THE EFFECT OF ACADEMIC DISCIPLINE AND GENDER DIFFERENCE ON TAIWANESE COLLEGE STUDENTS' LEARNING STYLES AND STRATEGIES IN WEB-BASED LEARNING ENVIRONMENTS

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ABSTRACT
This paper explores students' learning styles in relation to learning strategies in web-based learning environments, and in particular, how academic discipline and gender differences affect learning styles and learning strategies in web-based learning for college students in Taiwan. The results show that regardless of learning strategy, academic discipline or gender, the *visual* type learner is the most dominate learning style for web learners. In addition, *sensing* learners have significantly lower scores in the dimension of *anxiety* than *moderate* learners, which indicates that *sensing* learners feel uneasy in a web-based learning atmosphere, and its related activities. The study also finds that *sequential* learners are more highly motivated than *moderate* and *global* learners, and female learners have higher motivation than male learners in web learning situations. Moreover, students in colleges of liberal arts are less active in web-based learning, as compared with other colleges. Future directions and other related issues are also discussed.

INTRODUCTION

Web-based learning has also shifted traditional face-to-face classroom instruction toward a virtual learning environment. Beyond time and space barriers, web-based learning not only provides a novel learning experience to learners, but it also takes advantage of technology to create a "learners-centered" that emphasizes a learning atmosphere (Powers & Guan, 2000; Simonson, Smaldion, Albright, & Zvacek, 2006). In such a perspective, different from the traditional "teacher-centered" learning setting, web-based learners face a transition of changing familiar methods of learning, and assume an independent role to become self-directed learners (Long, 2003).

Although web-based learning is becoming popular because of its flexibility and convenience, learners could quickly and easily lose their motivation and find that they lack attention to lessons, due to "impersonal, irrelevant, boring, one-size-fits-all page-turners" course designs (Berge & Huang, 2004; Frankola, 2001; Liegle & Janicki, 2006; Moore, Sener, & Fetzner, 2005). O'Connor et al. (2003) surveyed the reasons for dropout statistics of online learning from 400 corporate and academic online students. The major factors behind dropouts are as follows:

- Instructional design-related factors and learning style mismatch (36%);
- Lack of motivation (36%);
- Time conflicts with work and family commitment (33.1%);
- Learning required course materials by the end of the course (25%);
- Lack of organizational support.

Obviously, instructional design and learning styles play critical roles that influence student retention and success in web-based learning (Akdemir & Koszalka, 2008; Moore & Kearley, 2004), which is consistent with Dunn and Dunn (1992) who suggested that if instruction and learning resources compliment learning styles, learners will feel contented and learning will be more effective.

Schemeck (1988) considered learning style as a type of learning strategy, and argued that learning style could be regarded as a tendency to use particular learning strategies in certain situations or learning environments. In other words, the selection of learning strategies should reflect the individual differences of learners. Learning styles and strategies affect student learning and performance (ChanLin, 2009; Ford & Chen, 2000; Weinstein, 1996). Yet, only a few studies involved these two important factors to examine learner behaviors and attitudes in web-based learning, especially on Asian countries (Yip & Chung, 2005). In order to recognize individual differences of learners and create appropriate learning resources and environments, this study examines students'

learning styles in relation to learning strategies in a web-based learning environment. Moreover, how academic discipline and gender differences effect learning styles and learning strategies in web-based learning, particularly for college students in Taiwan are also reported.

DEFINITION OF LEARNING STYLES

Learning style is an ongoing issue of great importance to educational research. Kolb (1976) indicated that learning style is a personal method of learning, through the process of learning. Some studies have considered that learning styles are tendencies and preferences (Dunn, 1983), and some consider learning styles are related to individual methods and strategies of information processing (Reid, 1995). McDermott and Beitman (1984) suggested that unique learning styles are learning methods that involve strategies of decision-making, problem solving, etc. According to Keefe (1979), learning styles are generally considered as "characteristic, cognitive, affective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to a learning environment"(p.4). Even though there is various definition of learning styles, which are unique and steady methods of effective learning and information processing is widely accepted (Butler, 1987; Canfield & Canfield, 1988; Keefe, 1991). Obviously, considering the difference of learning environments, learning styles not only affect learning in a traditional face-to-face setting, but it even more importantly influences learner's study in a web-based learning environment (Manochehri & Young, 2006).

