ONLINE LEARNING STYLE PREFERENCES: AN ANALYSIS ON TAIWANESE AND USA LEARNERS

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ABSTRACT
With the growing advances in telecommunication techniques, many countries have adopted e-learning into school education and life-long learning. College institutions in Taiwan and many other countries have followed such trend by establishing a wide variety of distance learning course offerings. In these new multicultural teaching and learning environments, learning styles surface as an important variable to take into consideration.This paper reports on the development of an online learning style preferences inventory and the analyses of data collected in two countries, Taiwan and USA. A 64-item online learning styles inventory was distributed to Taiwanese and American students respectively, 368 and 371 valid sets of data were collected and analyzed, and the results showed differing patterns on the online learning style preferences of the sample.The results of this exploratory study will be helpful in at least two ways. First, educators in different countriescan use our findings to hypothesize and further investigate their students' overall online learning style preferences. Second, the results can potentially serve as a basis for the design and implementation of cross-cultural telecommunication exchanges, many of which have been launched for second/foreign language and cross-cultural learning in the past few years.
Keywords: Learning styles, college students, Taiwan students, American students

INTRODUCTION
Rapid advances in telecommunication techniques have inspired many countries to adopt online learning (which is also referred to as e-learning) into school education and life-long learning, thereby offering more diverse and convenient learning options for students. College institutions in Taiwan have followed such trend by establishing a wide variety of distance learning course offerings. However, how suitable are online learning courses to meet the needs of students with diverse learning styles? According to some related studies, learning process is individualistic, which is affected by a person's cognitive ability, physiological state, motivation and emotion, and interaction between the instructional environment and teacher (Keefe, 1987). In other words, we need to value students' individual differences. Before we can teach students according to their background and strengths, we need to identify their different learning styles. Scholars have identified this needs for learners of different levels in their studies as well (Güven&Özbek, 2007; Naimie, Siraj, Abuzaid, &Shagholi, 2010; Özgen&Bindak, 2012). As different learning styles would affect students' learning outcomes, the present study recognized the importance to design an online learning style inventory. Online instructors may use the inventory and its outcomes to design effective e-learning courses for students of diverse online learning style preferences. The present study describes the ways in which we select learning style categories for online learning assessment, the design of items that gauge online learning styles, and the administration of the inventory to Taiwanese and American students. The research questions that guided the present study included: (1) What are the preferences of online learning styles of Taiwanese and American students respectively? and (2) Which online learning styles account for the largest differences in terms of Taiwanese and American students' learning preferences? The results of this exploratory study can potentially assist in the design, implementation, and assessment of future cross-cultural telecommunication exchanges, many of which might be based on projects geared towards second/foreign language and cross-cultural learning in the past few years.

LITERATURE REVIEW
Definition and Categorization of Learning Styles
In the past, school instruction was focused on course designs and teachers' instructional strategies, which was believed to suffice for promoting effective learning. Through time, we have come to an understanding that teaching quality is deeply affected by student's characteristics, the teacher's teaching styles, and teaching environment (Keefe, 1987). A student's characteristics (in terms of learning styles), refer to an individual's combination of stable cognitive, affective, and physiological states, thus the students' preferred behavior would be identified in terms of how they perceive, respond, and interact with the environment (see the definition of learning style in NASSP, from Keefe, 1987). Although "cognitive style" and "learning style" were considered as synonymous terms in the past, a more contemporary interpretation of terms indicates that learning styles not only encompasses cognitive styles, but also affective and physiological learning preferences.

Gregorc (1984) proposed that "style" actually reflects an individual's unique, systematic thoughts and modes of behavior. This is also the behavior model for environmental adjustment, formed from the interaction among an individual's genes, environment, and cultural factors. While "style" is a hypothesized constructive concept, understanding a person's learning style will be helpful to explain the series of learning actions and to further improve learning outcomes. If students are exposed to teaching methods inappropriate for their learning styles, this may result in affective and physiological perceptual problems.

