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LEARNING STYLES, TEACHING PERFORMANCE, AND STUDENT ACHIEVEMENT: A RELATIONAL STUDY

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Abstract

Learning styles have been shown to have an influence on students' academic achievement, how students learn, and student/teacher interaction. The purpose of this study was to describe relationships between students , learning styles, instructor 's teaching performance, and student achievement in an introductory animal science course. The Group Embedded Figures Test (GEFT) was used to assess students , preferred learning styles. Four instructors with GEFT scores ranging from 6 to 18 taught the course. Students rated each instructor 's teaching performance using a standard university evaluation. Learning style classifications of students were: field-independent, 56%; neutral, 22%, andfield-dependent, 22%. The mean GEFT score (13.4 ± .28) was significantly higher than the national mean. Negligible to low correlation coefficients were found between students ' GEFT scores and teaching evaluation scores for all four instructors regardless of the instructor 's GEFT score. Students ' achievement in the course was found to have a low positive relationship with their preferred way of learning. Students , advising group status accountedfor 30% of the variance in their achievement in the course. The diversity of learning styles was found to have little to no influence on students , achievement in the course or their perceptions of the instructors' teaching performance.

Introduction/Theoretical Base

An issue facing teachers of agriculture in higher education is providing quality instruction that meets the learning needs of students. Schroeder (1993) concluded that students are coming to institutions of higher learning with more diversity in their learning styles than ever before. Anderson and Adams (1992) indicated more attention than ever was needed to meet the challenge of this increasing diversity. Anderson and Adams further stated that:

> One of the most significant challenges that university instructors face is to be tolerant and perceptive enough to recognize learning differences among students. Many instructors do not realize that students vary in the way they process and understand information. The notion that students' cognitive [learning] skills are identical at the college level [suggests] arrogance and elitism by sanctioning one groups' style of learning while discrediting the style of others (p.19).

In investigating the complex phenomenon of teaching and learning, Dunkin and Biddle (1974) suggested that the creation of a model was necessary in developing a theoretical underpinning. Cruickshank (1990) supported the development of theoretical models by stating that they were needed in the study of teaching and learning to capture the complex interactions that occur.

Dunkin and Biddle, (1974) presented a model, based on the original work of Mitzel (1960), to guide the study of teaching and learning. In their model, Dunkin and Biddle suggested that the study of teaching and learning involved four major variable types: presage, context, process, and product (Figure 1). Presage variables include those that influence teachers and their teaching behaviors.

Context variables are those that involve the background of the learners, including their personality traits and learning styles. Process