RELATED STUDIES IN LEARNING STRATEGIES

Weinstein (1996) pointed out that traditional education has focused on "how to teach", but in the face of a new era, teaching students "learn how to learn" is an even more important issue to discuss. Weinstein mentioned that students must learn how to acquire knowledge, integrate their gained knowledge, and learn problem-solving techniques of higher level thinking, and transfer what they learn to novel tasks. Simply said, "they must become 'strategic learners'" (p. 49). As learning style, learning strategy also play a key role during the entire learning process. Learning style is a relatively stable trait, but allows flexibility of learning strategies, which could be changed when facing various situations or tasks. Learning strategy is different from learning skills. Usually, learning skills could be taught and mastered through practice, yet a skillful person may not be a good strategic learner. A good strategic learner must understand how to identify their learning goal, integrate the learning style, apply proper skills, and be self-regulated to achieve the best results from learning (Paris & Wingrad, 1990; Zimmerman & Schunk, 2001). In fact, for both students and instructors, recognizing learning strategies of students is very critical for improved learning achievements and more appropriate instructional designs (Wadsworth, Husman & Duggan, 2007).

Kauffman (2004) and Whipp and Chiarelli (2004) argued that although students in web-based courses apply some similar learning strategies when facing traditional lectures, they usually face some very unique situations and handle them quite differently. Therefore, facing the challenge of the upcoming demands of increasing web-based learning, it is important to understand how web-based environments affect learning behaviors, and crucial to understand how learning styles and the strategies of learning affect student attitudes toward web-based learning.

METHODOLOGY

In order to investigate students' learning styles in relation to learning strategies in web-based learning environment, a multivariate analysis of variance (MANOVA) was employed to analyze if learners with different learning styles had any effects on their learning strategies. Student's learning styles and learning strategies were used as independent and dependent variables respectively. In addition, using academic discipline and gender as independent variables, and learning styles and strategies as dependent variables, a chi-square test and a one-way of variance analysis (ANOVA) were used to analyze how academic disciplines and gender influenced learning styles and strategies of learners' in web-based learning environments.

Sample

A total of 229 college students from three distance learning courses of distance education, library information literacy, and introduction to computer information participated in this study. Students were asked to fill out both questionnaires of Index of Learning Styles (ILS) and the Learning and Study Strategy Inventory (LASSI) in class, which were retrieved immediately. A total of 203 questionnaires were retrieved, and the retrieval rate was 88%. After the exclusion of 9 invalid questionnaires, 194 remained for data analysis. The valid participants were assembled by the college of liberal arts (*N*=66), education (*N*=38), foreign languages (*N*=33), and management (*N*=57). 194 students participate to this study, 46 were males (23.7%), and 148 were females (76.3%). Their age were 17 to 24 years old (mean of 19, SD=.82).

Procedure

Two measurements, Index of Learning Style, and Learning and Study Strategy Inventory were asked participants to complete. During face to face classroom period one week before midterm in each class, participants filled out two surveys and collected immediately.

Instruments

ILS and re-phrased ILS. In order to investigate the correlation of learning styles and web-based learning, the instrument has to fit the attributes of the web-based learning. Therefore, the Felder and Soloman Index of Learning Styles (ILS) was selected. Initially, Felder and Silverman (1998) formulated a learning style model that intended to recognize the various significant learning style differences among students, and they believed that the results of measurement would give instructors and instructional designers critical information to approach teaching for learning needs and preferences of students (Felder, 1996).

