

THE INFLUENCE OF STUDENT LEARNING EXPERIENCE LEVEL AND LEARNING STYLE ON ACHIEVEMENT

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Abstract

An emerging trend on university campuses has been to offer courses totally online, or with a blend of online and face-to-face components. In 2002, over 80% of public universities offered both blended and online courses to their on-campus students. It is reasonable to assume that students enrolled in an online class have a different learning experience and experience the course content differently than students enrolled in a face-to-face class, recognizing that different does not necessarily imply better or worse. The purpose of this quasi-experimental study was to determine if that difference in experience with the course content affects the amount of learning for students of differing learning styles. The sample used in this study consisted of undergraduate students enrolled in an introductory food science course. The control group consisted of students enrolled in a section of the course taught with a traditional lecture (N = 253). The experimental group consisted of students enrolled in a section of the course taught asynchronously using WebCT® and web pages (N = 247). Results indicated no differences for Concrete Sequential, Concrete Random, and Abstract Sequential learners. A significant, but impractical difference was found for Abstract Random learners, who achieved higher in the control group.

Introduction

In 2000, 15.3 million students were enrolled in post-secondary degree-granting institutions, which represented an 11% increase since 1990 (National Center for Educational Statistics, 2002). Further, over 51% of these students were enrolled at larger universities with enrollments of over 10,000 students (which represented only 11% of all universities). Larger campuses may offer an efficiency of scale; however, larger enrollments can make offering sufficient courses challenging.

An emerging trend on university campuses has been to offer courses totally online, or with a blend of online and face-to-face components (Allen & Seaman, 2003). In 2002, over 80% of public universities offered both blended and online courses to their on-campus students. They go further to assert that given a choice between an online and a traditional course, that students will enroll in the online version, as evidenced by the 1.6 million students who took an online

course in the fall of 2002. This phenomenon is also pertinent to university agricultural education programs where Roberts and Dyer (2005) reported that distance and technology delivered courses are prevalent.

It is reasonable to assume that students enrolled in an online class have a different learning experience than students enrolled in a face-to-face class, recognizing that different does not necessarily imply better or worse. Further, as different learning experiences occur, it is reasonable to presume that as students construct meaning from their respective experiences that certain experiences may be better suited for certain students.

Theoretical Framework

This study was guided by the grand-level theory of constructivism, with its central precept that students actively construct meaning from their experiences (Doolittle & Camp, 1999). More specifically, student learning experiences consist of complex

interactions between other students, the instructor, and the content (Moore, 1989). In some instances, student learning experiences also involve interaction with technologies (Hillman, Willis, & Gunawardena, 1994). It was also recognized that student learning experiences do not occur in isolation, but rather in complex social environments (Vygotsky, 1978)

Additionally, student experience with content can occur at different levels from direct to indirect (Dale, 1946). Presented as a *Cone of Experience*, Dale posited that at the most direct level students learn through direct participation or concrete experience with the content, while at the most indirect stage students experience the content abstractly through verbal symbols. Thus, student interaction with content can occur on a continuum from direct, concrete experience to abstract, vicarious experience.

The theory that students have a preferred way of inputting, processing, and storing information also framed this study (Gregorc, 1982a). Often referred to as learning or cognitive style, this preference is not synonymous with academic ability. Numerous taxonomies have been developed to differentiate learning styles (Dunn & Dunn, 1993; Gregorc, 1982a; Kolb, 1984; Witkin & Goodenough, 1981). Gregorc's work has identified four categories of student learning styles: concrete sequential

(CS), concrete random (CR), abstract sequential (AS), and abstract random (AR).

According to Gregorc (1982a), CS learners approach learning in a logical, concrete, objective fashion. They utilize their senses to collect data. CS learners prefer orderly, quiet learning environments. CR learners also approach learning in a logical fashion, but they utilize intuition and instinct to collect data. CR learners prefer active learning environments, but are adept at learning by themselves. AS learners approach learning from an abstract perspective, relying on symbols and signs. They think logically and are comfortable working with theories. AS learners prefer lectures and reading assignments. AR learners approach learning with their feelings and emotions. They organize content in non-linear fashions. AR learners prefer learning in groups with much interaction.

In summary, students learn by constructing meaning from their experiences, which can occur at different levels. Further, students have preferred learning styles. As depicted in Figure 1, conceptually, students enter a learning environment with a preferred way of learning. In that learning environment, they experience the content somewhere on a continuum from concrete to abstract. In turn, they learn the content to some proficiency.

