DOCUMENT RESUME

ED 460 150 TM 033 624

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TITLE An Examination of the Relationship between Learning Style and Technology Use.
PUB DATE 2001-11-15
NOTE 27p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (30th, Little Rock, AR, November 14-16, 2001).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Style; *Educational Technology; Higher Education; Individual Development; *Internet; *Student Attitudes; *Undergraduate Students

ABSTRACT

The relationship between students' learning styles and Internet use was studied in a college course in which technology was infused. The setting was a large multisection undergraduate education course on lifespan human development. The course was a traditional on-campus course in which technology was infused through an interactive course Web site, online substantive course material, and the use of online discussion rooms. All students were trained in the use of campus technology resources. The sample was approximately 300 undergraduate students, but only 139 students completed all 3 surveys over the course of the semester. Learning style was assessed through the Learning Style Inventory (D. Kolb, 1999), and measures of exposure to the Internet and computers and "Internet-focused style" were also administered. The study demonstrated that students preferred different styles when using the Internet than when learning in general. Regardless of their general learning style preferences, students moved toward more active dimension and mode styles when using the Internet. Previous research has suggested that a preference for an active learning style has a positive relationship with attitudes toward and performance on computer tasks. The results of the current study complement those findings. (Contains 3 tables and 19 references.) (SLD)

An Examination

of the

Relationship between

Learning Style and Technology Use

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MSERA Conference

November 15, 2001

An Examination of the Relationship

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Technology is changing the way the world is viewed. The advent of e-mail and the Internet has provided the opportunity to collect information from around the world in seconds. Individuals have the power at their fingertips to connect to libraries, researchers, authors, publishing companies, college classrooms, and professors (Simerly, 1999). Are institutions of higher education ready for the technological changes that are taking place, and how are they helping students adapt to this new technological environment? Young (1997) reported that many colleges and universities require students to take computer classes and have implemented computer competency entrance and exit exams. Some colleges have made ownership of computers a requirement for entrance, while others have distributed computers to each of their students (Young, 1997).

Having access to a computer and having the skills to use it are two different situations. Students need computer literacy skills to meet the demands they are facing in today's highly technical world. Davis (1999) conducted a survey of 1,176 undergraduates at Cornell University and asked students to rate the effectiveness of various methods for learning computer skills. The eight methods students could choose from were credit classes, non-credit workshops, drop-in clinics, faculty support, peer support, online help, printed documentation, and trial and error. Students selected credit classes, trial and error, and peer support as more effective than the other methods. Considering this information about the methods many students believe are most effective in learning technology skills and the opportunities to provide technical training in the classroom today, higher education faculty and staff can assist students in developing the skills they need.

The purpose of this study was to examine the relationship between students' learning styles and Internet use in a college course in which technology was infused. The setting was a large multi-section undergraduate education course on lifespan human development. All students were trained in the use of campus technology resources. The course was a traditional on-campus course in which technology was infused through the use of an interactive course website, online substantive course material, and use of online discussion rooms. Specific assignments requiring use of the online material were made and composed a percentage of students' grades.

The literature review begins by exploring Kolb's (1976) Experiential Learning Theory (ELT), which includes two dimensions, four modes and four learning style categories. Measurement issues are discussed. Then, the research studies on learning style (using Kolb's Learning Style Inventory) and computer use are reviewed.

Experiential Learning: A Theoretical Model

The present study focuses on Kolb's (1976) ELT because this theory is applicable to questions about Internet use and learning style preferences in terms of abstract, concrete, active and reflective learning. ELT has elaborated on the value of experience in learning and development. Murrell and Claxton (1987) explained that ELT offers a framework that can help faculty design courses that meet the needs of diverse learners. Kolb, Boyatzis, and Mainemelis (2001) reported that "judged by the standards of construct validity Experiential Learning Theory has been widely accepted as a useful framework for learning-centered educational innovation, including instructional design, curriculum development, and lifelong learning" (p. 240). Throughout more than twenty years, Kolb has been improving and adding to his model of

learning styles, yet the dimensions, modes and styles that compose his model have remained stable (Kolb, Boyatzis, & Mainemelis, 2001).

Dimensions

Kolb's model contains two dimensions, "prehension" and "transformation". These dimensions are based on Piaget's (1971) adaptive processes of assimilation and accommodation. Kolb maintains that effective learning requires students to choose between abilities that are polar opposites. He classifies these dimensions as primary to the learning process (Kolb, 1976). Prehension represents how the learner prefers to receive or grasp information. Transformation represents how the learner prefers to process the information.

