adult's learning needs and the teachers' responsibility to teach adults how to learn. He argued that “the transmissional modes of pedagogy were not considered as sufficient in enabling adults to deal with the rapid change going on in our society. The result of the timespan of major cultural change changing more than once in one's lifetime called for a new and more successful approach to adult learning” (p. 39). Knowles (1973) has compared his andragogical model with that of a pedagogical model. Holmes and Abington-Cooper (2000) explained Knowles comparison as follows:

The pedagogical model is a content model concerned with the transmitting of information and skills. For example, the teacher decides in advance what knowledge or skill needs to be transmitted, arranges this body of content into logical units, selects the most efficient means for transmitting this content (lectures, readings, lab exercises, films, tapes, for example), and then develops a plan for presenting these units in some sequence.

By contrast, the andragogical model is a process concerned with providing procedures and resources for helping learners acquire information and skills. In this model, the teacher (facilitator, change-agent, consultant) prepares a set of procedures for involving the learners in a process that includes (a) establishing a climate conducive to learning, (b) creating a mechanism for mutual planning, (c)

diagnosing the needs of learning, (d) formulating program objectives (content) that will satisfy these needs, (e) designing a pattern of learning experiences, (f) conducting these learning experiences with suitable techniques and materials, and (g) evaluating the learning outcomes and re-diagnosing learning needs. (p. 51)

Knowles' idea of developing a newer approach to learn was taking into consideration "more accurate set of assumptions of adults as learners" (Schugurensky & Friedman, 2002, para. 4). Schugurensky and Friedman (2002) summed up Knowles' four assumptions of andragogy in relation to pedagogy as follows:

The self-concept principle reflects the self-directing character of the adult learner rather than dependent nature of the child. The principle of experience simply acknowledges the need to draw on the adult's rich source of experience. Readiness to learn indicates that adults differ from children in their developmental stage and as a result have special learning needs. The assumption implies that adult learning needs tend to focus more towards their social roles. Orientation to learning assumes that adults put more value on being able to practically apply their learning while pedagogy suggests that children naturally focus on postponing immediate application for future needs. These four sets of assumptions establish significant guidelines for creating adult learning environments. (para. 5)

Kennedy (2002) contended that youth is not the only phase in an individual's life to learn as "Adults are as well-equipped as younger learners to continue learning" (p. 435). Jarvis (1985) compared pedagogy and andragogy as presented in Table 1.

Table 1

Comparison of Pedagogy and Andragogy

	Pedagogy	Andragogy
The learner	Dependent	Moves towards independence. Self-directing
The learner's experience	Of little worth	A rich resource for learning
Readiness to learn	People learn what society expects them to	People learn what they need to know
Orientation to learning	Acquisition of subject matter	Learning experiences should be based around experiences.

The most important characteristic to consider when teaching adults would be a mixture of andragogical and pedagogical assumptions. Conner (2004) indicated that Knowles conceded that the four of andragogy's five key assumptions apply equally to adults and children. Conner (2004) added that the sole difference was that children have fewer experiences and pre-established beliefs than adults and thus have less to relate. Bedi (2004) mentioned Knowles' argument that pedagogy for children is the most effective way to impart education as the children's dependency on adults is more but as the dependency reduces, pedagogy will become self-direction in the individual's life. Zmeyov (1998) agreed that the andragogical principles of learning were widely needed not only in adult education but also in all sectors of educational services. Knowles (1980) agreed that both the models of andragogy and pedagogy were necessary depending on the situation.

Knowles (1980) mentioned that

andragogy is simply another model of assumptions about adult learners to be used alongside the pedagogical model of assumptions, thereby providing two alternative models for testing out the assumptions as to their 'fit' with particular situations. Furthermore, the models are probably most useful when seen not as dichotomous but rather as two ends of a spectrum, with a realistic assumption (about learners) in a given situation falling in between the two ends. (p. 43)

Cross (1981) described Knowles' argument that andragogy could be viewed as a unified theory of adult education and as "optimistic". Cross (1981) pointed out that

it is not really clear whether Knowles was advocating two distinct approaches to teaching – one for children and a different one for adults – or whether he is suggesting that andragogy should replace pedagogy as a sounder approach to the education of both children and adults. However, in a recent clarification of the assumptions of andragogy, Knowles (1979) acknowledges that it would have been preferable to recognize the continuity of human development by using the subtitle "From Pedagogy to Andragogy" rather than "Andragogy Versus Pedagogy," which implies a dichotomy between childhood and adulthood. (p. 223)

Ozuah (2005) argued that if the principles of andragogy are used, efforts to help the learners direct and move them to being autonomous and self-directedness would be a success. Rachal (1994), after a review of the experimental literature on andragogical and pedagogical methods, concluded that "the bulk of the experimental and quasi-experimental work done to date suggests an approximate equivalence between andragogical approaches and pedagogical ones on both achievement and learner satisfaction. Ultimately, practitioners will continue to employ methods that work for them" (p. 25).

Edmunds, Lowe, Murray, and Seymour (2007) summarized that there are three principles that provide the foundation for adult learning:

1. The adult learner is primarily in charge of his or her own learning. Remember that instructors do not have the power to implant ideas or to transfer skills directly to the learner. They can only suggest and guide.
2. An instructor's primary responsibility is to do a good job of managing the process through which adults learn.
3. The learners are encouraged to use their own judgment and decision-making capabilities. (p. 3)

MacKeracher (1996) viewed adult learning as an energetic set of processes that are interconnected emotionally, socially, physically, cognitively and spiritually. Merriam (2001) described that adult learning is an "ever-changing mosaic, where old pieces are rearranged and new pieces added" (p. 1).

Adult Learners

Ausburn (2004) described adult learners as those who have distinctive needs and expectations of learning which sets them apart from the young learners. Ausburn (2004) acknowledged that in American education adult learning has become important and literature places emphasis on adult educators. In the year 2003 part-time adult learners have become the majority of learners in colleges and universities. Adult learners are the fastest growing learner population (Cappelli, 2003; Levine, 2003; Shea, 2002; Symonds, 2003). Edmunds et al. (2007) indicated that adults can learn, are willing to learn in spite of age, bring a treasure of knowledge and experience to the learning process, are practical in their learning and makes use of the learning in real time situations. Sherow (2006) mentioned that adults learn when the need arises to know new things, that they are self-directed, autonomous and take charge of their learning and learning experience. Kennedy

(2002) argued that adult learning does not occur in a single best way. Edmunds et al.

(2007) stated that

generally, most adults prefer to be treated as individuals who are unique and have particular differences. The instructor must keep in mind that although adults have common characteristics as learners, adults also have individual differences and most adults have preferred methods for learning. Adult learners respond better when new material is presented through a variety of instructional methods, appealing to their different learning preferences. (p. 3)

Edmunds et al. (2007) explained that

Adults bring to a learning situation a background of experience that is a rich resource for themselves and for others. In adult education, there is a greater emphasis on the use of experiential learning techniques (discussion methods, case studies, problem-solving exercises) that tap into the accumulated knowledge and skills of the learners and techniques such as simulation exercises and field experiences that provide learners with experiences from which they can learn by analyzing them. A rich, adult-focused instructional approach takes into account the experiences and knowledge that adults bring to the session. It then expands upon and refines this prior knowledge by connecting it to new learning, making the instruction relevant to important issues and tasks in the adults' lives. (p. 3)

Kennedy (2002) supported that as adults obtain new knowledge, they add it to their already existing knowledge by integration of new knowledge to the old knowledge and build new meaning to the already existing one. Ross-Gordon (2003) mentioned that it is the responsibility of the instructors to tap into and take advantage of the vast experience that adults bring into the learning situation.

Migletti and Strange (1998) after a study at North Carolina State University found that there was little variance between the age of students and their expectations of the environment in a classroom, course outcomes and learning styles and the study could not prove the fact that adults have different learning styles and have different learning needs.

However, Ross-Gordon (2003) mentioned that

Although these studies do not point to a uniquely adult learning style, the value of responsiveness to diverse learning styles among adults exhibited by individual adults was supported by a study of students between twenty-one and fifty years of age in a predominantly black community college. (p. 48)

Historical Review and Background of Learning Styles

Koch (1998) confirmed that starting in the 1950s and 1960s researchers identified learning and teaching theories which led researchers and educators to concentrate on each individual learner's learning needs in the late 1960s and early 1970s. Lemire (2000) pointed out that extensive attention to individual learning styles was a major movement in education for the past 25 years. Jonassen and Grabowski (1993) argued that "An outgrowth of the interest in cognitive styles has been the evolution of learning styles, which are general tendencies to prefer to process information in different ways" (p. 233). Carbo, Dunn and Dunn (1986) suggested that one of the major developments in the field of education was the research and identification of learning styles. The research on learning styles started as early as 1892 (Keefe, 1987; Keefe & Jenkins, 1984). Kolb and Kolb (2003) indicated that learning styles have become a key factor in providing an effective learning experience. Riding and Cheema (1991) ascertained that

Studies in learning styles/cognitive styles initially developed as a result of interest in individual differences. These issues were very much in fashion during the 1960's, enjoyed a continuing popularity during the early 1970's, but have since tended to decline. This waning of interest left the whole field of investigation fragmented and incomplete, and without clear usefulness for the central concerns of education. Despite attracting little interest in the last two decades, the authors feel that cognitive/learning styles are once again coming into prominence, and are now being more seriously considered by the teaching and training world. (para. 5)

Koch (1998) described that the initial research in psychology had impacted the evolution of the field of learning styles. Cassidy (2004) recorded that

Although its origins have been traced back much further, research in the area of learning style has been active for – at the conservative estimate – around four decades. During that period the intensity of activity has varied, with recent years seeing a particularly marked upturn in the number of researchers working in the area. (p. 419)

Literature reviews indicate that there is evidence of the occurrence of a revival of learning style research to find the learning styles influence on an individual's learning process (Dunn, 1990; James & Blank, 1991a; 1991b; 1993; Sternberg & Grigorenko, 1997). Researchers stipulated that in the past two decades much attention was given to learning style preferences of students to design effective instruction for a large diversity of students with different learning styles (Herrmann, 1988; Kolb, 1984; McCarthy, 1990; Wilkerson & White, 1988).

Smith (2002) mentioned that a substantial quantity of learning styles research exists, however, it is mostly concentrated on adult learning. However, Wang, Wang, Wang, and Huang (2006) mentioned that learning styles research has slowly extended to the field of science education. Curry (1983) mentioned that the significance of individual differences gave way to the interest in learning styles in the field of health professions education. Zhang and Sternberg (2005) asserted that the last couple of decades have observed a great interest of learning styles research in both academic and nonacademic settings.

Loo (2002b) defined a learning style as “the consistent way in which a learner responds to or interacts with stimuli in the learning context” (p. 252). Dunn, Beaudry and

Klavas (1989) defined learning style as “a biologically and developmentally imposed set of personal characteristics that make the same teaching method effective for some and ineffective for others” (p. 50). Dunn and Dunn (1998) defined a learning style as the way each person begins to concentrate on, process, and retain new and difficult information. Johnson and Orwig (1998) defined learning style as “the unique collection of individual skills and preferences that affect how a person perceives, gathers, and processes information” (para. 2). Felder (1996) defined learning styles are the “characteristic strengths and preferences in the ways they take in and process information” (p. 18).

Dunn and Dunn (1998) mentioned that each individual’s concentration occurs differently, for different individuals, at unique times of the day and that is significant to recognize each individual’s learning styles to draw their concentration, utilize their processing ability to the maximum and increase long-term memory. Smith (2002) reinforced that it is a common experience for every individual to learn and perceive in a variety of ways.

Yannibelli, Godoy and Amandi (2006) stated that “Learning styles encapsulate the preferences of the students, regarding how they learn” (p. 55). Felder and Spurlin (2005) mentioned that individuals use a variety of learning preferences and strengths to process learning material. Briggs (2000) agreed that analyzing learning styles of individuals has always been a debate and investigated constantly in the past.

Kolb (1981, 1984) characterized a learning style by the degree of a learner’s emphasis on abstractness over concreteness while perceiving information and of a learner’s emphasis on action over reflection while processing information in a learning environment. Truluck and Courtenay (1999) mentioned that learning style is a method

that students respond to consistently in order to process any information in the learning environment. Dunn and Dunn (1975) indicated that “Learning styles is based on a complex set of reactions to varied stimuli, feelings, and previously established patterns that tend to repeat similarly when the person concentrates” (p. 4). Hergenhahn and Olson (1993) mentioned that the term learning style is used to recognize individual differences in learning as a learner responds consistently using the stimuli in a learning environment. Truluck and Courtenay (1999) asserted that learning style is an effort to better understand the variety of ways different people learning and use the knowledge by applying it in a learning environment. Learning styles are ways that individuals employ to collect, organize and transform data into information that can be used (Cross, 1976; Kolb, 1984; Spoon & Schell, 1998).

Koch (1998) realized that the definition of the term learning style is elaborate and most of the terms originated from the fields of Education and Psychology. Loo (2002b) asserted that learning styles is directly connected to cognitive styles as both were associated to a “learner’s personality, temperament, and motivations” (p. 349). Riding and Cheema (1991) ascertained that the term learning style has emerged comparatively as a more commonly used term or used instead of cognitive style in the 1970s. The terms cognitive and learning styles occasionally are used interchangeably, while at certain times are used as separate terms (Cassidy, 2004; Keefe, 1987; Keefe & Jenkins, 1984; Truluck & Courtenay, 1999).

According to Keefe (1987), learning styles are considered to be “characteristic cognitive, affective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (p. 4).

Keefe (1987) characterized learning styles into three types – cognitive, physiological and affective. Keefe (1987) explained that the term cognitive referred to how an individual perceives, thinks and remembers, the term physiological referred to the aspects that directly deal with physical environment and the term affective referred to values, interests and motivation that are personality features. Dunn and Griggs (1989) explained that “individual responses to sound, light, temperature, design, perception, intake, chronobiological highs and lows, mobility needs, and persistence appear to be biological, whereas sociological preferences, motivation, responsibility (conformity), and need for structure are thought to be developmental” (p. 56).

Krätzig and Arbuthnott (2006) mentioned that “a person’s learning style is hypothesized to be a combination of cognitive, affective, and psychological characteristics that describe how that individual interacts with his or her environment” (p. 238). Several researchers agreed that learning style is a collection of characteristics that are both biological and developmental which make similar instructional settings, techniques and resources more efficient learning situations to some individuals and less efficient for other individuals (Dunn & Dunn, 1972, 1992, 1993; Dunn, Dunn, & Perrin, 1994). Conti and Welborn (1986) believed that learning styles influence a learner’s choice of settings, the types of topics that they desire to learn and how they would like to move towards the learning experience.

Dunn and Griggs (1989) indicated that learning styles “encompasses motivation, on-task persistence versus the need for multiple assignments simultaneously, the kind and amount of structure required, and conformity versus nonconformity” (p. 50). Learning style is considered a theoretical construct to help clarify a learning process (Hardigan &

Sisco, 2002; Sewall, 1986). Sewall (1986) referred to learning style as a learners' distinctive way of environmental interaction.

Hall and Moseley (2005) stressed that “Models of learning styles aim to increase teachers' and students' understanding of their own learning and to provide a common vocabulary in which strategies, motivation and the processes particular to each learning experience can be collaboratively explored” (p. 251).

Keefe (1979b) mentioned that

Learning style diagnosis opens the door to placing individualized instruction on a more rational basis. It gives the most powerful leverage yet available to educators to analyze, motivate, and assist students in school. As such, it is the foundation of a truly modern approach to education. (p. 132)

Gadt-Johnson and Price (2000) found, from the results of their study of 25,104 students in grades five through twelve that learners do have specific learning style preferences and that instructors should consider this while developing the instructional materials and methods. Gadt-Johnson and Price (2000) added that including appropriate activities enhances the compatibility of learners and teachers in a learning environment and makes the learning situation more motivating, enjoyable, effective and productive while in the process, the teachers encourage the learners to strengthen the learners' weaker learning styles.

James and Blank (1993) argued that the field of learning styles lack “widely agreed-on terminology” (p. 47). Cano-Garcia and Hughes (2000) indicated that as several researchers provide individual definitions to the term ‘learning style’ for different reasons, there is no one definite definition for it. Koch (1998) mentioned that the field of learning styles is complicated with a variety of definitions for the term ‘learning style’

and differences in the learning style instruments. Truluck and Courtenay (1999) agreed with other researchers in regards to the criticism on learning styles research of not having a unifying theory as there were a variety and instruments that measure different modalities (p. 223).

Learning Styles as a Tool

Witte noted that “in adult education programs, ignorance is not vested in the students while knowledge is vested in the instructor. Both are learners and have contributions to make to each other. Both are responsible for their own learning” (Dr. James E. Witte, personal communication, February 12, 2008). Curry (1983) indicated that a major part of literature review on learning styles focused on the improvement of an immediate and long-term benefit of learning and teaching processes. She (2005) mentioned that it was a challenge through the 1960s and 1980s “as to whether matching students’ learning preference with instructional approaches would actually benefit students” (p. 32). Heffler (2001) signified that the knowledge of individual learning styles enhances a learner’s learning. Bajraktarevic et al. (2003) mentioned that a significant contributing factor for student progress is learning styles. Loo (1997) agreed that effective learners are willing to adapt their learning styles to new learning situations. Edmunds et al. (2007) described that a learning process is a process in which learners learn best when new information or skills were built on past knowledge and experience and that learners are more motivated to learn when a range of teaching methods were used. Sonnenwald and Li (2003) argued that each individual has different ways to learn and “when teaching accommodates these styles, learning is enhanced” (p. 420).

Heffler (2001) cautioned the teacher that one should consider and plan different activities for learning based on learning styles of the students and that as a student, each individual learner has to take their own responsibility to learn. Richardson (2005) mentioned that assessing a learner's learning style prior to instruction would be the most effective instruction. Koch (1998) indicated that there is immense evidence that "adult educators should employ assessment techniques to measure individual student learning styles when developing individual teaching strategies that were produced to address and assist individual differences" (p. 87). James and Galbraith (1985) mentioned that it would be advantageous for learners if educators use assessment techniques and measure learners' learning styles to develop individual learning strategies based on individual learning differences.

Smith (2002) revealed that the most effective way to respond to individual student unique learning styles was to plan courses and instructional sessions by considering a variety of learning styles. Yannibelli et al. (2006) indicated that researchers from several disciplines attempted to define learning styles and classify them to aid instructors and course designers to enhance and customize teaching to individual needs. Lovell (1980) mentioned that every learner has a different learning style and approach to learning in a unique way. Lovell (1980) added that in order to tap into the learner's potential to the maximum based on their uniqueness, one should consider a learner's personal weaknesses and strengths that account for an individual's learning styles. Truluck and Courtenay (1999) signified the maximization of learning and to achieve it, trainers, instructors and educators should take into consideration individual learning differences

and design appropriate learning environments and meet every individual learning style preferences.

Loo (2002a) argued that achievement in education not only depends on the aptitudes and intellectual ability of an individual but also on an individual's learning styles. For learning to be effective and lasting, it should be a meaningful learning experience (Novak, 1991; van Rossum & Schenk, 1984). Cassidy (2004) argued that in an educational setting immense attention is given to the impact of learning styles to distinguish learner-centered approaches. Curry (1983) mentioned that the learning styles were observed to be connected in several ways to areas of professional career such as “admissions to study, scholarly achievement, willingness to practice in small communities, choice of specialty and general competence” (p. 6). Koch (1998) mentioned that individuals utilize several unique learning styles “while making moment by moment style adjustments depending on the nature of the task and the teaching style being used” (p. 66-67). Felder and Silverman (1988) indicated that learning occurs both by the “student's native ability and prior preparation but also by the compatibility of his or her learning style and the instructor's teaching style” (p. 674).

Fischer and Fischer (1979) defined teaching style as a “pervasive way of approaching the learners that might be consistent with several methods of teaching” (p. 253). Gregorc (1979) defined teaching style as more than a methodology as “it places subjective demands upon the learner who may or may not have the abilities to match such demands” (p. 236). Dunn and Dunn (1977) considered that teaching style is developed over time with a combination of eight key categories – planning of instruction, methods

of teaching, grouping students, designing the room, environment of teaching, educational philosophy, characteristics of instruction and techniques of evaluation.

Fischer and Fischer (1979) identified teaching styles as the task-oriented, the cooperative planner, the child centered, the subject centered, the learning centered and the emotionally exciting and its counterpart. Fischer and Fischer (1979) added that “Styles are hypothetical constructs which help explain the teaching-learning process” (p. 253) and that it is important to realize that teaching and learning styles are theoretical concepts that could be used to understand and explain significant characteristics of a learning-teaching process. Riding and Cheema (1991) extended the notion that in an training or an educational scenario, style is already present as an in-built feature and is a fixed characteristic of an individual and should be identified to match or adapt the instructional material.

Kelley (2004) mentioned that mere identification of teaching style does not impact learning until the teaching style is matched with the learning styles of the students. Briggs (2000) revealed that the instructors should have access to the learning styles information of individuals whom they teach so that teaching styles could be matched to the majority of students’ learning style needs. Turner (1997) indicated that all teachers should be skilled and should use various teaching styles. Gadt-Johnson and Price (2000) pointed out that program developers and planners ought to recognize the students’ prominent learning styles to facilitate the selection of appropriate content materials and resources and to finalize the methods and procedures to teach the learners.