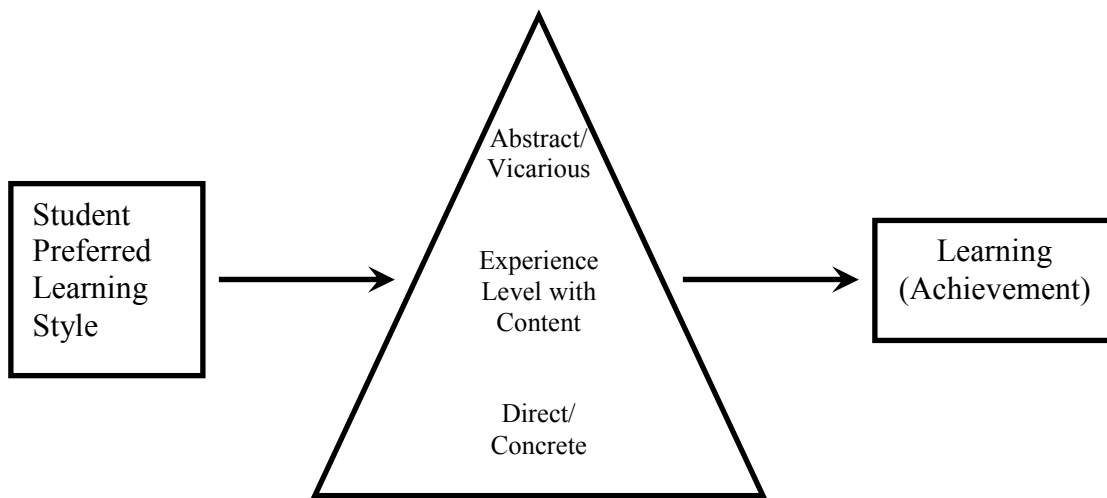


Figure 1. Model of the relationship between learning style, experience level, and learning.

Previous research has documented the influence of learning styles when student learning experiences are affected by teaching approach. For example, Dyer and Osborne (1996) found that field-neutral students scored significantly higher on achievement tests when students were taught with the problem-solving approach, which provides more concrete interaction with the content. In an earlier study, Marrison and Frick (1994) compared students of differing learning styles (field independent/dependent) on achievement and perceptions when course content was presented as a lecture versus a “multimedia” approach (that consisted of text, still pictures, and graphics). They reported no difference in achievement. However, field dependent learners expressed a desire for sound in the “multimedia” approach.

Student experiences in a course are affected by the method used to deliver course content. As such, researchers have compared courses delivered face-to-face and those mediated through technology. Results generally support the premise that courses delivered through technology can be equivalent to courses taught face-to-face (Born & Miller, 1999; Miller & Pilcher, 2000; Miller & Shih, 1999; Russell, 1999).

Recognizing that delivering course content mediated through technology was a different learning experience for students, several researchers examined if differences existed in achievement based on learning style. Results of this line of inquiry produced conflicting results. For example, Daniel (1999) as well as Oxford, Park-Oh, Ito, and Sumrall (1993) reported an influence, while Day, Raven, and Newman (1998) along with Freeman (1995) found no relationship. The variability in conclusions drawn by these researchers clouds the picture of the influence of learning styles. Therefore, a conclusive statement regarding the influence of learning styles cannot be made.

Existing research examined student experiences at the macro-level (entire courses), either comparing technology mediated courses to face-to-face courses or examining the influence of learning styles in course achievement. However, examining these variables at the macro-level does not

provide insight in to specific learning activities delivered at different levels of experience (concrete versus abstract). Missing from the literature are studies examining how the type of experiences provided to students at the micro level (units of instruction) affect achievement.

Purpose

The purpose of this study was to determine if the level of experience with course content affects the amount of learning for students of differing learning styles. Initially, one null hypothesis was used to guide this study.

Ho: There is no difference between groups in achievement across learning styles.

Upon initial data analysis, it was determined that students of each learning style should be examined individually. Consequently, four null hypotheses were developed that address each learning style, respectively. These hypotheses were used to further guide this study.

Ho₁: There is no difference between groups in achievement for Concrete Sequential students.

Ho₂: There is no difference between groups in achievement for Concrete Random students.

Ho₃: There is no difference between groups in achievement for Abstract Sequential students.

Ho₄: There is no difference between groups in achievement for Abstract Random students.