Modes

According to Kolb's model, learners move and develop. At the center of Kolb's model are the two dimensions: prehension and transformation. On opposing poles of each dimension are modes. Concrete Experience (CE) and Abstract Conceptualization (AC) are the opposing modes on the prehension dimension. Reflective Observation (RO) and Active Experimentation (AE) are the opposing modes on the transformation dimension (see Figure 1). ELT suggests that for students to be effective, they need abilities in each of these modes.

Concrete Experience. CE abilities represent an experience-based, receptive approach to learning. Individuals who emphasize CE learn best from being involved with specific examples, are often more affective, and tend to be oriented more to peers than to authority. Students with a focus on CE often benefit from and enjoy discussions with peers (Kolb, 1984).

Reflective Observation. RO abilities represent a tentative, impartial and reflective approach to learning. Individuals who emphasize RO learn best from careful observation.

Students with a focus on RO often benefit from and enjoy opportunities such as lectures to be objective observers (Kolb, 1984).

Abstract Conceptualization. AC abilities represent a conceptual, analytical approach to learning. Individuals who prefer AC often learn best from authority-directed, impersonal learning situations. Students who prefer AC often enjoy systematic planning, quantitative analysis, and manipulation of abstract symbols. They focus on logic, concepts, and ideas, and often learn best from building theories as opposed to intuitively understanding (Kolb, 1984).

Active Experimentation. AE abilities represent practical applications as opposed to reflective understanding. Individuals who prefer AE emphasize doing rather than observing and they enjoy getting things accomplished. These learners are willing to take risks in order to achieve objectives and they value having an influence on their environment. They focus on actively changing situations and influencing people (Kolb, 1984).

Dimensions and Modes

As the learner develops, she/he moves around the four modes in a circular direction (see Figure 1). "The core of the model is a simple description of the learning cycle - of how experience is translated into concepts, which in turn, are used as guides in the choice of new experiences" (Kolb, 1981, p. 235). First, there is an actual learning experience. Second, the learner reflects on this experience and/or observes others. Third, the learner conceptualizes her/his observations and/or reflections into abstract theories or ideas. Fourth, the learner participates actively in her/his learning by experimenting or doing. Thus, the learner moves around the circle of learning modes. The process of moving around the circle provides a balanced learning experience.