Curry (1983) supported that the development of learning styles would be a useful construct that “has potential for real economic effects by improving selection, training

and continuing education of professionals” (p. 13). Loo (2004) indicated that there has been much research to find out the relationships between learning styles and preferences with the goal of customizing instructional methods to the individuals’ preferences to learn. James and Galbraith (1985) indicated that the results from the learning styles should be put to use to re-design instructional materials and instruction for the benefit of the learners. Gadt-Johnson and Price (2000) suggested that the provision of different activities related to instruction would meet different learning styles of a learner. Felder (1993) suggested that

the point, however, is not to determine each student's learning style and then teach to it exclusively but simply to address each side of each learning style dimension at least some of the time. If this balance could be achieved in science courses, the students would all be taught in a manner that sometimes matches their learning styles, thereby promoting effective learning and positive attitudes toward science, and sometimes compels them to exercise and hence strengthen their less developed abilities, ultimately making them better scholars and scientists. (p. 287)

Felder (1996) argued that

if professors teach exclusively in a manner that favors their students' less preferred learning style modes, the students' discomfort level may be great enough to interfere with their learning. On the other hand, if professors teach exclusively in their students' preferred modes, the students may not develop the mental dexterity they need to reach their potential for achievement in school and as professionals. (p. 18)

Felder and Silverman (1988) determined that additions of a small amount of “teaching techniques to an instructor’s repertoire should therefore suffice to accommodate the learning styles of every student in the class” (p. 675).

Felder and Solomon (1999) stated that

A student's learning style profile provides an indication of possible strengths and possible tendencies or habits that might lead to difficulty in academic settings. The profile does not reflect a student's suitability or unsuitability for a particular subject, discipline, or profession. Labeling students in this way is at best misleading, and can be destructive if the student uses the label as justification for a major shift in curriculum or career goals. (para. 4)

Krätzig and Arbuthnott (2006) expressed that “According to learning style theory, individuals should show superior learning and memory for material presented in their preferred modality” (p. 238). Bacon (2004) mentioned that “the learning style paradigm holds that when course delivery is tailored to the different learning styles of students, student learning is enhanced” (p. 205). Baldwin and Sabry (2003) believed that the learning style instruments do not provide definite answers about their learning styles to all learners and their learning problems. However the instruments help identify certain “areas of possible significance to an individual’s learning in order to take necessary avoidance actions and if necessary remedial actions before it is too late” (p. 337).

Gardner (1991) stressed that individual learners learning through diverse intelligences are making it a necessity for instructors to teach in their preferred learning modes. Gardner (1991) stated that

Students learn in ways that are identifiably distinctive. The broad spectrum of students and perhaps the society as a whole would be better served if disciplines could be presented in a number of ways and learning could be assessed through a variety of means. (p. 12)

Loo (2002b) concluded that

The idea that ‘style awareness’ may help reach the ‘hard to teach’, and perhaps contribute to reducing failure generally by enhancing the learning process, is an elusive but tantalising prospect which clearly merits further attention. The current interest in teaching and learning style is evident not only in schools, but in higher education, work-place training and professional development. (p. 359)

De Vita (2001) expressed that “many teachers and management educators find that even well-prepared lectures or workshops often fail to engage all students.....one of the reasons for this lies in the mismatch between the instructor’s teaching style and the students’ learning styles” (p. 165). Felder and Silverman (1988) agreed that mismatches exist “between common learning styles of engineering students and traditional teaching styles of engineering professors” (p. 674). Loo (2002b) commended that the researchers from the field of business and other educators “have recognized the importance of learning styles for learners and for teachers in terms of using a variety of teaching or learning methods” (p. 353). De Vita (2001) indicated that “constant or total mismatching may represent too big a gap to bridge, resulting in utter frustration and disengagement” (p. 170).

Ford and Chen (2001) agreed with other researchers and stated that “the learning in matched conditions, in which instructional strategy is matched with students’ learning styles, may in certain contexts be significantly more effective than learning in mismatched conditions” (p. 6). Pask and Scott (1973) argued that the outcomes of learning were significantly affected when learners were presented with instructional materials that were matched and mismatched with their learning styles. Ford and Chen (2001) asserted that “Learning in matched conditions was significantly superior to learning in mismatched conditions” (p. 10). De Vita (2001) stated that

matching teaching style to learning styles may lead to greater motivation and participation, some mismatching, that is exposing students to learning situations that do not naturally fall within their personal learning range, may, if done with consideration, expand the spectrum of activities students feel comfortable with, and hence lead to the development of a wholly effective, more integrated learner. (p. 172)

Dunn and Griggs (1989) indicated that if and when the students were provided instruction addressing their learning strengths, the students tend to internalize more, retain the knowledge for a longer period and benefit more from the process than when they were taught without addressing their learning strengths. Packer and Bain (1978) after a study of cognitive style matching in 32 teacher-student pairs concluded that students whose learning styles were matched with teaching styles of teachers had greater ease of learning than those students whose learning styles were mismatched with the teaching styles of teachers. Dee, Nauman, Livesay and Rice (2002) after a study of biomedical engineering students at Tulane University concluded that

Mismatches between learning and teaching styles can impede student learning, have been linked to lower course grades, and make students less likely to develop or nurture an interest in course material. Implementing a variety of teaching styles within a given class period gives all of the students a chance to work in their preferred learning modes sometimes, while encouraging them to develop skills in less-preferred modes at other times. (p. 1105)

Demirel (2004a) stated that “often mismatches between learning and teaching styles arise because students are in majority visual and sensing learners, and most instructors are intuitive and reflective learners” (para. 1). Felder and Silverman (1988) confirmed that there are numerous studies which show that the majority of professors belong to intuitive dimension while the engineering students are sensors “suggesting a serious learning/teaching style mismatch in most engineering courses” (p. 676). Demirel (2004b), after a study that used workbook strategy in three engineering courses with 47, 31 and 36 students reported that

Around 90-92% of students agreed and tended to agree that:

- The workbook strategy reduced mismatches between learning and teaching styles, and hence offered a multistyle learning environment for students with various learning preferences;
- Enhanced problem-based learning, subject-specific skills and stimulated active learning; (p. 56)

Fowler, Allen, Armarego and Mackenzie (2000) after a pilot study at The School of Engineering, Murdoch University found that 80% were active, 55% were sensors, 75% were visual and 60% students were sequential learners. Broberg and Lin (2003) suggested that teaching methods to support learning styles of students should be used in order for students to learn from their preferred learning methods.

Kelley (2004) mentioned that matched styles lead to an improved level of learning and added that if the students are aware of their learning styles they learn better which in turn helps the teacher to teach by matching to the students' learning styles. Knowledge of learning styles allows the teacher to identify the students and accommodate their learning needs to achieve the course goals. Claxton and Murrell (1987) suggested that knowledge of individual learning styles would allow students to choose appropriate classes and teachers that are flexible and let them learn according to their individual learning styles. Briggs (2000), after a study of 8,531 students in 1998, revealed that students who are aware of their learning styles were excited to know about themselves, boosted their self-esteem and used that knowledge to learn better over the years. Hilgersom (1987) encouraged instructors to obtain the information of their students' learning styles, related teaching strategies and learning activities to make the process of learning more effective. Claxton and Murrell (1987) indicated that awareness of individual learning styles by the

learners gives an experience of increased self-confidence which in turn contributes to higher grades of students. This indirectly points out that awareness of learning styles will contribute to better learning experience with higher grades.

Kelley (2004) mentioned that for the learning and teaching processes to be effective, learning styles should be vital so that instruction could be designed and delivered accordingly. Dunn and Dunn (1979) found that when teaching styles are matched with learning styles, students showed an advanced level of motivation to study. Napolitano (1986) found that there was an increased level of attitudes when the students learning styles were matched with the teaching style. A couple more found that students exhibited more control of their progress when they understood their learning styles and showed a higher level of academic success (Hodges, 1987; Nelson, Dunn, Griggs, Primavera, Fitzpatrick, Bacilious, & Miller, 1993).

Kelley (2004) mentioned that matching learning and teaching styles might be a difficult situation due to different combinations of learning and teaching styles, but believes in an “obvious advantage to students when teachers understand a variety of learning styles and use this variety when teaching” (p. 53). Kelley (2004) suggested that when styles are matched students involvement in the learning process increases, attitudes and confidence to the learning material improves leading to higher motivation and better achievement and that students show higher level of interest in identifying their learning styles as the teachers match their teaching styles. Kelley (2004) added that the students who learn about their learning styles will increase their attention to develop additional learning styles and that the matching leads to enhanced classroom management. Kelley

(2004) indicated that matching of the learning and teaching styles increases regard and satisfaction between the teacher and individual students and also among the students.

Kelley (2004) encourages instructors and designers to be sensitive to student learning styles as the knowledge facilitates instructors and designers to use the best instructional methods that are appropriate and effective. Kirby (1979) mentioned that mismatch of learning and teaching styles might produce anger, avoidance and procrastination. Kelley (2004) stated that

Matching these styles leads to an increased satisfaction of learning. A student is more likely to enjoy learning when the style of learning makes sense to them. This match is also a way of showing the teacher situations where certain learning styles can hinder a student's performance. (p. 62)

Marshak (1979) mentioned that the awareness of students learning styles by the teachers allows them to employ other ways of teaching styles to improve students' performance academically. Graf and Kinshuk (2007) stated that learning becomes easier and leads to constructive effect in learning when students take courses that are developed by matching individual learning style needs. Graf and Kinshuk (2007), after a study of 137 students, found that students spent significantly less time in the course when the course matched with their learning styles "and achieved in average the same marks than students who got a course that either mismatched with their learning styles or included all available learning objects" (p. 2576). Dunn and Dunn (1998) argued that every individual learns easy things without much effort, however complicated and new material could be learned if teaching styles are matched with learning styles of the students. Price (2004) pointed out that learning styles are frequently used as a symbol to take into consideration the individual differences in learning. Price (2004) added that "The term "learning style"

when used in this way is considered to include a range of constructs describing variations in the manner in which individuals learn” (p. 681). Bajraktarevic et al. (2003) cautioned that accommodation of elements that reflect individual learning style differences is very significant in designing effective instructional material. Lovelace (2005) suggested that

on average, learning-styles responsive instruction increased the achievement or improved the attitudes toward learning, or both, of all students. Although several moderating variables influenced the outcome, results overwhelmingly supported the position that matching students’ learning-style preferences with complementary instruction improved academic achievement and student attitudes toward learning. (p. 176)

Honigsfeld and Dunn (2006) asserted that “adult males and females had significantly different learning styles, college students with higher grade-point averages had significantly different styles from those with low grade-point averages, and that learning style was statistically differentiated by participants’ ages” (p. 16). Cafferty (1980), after a study of 1,689 teacher-student paired comparisons, reported that the larger the degree of match between the teacher's Cognitive Style and the students' Cognitive Styles the greater the Grade Point Average for that group of students. Dunn and Griggs (1989) indicated that learning styles identification to provide matched instruction has become very important as course designers are being forced to meet the diverse student learning style needs. Kinshuk and Graf (2007) cautioned that learning styles was the major reason for some learners who find it easy to learn certain content when others find learning the same content difficult. Wang et al. (2006) found that learning styles “significantly affect student achievement and that they should be taken into account in the design” (p. 215).

Lovelace (2005) suggested that not every learning style element affects every individual. Dunn and Dunn (1998) stated that the preferences that were revealed were “likely to increase the ease with which that person concentrate and his or her enjoyment of doing so” (p. 8). Lovelace (2005) asserted that “Individuals’ vastly different combinations of learning-style preferences can explain why there is no single instructional method or resource that is effective for all students” (p. 177). However, Dunn and Griggs (2000) agreed that “Once learning styles have been identified, instructors can estimate the approach(es), method(s), and sequence(s) that are likely to make learning relatively comfortable for each person” (p. 19). Cassidy (2004) hinted that

research in the area of learning style is being conducted in domains outside psychology – the discipline from which many of the central concepts and theories originate. These domains include medical and health care training, management, industry, vocational training and a vast range of settings and levels in the field of education. (p. 419)

Loo (2002b) observed that

Unfortunately, the current literature appears to have largely neglected majors other than accounting and the broader distinction between hard majors (e.g. accounting, finance and production management), where quantitative and technical matters are emphasised in their business programme of studies and soft majors (e.g. human resource management, organisational behaviour and consumer marketing), where people-related concerns are emphasised in their programme (e.g. Becher, 1989; Macfarlane, 1994). Similarly, business research appears to have paid little attention to the possibility of sex differences in learning styles among business students. The examination of sex differences would be meaningful given that, more and more, women are entering business schools and women often make up the majority of student enrollments. (p. 353)

Graf and Kinshuk (2007) stated that “The most often used approach is to match the instructions to the preferences or abilities of the learners and teach according to the learners’ strengths” (p. 2576). Bajraktarevic et al. (2003) acknowledged that there would

be better performances, easier learning and increased learning efficiency if learning styles of individuals are matched with teaching styles. Graf, Lin, and Kinshuk (2007) agreed that provision of courses that match the learning style needs of learners makes the learning process much easy to the learners. Kinshuk and Graf (2007) supported that the best learning happens when “the individual needs of learners such as prior knowledge, learning styles and cognitive traits are considered” (p. 21).

Several researchers indicated that matching learning styles and teaching styles increase self-confidence and help achieve higher grades (Andrews, 1990; Bruner & Majewski, 1990; Budhu, 2002; Lenehan, Dunn, Ingram, Signer & Murray, 1994; Nelson et al., 1993; Orsak, 1990; Peña, Marzo & De La Rosa, 2002; Stash, Cristea & Bra, 2004). Several researchers acknowledged that matching learning styles and teaching styles affect the learner outcomes and satisfies the different aspects in a learning process (Kolb, 1984; O’Neil, 1990; Renzulli & Smith, 1984; Welborn, 1986). Several researchers ascertained that the research on learning styles has revealed that individual learners do well academically when the learning environments matched their individual learning styles (Border & Chism, 1992; Entwistle, 1981; Ford, 1985, 1995; Kinshuk & Graf, 2007; Kolb, 1984; McCarthy, 1980; Schmeck, 1988; Sims & Sims, 1995; Witkin, Moore, Goodenough, & Cox, 1977).

Learning Style Models and Instruments

Baldwin and Sabry (2003) ascertained that several learning style measuring models and instruments are being developed to assess and identify individuals learning styles. Smith (2002) clarified that the instruments are paper and web-based measurements. Krätzig and Arbuthnott (2006) indicated that the goal of the use of the

learning style instruments and models should not only be to identify the distinctive learning styles but the results should be used by educators to make changes and modifications of the instructional materials and methods and maximize every learner's learning experience. Koch (1998) mentioned that several instruments collect information of individuals' learning styles that could be utilized to enhance both students' learning and instructors' instruction. Krätzig and Arbutnott (2006) wrote that "learning style questionnaires can provide educators with information about respondents' preferences or self-beliefs and, thus, might assist them in structuring learning events in ways that are more popular or familiar to their students" (p. 245).

Koch (1998) mentioned that there are several definitions of learning styles that differ from one researcher or theorist to another. Koch (1998) added that there are different learning style instruments that aim at "obtaining differing concepts of an individual's learning styles" (p. 71). De Vita (2001) mentioned that the last two decades saw a rise in the development of learning style models and instruments to measure learning styles in order to assess, identify and classify learning styles and individual learning style preferences. Riding and Cheema (1991) indicated that the field of learning styles has become strong and that there are over 20 different learning style models available. In 2004, Coffield et al. (2004) identified 71 models of learning styles and argued that "many consist of rather minor adaptations of one of the leading models and therefore lack influence on the field as a whole" (p. 1).

A considerable amount of attention has been given to learning styles that paved the way for several learning style theories and instruments (Baldwin & Sabry, 2003; Felder, 1993; Felder & Brent, 2005; Felder & Henriques, 1995; Felder & Silverman,

1988; Hall, 2005; Heiman, 2006; Kolb, 1984; Lawrence, 1993; Litzinger & Osif, 1993; Manochehri & Jon, 2006; Mupinga, Nora, & Yaw, 2006; Myers & McCaulley, 1985; Price, 2004; Sheridan & Steele-Dadzie, 2005; Silverman, 2006; Ware & O'Donoghue, 2005). Without a reliable learning styles instrument, it is complicated to recognize learning styles precisely (Beaty, 1986; Dunn, Dunn, & Price, 1974, 1979, 1981, 1984, 1986, 1989, 1990, 1991, 1993, 1996; Marcus, 1977).

Keefe (1987) indicated that the review of literature on instruments related to learning styles were categorized into four concepts – personality, cognitive/ information processing, perceptual, and combination instruments. Koch (1998) specified that there is a wide range of definitions for the term learning style and there is a wide range of learning style instruments “to attempt to relate personality, cognitive/information processing, and perceptual modality preferences” (p. 81).

James and Blank (1993) identified learning styles based on the dimensions of perceptual modality, information processing, personality factors and a combination. Table 2 provides the dimensions and the list of the learning style instruments categorized as by James and Blank (1993).

Table 2

Dimensions of Learning Styles Instruments

Dimensions	Learning Styles Instruments
Perceptual Modality	<ol style="list-style-type: none"> 1. Swassing-Barbe Modality Index 2. Barbe-Milone Modality Checklist and 3. Multi-Modal Paired Associates Learning Test – Revised (MMPALT II)

Table 2 Continued

Information Processing	<ol style="list-style-type: none">1. Grasha-Riechmann's Student Learning Style Scales2. Gregoric's Style Delineator3. Hemispheric Mode Indicator4. Herrmann's Brain Dominance Inventory5. Kolb's Learning Style Inventory6. Schmeck's Inventory of Learning Processes, and7. Witkin's Group Embedded Figures Test
Personality Factors	<ol style="list-style-type: none">1. Canfield's Learning Styles Inventory2. Gardner's Multiple Intelligences Theory3. Honey and Mumford's Learning Styles Questionnaire4. Keirsey Temperament Sorter5. Myers-Briggs Type Indicator6. Silver and Hanson's Teaching, Learning, and Curriculum Model for Learning Preference Inventory; Learning Style Inventory; and Teaching Style Inventory7. Sternberg's Thinking Styles Questionnaire
Combination	<ol style="list-style-type: none">1. Center for Innovative Teaching Experiences (CITE) Learning Styles Instrument2. Dunn, Dunn, and Price's Productivity Environmental Preference Survey (PEPS)3. Hill's Cognitive Style Mapping, and4. National Association for Secondary School Principals' Learning Style Profile.

Each learning styles instrument pertaining to perceptual modality, information processing, personality factors and the combination are explained further.

Perceptual Modality Instruments

1. Swassing-Barbe Modality Index

The Swassing-Barbe Modality Index was developed to measure the strength of three modalities - auditory, visual, and kinesthetic to find out one's ability to perform an academically relevant task in each of the major modalities. The instrument consists of

three sets of matching-to-sample tasks. Barbe and Swassing (n.d.) confirmed that the instrument is short, simple and could be used for identifying learning modalities. Barbe, Swassing and Milone (1979) added that it could be used to identify the modalities of individuals of all age groups. James and Blank (1993) mentioned that the instrument tests the “recall of sensory data within three modalities” (p. 52).

2. *Barbe-Milone Modality Checklist*

Barbe and Milone developed the Barbe-Milone Modality Checklist in the year 1979 which measures the same modalities that the Swassing-Barbe Modality Index has measured – auditory, visual and kinesthetic modalities. However, the Checklist instrument is for instructors who are interested in comparing their student learning styles with their own learning styles. Koch (1998) described that it consists of a “series of ten incomplete sentences that were designed to approximate the relative strength of the individual” (p. 80). James and Blank (1993) mentioned that the Checklist requires an individual to check the one statement that is most like them and has 10 sets of three statements.

3. *Multi-Modal Paired Associates Learning Test – Revised (MMPALT)*

Multi-Modal Paired Associates Learning Test (MMPALT) is a performance test that measures recall of paired information in each of the seven perceptual modalities - print, aural, interactive, visual, haptic, kinesthetic, and olfactory. Cherry (1981) stated that it is “a seven-set paired associates learning test designed to rank order the perceptual modality strengths and weaknesses of each subject through objective measurement” (p. 16). James and Blank (1993) mentioned that the test consists of “seven performance

based subtests often items, each covering seven sensory modalities” (p. 52). Cherry (1981) developed the Perceptual Modality Preference Survey (PMPS). Koch (1998) mentioned that “Although both instruments provide data on perceptual modality preferences, the MMPALT gathers information extracted by the senses to measure demonstrated learning style which may differ from measurements of an individual’s self-perceived learning style” (p. 89). Koch (1998) stated that “MMPALT-II is administered to an examinee to measure demonstrated elements of learning style; whereas, the PMPS is a self-report instrument which measures perceived learning style” (p. 94).

Information Processing Instruments

1. Grasha-Riechmann’s Student Learning Style Scales

Cassidy (2004) described the Grasha-Reichmann’s Student Learning Style Scale places learners in independent/ dependent, collaborative/competitive, and participant/avoidant level and type of interactions. Jonassen and Grabowski (1993) described the scale as a social interaction 90 item-scale. Curry (1991) mentioned that the scale contains a self-report 5 point Likert-type scale along the three bipolar scale dimensions of independent-dependent, avoidant-participant, collaborative-competitive.