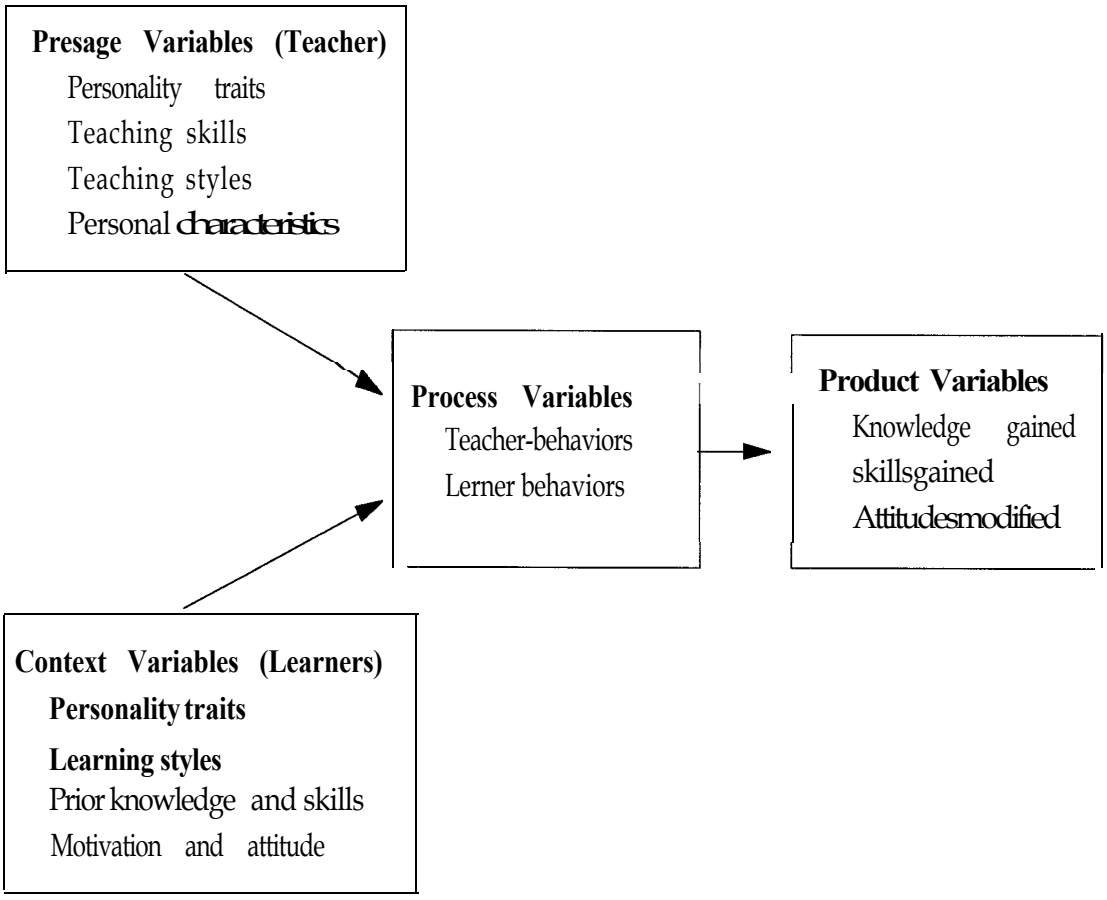

Figure 1. Conceptual Framework

variables describe the interaction of teacher and learner behaviors in the teaching-learning process. Finally, product variables include the knowledge and skills gained or attitudes modified as a result of the teaching and learning. The learning styles of students, a context variable, have been found to influence the educational process and students' opportunity to learn (Schroeder, 1993; Claxton & Murrell, 1987). Researchers (Witkin, 1973; Gregorc, 1979; Garger & Guild, 1984; Witkin, Moore, Goodenough, & Cox, 1977) have suggested that learning style was influential in students' academic achievement, how students learn, student and teacher interaction and in students' academic choices. Schroeder (1993) acknowledged that accommodating variations in learning styles could improve curricula and the teaching-learning process in higher education.

Gregorc (1979) described a person's learning style as consisting of distinct behaviors which serve as indicators of how a person learns and adapts to learning environments. Others (Dunn & Dunn, 1979; Garger & Guild, 1984) defined learning style as the educational conditions under which an individual is most likely to learn. Witkin (1973) indicated that a learning style influences a student's preference for particular teaching strategies and learning environments. Therefore, learning style describes how a student learns, not how much he/she learned.

The most extensively researched and applied learning style dimension has been field-dependence/independence (Kogan, 197 1; Guild & Garger, 198.5). Chickering (1976) noted that the field-dependence/independence dimension had major implications for college admissions requirements and for faculty who make decisions about learning environments and practices. In the field-dependence/independence learning style dimension, a person can be categorized as preferring a field-dependent, field-independent, or neutral (possessing characteristics of both field-dependent and field-independent) learning style.

Individuals who prefer a field-dependent learning style tend to perceive globally, have a more difficult time solving problems, are more attuned to their social environment, learn better when concepts are humanized, and tend to favor a "spectator approach" to learning. Additionally, individuals preferring a field-dependent learning style have been found to be more extrinsically motivated and learn better when organization and structure is provided by the teacher (Witkin, Moore, Goodenough et al., 1977).

Conversely, individuals who prefer a field-independent learning style tend to view concepts more analytically, therefore finding it easier to solve problems. Individuals preferring a field-independent learning style are more likely to favor learning activities that require individual effort and study. In addition, field-independent learners prefer to develop their own structure and organization for learning, are intrinsically motivated, and are less receptive to social reinforcement. (Witkin, Moore, Goodenough et al., 1977).

Research has been conducted to assess the preferred learning style of university students (Anderson & Adams, 1992; Torres & Cano, 1994) and the interaction of teaching approach and learning style on student achievement (Honeyman & Miller, 1998). Additional studies have suggested that students' learning style influences their cumulative grade point average (Torres, 1993; Torres & Cano, 1994). Cano and Porter (1997) and Cano (1999) reported that students preferring a field-independent learning style were more successful in higher education. The previously identified research has focused on describing how different groups of students learn and their academic performance based on grade point average. What has been lacking is research that focuses on the knowledge and skills learned in an individual course and the factors that influence students' achievement in that course.