Based on Felder and Silverman's learning style model, four learning style dimensions, each having two categories: Processing (*active/reflective*), Perception (*sensing/intuitive*), Input (*visual/verbal*), and Understanding (*sequential/global*) are measured in Felder and Soloman ILS (Felder & Soloman, 1999). Felder and Brent (2005) described the categories of the four dimensions, as shown in Table 1.

Table 1. Description of the categories of the four dimensions of learning style model

Dimensions	Relevant preferences
Processing	How does the student prefer to process information?
Active	Learn by trying things out, enjoy working in groups
Reflective	Learn by thinking things through, prefer working alone or with one or two familiar partners
Perception	What type of information does the student preferentially perceive?
Sensing	Concrete, practical, oriented toward facts and procedures
Intuitive	Conceptual, innovative, oriented toward theories and underlying meanings
Input	What type of sensory information is most effectively perceived?
Visual	Prefer visual representations of presented material, such as pictures, diagrams, and flow charts
Verbal	Prefer written and spoken explanations
Understanding	How does the student characteristically progress toward understanding?
Sequential	Linear thinking process, learn in incremental steps
Global	Holistic thinking process, learn in large leaps

ILS is a 44-question instrument, which was created to measure the four dimensions of learning styles of the Felder-Silverman model, and each dimension has associated 11 questions. In the ILS, each answer is either the statement "a" or "b." The method of scoring is to calculate the number of "a" answers and "b" answers separately in the 11 questions of each dimension and to then subtract the smaller number from the larger. Thus, each dimension should show an uneven score with either "a" or "b" predominating and thereby distinguishing the learning style on that dimension. The higher the predominating score, the stronger the preference. The highest score is 11 (a/b), and the lowest score is 1 (a/b).Theoretically, the four dimensions are orthogonal, and all four learning styles should be well established for each individual style, without interference of the other three.

Increasingly, studies have examined learners' attitudes, behaviors, cognitive styles, and learning styles in web-based learning (Papanikolaou, Mabbott & Bull, 2006); however, most learning style inventories are designed for traditional face-to-face learning and learners. To produce more adequate results, this study attempts to re-phrase Felder-Soloman ILS to match the unique nature of web-based learning. For instance, the original item 6 asks: "*If I were a teacher, I would rather teach a course (a) that deals with facts and real life situations; (b) that deals with ideas and theories"*, is re-phrased as: "*If I were an online instructor…*". The original item 11 asks: "*In a book with lots of pictures and charts, I am likely to (a) look over the pictures and charts carefully; (b) focus on the written text"*, is re-phrased as: "*In a webpage with lots of pictures and charts, I am likely to…*". The aim of re-phrasing the original ILS items is to help Taiwanese students refer to their normal behaviors and attitudes toward online learning, and the cultural-friendly translation provides familiar language and terms for the testers. The original Chinese version of ILS was authorized by the North Carolina State University, and translated by Ku and Shen (2009). The Cronbach's coefficient alpha for each dimension of the re-phrased ILS is .68, .71, .75, and .64. According to Tuckman (1999), for the instrument to measure attitude and preference, a .50 Cronbach's alpha value is acceptable for reliability.

Learning and Study Strategy Inventory (LASSI). To measure students' learning strategies, the Learning and Study Strategy Inventory (LASSI) (Weinstein, Palmer & Schulte, 1987) was selected. LASSI is a popular instrument to assess learning strategies (Mealey, 1988; Weinstein, 1988; Olaussen & Braten, 1997; Wadsworth,

Husman & Duggan, 2007) and consists of scales to measure attitude, motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids, self-testing, and test strategies, and it comprehensively reflects the situation of learning and study. Hong (1990) was authorized to translate and modify LASSI into a Chinese version, which has since been extensively used in Taiwan.

