The Effectiveness of Instructional Methods based on Learning Style Preferences of Agricultural Students: A Research Tool for Continuous Improvement for Faculty in Career and Technical Education (CTE) Programs

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Abstract

This study was conducted to research learning style preferences of agriculture students. Specifically, the objectives which guided the study were: (1) to determine the learning style preferences of undergraduate agricultural students enrolled in a given Soil Science course and (2) to ascertain if there were differences in the students' course grade average (CGA) in the given Soil Science course when the treatment group were taught according to their learning style preferences versus the control group. For research question two, there was a hypothesis statement to determine if modifying the instructional approach to the students' learning style preference for the treatment group produces a higher course grade average (CGA) than the control group. The Productivity Environmental Preference

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Survey (PEPS) was used to obtain the students' preferred learning style preferences. Results indicate that modifying the instructional approach to the students' learning styles preference (Structure) would result in a higher course grade average (CGA) for the treatment group versus the control group.

Introduction

Two challenges that face faculty are how to engage in continuous improvement in delivering instruction to today's students and how faculty can use students' learning styles to improve the classroom environment. These questions present everyday challenges to improving learning outcomes and quality of instruction. According to Sims and Sims (2006), "Understanding the role of learning style in the learning process is an important concept for those committed to meeting the demands being placed on education and their own personal commitment to learning excellence" (p. xiv). To meet the demands of the 21st century classroom, instructors must be prepared to use a variety of instructional methods. Students' learning styles, or cognitive styles, involve their specific preferences when processing information. Burris, Kitchel, Molina, Vincent, & Warner (2008) stressed, "Student learning styles can impact a variety of areas in the classroom, such as environment, student praise or reinforcement, class structure, and teaching methods" (p. 44). Careful assessment of student differences shows that students differ along several important dimensions (Alexander & Murphy, 1999; Humphreys, Lubinski, & Yao, 1993; Scarr, 1992); the acknowledgement of these individual differences has not, in our estimation, been an accepted formula for academic success in our colleges and universities.

Students come to class with diverse ways of perceiving information and with diverse needs for what constitutes a suitable learning environment or climate. Educators must provide all students, regardless of their background and ethnicity, the opportunity to be engaged in the learning process (Whittington, 2005). Therefore, faculty is challenged with positive learning

outcomes for today's faculty through developing multi-faceted instructional approaches. As faculty become more aware of their students' learning style preferences, they are more likely to apply efforts to accommodate their differences (Beck, 2001). Therefore, it is necessary for instructors to not only employ learning styles assessments, but to understand the results and to apply them to their instructional methods in the classroom.

Learning style research has been documented and used to assist in enhancing learning environments that fit students' needs and educate faculty on the impact that learning styles have on education. Learning style research has been viewed by some educators as very helpful in understanding the nature of learning in the classroom while some dismiss learning style research as unusable and invalid based on methodology and confusing constructs (Lemire, 2002). Learning style research must present consistent models where population and identification of assessments are similar in content (Kavale & LeFever, 2007).

Background

Background on Learning Styles and Theoretical Framework

There have been a myriad of learning theories that emerged in the past 40 years, such as Felder-Silverman (1996), Kolb's Experiential Learning (1984), and the Dunn and Dunn Learning Style Model (1978). Thelen (1954) was the first to use the term *learning style*, observing the changes in how groups learn and interact in a given environment. The term learning style was further developed using cognitive, affective, and physiological domains which are influenced by the environment (Keefe, 1987). Scarpaci and Fradd (1985) suggested learning styles are "ways in which individuals perceive, organize, and recall information in their environment" (p. 184).

The aim of learning style inventories is to identify, assess, and provide alternative instructional solutions to improve classroom outcomes. Hickox (2006) indicated that "researchers use learning styles as a byword to reflect that their field is seeking to meet the

needs of their students or population" (p. 8). The theoretical foundations of traditional and formal learning environments possess potential non-alignment with today's students, which prompts further research to investigate and hypothesize relationships between aspects of learning styles and academic performance (Bedford, 2006).

Individuals have innate cognitive tendencies and, as Scarr (1992) suggests, they seek out environments and experiences that reinforce those natural tendencies. As they do so, they are reinforced positively or negatively and become conditioned to specific environments and experiences. The theory shares elements of Guilford's (1965) model of the structure of intellect in which he differentiated between a number of cognitive operations that included convergent and divergent thinking. Hudson (1968) suggested that divergent thought was nothing more than an individual's preferred style of thinking. Hudson tested this theory with science and arts students, finding that science students generally preferred a convergent style of thinking, and that arts students were more likely to be divergent thinkers (Lovell, 1980). Hudson's work was crucial in tying what began as Cognitive Style Theory to what we now know as Learning Style Preference Theory.