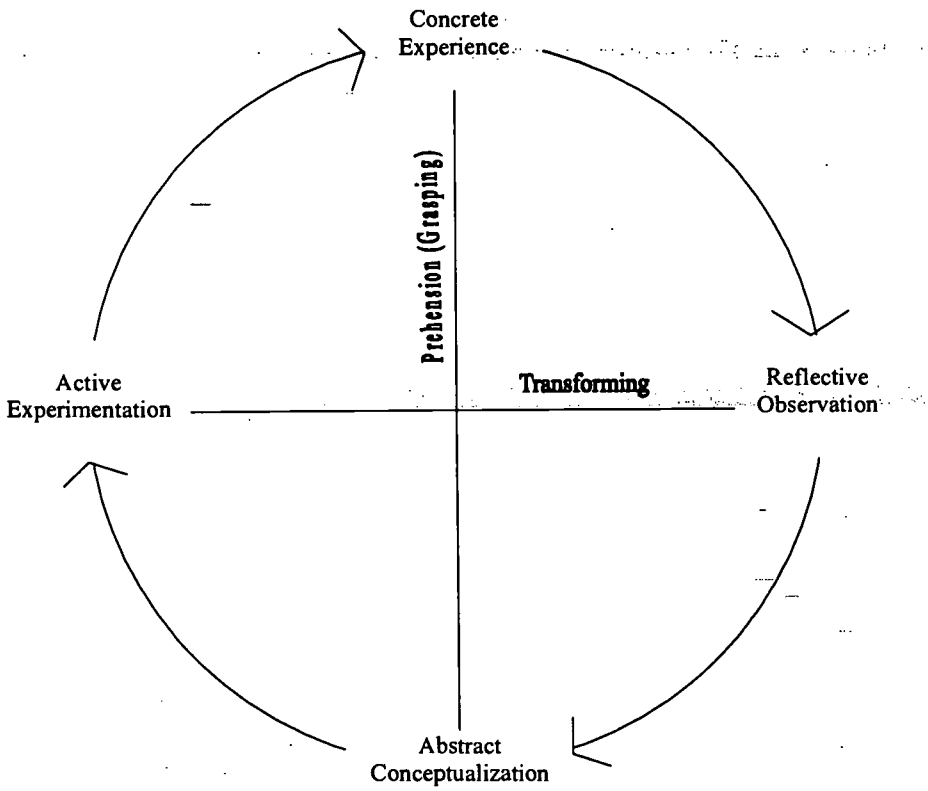

Figure 1. Movement around the Circle of Learning Modes

Kolb's Learning Styles and Their Measurement

Over the past twenty years, Kolb (1976, 1985, 1999) has created three versions of the Learning Style Inventory which have been used in more than 1000 studies (Kolb, Boyatzis, & Mainemelis, 2001). Each of the three versions is a brief self-descriptive questionnaire which measures differences in learning styles. Norms for the 1976 version were based on a sample of 1,933 people ranging in age from 18 to 60 years (Kolb, 1976). The test-retest reliability ranged from .34 to .73 and the internal consistency ranged from .54 to .73. Even though the Learning Style

Inventory was weak in these areas, many researchers and educators used this version of the instrument to study and explore student learning styles.

In response to criticism of the 1976 Learning Style Inventory's poor measurement properties, Kolb (1985, 1999) revised the format and the scoring and designed two additional versions of the Learning Style Inventory. The internal consistency of the 1985 instrument was improved to a range of .82 to .85. However, the stability of learning style classification across administrations decreased to a range of .25 to .56 (Sims, Veres, & Buckner, 1986).

Veres, Sims, and Locklear (1991) suggested that the improved internal consistencies were inflated due to response bias. They conducted two studies to investigate the reliability and stability of the Learning Style Inventory when its format was altered to eliminate the probable response bias. The mean alpha coefficients decreased from a range of .82 to .85 to a range of .52 to .71. The researchers had expected such a drop after removing the response bias. What was unexpected was the increase in test-retest reliability to a range of .92 to .97 in the initial study. A replication study produced similar results with a range of .97 to .99. Despite the psychometric weaknesses of the 1976 and 1985 versions, the Learning Style Inventory has been selected as the instrument of choice by many researchers interested in learning styles. Veres et al. (1991) suggested that, based on their two studies, the altered version of the Learning Style Inventory demonstrated adequate levels of reliability to assist researchers in evaluating learning styles.

Due to the research of Veres et al. (1991), Kolb created his newest version of the Learning Style Inventory (Kolb, Boyatzis, & Mainemelis, 1999). The sentence endings of the 1985 version were aligned in four columns. All CE responses were situated in the first column, RO responses were in the second column, AC responses were in the third column and AE

responses were in the fourth column. Kolb's newest version mixed up the responses in order to eliminate any bias based on column alignment.

Four Learning Styles

Many different patterns of scores emerged from Kolb's (1976) original study, and from these patterns Kolb identified four statistically significant learning style categories: Diverger, Assimilator, Converger and Accommodator (see Figure 2).

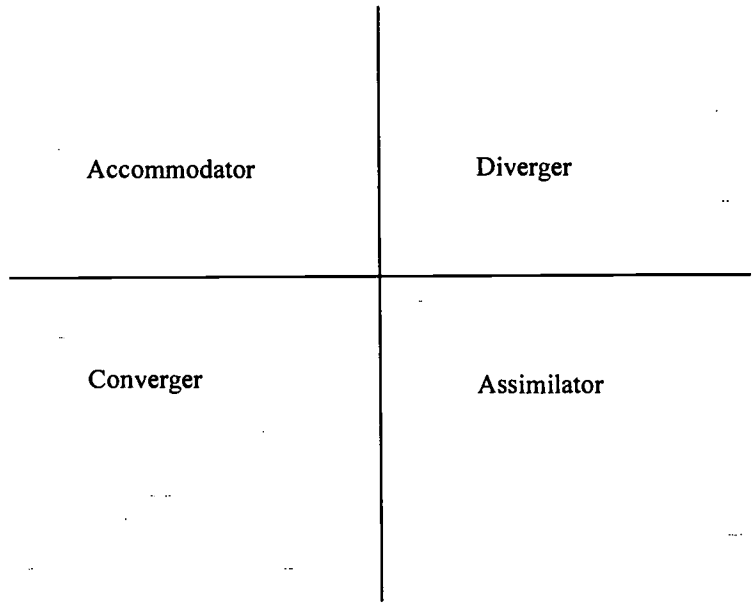

Figure 2. Learning Styles

A Diverger. Learning abilities in Concrete Experience and Reflective Observation are preferred by a Diverger. Imaginative ability, multiple-perspective-taking skills, and the ability to organize various relationships into a "gestalt" characterize this learning style. Divergers are comfortable expressing their emotions and interest in other people. The terms creators or artists may be used to describe Divergers (Kolb, 1976).