Methodology

To address the purpose of this study and test the null hypotheses, a quasi-experimental design was used. Specifically, a nonrandomized control group, pre-test – post-test design was chosen (Ary, Jacobs, & Razavieh, 2002). This design was necessary, because participants were already assigned

to intact groups, so random assignment was not possible. Without random assignment, groups cannot be considered equivalent prior to beginning the study, but differences can be statistically controlled for (Ary et al.). This study consisted of two groups – a control group and an experimental group.

Ary et al. (2002) indicated that if the groups do not differ on pre-test scores the selection threat to internal validity is eliminated. They go further to posit that because the study occupied the same period of time and both groups take the same pre-test and post-test that maturation, instrumentation, pretesting, history, and regression should not be threats to internal validity.

Both the control and experimental groups were taught by the same instructor and consisted of students enrolled in an introductory undergraduate food science course taught at the University of Florida. The treatment period consisted of one-third of the content covered in the course and was two weeks in duration. Both groups had access to the same supplemental texts.

The control group consisted of students enrolled in a section of the course taught with a traditional lecture ($N = 253$). Class sessions were held in a lecture hall and consisted of the instructor presenting the content using PowerPoint® slides as a visual supplement to the lecture and class discussions. In this group, student experiences consisted of direct interaction with the instructor and with fellow students throughout the class sessions. For this group, the treatment period of two weeks consisted of 9 class sessions that lasted approximately 1 hour and 15 minutes, although some of this time was used for announcements and other housekeeping activities typically associated with teaching a class.

The experimental group consisted of students enrolled in a section of the course taught asynchronously using WebCT® and web pages ($N = 247$). The content was delivered using streaming videos that consisted of an auditory recording of the instructor delivering the lecture and the same PowerPoint® slides as the control group. This delivery method provided a more abstract experience than the control group and has been previously called an

illustrated web lecture (Roberts, 2003). In this group, student experiences consisted of reading and listening with little or no direct interaction with other students or the instructor. However, they did have the opportunity to interact through electronic mail. For this group, the treatment period of two weeks consisted of nearly six hours of streaming videos that the students could view at their own pace. Students also had access to web pages that contained the same announcements as were delivered to the control group.

As indicated previously, this study used a pre-test – post-test design. The instructor of the course developed the instrument used as the post-test. This was deemed appropriate, as the instructor was the subject matter expert. The researcher then created a parallel form to use as the achievement pre-test. Ary et al. (2002) defined a parallel form as one that is as similar as possible in content, difficulty, length, and format. This was achieved in this study by altering the ordering of the questions, altering the ordering of the responses for each question, and rewording questions from the post-test. The instruments consisted of 100 single-response multiple-choice questions. Both instruments were evaluated for face validity by an expert panel. The instructor of the course evaluated the instruments for content and construct validity. Post hoc reliability analysis yielded a Kuder-Richardson-20 score of .82. Both the pre-test and the post-test were administered as web-based forms.

Learning styles were assessed using the Gregorc Style Delineator (Gregorc, 1982a). This instrument was chosen based on its ability to separate learners into four distinct learning styles and the relative ease to create an electronic version of the instrument. The instrument identifies people as Concrete Sequential (CS), Concrete Random (CR), Abstract Sequential (AS), and Abstract Random (AR). Gregorc (1982b) has previously established the validity and reliability of this instrument (alphas for each construct ranged from .89 to .93). A web-based version of this instrument was used in this study.

A researcher-developed web-based instrument was utilized to collect demographic data in this study. An expert

panel of university faculty evaluated the instrument for face and content validity. Because questions had “an accurate, ready-made answer”, the questions did not elicit demands for considerable time, thought, nor variation and therefore posed no reliability risks (Dillman, 2000, p. 35).

Results

Because groups were not randomly assigned, groups were first examined for

comparability. The control group consisted of 80 males and 173 females, while the experimental group contained 100 males and 147 females (Table 1). When comparing the gender makeup of the two groups, a difference was observed ($X^2_{(1, N=500)} = 4.53, p = .033$). However, subsequent correlation analysis revealed that gender was not practically or significantly correlated with post-test score ($r = -.05, p = .225$). Therefore, gender was excluded from further analysis.

Table 1
Gender Frequencies by Group

Gender	Control Group		Experimental Group	
	<i>f</i>	%	<i>f</i>	%
Male	80	31.62	100	40.50
Female	173	68.37	147	59.50

Note. Groups differed on gender ($X^2_{(1, N=502)} = 4.53, p = .033, \text{Effect Size} = .082$)

The two groups were also compared to determine if there was a difference in learning styles among students in each group. The control group had 86 CS students, 64 CR students, 30 AS students, and 73 AR students (Table 2).