In the environment of distance learning, Simonson et al. (2006) pointed out that some characteristics of learners, such as learning attitudes, motivations, anxieties, and information navigation must be considered to insure a successful learning experience. Based on the suggestion of Simonson et al., and for reducing the workload of testers, the current study selected four scales from the Chinese version of LASSI, *anxiety*, *attitude*, *motivation,* and *information processing* to measure and analyze the correlation with learning styles. The Cronbach's alpha values of the original Chinese version: *anxiety .76*, *attitude .72*, *motivation .62,* and *information processing .82* proves that instrument in this study is quite stable and reliable.

FINDINGS AND RESULTS

General description

The result in learning styles showed that the most popular learning style is *visual* (98.45%, 1a~11a), the second is *sensing* (70.1%, 1a~11a), and *verbal* (1.55%, 1b~11b) is the lowest. However, since the four learning style dimensions are independent, a comparison within each dimension is more important than the overall numbers. Therefore, this study rearranged the levels of learning styles as strong tendency (11a~5a and 5b~11b) and moderate tendency (3a~3b) within each dimension. Table 2 presents the distribution of learning style tendencies of all four dimensions. With the exception of *visual* (81.5%) and *verbal* (0.5%) learners, in the other three dimensions, regardless of the comparison of two extremely strong tendencies, moderate learners are the largest group in each dimension. This indicates that visualized presentation styles such as graphics, charts, and motion pictures are highly preferred and accepted by the majority web learners.

Table 2. Learning style distribution of participants (n = 194)

Learning Style	n	%
Processing		
Active (11a~5a)	36	18.6
Moderate (3a~3b)	123	63.4
Reflection (5b~11b)	35	18.0
Perception		
Sensing (11a~5a)	52	26.8
Moderate (3a~3b)	132	68.0
Intuitive (5b~11b)	10	5.2
Input		
Visual (11a~5a)	158	81.5
Moderate (3a~3b)	35	18.0
Verbal (5b~11b)	1	0.5
Understanding		
Sequential (11a~5a)	17	8.8
Moderate (3a~3b)	136	70.1
Global (5b~11b)	41	21.1

In learning strategies, according to the measurement of the four dimensions (*attitude*, *motivation*, *anxiety*, and *information processing*), in the 5-point Likert-type scale, the average score per item of all four dimensions was 3.32. *Information processing* has the highest average score at 3.48. With the exception of the *anxiety* dimension, which scored the lowest at 2.99, the remaining dimensions scored higher than average. The LASSI test results are show in Table 3.

Table 3. Description of LASSI test results

Learning Strategy	M	SD	Ave per/item
Attitude (7 items)	24.34	3.19	3.47
Motivation (7 items)	23.38	3.10	3.34
Anxiety (8 items)	23.95	4.39	2.99
Info. Processing (9 items)	31.36	3.85	3.48
Total (31 items)	103.04	9.20	3.32

Learning styles in relation to learning strategies in web-based learning environments

Using learning styles as an independent variable, and learning strategy as a dependent variable, a MANOVA analysis was conducted to investigate how the three levels of each dimension of learning styles (two extreme sides and moderate) correlate to learners' learning strategies in web-based learning. Since there is no violation of the assumption of variances homogeneity in each dimension (*active/reflection:* Box's M=18.666 F=.892, p=.598>.05; *visual/verbal:* Box's M=8.522 F=.814, p=.615>.05; *sensing/intuitive:* Box's M=30.858 F=1.382, p=.120>.05; *sequential/global:* Box's M=18.112 F=.845, p=.659>.05), the MANOVA was conducted. The MANOVA showed no statistically significant results in *active/reflection* (Wilks' Lambda=.961, F=.933, p=.489>.05) and *visual/verbal* (Wilks' Lambda=.939, F=1.496, p=.157>.05). It indicated that in both *active/refection* and *visual/verbal* learning styles, three level students have no difference in learning strategies. However, the MANOVA showed statistically significant results in both *sensing/intuitive* (Wilks' Lambda=.916, F=2.101, p=.035<.05) and *sequential/global* (Wilks' Lambda=.918, F=2.063, p=.039<.05) dimensions, indicating that at least one of the four learning strategies have significant effects. Scheffe posteriori tests were conducted to examine the significance level of *sensing/intuitive* and *sequential/global* effects on each of the four learning strategy dimensions.