An Assimilator. Learning abilities in Abstract Conceptualization and Reflective Observation are preferred by an Assimilator. The creation of theoretical models, use of inductive reasoning, and ability to integrate disparate observations are characteristics of this learning style. Assimilators are often less interested in people or the practical use of theories than they are in abstract concepts. The terms planners, theorists and analysts may be used to describe Assimilators (Kolb, 1976).

A Converger. Learning abilities in Abstract Conceptualization and Active Experimentation are preferred by a Converger. Practical application of ideas, organization of knowledge, use of hypothetical-deductive reasoning, and focus on specific problems are all characteristics of this learning style. Convergers prefer to be unemotional and to deal with things instead of people. The terms problem-solvers, decision-makers, and deducers may be used to describe Convergers (Kolb, 1976).

An Accommodator. Learning abilities in Concrete Experience and Active Experimentation are preferred by an Accommodator. Carrying out plans and experiments, taking risks, and adapting to specific immediate circumstances are characteristics of this learning style. Accommodators are intuitive trial-and-error problem solvers and are at ease with people. The terms leaders, risk-takers, and achievers may be used to describe Accommodators (Kolb, 1976).

Learning Style and Technology

Kolb's Learning Style Inventory (1976, 1985, 1999) has been used in multiple studies of computer use and learning style. College student learning styles in relation to attitudes toward computer use have been explored by Bozionelos (1997). Bozionelos utilized the 1976 version of Kolb's Learning Style Inventory. Learning styles and performance in technology-rich environments have also been explored by researchers. In addition, movement in student learning

style with exposure to technology has been studied (Clariana, 1997). Clariana utilized the 1976 version of Kolb's Learning Style Inventory.

Several researchers have examined the relationship between student performance on technology tasks and learning style preferences. A variety of results have emerged from the data. Bostrom, Olfman, and Sein (1990) argued that individual differences are important in end-user computer training. They focused on one specific individual difference construct, learning style, and used Kolb's (1976) Learning Style Inventory to measure the styles of the participants. The researchers conducted four studies to determine the influence of learning style on novice computer trainees. All four studies involved hands-on training in group workshops.

Results of Bostrom et al.'s (1990) studies revealed a consistent, albeit not statistically significant, pattern. These researchers based their studies specifically on the four modes but reported their conclusions in terms of learning style. Bostrom concluded that "Convergers, who combine active experimentation and abstract conceptualization, performed better than those subjects with other learning styles" (p.114-115).

Bozionelos (1997) studied the relationship between computer anxiety and learning styles for 204 adults attending advanced courses in management. The author reported that previous computer experience was found to correlate negatively with computer anxiety. Post-hoc Neuman-Keuls tests revealed a significant difference on computer anxiety between individuals with preferences for the Converger and Diverger learning styles. Individuals with a preference for the Converger learning style expressed more comfort interacting with computers than did the individuals with preferences for the other learning styles. Bozionelos stated that individuals with a preference for the Converger learning style tended to experience fewer negative feelings interacting with computers than did the individuals with preferences for the other learning styles.

In several studies on learning style and technology use, students preferring the Active Experimentation mode were more comfortable and performed better on tasks than other students. Students preferring the Converger learning style, a combination of the Abstract Conceptualization mode and the Active Experimentation mode, were more comfortable with computers (Bozionelos, 1997) and performed better on some technological tasks than students preferring other learning styles (Bostrom et al., 1990). Overall, students preferring the Reflective Observation mode did not perform as well on technological tasks as students preferring the Active Experimentation mode.

In 1993, Kolb proposed that individuals adapt to different situations by utilizing other learning styles in addition to their preferred learning style. One researcher, Clariana (1997) suggested that the use of technology could actually change an individual's overall learning style within several weeks. He reported that learning styles actually changed when individuals were exposed to courses using the computer. Clariana studied three different populations and their computer-assisted learning (CAL) experiences. His purpose in studying learning style and achievement was to inform the guiding principles for developing individualized computer-assisted learning. In each of these studies, Clariana gave pre and post learning style surveys using Kolb's 1976 inventory. Achievement was measured by combining scores on a standardized math test and midterm grades. Clariana used the achievement scores to determine high and low ability groups. He used step-wise multiple regression to study the shift in learning style due to technology use. His dependent variable was the math post-test. In all three studies, Clariana reported a general shift in learning style. He suggested that exposure to CAL related with a shift in style toward the Concrete Experience and Active Experimentation modes.