The experimental group had 88 CS students, 60 CR students, 43 AS students, and 56 AR students. Chi-square analysis revealed that the two groups did not significantly differ ($X^2_{(3, N = 500)} = 4.636, p = .200$).

Table 2
Descriptive Statistics of Pre-test Scores by Group

Learning Style	Control Group			Experimental Group		
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Concrete Sequential	86	35.56	10.40	88	34.93	10.49
Concrete Random	64	32.80	13.30	60	33.43	9.82
Abstract Sequential	30	36.67	13.08	43	37.77	13.64
Abstract Random	73	33.37	10.68	56	36.09	12.31
Total	253	34.36	11.62	247	35.32	11.39

Note. Learning style frequencies did not differ between groups ($X^2_{(3, N = 500)} = 4.636, p = .200, \text{Effect Size} = .096$)

Pre-test scores were normally distributed around the mean. As seen in Table 2, the lowest mean score was observed for CR students in the control group ($M = 32.80, SD = 13.30$), while the highest was observed for AS students in the experimental group ($M = 37.77, SD = 13.64$).

Two-factor Analysis of Variance was conducted to determine the effects of group,

learning style, and the interaction between the two on pre-test scores (Table 3). No significant differences between groups were observed. Results indicated no main effect for group ($F_{(1, 492)} = .775, p = .379$), no main effect for learning style ($F_{(3, 492)} = 2.015, p = .111$), and no main effect for the interaction between group and learning style ($F_{(3, 492)} = .524, p = .666$).

Table 3
Two-factor Analysis of Variance of Pre-test Scores

Source	df	F	p	η^2
Intercept	1	4160.098	.000	.894
Group	1	.775	.379	.002
Learning Style	3	2.015	.111	.012
Group*Learning Style	3	.524	.666	.003
Error	492			
Total	500			

Post-test score data was collected for 496 students, which represented a loss of four participants. Descriptive statistics are presented in Table 4. Post-test means were normally distributed around the mean. The

lowest mean score was observed for AR students in the experimental group ($M = 54.42, SD = 7.93$), while the highest was observed for AR students in the control group ($M = 57.67, SD = 8.54$).

Table 4
Descriptive Statistics of Post-test Scores by Group

Learning Style	Control Group			Experimental Group		
	N	M	SD	N	M	SD
Concrete Sequential	86	57.52	8.67	87	56.78	9.21
Concrete Random	63	55.25	8.77	60	56.78	8.81
Abstract Sequential	30	56.07	8.13	42	55.86	8.50
Abstract Random	73	57.67	8.54	55	54.42	7.93
Total	252	56.83	8.61	244	56.09	8.71

Ho: There is no difference between groups in achievement across learning styles.

Two-factor Analysis of Covariance was conducted to determine the effects of group, learning style, and the interaction between the two had on post-test scores, while controlling for pre-test scores (Table 5).

Results indicated an effect for pre-test score ($F_{(1, 487)} = 32.248, p = .000$). In contrast, it indicated no main effect for group ($F_{(1, 487)} = 1.159, p = .282$) and no main effect for learning style ($F_{(3, 487)} = .748, p = .524$). As such, the null hypothesis was not rejected.

Table 5
Two-factor Analysis of Covariance of Post-test Scores

Source	df	F	p	η^2
Intercept	1	1635.504	.000	.771
Pre-test	1	32.248	.000	.062
Group	1	1.159	.282	.002
Learning Style	3	.748	.524	.005
Group*Learning Style	3	2.064	.104	.013
Error	487			
Total	496			

Although not significant at $\alpha = .05$, the effect of the interaction between group and learning style ($F_{(3, 487)} = 2.064, p = .104$) and the limited research in this area presented grounds to further explore the effect of learning style. As such, the simple main effects of group were examined for each learning style. To test the effect of group membership for students of each learning style while controlling for pre-test score, four additional null hypotheses were developed, addressing CS, CR, AS, and AR students, respectively.

Ho₁: There is no difference between groups in achievement for Concrete Sequential students.

For CS students, the control group mean was 57.52 ($SD = 8.67$) and the experimental group mean was 56.78 ($SD = 9.21$). Analysis of Covariance indicated no main effect for group ($F_{(1, 170)} = .186, p = .667$) while controlling for pre-test score (Table 6). Therefore, the null hypothesis (Ho_1) was not rejected.