2. Gregorc’s Style Delineator

Gregorc’s (1982) Mind Styles Model and Style Delineator (GSD) measures four distinctive behaviors: abstract, concrete, random and sequential tendencies and an individual style is the combination of each of these tendencies – abstract sequential, abstract random, concrete sequential and concrete random. Coffield et al. (2004) pointed out that out of the four categories, an individual tends to be either strong in one or two of the categories.

Cassidy (2004) described the four categories as

concrete-sequential, featuring direct, step-by-step, orderly, sensory-based learning; concrete random, featuring trial and error, intuitive and independent approaches to learning; abstract sequential, featuring analytic, logical approaches and a preference for verbal instruction; and abstract random, featuring a preference for holistic, visual, experiential, and unstructured learning. (p. 429)

Truluck and Courtenay (1999) described that the GSD was a cognitive instrument that is self-reporting and reveals the mediation abilities of ordering and perception. Zhang and Sternberg (2005) pointed out that the inventory consists of four words of 10 columns with a total of 40 words and that the GSD takers are expected to rank the four words according to their preference for receiving and processing information.

3. *Hemispheric Mode Indicator*

Saleh (2001) described that an individual's capacity of the use of either the left or right hemispheres or the combination of both to process instructional material is called brain hemisphericity. McCarthy's Hemispheric Mode Indicator (HMI) instrument was developed to determine each individual's use of brain hemisphericity with reference to an individual's learning. The instrument consists of 32 pair bi-polar statements to rate on a Likert scale (James & Blank, 1993). Saleh (2001) described the instrument that

each item consists of a continuum between two adjectives, such as "neat" and "sloppy." On the continuum, there are four choices, the subject either chooses "a lot" or "somewhat" from one side of the continuum or "a lot" or "somewhat" from the other side of the continuum. The participant chooses one adjective and the degree to which he/she exhibits this characteristic for each item and then self scores the questionnaire. The high negative scores on the HMI continuum are associated with a left hemispheric mode, and the high positive scores are associated with a right hemispheric mode. Scores between -8 and +8 on the continuum are associated with whole-brain dominance. (para. 10)

4. *Herrmann's Brain Dominance Inventory*

Herrmann's inventory was based on the four quadrants of physical brain. She (2005) mentioned that the four quadrants were labeled counter clockwise as A, B, C, and D from the left cerebral quadrant. The inventory measured the external learning, procedural learning, interactive learning and internal learning. The quadrant A which is the upper left cerebral quadrant deals with external learning and is logical, technical, analytical, factual, critical and mathematical. The quadrant B is the lower limbic left quadrant and deals with procedural learning and is structured, sequential, organized, detailed, and planned. The quadrant C is the lower limbic right quadrant and deals with interactive learning and is emotional, interpersonal, kinesthetic, listening, feedback, sharing ideas and experiencing sensory input. The quadrant D is the upper right cerebral quadrant and deals with internal learning and is holistic, visual, innovative, conceptual and imaginative.

5. *Kolb's Learning Style Inventory*

Cano-Garcia and Hughes (2000) pointed out that the Kolb's Learning Style Inventory (LSI) uses experience as the major component of learning. Kolb integrated diverse elements of the learning models proposed by Lewin, Dewey and Piaget, and suggested an experimental cyclical model (Cano-Garcia & Hughes, 2000). Experience and the analysis of the experience can help to form concepts which, once assimilated and organized, may be applied to new experiences. Learning is considered a process that creates knowledge through the transformation of experience.

Kolb (1984) designed the Learning Styles Inventory (LSI) to measure the four individual learning styles, preferences or primary adaptive modes proposed by his theory:

Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualisation (AC) and Active Experimentation (AE). The four learning styles according to Kolb are Diverger (prevalence of CE and RO); Assimilator (AC and RO); Converger (AC and AE); and Accommodator (CE and AE). For example, Cano-Garcia and Hughes (2000) mentioned that “Divergers are learners who perceive information ‘concretely’ and process it ‘reflectively’, and who are typically imaginative, creative and have a wide range of cultural interests” (p. 416). James and Blank (1993) stated that the inventory “involves rank ordering four choices within twelve sets of statements” (p. 52).

6. *Schmeck’s Inventory of Learning Processes,*

Schmeck, Ribich, and Ramaniah (1977) revealed that the self – report instrument Schmeck’s Inventory of Learning Processes (ILP) was developed to measure individual differences in a learning process such as “encoding, organization, imagery and depth of processing” (p. 413) “using behaviorally oriented statements to assess important learning processes in the academic setting” (p. 414). The four factors of ILP are synthesis-analysis, study methods, fact retention and elaborative processing. Curry (1991) mentioned that the ILP can be used to assess every day learning behavior and conceptual processes involved to learn fresh material, with 62 written items in the format of true or false that are classified into four scales synthesis-analysis, study methods, fact retention and elaborative processing.

7. *Witkin’s Group Embedded Figures Test*

The Group Embedded Figures Test (Witkin, Moore, Goodenough, and Cox, 1977), was initially developed as a paper-and-pencil test in the year 1971 which was later modified in 1977. Koch (1998) stated that the modification occurred to achieve the goal

of matching teaching methods to individual “cognitive processing style to increase student achievement and self-esteem results in the classroom” (p. 73). The Group Embedded Figures Test is an instrument of 18 pictorial items which were used to score for accuracy and time. Curry (1991) pointed out that each of the pictorial items consisted of locating non-meaningful geometric target shapes that are hidden within a larger non-meaningful geometric shapes. The score of the instrument reveals a respondent’s tendency to function at a more differentiated or less differentiated level. Zhang and Sternberg (2005) stated that “The test takers are presented with 8 simple figures and 25 complex figures. One of the 8 simple figures is embedded within each of the 25 complete figures” (p. 31). One is expected to locate the 8 simple figures in three timed sections of 2, 5 and 5 minute duration.

Personality Factors Instruments

1. Canfield’s Learning Styles Inventory

Canfield's Learning Style Inventory (Canfield & Cafferty, 1988) is a questionnaire that requires self-reporting with 30 attitudinal items that describe the students’ preferred learning styles modalities. Keri (2002) indicated that each participant is expected to rank the responses for every item on a four-point scale, which is ipsative that ranges from a (1) for the most liked choice to a (4) for the least liked choice. The eight subscales of the instrument represent the conditions for learning - four for dealing with areas of interest and four modes of learning scales. An item for which students are expected to predict their course final grade is also included in the inventory.

2. *Gardner's Multiple Intelligences Theory*

Gardner's Multiple Intelligences Theory suggests that every individual possesses several unique forms of intelligence in different levels. Howard Gardner proposed eight intelligences - verbal/linguistic, visual/spatial, musical, body-kinesthetic, logical-mathematical, intrapersonal, interpersonal and naturalistic. Sherow (2006) mentioned that the implication of the theory is for learning to be focused on each individual's specific intelligences. The verbal/linguistic intelligence is the use of language and words, the visual/spatial is to perceive the visual, kinesthetic is to use body movements and skilful handling of objects, mathematical is to make use of logic, numbers and reason, intrapersonal is to reflect on one's own status, interpersonal is relating to others and naturalistic is to observant of environment.

3. *Honey and Mumford's Learning Styles Questionnaire*

Honey and Mumford (1992) developed an instrument 'Learning Style Questionnaire' (LSQ) of 80 agree/disagree questions and was primarily meant for management trainees and measured the four learning styles -activist, reflector, theorist and pragmatist. Coffield et al. (2004) mentioned that "LSQ probes the attitudes and behaviours which determine preferences with regard to learning. To be used for personal/organizational development and not for assessment/selection. Not a psychometric instrument, but a checklist about how people learn" (p. 76).

4. *Keirsey Temperament Sorter*

The Keirsey Temperament Sorter (Keirsey & Bates, 1978, 1984) is a 70 bi-polar self-report question instrument that surveys personality. First published in 1978, it was used in more than 120 countries by more than 35 million people. The instrument was

developed to help individuals discover their personality type. The instrument is based on Dr. David Keirsey's Temperament theory. The four temperaments are the guardian, rationalist, idealist and artisan.

5. Myers-Briggs Type Indicator

Myers (1962) indicated that the instrument was based on the theory that different individuals learn differently by using different but effective problem solving techniques. Curry (1991) described that the Myers-Briggs Type Indicator (MBTI) consists of 142 forced choice questions. The questions have four alternatives to choose from and every alternative is aggregated towards one of the four bipolar concepts that contrast the types of cognitive controls: extraversion v. introversion; sensing v. intuition, thinking v. feeling and judgment v. perception. Koch (1998) mentioned that the instrument uses forced-choice questions and word pairs to reveal the “16 different varieties of possibilities from each of the four elements” (p. 72). Coffield et al. (2004) described MBTI as an instrument that has provided “a view of whole personality including learning” (p. 51) and added that “The MBTI, while it focuses on the personality type of the individual, has a well-established role in locating and understanding interpersonal and community dynamics” (p. 50). Felder and Silverman (1988) described that MBTI measures “the degree to which an individual prefers sensing or intuition”.... and that it was taken by “hundreds of thousands of people and the resulting profiles have been correlated with career preferences and aptitudes, management styles, learning styles, and various behavioral tendencies” (p. 676).

6. *Silver and Hanson's Teaching, Learning, and Curriculum Model*

James and Blank (1993) indicated that the Curriculum Model is the basis for several other instruments for teachers and students such as for Learning Preference Inventory (Silver & Hanson, 1978), Teaching Style Inventory (Silver & Hanson, 1980a) and Learning Style Inventory (Silver & Hanson, 1980b). There are 30 pairs of four self-description items that should be ranked according to their preference in the Learning Style Inventory.

7. *Sternberg's Thinking Styles Questionnaire*

Coffield et al. (2004) described that Sternberg's Thinking Styles Inventory (TSI) (Sternberg, 1999) was based on his theory called 'mental self-government' and proposed 13 thinking styles with eight statements rated on a 1-7 Likert-type scale, depending on four forms, three functions, two scope, two levels and two leanings of government. Sternberg chose oligarchic, hierarchic, monarchic and anarchic forms of government; three functions of government namely judicial, legislative and executive; the two scopes are internal and external; global and local levels of government; and conservative and liberal leanings. Zhang and Sternberg (2005) mentioned that the instrument is a self-report measure with 65-items which requires respondents to rate themselves on a 7-point scale.

Combination Instruments

1. *Center for Innovative Teaching Experiences (CITE) Learning Styles Instrument*

The participants are expected to self-report the 45 questions for the Learning Styles Instrument of CITE. The nine styles of CITE instruments are auditory and visual

language, auditory and visual numerical, auditory- visual- kinesthetic combination, individual and group learner, oral and written expressive.

2. *Dunn, Dunn, and Price's Productivity Environmental Preference Survey (PEPS)*,

Lovelace (2005), after an experimental research conducted between 1980 and 2000 using Dunn and Dunn Learning-Style model, concluded that the model has a “robust moderate to large effect that was practically and educationally significant” (p. 176). Koch (1998) mentioned that Dunn and Dunn have identified 18 diverse elements of four basic stimuli of emotional, environment, physical, and emotional domains. Coffield et al. (2004) added that Dunn and Dunn model is “A user-friendly model that includes motivational factors, social interaction, physiological and environmental elements” (p. 35). Coffield et al. (2004) recorded that

Over 25 years, Dunn and Dunn have produced the following self-report instruments: the Dunn and Dunn Learning Styles Questionnaire (LSQ) (1979), the Dunn, Dunn and Price Learning Styles Inventory (LSI), (1992, 1996), the Dunn, Dunn and Price Productivity Environmental, Preference Survey (PEPS) (1996), the Building Excellence Survey (BES) (2002), Our Wonderful Learning Styles (OWLS) 2002. The instruments are supported by the following resources and material for teaching and homework: Contract Activity Packages (CAPs), Programmed Learning Sequences (PLSs), Multi-Sensory Instructional Packages (MIPs). (p. 23)

3. *Hill's Cognitive Style Mapping (CSM)*

Jonassen and Grabowski (1993) mentioned that the Cognitive Style Mapping is an instrument to determine a learner's cognitive style that was developed by Joseph E. Hill. It is a self-report inventory of 224 items.

4. *National Association for Secondary School Principals' Learning Style Profile.*

Rollins and Scholl (1992) stated that the instrument Learning Style Profile (LSP) was developed by the National Association of Secondary School Principals consisted of

23 subscales. The subscales provide data for three major areas of cognition, perceptual learning styles, and the response to study and instructional environments. James and Blank (1993) mentioned that the LSP has 126 items.

Other Learning Style Instruments

There are several other learning styles models and instruments. Some of them are listed as follows:

- Allinson and Hayes' Cognitive Styles Index (CSI),
- Apter's Motivational Style Profile (MSP),
- Entwistle's Approaches and Study Skills Inventory for Students (ASSIST),
- Friedman and Stritter Instructional Preference Questionnaire (1976),
- Jackson's Learning Styles Profiler (LSP),
- Jerome Kagan's Matching Familiar Figures Test,
- Learning Preference Scale: Students (LPSS),
- Pinchas Tamir's Cognitive Preference Inventory (1976),
- Rezler and Rezmovic Learning Preference Inventory (1974)
- Riding's Cognitive Styles Analysis (CSA), and
- Vermunt's Inventory of Learning Styles (ILS)

Allinson and Hayes' Cognitive Styles Index (CSI):

Cassidy (2004) summarized that Allinson and Hayes' Cognitive Styles Index (CSI) was developed in 1996 "in an effort to operationalise cognitive style for use in the area of management. It focuses on the dimension of intuition versus analysis that represents a super ordinate dimension of cognitive style" (p. 430).

Apter's Motivational Style Profile (MSP):

Kerr, Au, and Lindner (2004) mentioned that Apter's Motivational Style Profile (MSP) "has subscales that measure metamotivational dominance for all four metamotivational state dyads in reversal theory (i.e. telic-paratelic, negativistic-conformist, mastery-sympathy and autic-alloic states), as well as for arousal avoiding-arousal seeking and optimism-pessimism" (p. 1246). The salience of each dimension compared to the other dimension is also measured by the MSP.

Entwistle's Approaches and Study Skills Inventory for Students (ASSIST):

Coffield et al. (2004) stated that the goal of Entwistle's Approaches and Study Skills Inventory for Students (ASSIST) model is to include several approaches to study strategies, intellectual development skills, learning, and attitudes in higher education and it "assesses study/learning orientations, approaches to study and preferences for course organization and instruction" (p. 102). Vermunt and Vermetten (2004) mentioned that the inventory consists of scales in the domains of cognitive processes like deep, surface, strategic and apathetic approaches, study motivation and affection like "active interest, fear of failure, intention to excel and lack of direction" (p. 360). Boyle, Duffy, and Dunleavy (2003) mentioned that Vermunt's model was prominent in Holland's higher education.

Friedman and Stritter Instructional Preference Questionnaire:

Curry (1991) mentioned that Friedman and Stritter Instructional Preference Questionnaire (1976) consists of 40 items that were self-reported in 6-point Likert-type scale and described the learning preferences for pacing, media, active role in learning, influence over learning, and the feedback during learning.

Jackson's Learning Styles Profiler (LSP):

Coffield et al. (2004) acknowledged that in the Jackson's Learning Styles Profiler (LSP) initiator, analyst, reasoner and implementer were discussed and is considered as "a sophisticated instrument in terms of its theory base and computerized format, designed for use in business and education" (p. 59).

Jerome Kagan's Matching Familiar Figures Test:

Curry (1991) mentioned that the Jerome Kagan's Matching Familiar Figures Test concept came into existence in order to measure the degree that people will reflect on the validity of solution hypotheses in problems that consists of response uncertainty. The test is made up of 12 visual meaningful items of line drawings and requires matching to an available target. The score places the respondent on a bipolar scale that measures conceptual tempo or a tendency to venture answers after cursory as opposed to careful search labeled as reflectivity v. impulsivity.

Learning Preference Scale: Students (LPSS):

The Learning Preference Scale: Students (LPSS) was developed by Owens and Straton. The scale has 30 true or false statements to which the participants were expected to respond. Sonnenwald and Li (2003) mentioned that the LPSS statements were "regarding preferences with respect to working with peers, competing with peers, and having no involvements with others, indicating cooperative, competitive and individualistic learning preferences" (p. 424).

Pinchas Tamir's Cognitive Preference Inventory:

Curry (1991) described that Pinchas Tamir's Cognitive Preference Inventory was an instrument developed with 18 items of four statements each to be rank ordered which

signify four modes of recalling, questioning, principles and application that students use to deal with scientific information.

Rezler and Rezmovic Learning Preference Inventory:

Curry (1991) detailed that Rezler and Rezmovic Learning Preference Inventory (1974) was developed to identify the individuals' preferred modes of learning, with the preference defined as a choice made by an individual of one learning situation or condition over another. The inventory is comprised of 15 items with six choices to be rank ordered. The choices are descriptive of three bipolar concepts: abstract v. concrete, student structure v. teacher structure, and individual v. interpersonal.

Riding's Cognitive Styles Analysis (CSA):

Coffield et al. (2004) mentioned that the strength of Riding's Cognitive Styles Analysis (CSA) was that an individual's learning strategies could be learned and improved. Coffield et al. (2004) added that the assessment was computerized and does not self-report but presents cognitive tasks in such a way that it is not evident to the participant exactly what is being measured. The test items in the CSA for the holist-analytic dimension are all visual, and the scoring is based on a comparison of speed of response (not accuracy) on a matching task (holist preference) and on an embedded figures task (analytic preference).

Vermunt's Inventory of Learning Styles (ILS):

According to Cassidy (2004), Vermunt's Inventory of Learning Styles' (ILS) is a diagnostic tool to be used in higher education. Coffield et al. (2004) described Vermunt's ILS as an instrument that concentrates on the learning and thinking of university students, and was used to study the learning styles of teachers and student teachers. Vermunt and

Vermutten (2004) mentioned that the instrument was developed as part of a research project and the first results were reported in Dutch. The final version contains 120 statements and students were expected to indicate their choices on a scale of 1-5.

Vermunt and Vermutten (2004) stated that the statements cover “cognitive processing strategies, metacognitive regulation strategies, conception of learning, and learning orientations” (p. 364). Cassidy (2004) indicated that it describes

the concept of learning style in terms of processing strategies, including an awareness of the aims and objectives of the learning exercise used to determine what is learnt; regulation strategies, which serve to monitor learning; mental models of learning, encompassing the learner’s perceptions of the learning process; and learning orientations, described as personal aims, intentions and expectations based on past experience of learning. (p. 432)

Instrument – Index of Learning Styles

Yannibelli et al. (2006) indicated that efforts were made to apply learning style theories and instruments to educational and learning environments. The Index of Learning Styles (ILS) instrument was one of the instruments that was used to integrate learning styles into instruction and develop a motivating learning experience for the learners. The initial version was created in 1991. A new version was created in 1994 and was made available on the internet in 1996 as a paper-pencil version. The online version was made possible in 1997. The survey is available at no cost for individuals who wish to determine their own learning style and for educators to teach, advice or research.

Designed to be completed online and automatically scored with the score reported immediately to the user, the instrument is available at no cost. Dee et al. (2002) described the instrument as a short questionnaire, easy-to-use tool to assess students’ learning styles, and the focus is on the cognitive processes and does not require professional scoring.

Baldwin and Sabry (2003) stated that while the learning styles and models “are not without their critics or weaknesses, one of the most frequently used is the Index of Learning Styles developed by Felder and Solomon” (p. 329). They further added that they chose the instrument for their study “because of its applicability to online learning and its relevance to the principles of interactive learning systems (ILSs) design” (p. 329). It is a well-investigated and used often to identify learning styles (Graf & Kinshuk, 2007; Graf, Viola, Kinshuk, & Leo, 2006; Graf, Viola, Leo, et al. 2007; Kinshuk & Graf, 2007). ILS is also the most suitable instrument to be used in development of adaptive systems (Carver, Howard & Lane, 1999; Graf & Kinshuk, 2007; Kuljis & Liu, 2005). Graf, Viola, Kinshuk et al. (2006) focused on the ILS model for their study as it is “a learning style model that is often used in technology enhanced learning but is designed for traditional learning” (p. 2). De Vita (2001) agreed that

Felder and Silverman’s learning style model (1988), which was first applied in the context of engineering education, categorizes students’ preferences in terms of type and mode of information perception (sensory or intuitive; visual or verbal), approaches for the organization and processing of information (inductive or deductive; active or reflective), and the rate at which students progress towards understanding (sequential or global). (p. 166)

Laight (2004) agreed that ILS could be used to assess the unique strong and weak learning style characteristics that each individual possesses. Laight (2004) added that the instrument was mainly developed in “the context of engineering science and has been favorably evaluated by Multimedia Educational Resource for Learning and Online Teaching” (p. 230). Baldwin and Sabry (2003) confirmed that they used the research instrument to explore three important aspects of learners - the actual learning styles that were exhibited by the learners, the learning styles that have to be developed so that the

learners could obtain specific skills that are relevant to the aims and objectives of a particular course and the percentage of learners who show signs of a particular learning style. The ILS classifies students into four dimensions – perception, input, processing and understanding (See Table 3).