Purpose of Study

The intent of this study was to examine the relationship between students' learning styles and Internet use in a college course in which technology was infused. The following research questions guided the research: (1) Is there a difference in student learning style when measured by Kolb's (1999) Learning Style Inventory and an Internet-Focused Style Inventory (adapted from Kolb's Inventory)? (2) Is there a change in student learning style as reported on Kolb's (1999) Learning Style Inventory at the beginning and the end of the semester when technology is used in a course?

These questions are important because educators need to know if and how students are adapting their learning styles to technological environments. Knowledge of the relationship between learning style, in general, and learning style while using the computer may better prepare teachers and students for more efficient, successful learning in the current age of technology. The stability of learning style is another valuable key to understanding student preferences over both the short term and the long term.

Method

Sample

The sample population was comprised of approximately 300 undergraduate students, majoring in education or health care, enrolled in the fall 2000 semester lifespan human development course at the University of Memphis. During the course of the semester, three surveys were given. Two hundred and sixty-four students completed at least one survey, but only 139 students completed all three surveys. Due to the small number of students classified as Asian (2), Hispanic (1), and Other (2), these five students were removed from the study. Hence,

134 students (113 women and 21 men, 53 African Americans and 81 Caucasians) were examined on all variables. Table 1 gives the year in college, gender and ethnic composition of the sample.

Table 1.

Student Sample by Gender, Ethnicity and Year in College

Year	Gender				Total
	Women		Men		
	African American	Caucasian	African American	Caucasian	
Freshman	3	4	0	0	7
Sophomore	14	35	6	5	60
Junior	17	16	2	4	39
Senior	11	13	0	4	28
Total (ethnicity)	45	68	8	13	134
Total (gender)	113		21		134

Measures

Exposure to the Internet and Computers. The Technology Survey was designed for this project by Dr. Steitz (1999, 2000). This survey includes demographic questions such as age, ethnicity, gender, major, and year in college. In addition to demographic questions, questions regarding frequency of computer use, interest in using the Internet, and location of computer use are included. Further information about the instrument and a detailed analysis of the items can be found in Steitz, Magun-Jackson, and Jordanov (2000).

Learning Style. Learning style was assessed using the Learning Style Inventory (Kolb, 1999). The Learning Style Inventory provides nominal data in terms of which of the four learning styles (Diverger, Assimilator, Converger, and Accommodator) is preferred. In addition, the Learning Style Inventory provides scores on the Abstract Conceptualization-Concrete Experience and Active Experimentation-Reflective Observation Dimensions. These scores range from – 44 to + 44. The Learning Style Inventory also provides scores on each of the four learning modes: Concrete Experience, Reflective Observation, Abstract Conceptualization and Active Experimentation. These scores range from 4 to 48.

Internet-Focused Style. In an effort to assess Learning Style preferences when individuals are using the Internet, a stem was added to Kolb's Learning Style Inventory (Kolb, 1999). The difference between the Internet-Focused Style Inventory and the Learning Style Inventory (Kolb, 1999) is in the stem of the sentence. This adapted inventory was designed to explore the question of what happens to learning style when the stem that Kolb uses "when I learn..." is changed to "when I use the Internet...." The Internet-Focused Style Inventory includes the same ending choices for all 12 sentences that Kolb's Learning Style Inventory (1999) uses. The responses range from concrete experience, reflective observation, abstract conceptualization or active experimentation.

Procedure

Participants were asked to complete a brief survey at three points during the semester. The Technology Survey (Steitz, 1999, 2000) and Learning Style Inventory (Kolb, 1999) were collected early in the semester. Students received a one-hour training session on the use of the University's technology resources and the Internet at the beginning of the semester. Throughout the semester, students were asked to complete four major assignments on the computer using the

skills they learned and to interact with an Internet-based course website. Approximately eleven weeks into the semester, the Internet-Focused Style Inventory was administered. At the end of the semester, the Learning Style Inventory (Kolb, 1999) was again given to students.