The theoretical framework of learning styles is based on the Dunn and Dunn Learning Style Model which was developed in 1967. Dunn and Dunn (1993) used 20 elements grouped into five stimuli which consisted of: environmental stimuli (sound, light, temperature, design), emotional stimuli (motivation, persistence, responsible, structure), sociological stimuli (self-oriented, peer-oriented, or learn in several ways, (i.e. sometimes alone, with peers and/or with authority figures), physiological stimuli (perceptual, intake, time mobility), and psychological/ cognitive processing stimuli (global, analytic, hemisphericity, impulsive/ reflective). The Dunn and Dunn model is based on Cognitive Style and Brain Lateralization Theories. The Cognitive Style Theory is based on the learned responses and subsequent development of inherent traits, while the Brain Lateralization Theory is based on the idea that the two hemispheres of the brain control different abilities and information processing functions (i.e., functional specialization). For example, verbal/ sequential abilities are believed to belong to the left brain while

spatial and emotional/holistic abilities belong to the right brain (The NC Education Place, n.d.). Thus, individuals who are right brain dominant process information through their emotions or subjective reasoning; they tend to be relational information processors. Left-brain dominant process information sequentially and are therefore analytical information processors

The Cognitive Style and Brain Lateralization Theories address the cognitive and affective components of learning, but they do not address the socio-cultural origins of the individual's learning styles (Keefe, 1987). This nurture component of learning styles preference is also very important; individuals unable to make choices congruent with their naturally occurring ability profiles may become frustrated and/or disinterested. And, to date, the U.S. educational system has primarily been one dimensional and directed at convergent learners, while ignoring the learners with diverse learning styles (White, 2001).

Studies Researching Learning Style Preferences in Agriculture and CTE Programs

The majority of past research regarding the learning styles of agriculture students has utilized the cognitive approach (Dyer & Osborne, 1996; Garton & Thompson, 1999; Marrison & Frick, 1994; Rollins, 1990; Torres & Cano, 1994; White, 2004). However, these studies have not examined the influences of the classroom environment on learning to produce a more holistic approach to learning. There is literature on research examining the effectiveness of aligning students' learning styles preferences to instruction (Chiou & Yang, 2006; Dunn, Pratt-Johnson, & Honigsfeld, 2008; Faraks, 2003). These studies present a positive case for the success of student learning; however, there are other external factors or non-controlled factors that may contribute to student learning outcomes.

Research on improving the learning environment of Career and Technical Education (CTE) majors is an on-going effort to produce a well-qualified workforce. Universities must be able to produce exceptional employees for high wage and highly skilled technical jobs to compete in the global market. With an increasing enrollment

of a multi-ethnic student population in colleges and universities today, quality of instruction is a necessity. According to Ausburn and Brown (2006),

An effort to individualize instruction and improve the effectiveness of instructor-learner transactions, education and instructional research has addressed a wide assortment of learner variables and assessed their relationships to instructional methods and environments. (p. 6).

Gordon and Yocke (2005) used the PEPS to identify learning style preferences of graduates who entered the CTE teaching field. Results revealed that graduates with a standard score of 60 or more preferred mobility, structure, tactile, and authority.

Purpose of Study

The purpose of this study was to determine the learning style preferences of undergraduate Agriculture students in a Soil Science course (treatment group) using the Productivity Environmental Preference Survey (PEPS) and to determine, when using the students' learning style preferences, if their course grade average (CGA) is higher versus the control group of the Soil Science course. In turn, modifying instruction will better fit the students' learning style preferences for the course. The study also sought to determine the students' preferred learning styles from the treatment group. There are two research questions which the study addressed:

(1) What are the learning style preferences of undergraduate agricultural students enrolled in a given Soil Science class?

(2) Is there a difference in the students' course grade average (CGA) in the Soil Science class when the treatment group is taught according to their learning style preferences versus that of the control group?

Research Question Two requires a hypothesis statement to test the significance of the treatment and control groups regarding the effectiveness of using students' learning style preferences, based on of an alpha level .05.

H_o: There is no significant difference in the students' course grade average (CGA)s in the Soil Science class, when the treatment group is taught according to their learning style preferences versus that of the control group.

H_a: There is a significant difference in the students' course grade average (CGA)s in the Soil Science class, when the treatment group is taught according to their learning style preferences versus that of the control group.