Table 3

Four Dimensions of Learning Styles

Dimensions	Learning Styles
Perception	Sensory/Intuitive
Input	Visual/Verbal
Processing	Active/Reflective
Understanding	Sequential/Global

Perception denotes what information students prefer to perceive using the sensing and intuitive dimension, input indicates which channel the student’s use to effectively perceive external information – visual and verbal dimension. Processing indicates how preferred information is perceived – active and reflective dimension, and understanding denotes how a student progresses to understand information – sequential and global (Villaverde, Godoy & Amandi, 2006; Yannibelli, et al., 2006).

De Vita (2001) acknowledged that the instrument “was chosen against competing alternatives because it has been explicitly developed for classroom application and, though suitable to profile individual learning preferences” (p. 168). Laight (2004) considered that the Felder and Silverman model measured the dichotomous dimensions of learning and were concerned with students’ preferences: - perceive information either

by being sensing or intuitive, take in information either visually or verbally, organize and process either by being active or reflective, and how they understand information either sequential or global. Several models place learners in groups while the ILS describes the learner's unique learning styles in a detailed manner (Graf, Lin, Jeffrey, & Kinshuk, 2006; Graf & Kinshuk, 2006a, 2006b, 2007; Graf, Viola, Kinshuk, et al., 2006). The survey questions are related to four dimensions with 11 questions for each dimension – active/reflective, sensing/intuitive, sequential/global and visual/verbal. Yannibelli et al. (2006) described that the ILS categorizes an individual student's learning style “by a sliding scale of these four dimensions and it is possible, for example, to have a student who is characterised by the sensory/verbal/active/sequential style” (p. 57). Baldwin and Sabry (2003) ascertained that the 44-element instrument “develops preference profile on the dimensions” (p. 331).

Baldwin and Sabry (2003) described the Index of Learning Styles as an instrument that “categorizes a person's learning preferences in terms of information perception (sensory–intuitive; visual–verbal), information processing and organization (inductive–deductive; active–reflective) and progress towards understanding (sequential–global)” (p. 331). Dee et al. (2002) stated that the instrument:

summarizes self reported preferences concerning whether a person prefers to process information actively or in a reflective manner, understand information in a sequential or a global fashion, receive information visually or verbally, and focus on and recall sensory information - what is seen, heard, etc. or intuitive information - ideas, theories, possibilities! (p. 1110)

Baldwin and Sabry (2003) developed a “preference profile on the dimensions” (p. 331) that describes the four learning style ILS dimensions as developed by Felder and Solomon (See Table 4).

Table 4

Learning Style Dimensions

Dimensions		Categorization	Preferences
Active - Reflective	Active	Information processing: through active and interactive engagement in physical activity or discussion	Like trying things, discussing what they learn, applying it or explaining it to others. Tend to like group work. Find it hard sitting in lectures only taking notes without doing something active.
Active - Reflective	Reflective	Information processing: through introspection.	Prefer to think about what they learn quietly first. Prefer working alone. Find it hard sitting in lectures only taking notes without being given the chance to reflect on what has been learned.
Sensing- Intuitive	Sensing	Perception of information: sights, sounds, physical sensation.	Tend to like learning facts, solving problems using familiar and well- established methods and dislike complications, surprises, to be tested on material that has not been fully covered in class. Tend to be patient with details and good at memorizing facts and doing hands-on (laboratory) work. Tend to be more practical and careful; do not like courses that have no apparent connection to the real world. Remember and understand information best if they can see how it connects to the real world.

Table 4 (Continued)

Sensing– Intuitive	Intuitive	Perception of information: memories, ideas, insights.	Like innovation and prefer discovery-based approaches, finding relationships, dislike repetition and impatient with details. Good at grasping new concepts and are often more comfortable with abstractions and mathematical formulations. Tend to work faster. Get bored with courses that involve a lot of memorization, rote learning and routine operations.
Visual– Verbal	Visual	Perception of sensory information: pictures, diagrams, graphs, demonstration.	Tend to remember best what they see: static pictures (e.g. diagrams) or dynamic pictures (e.g. videos, DVDs).
Visual– Verbal	Verbal	Perception of sensory information: sounds, written, spoken words, formulas.	Tend to get more out of words (written and spoken explanations).
Sequential – Global	Sequential	Progress towards understanding: in logical and small incremental steps.	Tend to gain understanding/find solutions in linear manner, with steps following each other logically. Sequential learners may not fully understand the material or establish a link with other parts, but able to know a lot about specific aspects of a subject.

Table 4 (Continued)

Sequential – Global	Global	Progress toward understanding: in non-linear way, large jumps, holistically.	Tend to learn in large jumps, absorb material almost randomly, and may be able to solve complex problems quickly. Strongly global learners may be fuzzy about details or have serious difficulties understanding until they have the big picture.
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Bacon (2004) described the index of learning styles survey as follows:

Felder developed a learning style measure comprising four dimensions. The first dimension, sensing versus intuitive learners, distinguishes between learners who prefer concrete, practical facts and procedures (sensors) and learners who prefer conceptual or theoretical information (intuitors). The second dimension, visual versus verbal learners, distinguishes between learners who prefer pictures, diagrams, or charts (visuals) and learners who prefer written or spoken explanations (verbals). The third dimension, active versus reflective learners, distinguishes between learners who prefer to learn by trying things out or working with others (actives) and learners who prefer thinking things through and working alone (reflectives). Finally, the fourth dimension, sequential versus global learners, distinguishes between learners who prefer linear, orderly learning in steps (sequentials) and learners who are more comfortable with holistic approaches and learn in large leaps (globals). (p. 205)

The preferences of the learning styles are expressed with the values +11 to -11 for each dimension. The questions are forced-choice items with two options with an answer *a* of value +1 and an answer *b* of value -1. Graf, Viola, Leo and Kinshuk (2007) explained as follows:

When answering a question, for instance, with an active preference, +1 is added to the value of the active/reflective dimension whereas an answer for reflective preference decreases the value by 1. Answer *a* corresponds to the preference for the first pole of each dimension (active, sensing, visual, or sequential), answer *b* to the second pole of each dimension (reflective, intuitive, verbal, or global. (p. 82)

Baldwin and Sabry (2003) stated that “the results from the ILS questionnaire were obtained through adding scores using a scoring sheet to determine different strength scales (mild, moderate and strong)” (p. 331). Graf, Lin and Kinshuk (2005)

Each learner has personal preference for each dimension. These preferences are expressed by values between +11 to -11 per dimension. Using the active-reflective dimension as an example, the value +11 means that a learner has strong preferences for active learning, whereas the value -11 states that a learner has strong preferences for reflective learning. Thus, each learner can be characterized by four values between +11 and -11, each for one dimension. (p. 38)

Graf, Lin, Jeffrey et al. (2006) stated that the learning preferences “are considered tendencies indicating that it is possible that learners with a high performance for certain behaviour may sometimes act differently” (p. 471). Graf and Kinshuk (2007) stated that “These values represent tendencies, saying that even a learner with, for example, a strong active learning style can act sometimes in a reflective way” (p. 2577). Viola, Graf, Kinshuk, and Leo (2007) after another study of 207 individuals conducted at Vienna University of Technology and at Massey University in New Zealand, found that the visual learning style has strongly influenced the active learning style, and that active learners learn better from charts and diagrams. Felder and Silverman (1988) concluded that “any individual—even a strong sensor or intuitor — may manifest signs of either type on any given occasion” (p. 676). Viola, Graf and Kinshuk (2007) after a study of 469 students at Vienna University of Technology and at Massey University in New Zealand found that “because of the dependencies between styles, some styles overlap each other” (p. 238).

The ILS expects the participants to select the most appropriate answer for each question. The scores were added to determine whether a participant's strength level is mild, medium or strong. A mild learning style ranges from 1-3, the medium/moderate from 4-6 and the strong from 7-10 in the respective learning style. Graf and Kinshuk (2007) stated that they have "distinguished the preferences only as strong, moderate and balance (e.g. strong active, moderate active, balanced, moderate reflective, and strong reflective preference) rather than values between +11 to -11 for each dimension" (p. 2580).

Baldwin and Sabry (2003) described the mild preference as essentially well-balanced i.e. the learner has no learning difficulties if the teaching style used goes toward each style of that dimension. Baldwin and Sabry (2003) described the moderate preference where the learner learns more easily using a teaching style that accommodates the preferred learning style of that dimension. Baldwin and Sabry (2003) explained the strong preference where the learner may have difficulties if the teaching style used does not accommodate his/her preferred learning style of that dimension.

Active and Reflective

The dimension of processing information distinguishes between reflective and active preferences of a learner (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). The learners who are reflective learn by thinking about the learning material and tend to learn on their own without any communication with others (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). Felder and Silverman (1988) ascertained that learners who are active are those who actively do something in a class other than simple listening and watching but involves in discussion, question and answers, argument,

brainstorming, and or reflection. Active learners learn best by actively working with the learning material, by the application of it in real life situations, by trying things out manually, and are interested in discussing the material mostly in groups (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007).

Felder and Silverman (1988) described an active learner to be one who is comfortable with or better at “active experimentation than reflective observation and conversely for a reflective learner” (p. 678). Yannibelli et al. (2006) ascertained that a student who is active is more comfortable with active experimentation which means “doing something in the external world with the perceived information (discuss the information, explain or evaluate it in some way)” (p. 57). Yannibelli et al. (2006) stated that reflective learners depend on reflexive observation which means “the examination and manipulation of the information introspectively” (p. 57). Yannibelli et al. (2006) described that active students learn much in active situations and does not learn much in passive situations and reflexive students do not learn much if they are not given an opportunity to think about the information presented. Graf, Viola, Leo et al. (2007) after a study in which 207 students were surveyed, found that the active learners preferred more to try something out by themselves, less being involved in discussion groups and explanation of the learning material to others and that reflective learners preferred to think and reflect on the learning material individually. Graf and Kinshuk (2007) mentioned that active learners do not pay attention to examples as they “show how others have done something rather than let them doing it by themselves” (p. 2577). Active learners are comfortable and learn better in a group setting requires participation and that

reflective learners are comfortable and learn better on their own or with another person (Villaverde et al., 2006; Yannibelli et al., 2006).

Felder and Silverman (1988) found that engineers are mostly active learners. Felder and Silverman (1988) added that the individuals, who evaluate an idea, design and carry out an experiment, and find the solutions that work or the organizers and the decision-makers are all active learners. Felder and Silverman (1988) added that the individuals who are theoreticians or the mathematical modelers or the ones who can define a problem and propose possible solutions are all reflective learners.

Felder and Silverman (1988) made a clear distinction between active and reflective learners as tabulated in Table 5. The differences include working with others or by themselves, experimentalists and theoreticians.

Table 5

Differences between Active and Reflective Learners

Active learners	Reflective learners
do not learn much in situations that require them to be passive (such as most lectures)	do not learn much in situations that provide no opportunity to think about the information being presented (such as most lectures).
work well in groups	work better by themselves or with at most one other person.
tend to be experimentalists	tend to be theoreticians

Sensing and Intuitive

The learners who are sensing learn from facts and material that is concrete using standard approaches to solve problems, being more patient with details, more sensible, realistic and practical than learners who are intuitive who make connections with the learned content (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). Intuitive learners learn the abstract instructional material of theories, meanings of the theories, discover relationships and possibilities, and are innovative and creative (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). Science education addresses the dimension of intuitive learning with the presentation of interpretation and concepts instead of facts and observations which are the tools for sensing dimension (Felder, 1993; Laight, 2004). Graf, Viola, Leo et al. (2007), found that sensing learners preferred concrete learning material and intuitive learners preferred abstract material and were not interested in details. Felder and Silverman (1988) ascertained that “A student who favors intuitive over sensory perception, for example, would respond well to an instructor who emphasizes concepts (abstract content) rather than facts (concrete content)” (p. 674).

Sensory learners are slow to react when problems are given but come up with a better solution while intuitive learners are quick in solving problems and do not pay much attention to details causing occasional errors (Villaverde et al. 2006; Yannibelli et al., 2006). Facts, experiments and data were preferred by sensing learners, and principles and theories were preferred by the intuitive learners (Yannibelli et al., 2006). Yannibelli et al. (2006) indicated that sensors are those individuals who are patient with details, gets annoyed by problems, careful but can be slow. Yannibelli et al. (2006) stated that intuitors are problem solvers, fast workers but are “usually careless and prone to errors”

(p. 57). Felder and Silverman (1988) have marked a clear distinction between sensors and intuitors as tabulated in Table 6.

Table 6

Differences between Sensors and Intuitors

Sensors	Intuitors
like facts, data and experimentation	prefer principles and theories
like solving problems by standard methods and dislike “surprises”	like innovation and dislike repetition
are patient with detail but do not like complications	are bored by detail and welcome complications.
are good at memorizing facts	are good at grasping new concepts
careful but may be slow	are quick but may be careless
sensors’ slowness in translating words puts them at a disadvantage in timed tests: since they may have to read questions several times before beginning to answer them, they frequently run out of time.	are more comfortable with symbols than are sensors. Since words are symbols, translating them into what they represent comes naturally to intuitors and is a struggle for sensors. May also do poorly on timed tests but for a different reason—their impatience with details may induce them to start answering questions before they have read them thoroughly and to make careless mistakes

It was estimated that in general, the American population consists of 75% sensors and 25% intuitors (Jacob & Shoemaker, 1993; Kiersey & Bates, 1978; 1984). After several years of data collection and analysis researches concluded that intuitors might be between 15%-28% (Myers & McCaulley, 1985; Ogden, 2003). Parker (2001) found that 78.95% were sensors and 21.05% were intuitors. Sak (2004) mentioned that 70% of the

general population are sensors. Falt (1999) also estimated that there are about 75% sensors and 25% intuitors in the general population. This ratio is equal for men and women. Al-Othman (2004) found that 65% of the participants were sensors and 35% were intuitors.

Visual and Verbal

The visual and verbal dimensions differentiates the learners who learn by seeing pictures, flow-charts and diagrams (visual) and the learners who learn more from both written and spoken text (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). Felder and Silverman (1988) specified that learners who are visual learn better when they are exposed to diagrams, pictures, flowcharts, films, timelines and demonstrations.

Edmunds et al. (2007) described visual learners as follows:

Visual learners prefer, enjoy, or require: Graphic illustrations such as bar graphs or crosstabs to explain data; color codes to highlight salient information; maps to find their way on the subway or while driving in a new city; written material to study new concepts; wall charts that display points to be remembered; written outlines; drawings or designs to illustrate overhead presentations; sitting “up close” in a presentation in order to see the presenter’s face, gestures, or visuals; taking notes during a lecture; instructors to repeat verbal directions. (p. 3)

Russell (2006) mentioned that learners who are visual “will read and follow the directions as they work and will appreciate it even more when diagrams are included” (p. 370). Visual learners favor to seeing what they learn and that images and pictures give them a better understanding of information and ideas instead of explanations (Felder & Silverman, 1988; Jezierski, 2003). The visual learners preferred pictures while the verbal learners preferred more written words to spoken words (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). Yannibelli et al. (2006) reiterated that visual learners tend

to forget when something is simply said and that intuitors prefer verbal or written explanations.

Felder and Silverman (1988) pointed out that students who attend college are visual. Villaverde et al. (2006) indicated that visual learners “remember, understand and assimilate information better if it is presented to them in a visual way” (p. 198).

Villaverde et al. (2006) mentioned that verbal learners “are not only those who prefer auditory material but also those who remember well what they hear and what they read” (p. 198). Felder and Silverman (1988) have made clear the differences between visual and verbal learners as tabulated in Table 7.

Table 7

Differences between Visual and Verbal Learners

Visual	Verbal
remember best what they see: pictures, diagrams, flow charts, time lines, films, demonstrations.	remember much of what they hear and more of what they hear and then say., get a lot out of discussion, prefer verbal explanation to visual demonstration and learn effectively by explaining things to others

Sequential and Global

Laight (2004) ascertained that science education provides course content in a linear manner to the sequential learners and holistically and relationally to the global learner. The dimensions of sequential and global were differentiated by learners’ understanding - sequential learners learn better when instructional material is presented in

incremental steps in a linear manner and that they are more detail oriented (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007).

Global learners are those who use the process of holistic thinking, absorb learning content randomly with no connections initially but get the whole picture after learning enough material, are always interested in the end result as a whole and have difficulty in explaining how they have achieved it (Graf, Viola, Kinshuk et al., 2006; Graf, Viola, Leo et al., 2007). Felder and Silverman (1988) pointed out that sequential learners are comfortable and learn as the material is presented in a logical manner “mastering the material more or less as it is presented” (p. 679). Villaverde et al. (2006) described that sequential learners learn better when the information is presented in a fixed progression of intricacy and difficulty and that global learners understand the whole before understanding the parts that composed it. Yannibelli et al. (2006) mentioned that sequential learners follow a sequential or lineal order of thinking process to solve problems while the global learners “make intuitive jumps and they might not be capable of explaining how they have arrived at the solution of a problem” (p. 57). Felder and Silverman (1988) indicated that global learners

learn in fits and starts: they may be lost for days or weeks, unable to solve even the simplest problems or show the most rudimentary understanding, until suddenly they “get it”—the light bulb flashes, the jigsaw puzzle comes together.” They may then understand the material well enough to they apply it to problems that leave most of the sequential learners baffled. (p. 679)

Graf, Viola, Leo et al. (2007) found that global learners preferred relations and connections to other areas when the sequential learners inferred from parts to a whole. Baldwin and Sabry (2003) stated that “learners learn more effectively when information

is presented in a manner that fits in with their preferred method of acquiring and processing information” (p. 337). Dunn and Dunn (1998) indicated that

globals learn more easily when they either understand the concept first and then concentrate on the details, or when they are introduced to the information with, preferably, a humorous story replete with examples, applications, and graphics related to their lives. Most presentations usually follow a step-by-step, detailed lecture approach which, if interesting, appeals to analytic learners. (p. 8)

Felder and Silverman (1988) have made a clear distinction between sequential and global learners as presented in Table 8.

Table 8

Differences between Sequential and Global Learners

Sequential	Global
follow linear reasoning processes when solving problems	make intuitive leaps and may be unable to explain how they came up with solutions.
can work with material when they understand it partially or superficially	while global learners may have great difficulty doing so
may be strong in convergent thinking and analysis	global learners may be better at divergent thinking and synthesis
Learn best when material is presented in a steady progression of complexity and difficulty	sometimes do better by jumping directly to more complex and difficult material

Felder and Silverman (1988) confirmed that global learners have difficulty in attending school as “they do not learn in a steady or predictable manner” (p. 679) and they think out-of-step with their fellow students as they cannot meet the expectations of the instructor. Felder and Silverman (1988) added that global learners struggle to master the content and get disheartened with learning. However, Felder and Silverman (1988)

argued that “global learners are the last students who should be lost to higher education and society as they are the synthesizers, the multidisciplinary researchers, the systems thinkers, the ones who see the connections no one else sees” (p. 679). Yannibelli et al. (2006) indicated that “Sequential students can work on a reading material even when they only understand it partially or superficially, whereas global students may have serious difficulties when trying to do so” (p. 57).

Adaptive Systems

Felder and Silverman (1988) suggested a teaching technique that can be adapted to all types of learning styles was to discuss the learners’ learning styles and to explain their most efficient way to learn help “reshape their learning experiences so that they can be successful” (p. 680). Adaptive systems are course delivery learning management systems or courses that match learning styles, personalize and deliver the content of courses in the preferred learning styles of the individual. Baldwin and Sabry (2003) emphasized that “Good interactive learning systems design takes account of learners’ differences, good teaching principles, subject area issues and the relevant technology” (p. 337).

De Vita (2001) developed a multistyle approach to teach that aids the facilitation of learning by developing a teaching technique that could be “adopted to match individual learning styles” (p. 172). Yannibelli et al. (2006) mentioned that “The problem of giving personalized academic courses according to the learning style of the students has been considered in several works and that these works applies diverse models of learning styles” (p. 75). Carver et al. (1999) stated that “Adaptive hypermedia based on

student learning styles provides the ability to individually tailor the presentation of course material to each student” (p. 38).

Viola, Graf and Kinshuk (2007) indicated that “Adaptivity based on learning styles is considered by several adaptive systems, aiming at providing content that matches with the learning styles of students in order to make learning easier for them” (p. 233). There was extensive research that dealt with the investigation and development of adaptive systems to providing courses that fit the learning styles needs of individual learners (Brusilovsky, 1996; Graf & Kinshuk, 2007; Graf, Viola, Leo, et al. 2007; Sadat & Ghorbani, n.d.). Some of the adaptive systems Graf and Kinshuk (2007) listed that match the learning styles were CS383 (Carver et al., 1999), IDEAL (Shang, Shi, & Chen, 2001), MAS-PLANG (Peña, Marzo, & De La Rosa, 2002), TANGOW (Paredes & Rodríguez, 2004), and AHA! (Stash, Cristea, & Bra, 2006).