Results

The intent of this study was to examine the relationship between students' learning styles and Internet use in a college course in which technology was infused. The following research questions guided the research: (1) Is there a difference in student learning style when measured by Kolb's (1999) Learning Style Inventory and an Internet-Focused Style Inventory (adapted from Kolb's Inventory)? (2) Is there a change in student learning style as reported on Kolb's (1999) Learning Style Inventory at the beginning and the end of the semester when technology is used in a course?

Descriptive Statistics

Chi square analyses revealed no significant differences in learning style based on year in college (Pre-LSI χ^2 (df)= 133, p = ns; Internet Style χ^2 (df) = 133, p = ns). Only 7 freshmen were in this study and all cells in the freshmen category across all three surveys contained fewer than 5 participants. Overall, 16 cells contained fewer than 5 participants in terms of year in college (see Table 2). Due to the small number of freshmen in this study, results should be considered with caution. On the Internet-Focused Style Inventory, preferences of many sophomores (33.3%) and juniors (35.9%) changed to the Converger learning style (a combination of the Abstract Conceptualization and Active Experimentation modes). The learning style preferred by the largest percentage of seniors was different on each survey. Many seniors preferred the Diverger learning style (32.1%) on the Pre-LSI, the Assimilator learning

style (39.3%) on the Post-LSI, and the Accommodator learning style (39.3%) on the Internet-Focused Style Inventory.

Of the 134 students who responded to the gender question and completed all three learning style inventories, 113 were women and 21 were men. The largest percentage of women (30.1%) in this study preferred the Diverger learning style on the Pre-LSI and the Post-LSI. However, the largest percentage of women (32.7%) preferred the Accommodator learning style to other learning styles on the Internet-Focused Style Inventory. The largest percentage of men in this study preferred the Converger learning style on both the Pre-LSI and the Internet-Focused Style Inventory, 38.1% and 47.6 % respectively. On the Post-LSI, the largest percentage of men in this study (33.3%) preferred the Assimilator learning style to other learning styles. However, chi-square analyses indicated no significant differences in learning style based on gender (Pre-LSI χ^2 (df) = 133, p = ns; Internet Style χ^2 (df) = 133, p = ns). Because only 21 men were in this study several cells contained fewer than 5 participants. Overall, 6 cells contained fewer than 5 participants. Thus, the results of these chi-square analyses should be considered with caution.

Of the 134 students who responded to the ethnicity question and completed all three learning style inventories, eighty-one were Caucasian, 53 were African American, 2 were Asian, 1 was Hispanic, and 1 marked Other. Due to the small number of Asian and Hispanic students and the lack of complete information on the student responding with Other, only the Caucasian and African American students were examined in this study. The largest percentage of African American students in this study preferred the Diverger learning style to any other learning style on the Pre-LSI and the Post-LSI, 32.1% and 35.8% respectively. The largest percentage of African Americans preferred the Converger learning style (35.8%) on the Internet-Focused Style Inventory. The Caucasian students preferred the Diverger (25.9%), Converger (25.9%), and

Accommodator (25.9%) learning styles equally on the Pre-LSI. On the Post-LSI, the largest percentage of Caucasian students (28.4%) preferred the Assimilator learning style to other learning styles. On the Internet-Focused Style Inventory, the largest percentage of Caucasian students (33.3%) preferred the Accommodator learning style to other learning styles.

All cells in the chi-square analyses comparing African American students and Caucasian students contained more than 5 participants. Chi square analyses showed no significant differences between these two ethnic groups in terms of learning style preferences when looking at the surveys individually (Pre-LSI χ^2 (df) = 133, p = ns; Internet Style χ^2 (df) = 133, p = ns).

First Research Question

To answer the first research question comparing style when using the Internet and learning style when in other settings, students were asked to complete two surveys, the Learning Style Inventory (Kolb, 1999) and the Internet-Focused Style Inventory (adapted from Kolb's Inventory.

A chi-square analysis of the learning style categories indicated that there was a significant difference between learning style on the pre-LSI and Internet Style Inventory (χ^2 (df) = 133, p = .03). Table 2 shows that students with a preference for the Diverger learning style (the Concrete Experience and Reflective Observation modes) preferred to be more abstract and active while using the Internet than when learning in general. Students with a preference for the Assimilator learning style (the Abstract Conceptualization and Reflective Observation modes) preferred to be more active while using the Internet than when learning in general. Students with a preference for the Converger learning style (the Abstract Conceptualization and Active Experimentation modes) preferred to be more concrete while using the Internet than when learning in general. Students with a preference for the Accommodator learning style (the

Concrete Experience and Active Experimentation modes) stayed the same or became more reflective when using the Internet than when learning in general (see Table 2).