Table 6
Analysis of Covariance of Post-test Scores for Concrete Sequential Students

Source	df	<i>F</i>	<i>p</i>	η^2
Intercept	1	451.460	.000	.726
Pre-test	1	10.511	.001	.058
Group	1	.186	.667	.001
Error	170			
Total	173			

Ho₂: There is no difference between groups in achievement for Concrete Random students.

In the control group, the mean post-test score for CR students was 55.25 (*SD* = 8.77), while a mean of 56.78 (*SD* = 8.81)

was observed for the experimental group. No main effect for group ($F_{(1, 120)} = .853, p = .357$) was detected through Analysis of Covariance (Table 7). As such, the null hypothesis (*Ho₂*) was not rejected.

Table 7
Analysis of Covariance of Post-test Scores for Concrete Random Students

Source	df	<i>F</i>	<i>p</i>	η^2
Intercept	1	461.949	.000	.794
Pre-test	1	8.170	.005	.064
Group	1	.853	.357	.007
Error	120			
Total	123			

Ho₃: There is no difference between groups in achievement for Abstract Sequential students.

For AS students, the control group exhibited a mean of 56.07 (*SD* = 8.13) and the experimental group exhibited a mean of

55.86 (*SD* = 8.50). As seen in Table 8, Analysis of Covariance indicated no main effect for group ($F_{(1, 69)} = .071, p = .791$). Consequently, the null hypothesis (*Ho₃*) was not rejected.

Table 8
Analysis of Covariance of Post-test Scores for Abstract Sequential Students

Source	df	<i>F</i>	<i>p</i>	η^2
Intercept	1	295.032	.000	.810
Pre-test	1	8.526	.005	.110
Group	1	.0017	.791	.001
Error	69			
Total	72			

Ho₄: There is no difference between groups in achievement for Abstract Random students.

Examination of AR students yielded a mean of 57.67 (*SD* = 8.54) for the control group and 54.52 (*SD* = 7.93) for the experimental group. Analysis of Covariance indicated a main effect for group ($F_{(1, 125)} =$

6.357, $p = .013$), thus indicating a statistical difference in post-test means between the two groups (Table 9). Accordingly, the null hypothesis (Ho_4) was rejected. AR students in the control group scored nearly 6% higher than AR students in the experimental group. However, only a small effect size ($\eta_p^2 = .048$) was observed (Cohen, 1988).

Table 9
Analysis of Covariance of Post-test Scores for Abstract Random Students

Source	df	<i>F</i>	<i>p</i>	η^2
Intercept	1	476.918	.000	.792
Pre-test	1	5.669	.019	.043
Group	1	6.357	.013	.048
Error	125			
Total	128			

Conclusions, Discussion, and Implications

Readers are cautioned that without random assignment, conclusions drawn are only applicable to the sample. Based on the results of this study, we can conclude CS, CR, and AS students do not differ in achievement based on the level of their experience with content. We can, however, conclude that AR students achieve at a slightly higher level (although not practical) when they experience content in a more

concrete fashion, particularly when that experience involves interaction with the instructor and other students.

These conclusions provide a basis for discussion. Previous research was inconclusive of the influence of learning style on achievement. For CS, CR, and AS learners, the current study was in concordance with those showing no difference (Day et al., 1998; Freeman, 1995). Theory purports that AR learners prefer interactive, socially dynamic learning

environments (Gregorc, 1982a). Affirming theory, the results of this study suggest providing a more socially interactive experience for AR learners will increase their achievement. This assertion aligns with the findings of Marrison and Frick (1994) who found that field-dependent learners preferred a more socially dynamic environment by requesting the sound be added to textual representations in the "multimedia" approach.

The conclusions of this study imply that with this group of students that experiencing the content concretely in a face-to-face format and abstractly through representations delivered online can be equally effective, although AR students did slightly better in the more concrete face-to-face group. Thus, continuation of this delivery method as a means of efficiently delivering the content of this course is recommended.

Although not provocative, this study suggests that some learning experiences may be better suited for some students and that selecting appropriate experiences for students is important for learning. However, further research is needed to determine which types of experiences are best suited for which people. Why can some people learn from watching someone else, while others must practice over and over to achieve even limited proficiency? Why can the same person learn some information by watching others, but can never master other information, even with extensive practice? Why can some people learn by reading a book while others require more concrete experiences? Which content can be effectively presented in abstract forms? Which content is best learned through concrete experience?

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