Carver et al. (1999) developed a hypermedia course, CS383, which is a virtual computer that allows a student to construct a virtual computer and run a series of different benchmarks against their virtual computer. Paredes and Rodríguez (2004) described that the course CS383 provides

143 audio files, 63 graphic files, 57 digital movies, instructor slideshows for every lesson (25 lessons), lesson objectives, note-taking guides, a student legacy system with over 471 student papers and slideshows from previous semesters, and 300 pages of course hypertext with 178 cross references, 678 terms with pop-up definitions, and 600 terms that students could search. (p. 211)

The intelligent distributed environment for active learning (IDEAL) uses the Internet, digital library, Web and multi-agent technologies for delivery. Shang et al. (2001) mentioned that

IDEAL consists of a number of specialized agents with different expertise. In IDEAL, each student is assigned a unique personal agent that manages the student's personal profile including knowledge background, learning styles, interests, courses enrolled in, etc. The personal agent talks to other agents in the system through various communication channels. An online course is supported by a collection of teaching and course agents. The course agents manage course materials and course-specific teaching techniques for a course. Multiple course agents exist on distributed sites to provide better efficiency, flexibility, and availability. The teaching agents can talk to any course agent of a course and often choose one nearby for better performance. The course agents also act as mediators for communication among students. (p. 5)

PLAN-G came into existence at the University of Girona to provide interactive teaching materials to students via the Internet as part of their distance learning program.

Carrillo and Lazaro (1999) described that

The platform has been used by the students to access these materials in a decentralized way from anywhere on the Internet, and at the same time by the teachers to keep track of students' utilization. It also improves and facilitates communication between students and teachers at all levels. (p. 1)

PLAN-G, a hypermedia system, allowed access to the learning material only in a fixed way. To make it more adaptive, PLAN-G was considered to be upgraded to a multi agent system and was called MAS-PLANG. MAS-PLANG was developed to interact with the students, provide autonomy to the students so that they do not have to be under constant supervision of the instructor, involves students proactively so that the students would be able to achieve the course goals, and achieve expected learning. Peña et al. (2002) described MAS-PLANG user agent as a hypermedia system that learns from student interactions in order to adapt the learning environment to student preferences by providing learning content according to the learning styles of the student.

The Task-based Adaptive learner Guidance On the Web (TANGOW) is a tool designed and developed to build web-based courses. Structure which means teaching

tasks and rules and content is a list of media elements that are connected to each task are independent in TANGOW. Paredes and Rodriguez (2004) stated that “TANGOW provides adaptive guidance based on the student profile, the student actions and the teaching strategy” (p. 213).

Stash et al. (2006) developed a computer language AHA (Adaptive Hypermedia Architecture) system to specify instructional strategies, strategies for monitoring individual learner’s preferences, and a technique to apply and visualize them. Gilbert and Han (1999) developed ARTHUR which is an intelligent tutoring system with adaptive instruction that delivers instruction to different learners with unique learning styles using multiple instructional methods. The instructors are expected to add their course content to be made available by ARTHUR to students.

Table 9 presents the personalized academic courses that adapted learning styles and the learning styles that were considered in these courses (Yannibelli et al., 2006).

Table 9

Personalized Academic Courses and Learning Styles Adapted

Learning Styles Adapted	Personalized Academic Course Software and Authors
Visual (interactive), Lecto (auditory, textual)	Arthur (Gilbert & Han, 1999)
Sensitive/Intuitive (Felder & Solomon, n.d.)	CS383 (Carver et al., 1999) and MAS-PLANG (Peña, Marzo, & De La Rosa, 2004)
Honey Model (Honey & Mumford, 1992)	INSPIRE (Papanikolau, Grigoriadou, Knornilakis, & Magoulas., 2003)
Index of Learning Styles (Felder & Solomon, n.d.)	TANGOW (Paredes & Rodríguez., 2004)

Summary

This chapter addressed pedagogy, andragogy, the combination of pedagogy and andragogy and adult learners. A historical review and background of learning styles, learning style as a tool – matching and mismatching of learning and teaching styles, learning style models and instruments were also discussed. Research indicated that mismatches occur due to a variety of unique learning styles of both the students and instructors as the instructors tend to teach in a manner they learn. A discussion of the Index of Learning Styles, its four domains – active/reflective, sensing/intuitive, visual/verbal, and sequential/global learning styles was offered. The literature review also identified instructional design suggestions with adaptive systems as one of the tools to deliver content to individuals based on their learning styles in multiple ways.

CHAPTER III

METHODS

Introduction

Learning styles research has become a necessity in the present times as awareness of students' learning styles helps teachers and course designers to accommodate the learning style needs of students. Improving our understanding of all aspects of learning styles will help students' to achieve higher goals academically.

The purpose, statement of the problem, research questions, definition of terms, significance, assumptions, limitations and the organization of the study were addressed in the first chapter. The literature review discussed andragogy, pedagogy, the adult learners, historical review and background of learning styles, learning style models, learning style as a tool, Index of Learning Styles survey and the active and reflective, sensing and intuitive, visual and verbal, and sequential and global learning styles.

This chapter describes the design of the study, variables, the reliability and validity of the instrument, the sample, data collection, procedure and analysis.

Purpose of the Study

The purpose of this study was to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles (active/reflective, sensing/intuitive, visual/verbal and sequential/global). The study also examined the relationship between

the learning styles and the demographic information of gender, ethnicity, age, grade point average (GPA) and grade level.

Research Questions

This study was guided by the following two research questions:

1. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles?
2. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level?

Design of the Study

This study used the Index of Learning Styles (ILS) survey developed by Felder and Solomon (1999) as part of its research design. The ILS was made available online using SurveyMonkey.com to the three groups of students from the Colleges of Business, Education and Liberal Arts. The ILS survey with 44 questions and a demographic survey with 6 questions were included in the online survey. Responses were confidential and numbers were assigned to each participant to code the data.

The study was conducted after obtaining permission from the University's Institutional Review Board (IRB) by the researcher for the use of human subjects for research (see Appendix A). The requested consent detailed the abstract, purpose, participants, selection of participation, methods to collect, analyze, and security of the data. Once consent was approved and permission granted to collect data, participants were recruited. Instructors were contacted and asked to send out an email invitation to

participate to their students. A follow-up email was sent by the instructors after seven days of the initial email as a reminder. Each participant received a report of their learning styles scores.

The reasons for the data collection, description of the survey, number of questions, time to complete the survey was conveyed to participants via a Participant Information Letter (see Appendix B) which was made available before taking the survey online. The participants were also informed that they will receive a report on their individual learning styles upon completion of the survey and that there is no monetary benefit or compensation for taking the survey. The benefit of learning styles identification was also explained in the letter.

The researcher collected the surveys from the SurveyMonkey and generated individual reports to the students and emailed their reports (see Appendix E). Then the surveys were coded using the numbers from 1 to 411 (the total number of participants) before the data were analyzed. The participant information letter, demographic questionnaire, ILS survey and a sample ILS report to the instructor and the students are included as appendices (see Appendices B, C, D, E and F).

Sample

The participants for this study consisted of three groups of students enrolled in Colleges of Business, Education and Liberal Arts and majoring in an undergraduate curriculum at one of the largest universities in the South. Data collection took place over a period of one semester – Spring 2008. The participants were eligible to participate in this study only if they were 19 years of age and older. They represent a convenience sample in Accounting, Education, Philosophy and Sociology courses.

Instrumentation

The Index of Learning Styles (ILS) was used to identify the learning styles of undergraduate students enrolled in 2000 – 5000 level accounting, education, philosophy, and sociology courses to explore the relationship among the students' learning styles. The survey was made available at no cost for individuals who wished to determine their learning style. Once a survey was completed online, it was automatically scored and the results were reported to the user. De Vita (2001) indicated that the instrument

was chosen against competing alternatives because it has been explicitly developed for classroom application and, though suitable to profile individual learning preferences, as argued by Felder, the results provide an even better indication of the preference profile of a group of students (e.g. a class). (p. 168)

The survey questions are related to four domains – active/reflective, sensing/intuitive, sequential/global and visual/verbal. Learning in an instructional setting could be thought or considered as a two-step process that involves the reaction of taking in information and processing it internally (Felder & Silverman, 1988). Felder and Silverman added that

In the reception step, external information (observable through the senses) and internal information (arising introspectively) become available to students, who select the material they will process and ignore the rest. The processing step may involve simple memorization or inductive or deductive reasoning, reflection or action, and introspection or interaction with others. The outcome is that the material is either “learned” in one sense or another or not learned. (p. 674)

Based on the external and internal information processing, Felder and Silverman developed the four learning style dimensions. Boyd and Murphrey (2004) indicated that the instrument “combines three facets of learning styles: personality, learning modality, and cognitive processing and that it allows a multi-modal approach” (p. 124). Dee et al. (2002) stated that the instrument

summarizes self reported preferences concerning whether a person prefers to process information actively or in a reflective manner, understand information in a sequential or a global fashion, receive information visually or verbally, and focus on and recall sensory information - what is seen, heard, etc. or intuitive information - ideas, theories, possibilities! (p. 1110)

De Vita (2001) stated that the survey

categorizes students' preferences in terms of type and mode of information perception (sensory or intuitive; visual or verbal), approaches for the organization and processing of information (inductive or deductive; active or reflective), and the rate at which students progress towards understanding (sequential or global).....develops the preference profile of a student or an entire class on four of the learning style dimensions outlined above (the inductive-deductive dimension is not assessed by the ILS). (p. 166)

There are 11 questions for each domain. The preferences of the learning styles are expressed with the values +11 to -11 for each domain. The questions are forced-choice items with two options with an answer (*a*) of value +1 and an answer (*b*) of value -1. The participants are expected to select the most appropriate answer for each question. The scores are added to determine whether a participant is mild, medium/moderate or strong in a particular learning style. A mild learning style ranges from 1-3, the medium/moderate from 4 – 6 and the strong from 7-10 in the respective learning style.

For this study, the survey consisted of two sections. The first section was the demographic survey developed by the researcher. The demographic section contained six questions consisting of two fill-in-the-blank and four multiple choice questions regarding age, grade point average (GPA), academic college, gender, ethnicity, and grade level – freshman, sophomore, junior or senior. The second section was the ILS survey with 44 questions. A scoring guide for the ILS survey was used to determine the learning styles of the participants. The demographic survey was grouped together with the ILS survey.

Reliability and Validity

It has been recognized that validity and reliability for learning styles instruments scores are major issues within the learning style research (Cox & Gall, 1981; Ferrell 1983; James & Blank, 1993; Moran, 1991; Sewall, 1986). Gall, Borg & Gall (1996) defined validity as particular assumptions made from test scores that are appropriate, meaningful, and useful. Gall, Gall and Borg (2007) defined validity as “the appropriateness, meaningfulness, and usefulness of specific inferences made from test scores” (p. 657) in testing. Gall, Gall, and Borg (2007) added that in qualitative research validity is “the extent to which the research uses methods and procedures that ensure a high degree of research quality and rigor” (p. 657). Gall, Gall, and Borg (2007) defined reliability as “the extent to which other researchers would arrive at similar results if they studied the same case using exactly the same procedures as the first researcher” (p. 651). James and Blank (1993) concluded that adult educators and researchers should use caution when using learning styles instruments:

Perhaps the most important caution is that, given the conflicting and inconclusive evidence regarding the validity and reliability of many instruments, it is imperative to use data derived from them with great care when making decisions regarding students and programs. These data should be treated as potentially useful – but not all-important – pieces of information in the decision-making process. (p. 55)

ILS is used to assess the unique strong and weak learning style characteristics that each individual possesses and measured the dichotomous dimensions of learning (Laight 2004). According to Graf and Kinshuk (2007) it is a well-investigated and often used to identify learning styles. It was acknowledged that the instrument “was chosen against competing alternatives because it has been explicitly developed for classroom application

and, though suitable to profile individual learning preferences” (De Vita, 2001, p. 168). Baldwin and Sabry (2003) summarized that in spite of its low validity and reliability, the ILS is the most frequently used instrument by several researchers. They further indicated that the instrument was chosen for their study “because of its applicability to online learning and its relevance to the principles of interactive learning systems (ILSs) design” (p. 329).

Zwyno (2002) concluded that their reliability and validity data justified claim that the ILS is a suitable instrument for assessing learning styles. Felder and Spurlin (2005) examined the survey responses of 584 students at North Carolina State University and found Cronbach’s alpha coefficients to be in the range of 0.55 to 0.76. The Cronbalch’s alpha for a pilot study conducted by the researcher was (0.55) similar to the reliability scores reported by Felder and Spurlin (2005) which were 0.56 to 0.77. Though the instrument is not ideal in terms of reliability and validity, the psychometric properties are better than those of most instruments.

Data Collection

The survey was administered and the data were collected electronically via SurveyMonkey. The data were collected confidentially and numbers were assigned to each participant to code the data. Statistical Program for Social Science 16.0 (SPSS, 2007) software was used to analyze the data. Descriptive statistics were used for the demographics and a scoring guide, which was already in place, was used to determine the learning styles of the participants.

One of the requirements to participate in the study was that the participants should be 19 years of age and older. Hence 2000 – 5000 basic level courses were selected from the Colleges of Business, Education and Liberal Arts. The courses that enrolled a majority of freshman were removed from the selected list of courses.

The other requirement to participate in the study was that the participants should be majoring either in Business, Education or Liberal Arts. Hence, courses that have a majority of enrolled students from other Colleges were removed from the remaining course list. The instructors for the remaining courses were contacted and gave written permission to survey students within their respective classes. The individual student participants signed an electronic consent form through the SurveyMonkey data collection system.

Data Analysis

The participants consisted of 346 students enrolled in fifteen sections of seven courses that were being offered on campus. Participants were from the Colleges of Business, Education and Liberal Arts at one of the largest four-year public universities in the southeast. Data collection took place over a period of one semester – Spring 2008. Demographic information was collected in this study using a questionnaire designed by the researcher which consisted of six questions referring to age, gender, ethnicity, grade level, GPA and college. The learning styles information was collected using the ILS survey with 44 questions with forced-choice answers of ‘a’ or ‘b’.

To address the research questions for this study, data were analyzed using descriptive statistics, Chi-square analysis and the Analysis of Variance (ANOVA). Descriptive statistics were used to describe the participants. Gall, Gall, and Borg (2007) defined

descriptive statistics as “mathematical techniques for organizing, summarizing, and displaying a set of numerical data” (p. 638).

Chi-square analysis was used to measure demographic variables of gender, grade level and race/ethnicity and the relationship between these demographic variables and the four domains – active/reflective, sensing/intuitive, visual/verbal and sequential/global learning styles. Gall, Gall, and Borg (2007) explained that a chi-square test is “a nonparametric test of statistical significance that is used when the research data are in the form of frequency counts for two or more categories” (p. 634). Nicol and Pexman (1999) stated that a chi-square determines “whether differences between observed and expected frequencies are statistically significant” (p. 43).

An analysis of variance (ANOVA) was used to measure the relationship among the students from the Colleges of Business, Education and Liberal Arts and their learning styles scores. Nicol and Pexman (1999) described that one-way ANOVA “is used when there is one independent variable and one dependant variable and is used to assess the differences between two or more group means” (p. 15). Gall, Gall and Borg (2007) described an ANOVA as “a procedure for determining whether the difference between the mean scores of two or more groups on a dependent variable is statistically significant” (p. 632). A series of ANOVAs were used to measure the relationship between age and GPA and the learning styles – active/reflective, sensing/intuitive, visual/verbal and sequential/global as measured by the ILS survey.

Summary

This chapter described the purpose and design of the study, instrumentation – Index of Learning Styles survey - reliability and validity, the sample for the study, data collection, and analysis. Data were collected in compliance with the Institutional Review Board at the University.

CHAPTER IV

RESULTS

This chapter presents the results of the analyzed data associated with each of the research questions. The demographic profile of the sample population and the analysis of the data collected from the Index of Learning Styles survey are also discussed. To analyze data, the Statistical Program for Social Science 16.0 (SPSS, 2007) software was used.

Purpose of the Study

The purpose of this study was to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles. The study also examined the relationship between the learning styles and the demographic information of gender, ethnicity, age, grade point average (GPA) and grade level.

Research Questions

This study was guided by the following two research questions:

1. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles?

2. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level?

Instrument – Index of Learning Styles

The Index of Learning Styles survey was used to measure the four domains of active/reflective, sensing/intuitive, visual/verbal and sequential/global learning styles for the study. There were two sections in the survey. The demographic survey developed by the researcher was the first section. The ILS survey with 44 questions comprised the second section. There were six questions consisting of two fill-in-the-blank and four multiple choice questions regarding age, grade point average (GPA), academic college, gender, ethnicity, and grade level in the demographic section. A scoring guide that was already in place for the ILS survey, and descriptive statistics for the demographics were used to determine and describe the learning styles of the participants.

The ILS consists of 44 questions, 11 questions for each domain. All of the questions were forced-choice items with 'a' and 'b' options. The answer *a* value is +1 and the answer *b* value is -1. The participants were expected to select the most appropriate answer or the answer that represents them the most for each question. The scale is considered to be ipsative that forces participants to rank instead of rate items.

Questions 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, and 41 measure the domain of active/reflective with 'a' for active and 'b' for reflective. Questions 2, 6, 10, 14, 18, 22, 26, 30, 34, 38 and 42 measure the domain of sensing/intuitive with 'a' for sensing and 'b' for intuitive. Questions 3, 7, 11, 15, 19, 23, 27, 31, 35, 39 and 43 measure the domain of visual/verbal with 'a' for visual and 'b' for verbal. Questions 4, 8, 12, 16, 20, 24, 28, 32,

36, 40, and 44 measure the domain of sequential/global with 'a' for sequential and 'b' for global.

Demographic Results

The total number of participants was 411. Three students were 18 years old and 64 were not from the Colleges of Business, Education and Liberal Arts and could not be included in the study. The remaining 346 (*N*) undergraduate students constitute the sample for this study. The participants completed a survey with six demographic and 44 learning style questions (Appendices C and D) as presented over the internet using SurveyMonkey.

Index of Learning Styles Domains

Active/Reflective Learners

Out of the 346 participants, 244 were active learners, and 102 were reflective learners. The majority of the students were active learners and almost half of active learners were reflective learners (see Table 10).

Sensing/Intuitive Learners

The data indicated that there were 272 sensing learners and 74 intuitive learners. Sensing learners were almost four times the number of intuitive learners (see Table 10).

Visual/Verbal Learners

The results for the study yielded that 274 were visual learners and 72 were verbal learners. There were almost four times as many visual as verbal learners (see Table 10).

Sequential/Global Learners

The data revealed that there were 237 sequential learners and 109 were global learners. The majority of the students were sequential learners and almost half of sequential learners were global learners (see Table 10).

Table 10

Distribution and Percentages of Participants by Learning Styles Domains

Learning Styles	<i>n</i>	%
Active	244	71%
Reflective	102	29%
Sensing	272	79%
Intuitive	74	21%
Visual	274	79%
Verbal	72	21%
Sequential	237	69%
Global	109	32%

N=346

Colleges

The participants in this study were from three Colleges – Business, Education and Liberal Arts. Out of the 346 participants, 164 participants were from the College of Business, 86 from the College of Education, and 96 from the College of Liberal Arts (see Table 11).

Table 11

Distribution and Percentages of Participants by College

College	<i>n</i>	%
Business	164	47%
Education	86	25%
Liberal Arts	96	28%

N=346

Table 12 presents the distribution and percentages of participants by learning style domains and Colleges. The survey is an ipsative survey with four domains. The data in Table 12 indicates that the dominant learning styles were active, sensing, visual and sequential in the Colleges of Business, Education and Liberal Arts. The data also revealed that there were slightly more Liberal Arts students who were active and visual with 74% and 81%, than there were in Business with 69% and 77% and in Education with 70% and 80%. The data indicated that there were more sensing learners in the College of Education with 88% than in Business with 79% and in Liberal Arts with 70%. The data revealed that there were more sequential learners in the College of Business with 70% than in Education with 67% and in Liberal Arts with 68%.

Table 12

Distribution and Percentages of Participants by Learning Styles Domains and College

Learning Styles	<u>Business</u>		<u>Education</u>		<u>Liberal Arts</u>	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%
Active	113	69%	60	70%	71	74%
Reflective	51	31%	26	30%	25	26%
Sensing	129	79%	76	88%	67	70%
Intuitive	35	21%	10	12%	29	30%
Visual	127	77%	69	80%	78	81%
Verbal	37	23%	17	20%	18	19%
Sequential	114	70%	58	67%	65	68%
Global	50	30%	28	33%	31	32%

N=346

Gender

The participants for the study were male and female undergraduate students. Out of the 346 students, there were 187 female and 159 male. Percentage analysis of the data indicated that the enrollment for both female and male students was almost equal (see Table 13).

Table 13

Distribution and Percentages of Participants by Gender

Gender	<i>n</i>	%
Female	187	54%
Male	159	46%

N=346

The data in Table 14 presents the distribution and percentages of participants by learning styles domains and gender. The data revealed that there were more active, sensing, visual and sequential learners in both males and females and that the female learners scored higher than the male learners in the active, sensing, visual and sequential learning styles.

Table 14

Distribution and Percentages of Participants by Learning Styles Domains and Gender

Learning Styles	<u>Female</u>		<u>Males</u>	
	<i>n</i>	%	<i>n</i>	%
Active	134	72%	60	69%
Reflective	53	28%	26	31%
Sensing	154	82%	76	74%
Intuitive	33	18%	10	26%
Visual	147	79%	69	80%
Verbal	40	21%	17	20%
Sequential	136	73%	58	64%
Global	51	37%	28	36%

N=346

Race/Ethnicity

The participants for the study were 300 Caucasian, 34 African American, 5 Asian, 5 Hispanic, and 2 Native American. The majority of the students were Caucasian followed by African American, Asian, Hispanic and Native Americans in the minority. The 5 Asian, 5 Hispanic and the 2 Native American were combined together and classified as “Other” as none of the groups maintain a significant number (see Table 15).