In order to get a clearer picture of what happened when the general learning style assessment was changed to the preferred style when using the Internet, the Abstract Conceptualization-Concrete Experience (AC-CE) dimension and the Active Experimentation-Reflective Observation (AE-RO) dimension and all four modes were examined with dependent t-tests for 134 students who completed the Pre-LSI and the Internet-Focused Style Inventory.

A dependent t-test revealed no significant differences in learning style preferences on the Pre-LSI and the Internet-Focused Style Inventory for the Abstract Conceptualization-Concrete Experience dimension (AC-CE), $t(133) = -1.41$, $p = .16$. The mean for the Pre-LSI was 2.47 and the standard deviation was 10.05. The mean for the Internet-Focused Style Inventory was 4.03 and the standard deviation was 9.88.

A dependent t-test revealed a significant difference on learning style preferences on the Pre-LSI and the Internet-Focused Style Inventory for the Active Experimentation-Reflective Observation dimension (AE-RO), $t(133) = -5.11$, $p < .001$ (see Table 3). The mean for the Pre-LSI was 2.77 and the standard deviation was 11.49. The mean for the Internet-Focused Style Inventory was 8.57 and the standard deviation was 8.55. The effect size was .44, suggesting that there was a difference between styles with students preferring Active Experimentation more while using the Internet than when learning in general. Table 3 gives the means and standard deviations on the two dimensions of the Pre-LSI and the Internet-Focused Style Inventory.

Table 3.

Pre-LSI and Internet-Focused Style Inventory Means and Standard Deviations

	Pre-LSI (n=134)	IFSI (n=134)	P	Effect Size
	M (SD)	M (SD)		
AC-CE Dimension	2.48 (10.05)	4.04 (9.88)	.16	ns
AE-RO Dimension	2.78 (11.50)	8.57 (8.55)	<.001	.44
Concrete Experience (CE)	26.74 (6.50)	26.78 (6.19)	ns	ns
Reflective Observation (RO)	30.63 (7.65)	26.93 (5.63)	<.001	.38
Abstract Conceptualization (AC)	29.22 (6.66)	30.81 (6.66)	.03	.19
Active Experimentation (AE)	33.40 (6.54)	35.50 (6.21)	<.001	.32

Dependent t-tests suggested significant differences in terms of Pre-LSI and Internet-Focused Style Inventory preferences for three modes: Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE) (see Table 3). Results of the t-test for the Reflective Observation mode suggest that students prefer Reflective Observation more while learning in general than when they are using technology. Results of the t-test for the Abstract Conceptualization mode suggest that students prefer Abstract Conceptualization more while using technology than when they are learning in general. Results of the t-test for the Active Experimentation mode suggest that students prefer Active Experimentation more while using the Internet than when learning in general. The results indicate that student learning style

preferences are different depending on the setting. Students prefer being more active when using the Internet than when learning in general.

Second Research Question

The second research question asked if there was an association between differences in student learning style as reported on Kolb's 1999 Learning Style Inventory at the beginning and the end of the semester. Learning style preferences were split relatively evenly among the four learning styles. Forty-three percent of the students who preferred the Converger learning style on the Pre-LSI also preferred this style on the Post-LSI. Forty-two percent of the students who preferred the Diverger learning style on the Pre-LSI also preferred this style on the Post-LSI. Forty-one percent of the students who preferred the Assimilator learning style on the Pre-LSI also preferred this style on the Post-LSI. Thirty-eight percent of the students who preferred the Diverger learning style on the Pre-LSI also preferred this style on the Post-LSI.

The Abstract Conceptualization-Concrete Experience dimension (AC-CE) and the Active Experimentation-Reflective Observation dimension (AE-RO) preferences were examined on the pre and post Learning Style Inventories. A dependent t-test on the AC-CE dimension indicated there were no significant differences between the Pre-LSI and the Post-LSI preferences. A dependent t-test on the AE-RO dimension indicated there were no significant differences between the Pre-LSI and the Post-LSI preferences. Each of the four modes was also examined with dependent t-tests and no significant differences were found. This study reinforces the reliability of Kolb's 1999 Learning Style Inventory.

Discussion

The purpose of the present study was to examine the relationship between students' learning styles and computer use in a college course in which use of technology was infused. The study found that students preferred a different style of learning when they used the Internet than when they were learning in general. In addition, learning style preferences remained stable during a semester-long course which utilized technology.