The *sensing* learners (M=22.55) are significantly different from moderate learners (M=24.43) in the dimension of *anxiety* (mean difference =-1.874, p=.032 <.05). It suggested that comparing with the moderate learners, *sensing* learners are more nervous and worry about their learning related activities and situations, such as questioning or testing.

The *sequential* learners (M=25.41) are significantly different from both moderate (M=23.33) and *global* (M=22.70) learners in the dimension of *motivation* (mean difference=2.073, p=.032 <.05; mean difference=2.704, p=.010 <.05), but shows no difference between moderate and *global* learners. The results indicate that *sequential* learners have stronger motivations for their learning related situations than moderate and *global* learners.

The effects of gender and academic disciplines on learning styles in web-based learning environments

Chi-square tests were used to determine whether differences between learning styles and gender and academic discipline are statistically significant. The results of chi-square testing indicated that there are no statistically significant differences, in the four learning style dimensions, due to gender differences: $x^2 = 2.1$, p=.338 > .05; $x^2 = 4.1$, p=.125 > .05; $x^2 = .3$, p=.846 > .05; $x^2 = .3$, p=.827 > .05. For academic disciplines, the results of chi-square show no statistically significant differences in *sensing/intuitive*, *visual/verbal,* and *sequential/global* are due to academic disciplines: $x^2 = 11.3$, p=.078 > .05; $x^2 = 4.3$, p=.225 > .05; $x^2 = 6.1$, p=.402 > .05, with the exception of *active/reflection*: $x^2 = 14.71$, p=.023 < .05. A residual analysis was conducted to investigate the correlation between the *active/reflection* dimension and academic disciplines. Table 4 shows that the adjusted standardized residual of *active* learners in a college of liberal arts is -2.4, which is greater than the critical value of 1.96, in absolute value. This indicates that *active* learners in colleges of liberal arts are statistically less significant than the other three colleges. On the other hand, the adjusted standardized residual of *reflection* learners in colleges of liberal arts is 2.1, which is also greater than critical value of 1.96, and indicates that colleges of liberal arts have significantly more *reflection* learners than the other three colleges.

Table 4. Academic discipline x learning style crosstabulation (*Active/Reflection*)

Learning Style			Academic Disciplines (college)				Total
			Liberal Arts	Management	Foreign Language	Education	
	Active	Count	6	14	9	6	35
		Ex Count	12.0	10.3	5.9	6.8	35.0
		% of Total	3.2	7.4	4.7	3.2	18.4
		Adjusted Residual	-2.4	1.5	1.6	-.4	
	moderate	Count	42	34	16	31	123
		Ex Count	41.4	35.7	20.4	23.6	123.0
		% of Total	22.1	17.9	8.4	15.3%	63.7
		Adjusted Residual	.2	-.6	-1.8	1.7	
	Reflection	Count	17	8	7	4	36
		Ex Count	11.6	10.0	5.7	6.6	36.0
		% of Total	8.9	4.2	3.7	1.1	17.9
		Adjusted Residual	2.1	-.8	.6	-.18	
Total		Count	65	56	32	37	194
		Ex Count	65.0	56.0	32.0	37.0	194.0
		% of Total	34.2	29.5	16.8	19.5	100

The effects of genders on learning strategies in web-based learning environments

Independent t-test samples were used to determine if gender differences affect learning strategies. Table 5 shows that Levene's test results (p=.096>.05; p=.076>.05; p=.524>.05; p=.05=.05; p=.507>.05) present no significant level in any of the four learning strategy dimensions, and homogeneity of variance was assumed. Therefore, there was a significant effect on gender, t = -2.527, p=.012 < .05, with motivations of females testing higher than male learners. However, the overall learning strategy showed no significant differences between males and females: t=-.589, p=.557>.05.