Table 15

Distribution and Percentages of Participants by Race/Ethnicity

Race/Ethnicity	<i>n</i>	%
Caucasian	300	87%
African American	34	10%
Other	12	4%
<hr/>		
<i>N</i> =346		

Table 16 represents the distribution and percentages of participants by learning styles domains and race/ethnicity. The data revealed that the majority of both the Caucasians and the African-Americans were active, sensing, visual and sequential (see Table 16). Caucasian and African-American undergraduate students were equally active with 71% each, while Caucasians with 69% scored slightly higher than the African-Americans with 65% in sequential learning style. African-American students with 79% and 85% scored higher than the Caucasian students with 78% and 79% in sensing and visual learning styles.

Table 16

Distribution and Percentages of Participants by Learning Styles Domains and Race/Ethnicity

Learning Styles	<u>Caucasian</u>		<u>African-American</u>	
	<i>n</i>	%	<i>n</i>	%
Active	213	71%	24	71%
Reflective	87	29%	10	29%
Sensing	235	78%	27	79%
Intuitive	65	22%	7	21%
Visual	237	79%	29	85%
Verbal	63	21%	5	15%
Sequential	207	69%	22	65%
Global	93	31%	12	35%

N=346

Grade Level

The participants in this study were enrolled in undergraduate courses from the Colleges of Business, Education and Liberal Arts. Out of the 346 participants, 6 were freshman, 145 were sophomore, 104 were juniors and 91 were seniors. The data indicated that there were more sophomores and juniors enrolled in the 2000-5000 level accounting, education, sociology and philosophy courses (see Table 17).

Table 17

Distribution and Percentages of Participants by Grade Level

Grade Level	<i>n</i>	%
Freshman	6	2%
Sophomore	145	42%
Junior	104	30%
Senior	91	26%

N=346

Table 18 presents the distribution and percentages of participants by learning style domains and grade level. The data analysis indicated that the majority of freshman, sophomore, junior and senior undergraduate students were active, sensing, visual and sequential learners.

The results in Table 18 revealed that the majority of active learners were freshman students with 83%. The sensing learning style was predominant in sophomores and juniors with 82% each. The majority of visual learners were freshman students with 83% and juniors with 85%. Sophomores scored higher than others with 74% in sequential learning style.

Table 18

*Distribution and Percentages of Participants by Learning Styles Domains and Grade**Level*

Learning Styles	<u>Freshman</u>		<u>Sophomore</u>		<u>Junior</u>		<u>Senior</u>	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Active	4	83%	104	72%	71	68%	64	70%
Reflective	2	17%	41	28%	33	32%	21	30%
Sensing	4	67%	119	82%	85	82%	64	70%
Intuitive	2	33%	26	18%	19	18%	27	30%
Visual	5	83%	110	76%	88	85%	71	78%
Verbal	1	17%	35	24%	16	15%	20	22%
Sequential	4	67%	107	74%	71	66%	57	63%
Global	2	33%	38	26%	33	34%	34	37%

N=346

Results by College

A chi-square test was conducted to address the research question of the relationship between the participants' college and the learning styles domains. The colleges acted as the independent variable in the analysis and the learning styles as the dependent variables. Using an alpha level of 0.05, Levene's test indicated that the assumption of homogeneity of variances was not violated.

The results showed statistical significance $X^2(2, N=346) = 9.315, p < 0.01$ for sensing/intuitive and the three colleges (see Table 19). The results showed no statistical significance $X^2(2, N=346) = 0.776, p = 0.68$ for active/reflective, $X^2(2, N=346) = 0.609,$

$p = 0.74$ for visual/verbal and $X^2 (2, N=346) = 0.150$, $p = 0.93$ for sequential/ global and the three colleges.

Table 19

Chi-square Analysis of Participants' Learning Styles and Colleges – Business, Education and Liberal Arts

Learning Styles Domains	$X^2 (1)$	p
Active/Reflective	0.78	<i>ns</i>
Sensing/Intuitive	9.32	0.01*
Visual/Verbal	0.61	<i>ns</i>
Sequential/Global	0.15	<i>ns</i>

$N=346$, * $p < .05$

A chi-square test was further conducted to address the research question of the relationship between the colleges and the sensing/intuitive learning style domain. The colleges acted as the independent variables in the analysis and the scores of sensing/intuitive learning styles domain as the dependent variables. Using an alpha level of 0.05, Levene's test indicated that the assumption of homogeneity of variances was not violated.

The results yielded a statistical significance ($p < 0.01$) between the College of Education and other colleges in relation to the frequency with which the sensing/intuitive domain endorsed $X^2 (1, N=346) = 8.464$, $p < 0.01$. The results indicated that there was no statistical significance $X^2 (2, N=346) = 1.389$, $p = 0.24$ for the College of Business and $X^2 (2, N=346) = 1.171$, $p = 0.28$ for the College of Liberal Arts (see Table 20).

Table 20

Chi-square Analysis of Participants' Sensing/Intuitive Learning Styles and Colleges – Business, Education and Liberal Arts

Colleges	X ² (1)	<i>p</i>
Education	8.46	0.01*
Business	1.39	<i>ns</i>
Liberal Arts	0.28	<i>ns</i>

N=346, **p* < 0.05

Results by Gender

A chi-square test was conducted to address the research question of the relationship between the participants' gender and the learning styles domains. The participants' gender acted as the independent variable in the analysis and the scores of sensing/intuitive learning styles domain as the dependent variables. Using an alpha level of 0.05, Levene's test indicated that the assumption of homogeneity of variances was not violated.

The results showed no significance $X^2(1, N=346) = 0.253, p = 0.62$ for active/reflective, $X^2(1, N=346) = 3.386, p = 0.07$ for sensing/intuitive, $X^2(1, N=346) = 0.083, p = 0.77$ for visual/verbal and $X^2(1, N=346) = 3.375, p = 0.07$ for sequential/global and gender (See Table 21).

Table 21

Chi-square Analysis of Participants' Learning Styles and Gender

Learning Styles	X ² (1)	<i>p</i>
Active/Reflective	0.25	<i>ns</i>
Sensing/Intuitive	3.39	<i>ns</i>
Visual/Verbal	0.08	<i>ns</i>
Sequential/Global	3.38	<i>ns</i>

N=346

Results by Race/Ethnicity

A chi-square test was conducted to address the research question of the relationship between the participants' race/ethnicity and the learning styles domains. The participants' race/ethnicity acted as the independent variables in the analysis and the learning styles scores as the dependent variables. Using an alpha level of 0.05, Levene's test indicated that the assumption of homogeneity of variances was not violated.

The results showed no significance $X^2(4, N=346) = 2.895, p = 0.58$ for active/reflective, $X^2(4, N=346) = 0.582, p = 0.97$ for sensing/intuitive, $X^2(4, N=346) = 2.929, p = 0.57$ for visual/verbal and $X^2(4, N=346) = 3.370, p = 0.50$ for sequential/global and gender (see Table 22).

Table 22

Chi-square Analysis of Participants' Learning Styles and Race/Ethnicity

Learning Styles	$X^2(1)$	<i>p</i>
Active/Reflective	2.90	<i>ns</i>
Sensing/Intuitive	0.58	<i>ns</i>
Visual/Verbal	2.93	<i>ns</i>
Sequential/Global	3.37	<i>ns</i>

N=346

Results by Grade Level

A chi-square test was conducted to address the research question of the relationship between the participants' grade level and the learning styles domains. The participants' grade level acted as the independent variables in the analysis and the learning styles scores as the dependent variables. Using an alpha level of 0.05, Levene's test indicated that the assumption of homogeneity of variances was not violated.

The results showed no significance $X^2(3, N=346) = 0.830, p = 0.84$ for active/reflective, $X^2(3, N=346) = 5.854, p = 0.12$ for sensing/intuitive, $X^2(3, N=346) = 2.970, p = 0.40$ for visual/verbal and $X^2(4, N=346) = 3.565, p = 0.31$ for sequential/global and gender (see Table 23).

Table 23

Chi-square Analysis of Participants' Learning Styles and Grade Level

Learning Styles	$X^2(1)$	p
Active/Reflective	0.830	<i>ns</i>
Sensing/Intuitive	5.854	<i>ns</i>
Visual/Verbal	2.970	<i>ns</i>
Sequential/Global	3.565	<i>ns</i>

$N=346$

Results by Age

The participants for this study were between the ages of 19 – 43 years with an average of 20.90 and standard deviation of 2.336. The data indicated that the majority of the students were between the ages 19 – 22 (see Table 24). The largest number of

students (39.9%) was 20 years of age followed by the age 21 years (34.9%). The means and standard deviations for the learning styles with respect to age were presented in Table 25.

Table 24

Distribution of Participants by Age

Age	<i>n</i>	%
19	49	14%
20	138	40%
21	86	25%
22	43	12%
23	11	3%
24	4	1%
25	5	1%
26	2	1%
27	1	1%
28	1	1%
30	2	1%
31	1	1%
33	1	1%
39	1	1%
43	1	1%

N=346

Table 25

Means and Standard Deviations for Learning Styles by Age

Learning Styles Domains	<i>n</i>	Mean	Standard Deviation
Active	244	20.71	1.87
Reflective	102	21.34	3.15
Sensing	272	20.88	2.47
Intuitive	74	20.96	1.75
Visual	274	20.86	2.14
Verbal	72	21.01	2.98
Sequential	237	20.90	2.52
Global	109	20.89	1.88

N=346

An Analysis of Variance (ANOVA) was conducted to address the research questions of the relationship between the continuous variable of age and the learning styles domains - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The ANOVA yielded statistical significance, $F(1, 344) = 7.207, p = 0.01$ for active and reflective learning styles and age. The data analysis revealed that there is a small effect size a partial eta squared $r^2 = 0.015$. The data indicated a statistical significance; however, further examination of the data revealed that there was no practical significance between age and active and reflective learning styles.

The ANOVA yielded no statistical significance, $F(1, 344) = 0.123, p = 0.73$ for sensing and intuitive learning styles and age. The data analysis indicated that there is a small effect size with a partial eta squared $r^2 = 0.001$.

The ANOVA yielded no statistical significance, $F(1, 344) = 0.389, p = 0.533$ for visual and verbal learning styles and age. The data analysis indicated that there is a small effect size with a partial eta squared $r^2 = 0.001$.

The ANOVA revealed that there was no statistical significance, $F(1, 344) = 0.002, p = 0.96$ for sequential and global learning styles and age. The data analysis indicated that there is a small effect size with a partial eta squared $r^2 = 0.001$. Table 26 presents the ANOVA of learning styles domains and age.

Table 26

ANOVA of Learning Styles and Age

Learning Styles	<i>F</i>	<i>p</i>	r^2
Active/Reflective	7.207	0.01*	0.015
Sensing/Intuitive	0.123	0.73	0.001
Visual/Verbal	0.389	0.53	0.001
Sequential/Global	0.002	0.96	0.001

$N=346, *p < 0.05$

Results by Grade Point Average

The participants' GPA for the study ranged from 2.0 – 4.0 with the mean of 2.99 and standard deviation of 0.481. The Table 27 indicated that the majority of students – 9.2% had a 3.0 GPA, 6.6% had a 3.5 GPA, and 5.8% had a 2.5 GPA. See Table 27 for some of the GPA distribution among the participants. The means and standard deviations for the learning styles with respect to GPA are presented in Table 28.

Table 27

Distribution of Study Participants by GPA

GPA	<i>n</i>	%
2.0	7	2%
2.1	4	1%
2.2	10	3%
2.3	9	3%
2.4	12	4%
2.5	20	6%
2.6	12	4%
2.7	15	4%
2.8	19	6%
2.9	19	4%
3.0	32	9%
3.1	11	3%
3.2	15	4%
3.3	12	4%
3.4	19	6%
3.5	23	7%
3.6	8	2%
3.7	2	1%
3.8	2	1%
4.0	7	2%

N=346

Table 28

Means and Standard Deviations for Learning Styles Domains by GPA

Learning Styles Domains	<i>n</i>	Mean	Standard Deviation
Active	244	2.99	0.475
Reflective	102	2.97	0.499
Sensing	272	2.99	0.495
Intuitive	74	2.99	0.433
Visual	274	2.98	0.473
Verbal	72	3.00	0.515
Sequential	237	3.00	0.474
Global	109	2.96	0.498

N=346

An Analysis of Variance (ANOVA) was conducted to address the research questions of the relationship between the continuous variable of GPA and the learning styles domains - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The ANOVA yielded statistical significance, $F(1, 344) = 0.269$, $p = 0.60$ for active and reflective learning styles and GPA. The data analysis revealed that there is a small effect size a partial eta squared $r^2 = 0.001$. The data indicated a statistical significance; however, further examination of the data revealed that there was no practical significance between age and active and reflective learning styles.

The ANOVA yielded no statistical significance, $F(1, 344) = 2.871$, $p = 0.09$ for sensing and intuitive learning styles and. The data analysis indicated that there is a small effect size with a partial eta squared $r^2 = 0.001$. The ANOVA yielded no statistical

significance, $F(1, 344) = 1.621, p = 0.20$ for visual and verbal learning styles and GPA. The data analysis indicated that there is a small effect size with a partial eta squared $r^2 = 0.001$. The ANOVA yielded that there was no statistical significance, $F(1, 344) = 0.133, p = 0.72$ for sequential and global learning styles and GPA. The data analysis indicated that there is a small effect size with a partial eta squared $r^2 = 0.002$. Table 29 presents the ANOVA of learning styles domains and GPA.

Table 29

ANOVA of Learning Styles Domains and GPA

Learning Styles	<i>Sum of Squares</i>	<i>Mean Square</i>	<i>F Ratio</i>	r^2
Active/Reflective	0.28	0.28	0.120	0.001
Sensing/Intuitive	0.009	0.009	0.846	0.001
Visual/Verbal	0.019	0.019	0.776	0.001
Sequential/Global	0.143	0.143	0.433	0.002

$N=346$

Summary

This chapter presented the results of the study after surveying 346 participants learning styles from the three Colleges of Business, Education and Liberal Arts. The participants completed a self-report survey of 50 questions with 6 demographic and 44 learning styles questions. According to the analysis of the results, there were more Caucasians who were taking undergraduate courses at this one of the largest universities in the South, and that the GPA ranged from 2.0 – 4.0, the age ranged from 19 – 43 years. There were twice as many active and sequential learners as reflective and global learners.

There were four times as many sensing and visual learners as intuitive and verbal learners.

This study explored two research questions to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles. It also examined the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level.

Sensing/intuitive was the only domain observed to reach a statistical significance. Further analysis revealed that the sensing/intuitive learning style was statistically significant in the College of Education with chi-square results of $X^2(1, N=346) = 8.464$, $p = 0.004$. Conclusions, discussion and recommendations will be discussed in the next chapter.

CHAPTER V

SUMMARY, DISCUSSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

This study explored the relationship of learning styles among undergraduate students in three different colleges of a large south-eastern university. The first chapter introduced the purpose, statement of the problem, research questions, definition of terms, significance, assumptions, limitations and the organization of the study. The second chapter discussed the literature review of andragogy, pedagogy, the adult learners, historical review and background of learning styles, learning style models, learning style as a tool, Index of Learning Styles survey and the visual and verbal, active and reflective, sensing and intuitive, sequential and global learning styles. The third chapter described the design of the study, variables - the dependent and independent, the instrument – Index of Learning Styles - reliability and validity, the population sample, data collection, procedure and analysis and a summary. The fourth chapter explained the Instrument – Index of Learning Styles, and depicted the results of the demographic profile, college, gender, race/ethnicity, age, GPA and grade level along with chi-square and analysis of variance results. The present chapter provides conclusions, discussion and recommendations for future research.

Purpose of the Study

The purpose of this study was to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The study also examined the relationship between the learning styles and the demographic information of gender, ethnicity, age, grade point average (GPA) and grade level.

Research Questions

This study was guided by the following two research questions:

1. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles?
2. What are the relationships among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts, as measured by the Index of Learning Styles, based on gender, ethnicity, age, GPA and grade level?

Summary

The sample for this study consisted of 346 undergraduate students from three colleges – Business, Education and Liberal Arts of one of the largest four-year public universities in the southeast during the Spring 2008 semester. The instrument used to measure learning styles was the Index of Learning Styles survey. The survey consisted of 50 questions – 6 demographic and 44 ILS questions. The survey was made available on SurveyMonkey and data were collected confidentially. Each instructor received a comprehensive report of the demographics and the dominant learning styles information

for the entire section. If requested, each student received a report of their learning styles for their participation in the study.

The independent variables are the scores from the Index of Learning Styles survey. The dependant variables are the components of the demographic data - age, gender, race, GPA and grade level, compiled prior to the administration of the survey. The demographic data revealed that there were 187 (54%) females and 159 (46%) males. There were 164 (47%) Business, 96 (28%) Liberal Arts, and 86 (25%) Education participants. The participants' racial distribution was 300 Caucasian, 34 African-American, and 12 others. The majority of the participants were sophomore and juniors.

The participants' ages ranged from 19 – 43 years and the GPA ranged from 2.0 – 4.0. There were twice as many as active and sequential learners than reflective and global learners and four times as many as sensing and visual learners than intuitive and verbal learners. This finding supports studies that found the American population in general consists of sensing (75%) and intuitive (25%) learning styles (Jacob & Shoemaker, 1993; Kiersey & Bates, 1978, 1984). Intuitors might be between 15%-28% (Myers & McCaulley, 1985; Ogden, 2003). Sak (2004) indicated that 70% of the general population could be considered sensors. Al-Othman (2004) found that 65% of the participants were sensors and 35% were intuitors. Parker (2001) found that 79% were sensors and 21% were intuitors. Falt (1999) stated that “best estimates are that there are about 75% sensors and 25% intuitors in the general population. This ratio holds equally for men and women” (para. 7).

Discussion

Aspects of the learning environment that may impact classes at the undergraduate or graduate levels are instructional methods and strategies. These methods may be based on pedagogical or andragogical frameworks. The term pedagogy refers to a teacher-centered learning environment where the learning process is directed and evaluated by the teacher. Pedagogical methods rely on the teacher to make decisions on what, how and when the learning will occur. This method is understandable and acceptable in an environment in which teachers are expected to ensure the needs of young and immature students are being met. However, andragogical principles may be more appropriate for adult learners, as those found in this study. The term andragogy refers to a learner-centered approach where the learners are more responsible for their learning.

Andragogical methods would place the instructor in the role of being a facilitator thus assisting the learner to be more self-directed and accountable in their educational goals. As educational institutions prepare their learners, it might be beneficial to take into account the individual's self-concept, experience, readiness to learn, and orientation to learning. A majority of the present day learners are adult learners and could benefit from learner-centered instruction. Hence, the awareness of learning styles for both students and teachers is vital to maximize learning.

Chi-square and ANOVA statistical techniques were conducted to examine the relationships among participants' learning styles and the Colleges of Business, Education and Liberal Arts. The tests revealed that there was no statistical significance among the demographic variables of gender, race/ethnicity, age, GPA and grade level and the participants' learning styles.

The sensing/intuitive domain was the only learning styles domain observed to have a statistical significance over active/reflective, visual/verbal and sequential/global. Further analysis of the data revealed that there was statistical significance between sensing/intuitive learning styles and College of Education undergraduate students' learning styles.

Implications

This study was an effort to explore the relationship of undergraduate learning styles among three Colleges of Business, Education and Liberal Arts. The data revealed that only the College of Education has more sensing learners than intuitive learners. The participants in this study were predominantly visual, active and sequential learners than verbal, reflective and global learners.

Review of literature indicated that mismatches of teaching and learning styles certainly influence the learners' achievement academically. Attention should be given to incorporate specific activities to address individual learning styles of the learners in order to maximize a learning experience. Learners benefit if they are aware of their individual learning styles to make use of their most preferred learning styles and to enhance the less preferred learning styles in a learning situation. Some of the implications for the four learning domains are discussed in the next section.

Sensing and Intuitive Learners

The sensing/intuitive domain was the only learning styles domain observed to have a statistical significance over the active/reflective, visual/verbal, and sequential/global domains. Sensors prefer facts, data, solving problems and experimentation and the intuitors prefer principles and theories, innovation, and are good

at grasping new concepts. These are qualities that would be beneficial and expected in the classroom and learning environment. De Vita (2001) proposed provision examples, case studies and explicit links to the real world of business for sensing learners and for intuitive learners, models and theories, space for abstraction and conceptualization as excellent choices for instructors to enhance individual learners learning. Felder and Silverman (1988) suggested that the learning material could be instructed as a combination of information that is concrete like data, observable phenomena and facts for sensing learners and mathematical models, theories and principles which are abstract concepts for intuitive learners.

Yannibelli et al. (2006) confirmed that when given access to several examples for a given topic, sensitive learners tend to view all of the examples where intuitive learners just view a couple of them. Yannibelli et al. (2006) added that an intuitive learner given an option is not careful and does not work on the planned exercises whereas a sensitive learner checks and does all the exercises. Graf and Kinshuk (2007) suggested that “the number of examples should increase for sensing learners and examples should be presented before the abstract learning material” (p. 2578) and that “the presentation outlines between topics should be avoided and the number of examples and exercises should decrease” (p. 2579) for intuitive learners. Graf et al. (2005) ascertained that intuitive learners “like to discover possibilities and relationships and tend to be more innovative and creative” (p. 38) and achieve better scores in open-ended tests.