Methodology

Research Design

To answer the research questions and hypothesis statement, the research design for this study required a treatment group and a control group. The treatment group consisted of students enrolled in a Soil Science course (AGR 344) for the fall semester of 2007 with instructor A. The control group represents students enrolled in a Soil Science course (AGR 344) in the spring semester of 2008 with instructor B. See Figure 1 for research design layout[1].

	Treatment	Course grade average (CGA) (Final)
Treatment Group (Fall 2007)	X	G_1
Control Group (Spring 2008)	---	G_2

Figure 1. Research design layout for determining the effectiveness of learning style preferences.

[1] Adapted from Campbell, D.T. & Stanley, J.C. (1966). *Experimental and quasi-experimental designs for research*. Chicago, IL: Rand McNally & Co.

There were two different instructors used for this study. For the treatment group, instructor A was in charge of the treatment group, has ten years experience in industry and taught the course for six years. Instructors A and B were equally qualified. Instructor B had

no prior information of learning styles to contaminate the study and Instructor B taught according to the objectives and learning outcomes of the course syllabus. Both instructors utilized the same lesson plan package (i.e., lab assignments) for the courses.

The weakness in the research design was that neither Instructor A nor Instructor B was observed in the classroom. However, the study was conducted in this manner to prevent outside influences for potential contamination by outside observation. In essence, the research setting was a natural state.

Instructor A was provided with a learning style mini-workshop along with a learning style instrument for the study. The authors are aware of the internal threats to validity for this research design and used necessary safeguards (i.e. non-disclosure of study to instructor B and its students) to ensure the success of this research study.

Population of Subjects

The subjects for the study were Agricultural students who are required to take the soil science course as part of their major coursework. There are approximately 1,000 Agricultural majors in the department at a university located in the southwest region of the United States (see Table 1).

Table 1.
Demographics of Participants of Treatment and Control Groups

Group Type	No. of Participants
Treatment (Fall 2007)	46
Control (Spring 2008)	41

The course was selected based on availability in the scheduling rotation for the 2007-08 academic year. Purposeful sampling was used for the treatment group because of the researchers' knowledge

of the population and subjects' majors which would provide the best information needed for this study (McMillan & Schumacher, 2001).

Instrument for Study

The instrument used in the study was the Productivity Environmental Preference Survey (PEPS), which is based on the Dunn and Dunn Learning Style Model. PEPS is a comprehensive approach to identify how adults would prefer to learn and concentrate in work environments or educational settings (Price, 1996).

The researchers selected the Dunn and Dunn Learning Style Model because of its approach to assessing the way students learn in a classroom environment. Furthermore, the Dunn and Dunn Learning Style Model is used in post-secondary classrooms, with the support of validity data from a large source of empirical studies (Lovelace, 2005). PEPS has been used by researchers (Fazarro & Martin, 2004; Fazarro & Stevens, 2004; Gordon & Yocke, 2005; Larkin-Hein & Bundy, 2001) in college disciplines including agriculture, physics and engineering.

The PEPS contains 20 learning styles/elements, which are used to assess one's learning style preferences. There are 100 statement items on the Scantron survey to be completed by the respondent. This instrument uses a Likert-Scale to assess *how students like to learn*, not *why* (Price, 1996). Each of the 20 elements functions as a mini-scale for a preference related to the cognitive, environmental, or affective domains. Thus, for example, a student with a high score on the visual element has a learning style preference for learning information using illustrations, PowerPoint slides, and computers. Scores for the PEPS elements range from 20 to 80. Students who score 40 or less are "least preferred" for that particular element while a score of 60 or more indicates a "most preferred" element (i.e., style). The PEPS instrument has reliability scores equal to or greater than .60 in past research (Bevard College, 2003; Price, 1996).

Statistical Analysis Used

The study employed descriptive analysis and independent t-tests. The rationale for the descriptive analysis was to identify the preferred learning style preferences of the students according to the mean score of the learning style/element. The mean score of the preferred learning style was identified in the 60-80 range, the "most preferred" element. The scores generated by the PEPS were for the treatment group. The purpose for using the independent t-test was to compare the mean scores for two different groups course grade average (CGA) of the treatment group-fall 2007 versus the control group-spring 2008 and to test the hypothesis statement for significance between the groups.

Data Collection Procedures

The investigator was provided necessary documentation to IRB-Human Subjects at the participating university for approval and to the participating department before permission was given for the research study. Steps were taken to ensure the study was not contaminated and that any internal threat to validity did not exist for the treatment and control groups. Instructor A was asked to not disclose the study's information to Instructor B.