Purpose and Objectives

The purpose of this study was to identify relationships that existed between learning style, a context variable, teaching performance, a process variable, and student achievement, a product variable, in an introductory animal science course. The specific objectives of the study were to:

1. Describe the preferred learning style of students.
2. Describe the relationship between students' preferred learning style and the instructors' teaching performance as perceived by students.
3. Describe the relationship between students' preferred learning style and their achievement in the course.

4. Explain the variance in student achievement accounted for by learning style and/or prior knowledge and skills, as assessed by university admissions criteria.

Procedures

Population and Sample

The target population for this ex-post facto correlational study consisted of students majoring in animal science at the University of Missouri. A purposive sample of an intact group of students enrolled in an introductory animal science course, was selected (n=187). The introductory course is required of animal science majors and is usually taken during their first semester of enrollment.

Nonprobability sampling was used based upon the context of the study (Grosof & Sardy, 1985; Judd, Smith, & Kidder, 1991; Gay, 1996). To assist in affirming nonbias sampling, a comparison of university admissions criteria, including high school class rank and ACT score, was used to determine that the characteristics of the sample appropriately reflected the target population.

Instrumentation

The Group Embedded Figures Test (GEFT) (Witkin, Oltman, Raskin & Karp, 1971) was administered to assess the preferred learning style of students. The possible range of scores on the GEFT was 0 to 18. Individuals scoring 14 or greater were considered to prefer a field-independent learning style, individuals scoring 10 or less were considered to prefer a field-dependent learning style, and those individuals scoring from 11 to 13 were considered to prefer a neutral learning style.

The GEFT is a standardized instrument that has been used in educational research for over 25 years (Guild & Garger, 1985). The validity and reliability of the GEFT was established by the instrument's developers (Witkin et al., 197 1). The validity of the GEFT was established by determining its relationship with the "parent" test, Embedded Figures Test (EFT), as well as the Rod and Frame Test (RFT), and the Body Adjustment Test (BAT). The GEFT is a timed test, therefore internal consistency was measured by treating each section as split-halves (Spear-man-Brown reliability coefficient of .82).

Analysis of Data

The GEFT was administered to students enrolled in the introductory animal science course during the second class session. Four instructors, with GEFT scores ranging from 6 to 18, taught the course. Students rated the instructors' teaching performance at the conclusion of each instructor's portion of the course using a standard university instructor evaluation.

Descriptive statistics were calculated on GEFT scores, university admissions variables (ACT score and high school class rank), instructor evaluations, and student achievement as measured by scores on exams. Correlation coefficients were calculated between the variables of interest and were interpreted utilizing Davis' (1971) descriptors. Stepwise regression analysis was used to explain variance in student achievement accounted for by learning style and prior knowledge and skills, as assessed by university admissions criteria. An alpha level of .05 was established *apriori*.

Results

An analysis of the learning styles of students enrolled in the introductory animal science course indicated that a majority (56%) preferred a field-independent learning style (Table 1). The remaining students were split equally between a neutral (22%) and a field-dependent (22%) learning style. The mean GEFT score was 13.4 with a standard deviation of 3.8. A break down of learning styles by gender revealed that a

majority (56%) of both male and female students preferred a field-independent learning style. An analysis of the opposite end of the continuum revealed that 27% of the males, but only 18% of the females, preferred a field-dependent learning style. The remaining students, 17% of the males and 26% of the females, fell in the middle of the continuum and therefore were classified as neutral. The mean GEFT score for males was 13.2 (SD = 3.9) and females 13.5 (SD = 3.8).

The second objective sought to describe relationships between students' preferred learning style and the teaching performance of the instructors, as perceived by students on instructor evaluations Relationships ranged from a -.08 for instructor one on "the organization of the subject matter" to a .21 for instructor four on "knowledge of the subject matter" (Table 2). However, only one coefficient across all four instructors was found to be significant. The item "examinations

Table 1. Preferred Learning: Stvle by Gender (n=187)

	Field-Dependent n%		Neutral n%		Field-Independent n%		GEFT M	GEFT SD
Males (n=77)	21	27.3	13	16.9	43	55.8	13.2	3.93
Females (n=110)	20	18.2	28	25.5	62	56.3	13.5	3.78
Total	41	21.9	41	21.9	105	56.2	13.4	3.84

contributed to my learning" for instructor one was found to have a low positive relationship with students' GEFT scores. The second instructor, the only instructor of the four possessing a neutral learning style (GEFT = 1 1), received the highest rating on all 13 evaluation items.