In order to address the sensing learners’ needs, incorporate activities that involve creativity for course topics, as part of the course, to achieve the course goals. Felder and Solomon (n.d.) indicated that:

Sensors remember and understand information best if they can see how it connects to the real world. If you are in a class where most of the material is abstract and theoretical, you may have difficulty. Ask your instructor for specific examples of concepts and procedures, and find out how the concepts apply in practice. If the teacher does not provide enough specifics, try to find some in your course text or other references or by brainstorming with friends or classmates. (para. 7)

In order to address the intuitive learners' needs, incorporate activities that could connect facts with present situations for the related course topics, as part of the course, to achieve the course goals. Felder and Solomon (n.d.) indicated that:

Many college lecture classes are aimed at intuitors. However, if you are an intuitor and you happen to be in a class that deals primarily with memorization and rote substitution in formulas, you may have trouble with boredom. Ask your instructor for interpretations or theories that link the facts, or try to find the connections yourself. You may also be prone to careless mistakes on test because you are impatient with details and don't like repetition (as in checking your completed solutions). Take time to read the entire question before you start answering and be sure to check your results. (para. 8)

Active and Reflective Learners

The majority of participants in this study were active learners (71%). Active learners work well in groups, tend to be experimentalists, and will not learn as much in situations that require them to be passive. De Vita (2001) proposed that brainstorming, group projects, learn-by-doing and problem-solving exercises would be most appropriate for active learners, while reflective statements and functional pauses for reflection and evaluation might be best for reflective learners. Similarly, Felder and Silverman (1988) suggested that instructors should use material that emphasizes either practical problem solving (active) or fundamental understanding (reflective). Moreover, alternating lectures with frequent breaks for reflective learners, and providing short discussions or problem-solving activities for active learners. Yannibelli et al. (2006) confirmed that a strong

reflective student does not participate in a forum or chat where active participation is necessary while a strong active student will be an active participant in both a forum and a chat.

Graf and Kinshuk (2007) suggested that there should be an increased number of exercises along with self-assessment tests with a summary at the end of the chapter for active learners, and that information should be presented first and let the learners reflect on it before showing examples with outlines being provided in between the topics and a conclusion at the end of the chapter for reflective learners. In order to address the active learners' need, integration of self-tests, group discussions and projects and problem solving activities, as part of the course, help to achieve the course goals. Felder and Solomon (n.d.) mentioned that:

if you are an active learner in a class that allows little or no class time for discussion or problem-solving activities, you should try to compensate for these lacks when you study. Study in a group in which the members take turns explaining different topics to each other. Work with others to guess what you will be asked on the next test and figure out how you will answer. You will always retain information better if you find ways to do something with it. (para. 3)

Visual and Verbal Learners

In this study, the participants were predominantly visual (79%). Visual learners will remember and understand better if the information is presented in a visual manner, such as through pictures, graphs, flow charts, diagrams, videos, or demonstrations. De Vita (2001) agreed that visual learners learn better when trigger videos and visual organizers such as charts, maps, Venn diagrams were made available, and that verbal learners learn better with oral presentations and traditional lectures. Felder and Silverman (1988) suggested that to provide the best learning experience to visual learners, material

should be presented in different visual forms like diagrams, pictures, sketches, network diagrams, process and logic or information, graphs, films and live demonstrations. Laight (2004) indicated that science education delivers the content using the traditional way of oral presentation through lectures and by providing pre-planned and prepared written notes for the verbal learners and make available “visual learning clues in the form of pictures, diagrams, flow charts, time lines, films and demonstrations” (p. 229) to the visual learners.

Visual learners learn better when the information is provided to them through pictures, maps, and in colors. Hence integration of color coding, photographs and sketches help the instructor achieve the course goals and enhance the learning of a visual learner. Felder and Solomon (n.d.) stated that:

If you are a visual learner, try to find diagrams, sketches, schematics, photographs, flow charts, or any other visual representation of course material that is predominantly verbal. Ask your instructor, consult reference books, and see if any videotapes or CD-ROM displays of the course material are available. Prepare a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections. Color-code your notes with a highlighter so that everything relating to one topic is the same color. (para. 11)

Sequential and Global Learners

The majority of learners in this study were sequential (69%) and those sequential characteristics involve linear reasoning when solving problems and being able to work with partial material. In the classroom, sequential learners learn best when the material is presented in a steady progression of complexity and difficulty. De Vita (2001) agreed that sequential learners work great with “integrated progression of topics” and “breaking information down into smaller part” and global learners love “a two-step approach

combining specific-to-general and general-to-specific elements” (p. 172). Felder and Silverman (1988) mentioned that to accommodate the global learners’ course curriculum, course syllabi, textbooks and the instruction should be sequential providing the goal of a lesson, establishing a connection to the relevance of the content and relating it to the individual learners’ experiences. Felder and Silverman (1988) added that freedom to work out their own methods to solve problems and exposure to advanced concepts helps global learners.

Graf and Kinshuk (2007) recommended “presenting first the learning material, then some examples and afterwards a self-assessment test and some exercises for sequential learners and by providing outlines additionally between the topics, presenting a conclusion straight after the content, and providing a high number of examples after the learning material” (p. 2579) for global learners. Sequential learners tend to learn everything in an orderly manner. Provision of a document with description of class activities in a sequential manner enhances the learners to keep track of the organization of the course. Activities that involve step-step by process will help increase their learning.

Felder and Solomon (n.d.) stated that:

Most college courses are taught in a sequential manner. However, if you are a sequential learner and you have an instructor who jumps around from topic to topic or skips steps, you may have difficulty following and remembering. Ask the instructor to fill in the skipped steps, or fill them in yourself by consulting references. When you are studying, take the time to outline the lecture material for yourself in logical order. In the long run doing so will save you time. You might also try to strengthen your global thinking skills by relating each new topic you study to things you already know. The more you can do so, the deeper your understanding of the topic is likely to be. (para. 15)

Baldwin and Sabry (2003) developed a list of design features, as shown in Table 30, that could be included to design an interactive learning system and stated that the list could be used in an interactive learning system suitable for the development of skills This is naturally not an exhaustive list, and not in any way a rigid set of rules to be followed. It is also important to reiterate that each learning style should be considered in conjunction with other styles and not in isolation. (p. 333)

Graf, Viola, Leo et al. (2007) found that sensing learners learn concrete learning material with simple details better than intuitive learners who prefer abstract material and have no interest in details. Felder and Silverman (1988) confirmed that intuitive learners “respond well to an instructor who emphasizes concepts (abstract content) rather than facts (concrete content)” (p. 674). Villaverde et al. (2006) mentioned that learners who are sensing do not present better outcomes even though they are slow in reacting to the problem. The intuitive learners react quickly to solving problems and sometimes end up with minor errors.

Based on the literature review and the findings of this study, there are implications within the design and development of courses to meet the learners’ needs. Hence, it is important for teachers, instructors, adult educators, trainers, course designers, program and training developers to be aware of the individual learners’ need and design course and training curriculum. Adult educators, teachers and instructors could change the way they design the courses by including certain specific activities to accommodate different learning styles of the students to achieve course goals and to make sure that expected learning occurs. Students can enhance their learning using their most preferred or stronger learning styles and make an effort to enhance their weaker learning styles to make their learning experience more exciting for themselves.

Table 30

Interactive Learning System Design Features

Learning Style	Interactive Learning System Design Features
Active	For learner–content interactions, allow learner to apply what has been taught (e.g. through interactive self-assessment questions that allow for learner’s response and provide correlated and meaningful feedback). For learner–learner and learner–tutor interactions, allow the use of discussion (bulletin) board and electronic mail for group assignments, discussions, brainstorming and problem-solving exercises.
Reflective	Enable reflection through pauses through which the learner can do self-assessment questions, quizzes, use of synchronous (e.g. Internet relay chat) and asynchronous interactions (e.g. discussion board) to help understanding and evaluation of subject.
Sensing	Provide specific and explicit examples and case studies of the real world of that explain how concepts apply in practice through use of video, animation, sound, etc. Also through brain-storming sessions using the chat or discussion board.
Intuitive	Provide abstraction and conceptualization elements through the use of textual summaries and conceptual diagrams.
Visual	Provide relevant visual representations such as animation, graphs, videos, images, etc. Provide a concept map (e.g. listing key points in circles, arrows, etc.). Use of colour, and highlighting certain points.
Verbal	Allow for written words (textual presentation) as well as spoken words (sound). Provide summaries or outlines of course material. Also, allow learner to write points learned in own words. Group discussion using discussion board and Internet relay chat to write own understanding and see others’ explanations.
Sequential	Allow learners to take a linear approach through step-by-step progression of topics such as the use of structured-type presentation.
Global	Allow the learner to see the big picture, and connections between the parts. For example, by providing a section on the screen that provides an overview of main topics in the module, once a topic is chosen a list (overview) of subtopics is presented in the section. Provide mind maps, menus, embedded pictures, etc.

Higher education institutions and distance learning offices could use learning styles information within their course or curriculum design and development. Distance educators and curriculum developers could make distance learning an engaging experience by providing content and activities in a variety of ways to address different learning styles. These efforts would provide a learning experience that is more comfortable and productive for the learner.

Recommendations

As the study was limited to only three colleges from one of the largest four-year public universities in the southeast and to only one semester - Spring 2008, the findings suggest that:

1. The study could be extended to undergraduate students in other academic colleges e.g. Nursing, Engineering, Agriculture, Pharmacy, Architecture, Science, Mathematics etc.
2. The study could be extended to more than one semester from Spring to Fall and Summer semesters.
3. The study could be replicated with a larger sample of participants.
4. The study could be conducted with other university undergraduate students throughout the United States to compare and contrast.
5. The study could also be extended by including other geographical areas in the United States with international students as part of the study to compare between the nationals and internationals to examine if there are any multi-cultural relationships within the learning styles.

6. Adding social economic status (SES) could be added as another variable and then replicate the study.
7. The study could be extended by including a teaching styles survey for the instructors or the course designers to determine their teaching styles and investigate if there was a match or mismatch of the learning styles in the instruction.
8. The study could be conducted with two groups of students – students that take a course with matched learning styles and students that take a course with mismatched learning styles.
9. The study could be conducted with more students with different age groups – undergraduate and graduate students in the same college to find if age is a factor.
10. The study could be conducted with more students with different age groups – undergraduate and graduate students from different colleges to find if age influences the preferred learning styles.
11. The study could be extended over a period of several semesters with the same group of undergraduate students as they progress academically to find any change in the preferred learning styles.
12. The study could be conducted by administering the instrument before and after the assignment of specific tasks to the students.
13. The study could be extended by giving the instrument before and after the assignments of different tasks to the students.

The literature review supported that each individual learns differently, have different learning styles and that matching teaching styles to learning styles improve learning. Even though individuals learn differently and may have a strong learning style

preference, that does not mean that individuals cannot learn using the weaker learning style(s). Graf and Kinshuk (2006a) confirmed that there are several questionnaires to determine learning styles, thus learning style discovery is easily accessible and available for all learners. Kinshuk and Graf (2007) ascertained that “learners with strong preference for a certain learning style have difficulties in learning if this learning style is not considered by the teaching environment” (p. 25).

It is and always will be the responsibility of teachers/instructors to make a learning process interesting and effective to a learner who is involved in the process. As the world is getting smaller and smaller in terms of geographical distance due to innovative technology, and as culture has no bounds, there is a huge challenge of meeting the learning style needs of a variety of learners with different learning styles from across the globe. However, Witte noted that

The learner is also responsible in an educational setting or a learning situation. Hence, it is expected that the learner be aware of their learning styles and contribute to the learning situation by active participation and collaboration. (Dr. James E. Witte, personal communication, May 24, 2008)

Kinshuk and Graf (2007) argued that provision of courses that match students’ individual needs provides more customized access to education “for all those who otherwise may have difficulties in learning. This opens learning for a larger student community and facilitates more students to learn better” (p. 26). Viola et al. (2007) stated that “Incorporating learning style in technology enhanced learning has potential to help student in learning and make learning easier for them” (p. 233). Educators can make an effective learning experience possible to the learners with innumerable technological

tools that are readily available to develop innovative methods and activities to make the learning process a great experience to all the learners.

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APPENDICES

APPENDIX A
INSTITUTIONAL REVIEW BOARD

**AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS
RESEARCH PROTOCOL REVIEW FORM**

For information or help completing this form, contact: **THE OFFICE OF HUMAN SUBJECTS RESEARCH**, 307 Samford Hall,
Phone: 334-844-5966 e-mail: hsubjec@auburn.edu Web Address: <http://www.auburn.edu/research/vpr/ohs/index.htm>

Complete this form using Adobe Acrobat Writer (versions 5.0 and greater).

1. PROPOSED DATES OF STUDY: FROM: 04/01/2008 TO: 05/30/2008
2. REVIEW TYPE (Check one): FULL BOARD EXPEDITED EXEMPT
3. PROJECT TITLE: An Exploratory Study of Undergraduate Students' Learning Styles
3. Prasanthi Pallapu DL Specialist DLOT 844-3476 pallapu@auburn.edu
PRINCIPAL INVESTIGATOR TITLE DEPT PHONE E-MAIL
307 O.D.Smith Hall, Auburn University, Auburn, AL 36849
ADDRESS FOR CORRESPONDENCE FAX
4. SOURCE OF FUNDING SUPPORT: Not Applicable Internal External (External Agency): _____
5. STATUS OF FUNDING SUPPORT: Not Applicable Approved Pending Received

6. GENERAL RESEARCH PROJECT CHARACTERISTICS

A. Research Content Area	B. Research Methodology
<p>Please check all descriptors that best apply to this proposed research project.</p> <p><input type="checkbox"/> Anthropology <input type="checkbox"/> Anthropometry</p> <p><input type="checkbox"/> Biological Sciences <input type="checkbox"/> Behavioral Sciences</p> <p><input checked="" type="checkbox"/> Education <input type="checkbox"/> English</p> <p><input type="checkbox"/> History <input type="checkbox"/> Journalism</p> <p><input type="checkbox"/> Medical <input type="checkbox"/> Physiology</p> <p><input type="checkbox"/> Other (Please list): _____</p> <p>Please list 3 or 4 keywords to identify this research project: _____ <u>Learning Styles - Undergraduate Students</u></p>	<p>Please check all descriptors that best apply to the research methodology.</p> <p>Data collection will be: <input checked="" type="checkbox"/> Prospective <input type="checkbox"/> Retrospective <input type="checkbox"/> Both</p> <p>Data will be recorded so that participants can be directly or indirectly identified: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Data collection will involve the use of:</p> <p><input checked="" type="checkbox"/> Educational Tests (cognitive, diagnostic, aptitude, achievement)</p> <p><input checked="" type="checkbox"/> Surveys / Questionnaires</p> <p><input type="checkbox"/> Private Records / Files</p> <p><input type="checkbox"/> Interview / Observation</p> <p><input type="checkbox"/> Audiotaping and / or Videotaping</p> <p><input type="checkbox"/> Physical / Physiologic Measurements or Specimens</p>
C. Participant Information	D. Risks to Participants
<p>Please check all descriptors that apply to the participant population.</p> <p><input checked="" type="checkbox"/> Males <input checked="" type="checkbox"/> Females</p> <p>Vulnerable Populations</p> <p><input type="checkbox"/> Pregnant Women <input type="checkbox"/> Children</p> <p><input type="checkbox"/> Prisoners <input type="checkbox"/> Adolescents</p> <p><input type="checkbox"/> Elderly <input type="checkbox"/> Physically Challenged</p> <p><input type="checkbox"/> Economically Challenged <input type="checkbox"/> Mentally Challenged</p> <p>Do you plan to recruit Auburn University Students? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Do you plan to compensate your participants? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>	<p>Please identify all risks that may reasonably be expected as a result of participating in this research.</p> <p><input checked="" type="checkbox"/> Breach of Confidentiality <input type="checkbox"/> Coercion</p> <p><input type="checkbox"/> Deception <input type="checkbox"/> Physical</p> <p><input type="checkbox"/> Psychological <input type="checkbox"/> Social</p> <p><input type="checkbox"/> None <input type="checkbox"/> Other (please list): _____</p>

For OHSR Office Use Only

DATE RECEIVED IN OHSR: _____ by _____ PROTOCOL # _____

DATE OF OHSR CONTENT REVIEW: _____ by _____ DATE ASSIGNED IRB REVIEW: _____ by _____

DATE OF IRB REVIEW: _____ by _____ DATE IRB APPROVAL: _____ by _____

INTERVAL FOR CONTINUING REVIEW: _____



7. PROJECT ASSURANCES

PROJECT TITLE: An Exploratory Study of Undergraduate Students' Learning Styles

A. PRINCIPAL INVESTIGATOR'S ASSURANCE

1. I certify that all information provided in this application is complete and correct.
2. I understand that, as Principal Investigator, I have ultimate responsibility for the conduct of this study, the ethical performance this project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the Auburn University IRB.
3. I certify that all individuals involved with the conduct of this project are qualified to carry out their specified roles and responsibilities and are in compliance with Auburn University policies regarding the collection and analysis of the research data.
4. I agree to comply with all Auburn policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection of human subjects, including, but not limited to the following:
 - a. Conducting the project by qualified personnel according to the approved protocol
 - b. Implementing no changes in the approved protocol or consent form without prior approval from the Office of Human Subjects Research (except in an emergency, if necessary to safeguard the well-being of human subjects)
 - c. Obtaining the legally effective informed consent from each participant or their legally responsible representative prior to their participation in this project using only the currently approved, stamped consent form
 - d. Promptly reporting significant adverse events and/or effects to the Office of Human Subjects Research in writing within 5 working days of the occurrence.
5. If I will be unavailable to direct this research personally, I will arrange for a co-investigator to assume direct responsibility in my absence. This person has been named as co-investigator in this application, or I will advise OHSR, by letter, in advance of such arrangements.
6. I agree to conduct this study only during the period approved by the Auburn University IRB.
7. I will prepare and submit a renewal request and supply all supporting documents to the Office of Human Subjects Research before the approval period has expired if it is necessary to continue the research project beyond the time period approved by the Auburn University IRB.
8. I will prepare and submit a final report upon completion of this research project.

Prasanthi Pallapu		03/27/2008
Principal Investigator (Please Print)	Principal Investigator's Signature	Date

B. FACULTY SPONSOR'S ASSURANCE

1. By my signature as sponsor on this research application, I certify that the student or guest investigator is knowledgeable about the regulations and policies governing research with human subjects and has sufficient training and experience to conduct this particular study in accord with the approved protocol.
2. I certify that the project will be performed by qualified personnel according to the approved protocol using conventional or experimental methodology.
3. I agree to meet with the investigator on a regular basis to monitor study progress.
4. Should problems arise during the course of the study, I agree to be available, personally, to supervise the investigator in solving them.
5. I assure that the investigator will promptly report significant adverse events and/or effects to the OHSR in writing within 5 working days of the occurrence.
6. If I will be unavailable, I will arrange for an alternate faculty sponsor to assume responsibility during my absence, and I will advise the OHSR by letter of such arrangements.
7. I have read the protocol submitted for this project for content, clarity, and methodology.

Dr. Maria Witte		03/27/2008
Faculty Sponsor (Please Print)	Faculty Sponsor's Signature	Date

C. DEPARTMENT HEAD'S ASSURANCE

By my signature as department head, I certify that every member of my department involved with the conduct of this research project will abide by all Auburn University policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection and ethical treatment of human participants.

Dr. Jose Llanes		03/27/2008
Department Head (Please Print)	Department Head's Signature	Date

-  13. **PROJECT DESIGN & METHODS.** Describe the procedures you will plan to use in order to address the aims of this study. (NOTE: Use language that would be understandable to a layperson. Without a complete description of all procedures, the Auburn University IRB will not be able to review protocol. If additional space is needed for #13, part b, save the information as a .pdf file and insert after page 6 of this form.)

a. Project overview. (Briefly describe the scientific design.)

The study will use a descriptive research method that shows how two or more events are related and does not manipulate variables or controls the environment in which the study takes place. A cross-sectional approach will be used to gather descriptive data. One-way ANOVAs will be used to test the differences between the variables.

b. Describe all procedures and methods used to address the purpose.

The population of this study will be undergraduate, males and females from the Colleges of Business, Education and Liberal Arts at Auburn University, Alabama. The sample size will consist of at least 150 students. Each student must be 19 years of age or older. The selection and recruitment of participants will be chosen from the various class sections offered for Principles of Financial Accounting (ACCT 2110), Crime and Justice in America (CRIM 2000), Police and Society (CRIM 3100), Utilization of Instructional Technology for Educators (EDMD 3300), Media for Children (EDMD 5100), Business Ethics (PHIL 1040) and Methods of Social Research (SOCY 3700) courses at Auburn University. Participation will be voluntary. There will be no impact on their course grade if they choose not to participate. Each participant will receive the information letter with a web site link to the survey on SurveyMonkey via e-mail. After reading the information letter, if they are willing to participate, they are expected to click on the web site link that will be provided in the e-mail to access the survey. A follow-up e-mail will be sent to all as a reminder after seven days.