Treatment Group

The study commenced in the fall semester of 2007 on September 10th. The study for the treatment group took 15 weeks to complete. Instructor A had been briefed on the research study's purpose and procedures to collect the data before the study, and was asked to participate in a one-day mini-workshop to receive basic information about learning styles, which include theory and usage of the PEPS. The instructor had little knowledge of learning styles and its application in an education setting. After the mini-workshop was completed, the principal research investigator established a time and date to disburse the PEPS to the Agriculture majors in the class. The

instructor had been provided directions for disbursement of the survey.

On October 1st, the students were given the surveys to complete. The survey was disbursed on a volunteer basis, and every student in attendance agreed to participate. This was documented on the IRB-Human Subjects paperwork. Students who wished to view their learning style preference profile were sent to Instructor A for pick up. The investigator mailed the completed PEPS to Price Systems in Lawrence, Kansas to be scanned and the data was sent back to the research investigator. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) to observe the mean scores of the learning style/element for the treatment group. Instructor A used the students' preferred learning style which was signified by identifying the highest mean score for the learning style/element. The SPSS output of the students' preferred learning style preferences was discussed with the instructor. The learning style/element with the highest mean score from the 20 preferences was used enhance his lessons and instructional methodologies. Instructor A was asked to maintain a journal every two weeks to record any changes in the students' grades and attitudes toward the course throughout the semester. On December 4th, course grade average (CGA)s were provided by Instructor A for the course. All journal entries for the two months were collected for the study. Students in this academic department were active in several events and organizations during the semester (e.g. National FFA meeting, state fair, homecoming activities). The instructor began modifications to teaching only after these excused absences were completed. This delayed implementation of instructional modification toward the later portion of the semester.

Control Group

Instructor B began teaching the soil science course for the spring semester of 2008 with no changes or enhancements in the instruction. Instructor B was not provided information about the study. At the end of the spring semester, the researcher obtained

grades through Instructor B. The researcher did not use names and student identification numbers, only grades.

Results/Findings

Obtaining Learning Style Preferences

The learning style preferences of the students were ascertained by SPSS. The results were generated before implementation of the modified instructions to enhance instructional approaches. Table 2 reports the preferred learning style preferences for 46 students in the soil science course.

The preferred learning style/element ***Structure*** was the most preferred among the students. From the 20 learning style/elements, *Structure* was frequently scored. There were 36 out of 46 students who scored several times in the most preferred range with 60, 64, 67, 70, and 74. According to Price (1996), the element/learning style 'Structure' is described as follows:

> For standard score of 60 or more, be precise about every aspect of the assignment; permit no options; use clearly stated objectives in a simple form; list and itemize as many things as possible, leave nothing for interpretation; clearly indicate time requirements and the resources that may be used; required tasks should be indicated as successful completion is evidenced, gradually lengthen the assignment and provide some choices from among approved alternative procedures; gradually increase the number of options; establish specific working and reporting patterns and criteria as each task is completed.
>
> For standard score of 40 or less, establish clearly stated objectives but permit choice of resources, procedures, time lines, reporting, checking, etc.; permit choice of environmental, sociological and physical elements; provide creative options and opportunities to grow and to stretch talents and abilities; review work at regular intervals but permit latitude for completion if progress is evident. Some employees may not prefer structure but require close supervision (p. 9).

Table 2.

Summary of Preferred Learning Style Preferences

Learning Style/Element	M	SD
Noise Level	51.70	6.029
Light	48.50	10.191
Temperature	50.37	10.058
Design	49.89	8.481
Motivation	52.74	5.702
Persistence	54.52	5.819
Responsible (Conforming)	46.17	10.109
Structure	**62.76**	**6.819**
Learning Alone/Peer-Oriented Learner	50.78	10.673
Authority-Oriented Learner	58.83	8.001
Several Ways	47.20	6.017
Auditory	52.26	10.030
Visual	48.07	7.344
Tactile	59.02	7.006
Kinesthetic	56.37	5.135
Requires Intake	56.26	8.619
Time of Day	47.70	9.928
Late Morning	49.46	10.178
Afternoon	56.78	11.053
Mobility	56.52	8.123

Note. Bold type signifies the learning Style preference preferred by students for the course

The preferred learning style *Structure* was used by Instructor A to design a new instruction prescription for the course (see Figure 2).

An independent t-test was conducted to determine if the treatment (learning style preference "Structure") which was employed by Instructor A assisted in the increase of the group course average (GCA) versus the control group. To verify that SPSS output was valid, assumptions were checked to determine if there were any violations. The assumptions were not violated.

Using a two-tailed .05 alpha level, the null hypothesis was rejected and the alternative accepted. The treatment group (M=3.17, SD=.54007) course grade average (CGA) was significantly higher than the control group (M=2.67, SD=.64383), $t(85)$=3.919, p=.000. The eta squared statistic (Cohen's d=.83~.38) indicate a medium effect size.