Low positive and significant relationships were found between students' GEFT scores and student achievement on examinations when taught by the first instructor (r = .16) and the fourth instructor (r = .19) of the introductory animal science course (Table 3). A correlation matrix was generated to show the intercorrelations of variables regressed on student achievement, as measured by final course percentage (Table 4). Variables regressed on student achievement ranged from a substantial negative and significant relationship (r = -.55) for advising group to a low positive and significant relationship (r = .14) for learning style. In addition, prior experience with animals was found to have a negligible and non-significant relationship (r = -.02) with student achievement in the introductory animal science course.

Using guidelines offered by Lewis-Beck (19800, bivariate correlations near .8 were considered threats to multicollinearity and were removed prior to conducting regression analysis. ACT score was excluded from the regression equation because of its very strong relationship with advising group (r = -.77). Furthermore, high school class rank was deleted from the regression equation because of its very strong relationship with advising group (r = -.88).

Stepwise multiple regression was used to explain the variance in student achievement accounted for by learning style and/or prior knowledge and skills. Only one variable, advising group status, entered into the regression equation and accounted for 30% of the variance in student achievement in the introductory animal science

Table 2. Relationship Between Learning Style and Teaching Performance as Perceived by Students

	Teachers Performance Assessment Item[a]	Instructor 1		Instructor 2		Instructor 3		Instructor 4	
		M (SD)	r	M (SD)	r	M (SD)	r	M (SD)	r
1.	Instructor's organization of the subject matter made it easy to follow	4.12 (.65)	-.08	4.48 (.68)	.06	3.69 (.89)	-.02	3.94 (.83)	.14
2.	Instructor's explanations were easy to understand	3.82 (.83)	.02	4.50 (.68)	.07	3.51 (.92)	-.05	3.92 (.76)	.20
3.	Instructor' voice was clear and easy to understand	3.75 (.98)	.06	4.88 (.35)	.03	4.08 (.81)	.00	4.13 (.74)	-.05
4.	Instructor's ability to present alternative explanations was effective	3.67 (.80)	-.02	4.31 (.75)	.07	3.68 (.93)	-.01	3.93 (.79)	.05
5.	Instructor's use of examples and illustrations were helpful	3.94 (.79)	.04	4.23 (.79)	.07	3.97 (.84)	-.04	4.00 (.74)	.09
6.	Instructor was enthusiastic about teaching	3.78 (.89)	-.03	4.94 (.37)	.03	3.71 (.84)	.01	3.71 (.83)	.02
7	Course objectives were clearly communicated	3.95 (.84)	.03	4.59 (.66)	.09	3.64 (.93)	.04	3.93 (.88)	.10
8.	Instructor was available when extra help was needed	3.29 (.68)	.07	4.01 (.82)	.09	3.33 (.68)	.02	3.60 (.73)	.15
9.	Instructor was very knowledgeable of the subject matter	4.53 (.54)	-.07	4.74 (.44)	.05	4.48 (.59)	.03	4.40 (.57)	.21
10.	Assignments were helpful in learning the course content	3.22 (.82)	-.04	4.35 (.79)	.04	3.69 (.80)	.10	3.83 (.86)	.01
11.	Instructor provided feedback regarding my learning	3.34 (.88)	.01	4.09 (.84)	.07	3.38 (.84)	-.06	3.60 (.83)	.02
12.	Instructor's examinations contributed to my learning	3.78 (1.0)	.15*	4.15 (.93)	.08	3.83 (.80)	.02	3.72 (.83)	.04
13.	Overall teaching effectiveness[b]	3.66 (.82)	.12	4.68 (.55)	.05	3.55 (.79)	.06	3.76 (.81)	.10

Note. Pearson-product moment coefficients, *$p < .05$; [a]Scale: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree [b]Scale: 5 = excellent, 4 = quite good, 3 = satisfactory, 2 = fair, 1 = poor

course (Table 5). The variables not entering the regression equation were: learning style (GEFT) and prior experience with animals.