An online survey will be used to address the goal of the study. This survey is a learning style instrument "Index of Learning Styles" developed by Richard M. Felder and Barbara A. Solomon of North Carolina State University, Raleigh, North Carolina and is selected to survey and assess preferences of the students' learning styles. The survey is available at no cost for individuals who wish to determine their own learning style and for educators to teach, advise or research. It is available at <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>. The survey questions are related to four dimensions – active/reflective, sensing/intuitive, visual/verbal and sequential/global. It consists of 44 questions – 11 questions for each dimension. The questions are forced-choice items with two options – a and b. The participants will be expected to select the appropriate answer for each question. Each answer will be given '1' point for 'a' and '0' for 'b'. The scores will be added to determine whether the participant's score is mild, medium or strong. A mild learning style ranges from 1-3, the medium/moderate from 5 – 7 and the strong from 9 -11 in the respective learning style. The survey questionnaire's validity and reliability has been established and approved for use in this study by the Committee members.

The survey will be made available online via SurveyMonkey. It consists of two sections with 50 questions. The first section would be the demographic survey developed by the researcher. The demographic section consists of 6 questions - 4 multiple choice, and two fill in the blank questions regarding gender, ethnicity, age, GPA (Grade Point Average), grade level and academic college. The second section would be the learning styles survey with the 44 questions as described above. Descriptive statistics for the demographics and a scoring guide for the survey will be used to determine the demographics and learning styles of the participants.

Once the data are collected, the data will be coded into the Statistical Package for the Social Sciences (SPSS) software for processing and analysis. A series of ANOVAs will be conducted to determine whether there is a correlation among the students' learning styles from the Colleges of Business, Education and Liberal Arts. A series of ANOVAs will be conducted to determine whether a correlation exists between the learning styles based on their gender, ethnicity, age, GPA (Grade Point Average), and grade level and college. The investigator will use all reasonable care to process and secure the data.

-  c. List all instruments used in data collection. (e.g., surveys, questionnaires, educational tests, data collection sheets, outline of interviews, scripts, audio and/or video methods etc.) *Please include a copy of all data collection instruments that will be used in this project and label as Appendix C.*

An online survey will be used to address the goal of the study. This survey is a learning style instrument "Index of Learning Styles" developed by Dr. Richard M. Felder and Barbara A. Solomon of North Carolina State University, Raleigh, North Carolina. It was selected to survey and assess preferences of the students' learning style. It is available at <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>.

A demographic questionnaire with six questions, developed in-house by the researcher will be used as an instrument to collect the demographic data. The data will be used to obtain additional information about the participants and analyze differences from the Index of Learning Styles results.

Total time commitment for the participant will be approximately 7 – 10 minutes.

-  d. **Data Analysis: Explain how the data will be analyzed.**

A scoring guide for the Index of Learning Styles will be used to determine the participants learning styles. A series of ANOVAs will be conducted to determine whether a correlation exists among the students' learning styles from the Colleges of Business, Education and Liberal Arts. A series of ANOVAs will be conducted to determine whether a correlation exists between the learning styles based on their gender, ethnicity, age, GPA (Grade Point Average), grade level and college. Descriptive statistics for the demographics and qualitative analysis for the open-ended questions will be used to interpret the data. Statistical Package for the Social Sciences (SPSS) software will be used for data process and analysis.

-  14. **RISKS & DISCOMFORTS: List and describe all of the reasonable risks that participants might encounter if they decide to participate in this research. If you are using deception in this study, please justify the use of deception and be sure to attach a copy of the debriefing form you plan to use and label as Appendix D.**

There are no expected and hidden risks or discomforts in this study for the participants. As the data are collected confidentially, there is a risk of breach of confidentiality.

15. PRECAUTIONS. Describe all precautions you have taken to eliminate or reduce risks that were listed in #14.

There are no known reasonable risks and discomforts. Precautions are not required for this study as the students take the survey on SurveyMonkey. The Instructors will only provide the names and e-mail addresses of the students to the Researcher. The Researcher contacts, recruits and collects the data confidentially. Participation is voluntary and will not affect their course grade if they choose not to participate. As the data are collected confidentially, there is a risk of breach of confidentiality. However, utmost care will be taken by the Researcher to ensure that the confidentiality is maintained thoroughly and constantly during the analysis.

16. BENEFITS.

a. List all realistic benefits participants can expect by participating in this study.

Each participant will receive a report of the scores of their learning styles. By participating in this study, participants will understand that they will be a part of a research study in which the results help them better understand their learning styles, know how to enhance their learning with interactive course activities, and how to be an effective lifelong learner.

b. List all realistic benefits for the general population that may be generated from this study.

The realistic benefit is to provide group reports to the course instructors of the Principles of Financial Accounting (ACCT 2110), Crime and Justice in America (CRIM 2000), Police and Society (CRIM 3100), Utilization of Instructional Technology for Educators (EDMD 3300), Media for Children (EDMD 5100), Business Ethics (PHIL 1040) and Methods of Social Research (SOCY 3700) courses from the Colleges of Business, Education and Liberal Arts with the information about learning styles of their courses. This information helps the instructors for increased understanding of their students' learning styles and could be used to improve the course design and to meet their students' learning style needs.

The realistic benefit for the general population is that there will be well designed and better courses with several interactive activities incorporated in their course curriculum to increase motivation, enhance instruction and level of learning for all students that have different learning styles.



17. PROTECTION OF DATA.

a. Will data be collected as anonymous? Yes No *If "YES", go to part "g".*

b. Will data be collected as confidential? Yes No

c. If data is collected as confidential, how will the participants' data be coded or linked to identifying information?

The completed survey will be assigned a number by the researcher. The number scale from 1B, 1E, 1L for Business, Education and Liberal Arts respectively, to the number of participants, will be assigned accordingly as they are received. The numbers 1B, 1E and 1L to for example: 75B, 75E and 75L will be the participants' identification numbers. The number is used as a code to enter and analyze the data and will keep it confidential. Each participant's name is associated with the completion of the survey in SurveyMonkey. The name is used only to identify to the course and generate a report of their scores on the learning styles and to e-mail it to the student. Once the report is generated, the data will only be linked using the coding system.

d. Justify your need to code participants' data or link the data with identifying information.

Data will be coded with the participants number, so that when the data is analyzed it can be compared with each participants' gender, ethnicity, age, GPA, grade level and academic major. Based on my research questions, learning styles will be measured among the students from the Colleges of Business, Education and Liberal Arts and the participants' gender, ethnicity, age, GPA, grade level and college.

e. Where will code lists be stored?

The data will be stored in an electronic form with password protection on a flash drive and in a locked file cabinet in Dr. Witte's office, Haley 4012 at Auburn University.

f. Will data collected as "confidential" be recorded and analyzed as "anonymous"? Yes No

g. Describe how the data will be stored (e.g., hard copy, audio cassette, electronic data, etc.), where the data will be stored, and how the location where data is stored will be secured in your absence.

The data will be stored in an electronic form with password protection on a flash drive and in a locked file cabinet in Dr. Witte's office, Haley 4012 at Auburn University.

h. Who will have access to participants' data?

Dr. Maria Witte, the major professor and I will have access to the participants' data.

i. When is the latest date that the data will be retained?

Indefinitely

j. How will the data be destroyed? (NOTE: Data recorded and analyzed as "anonymous" may be retained indefinitely.)

It is not planned to destroy the data.

PROTOCOL REVIEW CHECKLIST

All protocols must include the following items:

- 1. Research Protocol Review Form (All signatures included and all sections completed)
- 2. Consent Form or Information Letter (examples are found on the OHSR website)
- 3. Appendix A "Reference List"
- 4. Appendix B if flyers, advertisements, generalized announcements or scripts are used to recruit participants.
- 5. Appendix C if data collection sheets, surveys, tests, or other recording instruments will be used for data collection. Be sure to mark each of the data collection instruments as they are identified in section # 13, part c.
- 6. Appendix D if a debriefing form will be used.
- 7. If research is being conducted at sites other than Auburn University or in cooperation with other entities, a letter from the site / program director must be included indicating their cooperation or involvement in the project. NOTE: If the proposed research is a multi-site project, involving investigators or participants at other academic institutions, hospitals or private research organizations, a letter of IRB approval from each entity is required prior to initiating the project.
- 8. Written evidence of acceptance by the host country if research is conducted outside the United States.

Appendix A

Reference List

- Bacon, D. (2004). An examination of two learning style measures and their association with business learning. *Journal of Education for Business*, 79(4), 205-208.
- Baldwin, L., & Sabry, K. (2003). Learning styles for interactive learning systems. *Innovations in Education & Teaching International*, 40(4), 325-340.
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- Entwistle, N. (1981). *Styles of learning and teaching: An integrated outline of educational psychology for students, teachers, and lecturers*. New York: Wiley.
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- McCarthy, B. (1980). *The 4mat system: Teaching to learning styles with right=left mode techniques*. Barrington, IL: EXCEL.

Sims, S. J., & Sims, R. R. (1995). Learning and learning styles: A review and look to the future. In R. R. Sims & S. J. Sims (Eds.), *The importance of learning styles: Understanding the implications for learning, course design, and education* (pp. 193 - 208). Westport, CT: Greenwood.

From: "Gerry Sasser" <sasser@gw.fis.ncsu.edu>
To: <pallapr@auburn.edu>
Date: Wednesday - January 2, 2008 10:39 AM
Subject: Re: Permission to use the ILS for my dissertation

Prasanthi,

For educational dissertation use, no license is required to use ILS.
Please feel free to use ILS in your dissertation.

GS

Warren G. Sasser III, M.B.A.
(Gerry)
Agreements Manager
North Carolina State University
Office of Technology Transfer

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919-515-3773 (fax)

>>> "Prasanthi Pallapu" <pallapr@auburn.edu> 12/31/07 3:21 PM >>>
Hello Mr. Sasser,

How are you? Happy New Year. I am Prasanthi Pallapu from Auburn University. I have contacted you in October 2006 regarding the use of the Index of Learning Styles survey for my dissertation and has received permission from you to use it. I have used it as a pilot for one of my statistics courses.

However, I have finally reached the stage of dissertation and is planning to use the survey in Spring 2008. Could you please let me know if I have to get a signed permission to use it? Or Is email permission enough? I have to submit an updated permission to use email/document to the Internal Review Board.

Please help.

Thank you once again.

Prasanthi

APPENDIX B
PARTICIPANT INFORMATION LETTER

The Auburn University Institutional Review Board has approved this document for use from 4/9/08 to 4/8/09 Protocol # 08-062 EP 0804

Auburn University

Auburn University, Alabama 36849-5221

Educational Foundations
Leadership and Technology
4036 Haley Center

Telephone: (334) 844-4460
Fax: (334) 844-3072

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

INFORMATION LETTER
for a Research Study entitled
"An Exploratory Study of Undergraduate Students' Learning Styles"

You are invited to participate in a research study to examine the relationship among undergraduate students' learning styles from the Colleges of Business, Education and Liberal Arts as measured by the Index of Learning Styles - active/reflective, sensing/intuitive, visual/verbal and sequential/global. The examination will also include gender, ethnicity, age, Grade Point Average (GPA), and grade level. The study is being conducted by Prasanthi Pallapu, a doctoral student at Auburn University and the Distance Learning Specialist, Distance Learning & Outreach Technology office, Auburn University, under the direction of Dr. Maria Witte, Associate Professor, in the Department of Educational Foundations and Leadership Technology, Auburn University. You were selected as a possible participant because you are presently enrolled in Accounting/Criminology/Educational Media and Computers/Philosophy/Sociology course at Auburn University and are age 19 or older.

If you decide to participate in this research study, you will be asked to complete a learning styles survey with 50 questions including 6 demographic questions by logging into your course on Blackboard. The survey questions are related to four dimensions - active/reflective, sensing/intuitive, sequential/global and visual/verbal. It consists of 44 questions - 11 questions for each dimension. The questions are forced-choice items with two options - a and b. You will be expected to select the appropriate answer for each question. Your total time commitment will be approximately 7 - 10 minutes.

There are no expected and hidden risks or discomforts associated with participating in this study. If you participate in this study, you can expect to receive a report of the scores of your learning styles. The information is collected confidentially. Your name is used only to identify you to the course and generate a report of your scores on the learning styles and to e-mail it to you. You will receive a report of your learning styles score in the form of an Adobe PDF document. Once the report is generated, your information will only be linked using an assigned code. Other benefits you can expect by participating in this study are that the results will help you better understand your learning styles, know how to enhance your learning and how to be an effective lifelong learner.

If you change your mind about participating, you can withdraw at any time during the study. Your participation is completely voluntary. If you choose to withdraw, your data can be withdrawn as long as it is identifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Educational Foundations and Leadership Technology, your instructor or the researcher.

Any data obtained in connection with this study will remain confidential. We will protect your privacy and the data you provide by storing in an electronic form with password protection on a flash drive and in a locked file cabinet in Dr. Witte's office, Haley 4012 at Auburn University. Information collected through your participation may be used to fulfill an educational requirement, published in a professional journal, and/or presented at a professional meeting.

If you have questions about this study, please ask them now or contact Prasanthi Pallapu by email at pallapu@auburn.edu or by calling at 334-844-3476 or at 334-703-3594.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE *click on this link*

TO ACCESS THE SURVEY:

http://www.surveymonkey.com/s.aspx?sm=y4E5Bj5P7LCAfbVpFKwr1w_3d_3d
YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

Investigator's signature

Date

PRASANTHI PALLAPU
Print Name

The Auburn University Institutional Review Board has approved this document for use from 4/9/08 to 4/8/09 Protocol # 08-062 EP 0804

APPENDIX C
DEMOGRAPHIC INFORMATION QUESTIONS

Demographic Information Questions

1. I am a
 - a. Male
 - b. Female

2. My ethnicity is
 - a. Caucasian
 - b. African-American
 - c. Asian
 - d. Hispanic
 - e. Native American
 - f. Other

3. My age is _____ years.

4. My Grade Point Average (GPA) is _____

5. My grade level is
 - a. Freshman
 - b. Sophomore
 - c. Junior
 - d. Senior

6. I am from the College of
 - a. Business
 - b. Education
 - c. Liberal Arts
 - d. Other

APPENDIX D
INDEX OF LEARNING STYLES SURVEY

Index of Learning Styles Survey

By Richard M. Felder and Barbara A. Soloman

Directions :

For each of the 44 questions below select either "a" or "b" to indicate your answer.

Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently.

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

6. If I were a teacher, I would rather teach a course
 - (a) that deals with facts and real life situations.
 - (b) that deals with ideas and theories.
7. I prefer to get new information in
 - (a) pictures, diagrams, graphs, or maps.
 - (b) written directions or verbal information.
8. Once I understand
 - (a) all the parts, I understand the whole thing.
 - (b) the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
 - (a) jump in and contribute ideas.
 - (b) sit back and listen.
10. I find it easier
 - (a) to learn facts.
 - (b) to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
 - (a) look over the pictures and charts carefully.
 - (b) focus on the written text.
12. When I solve math problems
 - (a) I usually work my way to the solutions one step at a time.
 - (b) I often just see the solutions but then have to struggle to figure out the steps to get to them.

13. In classes I have taken

(a) I have usually gotten to know many of the students.

(b) I have rarely gotten to know many of the students.

14. In reading nonfiction, I prefer

(a) something that teaches me new facts or tells me how to do something.

(b) something that gives me new ideas to think about.

15. I like teachers

(a) who put a lot of diagrams on the board.

(b) who spend a lot of time explaining.

16. When I'm analyzing a story or a novel

(a) I think of the incidents and try to put them together to figure out the themes.

(b) I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.

17. When I start a homework problem, I am more likely to

(a) start working on the solution immediately.

(b) try to fully understand the problem first.

18. I prefer the idea of

(a) certainty.

(b) theory.

19. I remember best

(a) what I see.

(b) what I hear.

20. It is more important to me that an instructor
- (a) lay out the material in clear sequential steps.
 - (b) give me an overall picture and relate the material to other subjects.
21. I prefer to study
- (a) in a study group.
 - (b) alone.
22. I am more likely to be considered
- (a) careful about the details of my work.
 - (b) creative about how to do my work.
23. When I get directions to a new place, I prefer
- (a) a map.
 - (b) written instructions.
24. I learn
- (a) at a fairly regular pace. If I study hard, I'll "get it."
 - (b) in fits and starts. I'll be totally confused and then suddenly it all "clicks."
25. I would rather first
- (a) try things out.
 - (b) think about how I'm going to do it.
26. When I am reading for enjoyment, I like writers to
- (a) clearly say what they mean.
 - (b) say things in creative, interesting ways.

27. When I see a diagram or sketch in class, I am most likely to remember
- (a) the picture.
 - (b) what the instructor said about it.
28. When considering a body of information, I am more likely to
- (a) focus on details and miss the big picture.
 - (b) try to understand the big picture before getting into the details.
29. I more easily remember
- (a) something I have done.
 - (b) something I have thought a lot about.
30. When I have to perform a task, I prefer to
- (a) master one way of doing it.
 - (b) come up with new ways of doing it.
31. When someone is showing me data, I prefer
- (a) charts or graphs.
 - (b) text summarizing the results.
32. When writing a paper, I am more likely to
- (a) work on (think about or write) the beginning of the paper and progress forward.
 - (b) work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
- (a) have "group brainstorming" where everyone contributes ideas.
 - (b) brainstorm individually and then come together as a group to compare ideas.

34. I consider it higher praise to call someone
- (a) sensible.
 - (b) imaginative.
35. When I meet people at a party, I am more likely to remember
- (a) what they looked like.
 - (b) what they said about themselves.
36. When I am learning a new subject, I prefer to
- (a) stay focused on that subject, learning as much about it as I can.
 - (b) try to make connections between that subject and related subjects.
37. I am more likely to be considered
- (a) outgoing.
 - (b) reserved.
38. I prefer courses that emphasize
- (a) concrete material (facts, data).
 - (b) abstract material (concepts, theories).
39. For entertainment, I would rather
- (a) watch television.
 - (b) read a book.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
- (a) somewhat helpful to me.
 - (b) very helpful to me.

41. The idea of doing homework in groups, with one grade for the entire group,
- (a) appeals to me.
 - (b) does not appeal to me.
42. When I am doing long calculations,
- (a) I tend to repeat all my steps and check my work carefully.
 - (b) I find checking my work tiresome and have to force myself to do it.
43. I tend to picture places I have been
- (a) easily and fairly accurately.
 - (b) with difficulty and without much detail.
44. When solving problems in a group, I would be more likely to
- (a) think of the steps in the solution process.
 - (b) think of possible consequences or applications of the solution in a wide range of areas.

APPENDIX E

COMPREHENSIVE LEARNING STYLES REPORT FOR THE INSTRUCTOR

Results for: COURSE NUMBER (Dr. Perfect)

Demographic Information

209 responded

190 provided their email addresses and received individual reports of their learning styles

Gender:

55.4 % male
44.6% female

Age: 18 – 26 years, **Average:** 20.33

GPA: 1.9 – 4, **Average:** 2.99

The students are from the following college:

Business 59.2%
Education 1.9%
Liberal Arts 14.1%
Other 24.9%

Ethnicity:

Caucasian 87.7%
African American 8%
Asian 1.9%
Native American 0.5%

Grade Level:

Freshman 1.9%
Sophomore 62.4 %
Junior 27.2 %
Senior 8.5 %

The Index of Learning Styles survey was used to measure the learning styles of your students. The survey measures four domains of learning styles – Active/Reflective, Sensing/Intuitive, Visual/Verbal and Sequential/Global. The following is the information for Course Name/Number (Spring 2008).

Out of the 209 responses:

Active Learners	Reflective Learners	Sensing Learners	Intuitive Learners	Visual Learners	Verbal Learners	Sequential Learners	Global Learners
63.16%	36.84%	79.90%	20.09%	80.38%	19.62%	73.68%	26.32%

Active and Reflective Learners

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

Sensing and Intuitive Learners

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

Visual and Verbal Learners

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

Sequential and Global Learners

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

For explanations of the implications of your preferences, please go to
<http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm>

For the actual survey, please go to <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>

APPENDIX F

INDIVIDUAL LEARNING STYLES REPORT FOR THE STUDENT

Index of Learning Styles
by Richard M. Felder and Barbara A. Solomon

Score

- If your score on a scale is **1-3**, you are fairly **well balanced on the two dimensions of that scale**.
(For example, a **3a** in the Active/Reflective category indicates a mild preference for active learning).
- If your score on a scale is **5-7**, you have a **moderate preference for one dimension of the scale** and will learn more easily in a teaching environment which favors that dimension.
- If your score on a scale is **9-11**, you have a **very strong preference for one dimension of the scale**. You may have real difficulty learning in an environment which does not support that preference.

Please note that your scores are larger and in bold.

Results for: Ms. Confidential													
Active	11	9	7	5	3	1 <--	1 -->	3	5	7	9	11	Reflective
Sensing	11	9	7	5	3	1 <--	1 -->	3	5	7	9	11	Intuitive
Visual	11	9	7	5	3	1 <--	1 -->	3	5	7	9	11	Verbal
Sequential	11	9	7	5	3	1 <--	1 -->	3	5	7	9	11	Global

Active and Reflective Learners

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

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

Visual and Verbal Learners

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

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

For explanations of the implications of your preferences, please go to
<http://www4.ncsu.edu/unity/lockers/users/f/felder/public/1LSdir/styles.htm>

For the actual survey, please go to <http://www.engr.ncsu.edu/learningstyles/ilsweb.html>