Oct. 22 , 2007 *Begin evaluating results of survey and develop a strategy of implementation.*

Nov. 5, 2007 *Begin modifying teaching*
Class begins with quick energetic review of previous lecture material (4 to 6 minutes)
Pop quizzes replaced with assignments
Assignments consist of students placed into groups of 2 to 3 people with all groups having the same question to answer and elaborate (3 to 5 minutes).

Nov. 25, 2007 *Assignments continue (once or twice a week)*
Send an e-mail to every student
I put each student's name in the greeting of the e-mail
Words of encouragement
Current grade average (100 point scale) included
Give invitation for additional assistance with course material

Dec. 3, 2007 *Review Session before Exam IV*
Conduct a question/answer session with one question for each student and allow each student time to answer his/her question. Questions cover most recent material covered in lecture and lab.
Floor open to all questions from students
Tell students to check their e-mail for a message from me (Nov. 25th e-mail)

Figure 2. *Sample-modification of instruction used for the preferred learning style* ***Structure.***

Conclusion and Discussion

Even though there was significance in the study, the authors would suggest that readers approach findings with caution. The findings should not immediately be generalized to the greater population due to the smaller sample size and lack of random sampling techniques utilized in the present study (McMillan & Schumacher, 2001). Even though the hypothesis of this study indicated there was a significant difference in the treatment group's course grade average (CGA) when compared to the control group's course grade average (CGA), one must conclude that there were uncontrollable external variables (i.e. parent pressure, monetary incentives, and self-motivation) which may have contributed to the higher course grade average (CGA). This study indicates that learning researchers have found that teaching to students' learning style preferences does make a positive impact quantitatively. However, common sense must be used to interpret the findings of learning style research, rather than being used as a cure-all for student success in the classroom.

According to McGee, Dobbins & King (2001), "[Agriculture instructors]…have a tremendous responsibility in working with students who have a variety of learning styles and intellectual capabilities within the…classroom" (p.27). Instructor A had a challenge to accommodate 46 students in the course; however, it required persistence and dedication to ensure the success of his students. An excerpt (see Figure 3) from the journal entry of Instructor A indicates a difference in the students' ability to address their learning styles.

The preferred learning style *Structure* is consistent with the Gordon and Yocke (2005) study that revealed *Structure* as being one of the preferred styles by the subjects. This preferred learning style and perhaps others that CTE majors possess are aligned to the established paradigm of CTE disciplines which attract students who desire to learn a technical skill. Ausburn and Brown (2006) emphasized, "providing CTE students with hands-on learning activities, clear explanations, multiple learning resources" (p. 32),

By implementing their preferred learning style Structure for the rest of the semester, participation by students, in the form of asking questions and feedback through comments about a lesson, increased compared to earlier in the semester. Assignments were precise with more focused objectives, which everyone understood. Some students have expressed thanks and appreciation for the email. As an instructor, there is now greater ease in holding the student's attention for 65 to 75 minutes. This research has allowed me to understand all students do not learn the same and their style of learning may come from different experiences outside of the classroom or by how other teachers taught their classes.

Figure 3. *Instructor A's journal entry on the observations of the students' engagement in learning.*

which this study attempts to provide using active research in learning style preferences to improving the learning environment. Instructor A implemented *Structure* to allow for a positive learning environment and to motivate students to understand the material.

This study is a catalyst for faculty to reflect on the growing number of students, especially first-generation students, who are presently in higher education classrooms. Faculty face socio-economic, cultural, gender, and age issues that complicate the learning environment and sometimes discourage effective teaching in the classroom. Learning style research in the past 30 years has been scrutinized and embraced as a possible means to change the paradigm of teaching in today's society. Rather than promoting learning styles as the only viable solution to effective teaching, this study can assist faculty to gaining increased knowledge about students' learning patterns. Sims and Sims (2006) stressed that, "The notion that all learners' [learning styles] are identical in educational institutions demonstrates arrogance and elitism by either sanctioning one group's style of learning while discrediting the styles of others or ignoring difference altogether" (p. xiv). For learning style research to

be educationally significant, alternative instructional tools should be provided to enhance the learning environment. For the universities' mission to be met, today's instructors must be in a continuous mode, striving for self-improvement, to ensure courses are taught effectively by using students' learning patterns.

The authors recommend that this study be a catalyst for further research to continue to investigate undergraduate student learning styles. Replications of this study should take place in other agriculture and related CTE disciplines at other universities. Additional research will provide a deeper understanding of teaching to student preferred learning styles and to further promote continuous improvement in utilizing different instructional approaches.

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