Learning Style and Technology

This study demonstrated that students preferred different styles when using the Internet versus learning in general. Regardless of what their general learning style preferences were, students moved toward more active dimension and mode scores when using the Internet. This study was set up differently compared to previous studies on learning styles and technology. However, the results are congruent with the findings of older studies. Previous studies have focused mainly on differences in performance and attitudes in relation to computer tasks. Bozionelos (1997) found that students who preferred the Active Experimentation mode were more comfortable using the computer than students who preferred other modes. In three of four studies, Bostrom et al. (1990) demonstrated that students who preferred the Converger learning style performed better on computer tasks than students who preferred other learning styles.

Therefore, previous research in this area supports that a preference for an active learning style has a positive relationship with attitudes toward and performance on computer tasks. This study did not examine students' attitudes and performance directly on computer tasks. Results of this study demonstrate that, while using the Internet, students tend to adapt their learning preferences and choose a more active learning style. This finding compliments the results of the previous studies, rather than confirming or reputing them. Instead of simply confirming that

active students perform better on computer-related tasks, this study found that a significant number of students tended to pursue more active learning styles in a technology-enriched learning environment. In using the Internet students become more active. Students take an active part in their learning performance. This tendency toward active engagement while using the computer has implications for educators. Teachers may see improved motivation and involvement of their students in the learning process when the Internet is used in the classroom.

One possibility for future research would be to look at different populations such as middle school students, high school students, undergraduate students and graduate students to see if students of different ages can adapt with variable ease and speed to a new learning environment such as a technology-filled classroom. It would be interesting to know whether older students (e.g. graduate students) have more difficulty adapting to a new technologically-dense learning environment because their learning styles are more firmly established or if they can adapt just as successfully as their younger counterparts.

A more complex study would be to look at not only if people could adapt, or how quickly they could adapt, but also how that adaptation affected their performance and attitudes toward technology. Did the people who adapted quickly to a more active learning style perform better on technology tasks than people who did not adapt as quickly? And what was their satisfaction or comfort level in relation to technology use? Did the people who adapted quickly to a more active learning style express higher levels of satisfaction and comfort toward technology tasks than did people who did not adapt as quickly?

Stability of Learning Style

Results of the second research question of this study, which deals with the stability of learning styles over a semester when technology is used, showed that learning styles remained

relatively stable throughout a semester. No significant differences in learning style preference were found between the Pre-LSI and the Post-LSI. Student preferences for specific modes, dimensions and learning styles did not change. These results support Kolb's (1976) view that learning styles are relatively stable.

However, the results of this study disagree with the findings of a previous study on learning style stability and technology exposure. Clariana (1997) found that student learning style preferences changed within several weeks when technology was used. Results of three studies showed shifts in learning style toward more active learning preferences.

Clariana's first study was conducted over a 5 month period while the other two were each conducted over 5 weeks. The time frame of this study was similar in that it was conducted over a 4-month period, yet the findings are different. All three of Clariana's studies, had small sample sizes (23, 30 and 41 students, respectively). In his study, he reported a significant shift toward a more active and concrete learning style. This study enrolled 134 participants and thus has more statistical power than any one of Clariana's studies.

Alternative research designs are warranted to further understand the relationship between learning style preference and other variables. Perhaps Kolb is right when he ascertains that learning styles can change over time but that a minimum of 6 months would be necessary for such a change to occur (1993). It would be interesting to look at students over a longer period of time and see if their learning styles would actually change. Longitudinal research would be an excellent way to explore learning styles and the interplay of variables such as age, college classification and technology use. Most research on learning styles has been conducted over a rather short time frame. This study examined students over the course of one semester, and suggested that learning styles remain stable over this period. This study reinforces the reliability

of Kolb's 1999 Learning Style Inventory throughout a college semester. However, longer studies are necessary to evaluate the true stability of learning styles. A prospective study of college students in their transition from freshmen to seniors would shed better light into whether such changes in learning styles actually occur and, if so, may even help clarify when these changes occur.

Conclusion

The current study adds information to the body of literature on learning styles in regard to the relationship between learning styles and technology use. Kolb has created a theory of learning that can be applied by students and educators to improve the learning process. If students are aware of their preferences they are more likely to seek learning environments and tools that enhance these preferences. In addition, if students become aware of their weaknesses they will have a better opportunity to focus on and strengthen these areas. Additional research on the interplay between learning styles and technology use could help educators better understand their students and enable them to be better teachers. By the same token, it could empower students to become more efficient learners.

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