Conclusions, Implications and Recommendations

A majority of the students enrolled in the introductory animal science course preferred a field-independent learning style. This finding was consistent with previous research which found that a majority of college agriculture students preferred a field-independent learning style (Torres & Cano, 1994; Cano & Porter, 1997; Cano, 1999). The students' mean GEFT score was 13.4 which was two points above the established norm of 11.4

Table 3. Relationshin Between Learning; Stvle (GEFT) and Student Achievement by Instructor

	r
First instructor's exam	.16*
Second instructor's exam	.11
Third instructor's exam	.07
Fourth instructor's exam	.19

Note. Pearson-product moment coefficients
*p < .05.

(Witkin, Moore, Oltman et al., 1977). However, the mean GEFT score of 13.4 approximated the GEFT score of animal science majors at other higher education institutions (Torres & Cano, 1994).

Both male and female students enrolled in the introductory animal science course preferred a field-independent learning style. A slightly higher percentage of females than males preferred a field-independent learning style. This finding is not consistent with previous research. Torres and Cano (1994) reported that a majority of female

Table 4. Intercorrelations of Variables Regressed on Student Achievement

Variable	Intercorrelations					
	X_1	X_2	X_3	X_4	X_5	*Y*
GEFT (X_1)	1.0	.34*	.15	-.27*	-. 12	.14*
ACT (X_2)		1.0	.54*	-.77*	-.09	.51*
High school rank (X_3)			1.0	-.88*	-.08	.43*
Advising group (X_4)				1.0	.11	-.55*
Experience (X_5)					1.0	-.02
Achievement (Y)						1.0

Note. Advising group 1, 2, 3, or 4 based on high school class rank, ACT score, high school grade point average; [0]= no experience, 1 = some experience, 2 = raised animals
[a]Spearman's rho.
*p < .05

Table 5. Stepwise Regression of Achievement on Variables of Interest[a]

Variable	B	SE B	β	t
Advising group	-4.82	.59	-.55	-8.19"
(constant)	95.37			

Note. "GEFT, advising group, experience with animals; R^2 = .30
*p < .05

agriculture students preferred a field-dependent learning style where in the current study only 18% of the females preferred a field-dependent learning style. Furthermore, the findings of the current study contrasts previous research (Witkin, Moore, Oltman et al., 1977; Garger & Guild, 1984; Claxton & Murrell, 1987) that found persistent gender differences in the field-dependence/independence dimension with females preferring a field-dependent learning style. Consequently, could the difference in preferred learning style have an impact on the teaching

performance of the four instructors?

There was no practical relationship between students' learning style and the four instructors' teaching performance, as perceived by students. This would imply that the instructors' teaching performance was not associated with learning style and, as viewed by students, the instructors were reaching their diverse learning needs. However, the instructor classified with a neutral learning style did receive higher ratings from the students on all 13 evaluation items.

A low positive relationship was found between students' learning style and their achievement in the course. Furthermore, low positive relationships were found between learning style and achievement in the section of the course taught by the first and fourth instructors. Although the relationships were low, they were in the positive direction, indicating that as students moved toward a field-independent learning style their achievement in the course increased.

Advising group status accounted for **30%** of the variance in student achievement. A negative correlation coefficient for advising group status implied that as a student's advising group status moved toward advising group four, achievement in the course was lessened. Interestingly, learning style and students' prior experience with animals did not explain a significant proportion of the variance above and beyond that explained by advising group status. Therefore, the conclusion can be made that the instructors of the course were meeting the diverse learning needs of students.

Possessing the knowledge that advising group status plays a crucial part in student achievement has implications for the instructors of the course. Information indicating a student's advising group is readily available to advisors and course instructors. Students falling into advising groups three and four should be closely monitored for their learning needs and should be provided regular feedback on their learning progress. Currently, the introductory animal science course meets three times per week in a large lecture class. It is recommended that the instructors consider switching to two lecture periods and have small discussion groups meet for the third period each week. Dividing the course into small discussion groups would allow instructors to more closely monitor students' progress and make it easier to identify and assist those students falling into advising group three or four status who are in need of learning assistance. It is further recommended that after modifications to the course are made that the instructors re-evaluate the impact that advising group status has on student achievement.

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