Table 5. Analysis of gender differences on learning strategies

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Attitude	EVA	2.791	.096	-1.265	192	.207	-.681
	EVNA			-1.170	67.137	.246	-.681
Motivation	EVA	3.184	.076	-2.527*	192	.012	-1.305
	EVNA			-2.982	102.939	.004	-1.305
Anxiety	EVA	.408	.524	1.509	192	.133	1.115
	EVNA			1.473	72.422	.145	1.115
Information processing	EVA	3.887	.050	-.070	192	.944	-.046
	EVNA			-.080	96.620	.936	-.046
Overall	EVA	.442	.507	-.589	192	.557	-.916
	EVNA			-.590	75.341	.557	-.916

*$p < .05$

[a] EVA = Equal variances assumed; EVNA = Equal variances not assumed

Using colleges as independent variables, and dimensions of learning strategies as dependent variables, a one-way ANOVA was employed to analyze whether academic disciplines affect learning strategies of web learners. There are significant effects for overall learning strategies, F=2.765, p=.043<.05. However, using Scheffe as the posteriori comparisons, there were no statistically significant differences reported, which suggests that academic disciplines do not affect neither the levels of dimensions of learning strategies.

CONCLUSIONS AND DISCUSSIONS

Based on the analysis results, students' learning styles are balanced, and the majority fall into moderate levels, with only *visual* learners dominating *verbal* learners. This may suggest the importance of visuals in web environments, and their effects on the learning habits of the young generation, who seem to feel comfortable navigating cyber space, yet, with *anxiety* showing the lowest score of all four learning strategy dimensions. In particular, *sensing* learners showed significantly higher tendency of anxiety than moderate learners. It indicates that even though students are used to and feel comfortable surfing on the web, web-based learning may be a different story for them. Therefore, how to reduce student anxiety on web-based learning environment to enhance their learning is a critical issue for continued discussion.

Sequential learners have significantly higher motivation scores than moderate and *global* learners. Felder and Soloman (2001) mentioned that regardless the performances, *sequential* learners seem work harder than *global* learners. According to the results of the study, females have significantly higher motivation scores than male learners. Ross and Powell (1990) pointed out that females have higher motivation and are more self-directed than males in learning. Females seem willing to spend more time reading, preparing presentations, and completing assignments. For scholarly degrees, academic credits, and even peer relationships, females take these issues more seriously than males, thus, females have higher completion rates than male in web-based learning (Simonson et al., 2006; Chen & Tsai, 2007)

Although the study showed no significant academic discipline differences in *sensing/intuitive*, *visual/verbal*, and *sequential/global* learning styles, in colleges of liberal arts, *active* learners are significantly less than other colleges. Therefore, providing a collaborative learning environment, such as web 2.0 strategies or group/team projects to encourage and reinforce interaction in learning may benefit liberal arts students.

Obviously, investigating the correlation in learning styles and learning strategies is critical. However, this important issue related to web-based learning has few previous studies for reference. In order to provide further information on this issue, increasing sample size is necessary, especially if colleges are also increased. Although

previous studies have suggested that learning style is a steady preference for learners, it could be adjusted through training and practice. Therefore, measuring the same group of students, test them in their freshman year, then retest them in their junior and senior year, may reveal clear tendencies of their learning styles and strategies if it can be affected by training and practice.

In addition, following the essential modifications mentioned above, exploring the other dimensions of learning strategies, such as time management and testing strategies are also very important for future studies. Moreover, adapting some related variables, such as instruction methods or satisfaction of instruction, could be further investigated for better understanding of students' learning behaviors in web-based learning environments.

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