Curry (1983) provided the analogy of the structure of learning styles as to the peeling of onions. There are several levels. First, the core of the onion is an individual's basic "personality trait" and this trait measures how this individual accesses and integrates information. The second level is "information-processing," which focuses on the individual's information-processing and cognitive preferences. The third level is "social interaction," that is, the effect from an individual's interaction between the learning environment and the individual's peers. Finally, the outer level is more focused on individual preferences for instruction and environment. An individual's learning style is stable and difficult to change near the core, while outer levels are prone to be changed with learning or experience.

The Role of Learning Styles in Learning and Teaching
Individuals possessing different learning styles often indicate respective learning styles preferences. However, scholars have pointed out that preferences of different learning styles do not lead to different results in intelligence or academic performance. For examples, Dunn (1990) believed that the nature of the content or subject matter is not the cause of learning failure—if an instructor can teach with the styles the students are good at, any student can learn effectively. Dunn, Griggs, Olson, Beasley and Gorman (1995) collected and analyzed 36 studies which adopted Dunn's learning style assessment tools from 1980 to 1990. Results showed that students exposed to learning environments suitable for their learning styles obtained average test grades and learning attitude scores that were three-fourth standard deviation higher than those obtained by students exposed to unsuitable learning environments. In another study, individuals exposed to learning environments suitable for their learning styles showed improvement in scores in their academic performance (Dunn, 1990). Hence, if teachers understand the types of learning styles students possess, and if they redesign or adjust the teaching methods to provide learning environments appropriate for students' specific learning styles, this may help to improve students' learning outcomes. Therefore, the adequate diagnosis of students' learning styles has the potential to provide useful information for educators wishing to design suitable teaching methods and teaching environments for their students (Keefe, 1987).

Assessment of Learning Styles
Five assessment measures are commonly used for the purpose of learning style assessment: (a) *the Group Embedded Figures Test* (Witkin, 1976); (b) the *Learning Style Inventory* (Dunn, Dunn, & Price, 1981); (c) *Learning Style Profile* (Keefe, 1987); (d) the *Gregorc Style Delineator* (Gregorc, 2004); and (e) *the Index of Learning Styles* (Felder &Spurlin, 2005). According to the available published literature on these measures, the reliability of the learning style inventories reported to date is moderate at best.

One of the precursor measures for the assessment of learning styles is the *Group Embedded Figures Test* developed by Herman Witkin (1976) and his colleagues. Participants who are administered this test are asked to locate a specific shape in a complicated figure in order to identify if the individual is field independent/analytic or field dependent/global when processing information. Another common assessment measure is the *Myers-Briggs Type Indicator* (Myers, 1978), which was developed according to Jung's personality theory, and is used to identify four personality dimensions (extraversion-introversion, sensation-intuition, thinking-feeling, and judging-perceiving). David Kolb (1976) developed a learning style scale based on his experience learning model. The model is a four-step cycle that goes from concrete experience, reflective observation, abstract conceptualize,

and then to active verification. Students' learning preferences are then categorized as divergers, assimilators, convergers, and accommodators.

Dunn's *Learning Style Inventory*(the version for grades 3~12) measures 24 factors (Dunn, Dunn, & Price, 1981), and the *Productivity Environmental Preference Survey* (for adult learners) measures 21 factors (Price, Dunn, & Dunn, 1982). Besides different cognitive or perceptual styles, Dunn et al. believed that individuals may also differ in terms of environment and social interaction preferences. An individual's learning styles may be classified into four main categories: environmental (sound, light, temperature, classroom design), emotion (motivation, persistence, responsibility, need for structure), sociological (working alone, with others, with an adult), and physical/perceptual preference (visual, auditory, tactile, kinesthetic, intake, time of day, need for mobility). Dunn's inventory reported low to moderate reliability coefficients ranging from .55 to .88.

Keefe (1987) and his associates developed a *Learning Style Profile* for grades 6-12 students, measuring 23 factors in total—cognitive skills (analytic, spatial, discrimination, categorizing, sequential processing, memory), perceptual response (visual, auditory, emotive), persistence orientation, verbal-spatial, manipulative, study time (early morning, late morning, afternoon, evening), grouping, posture, mobility, sound, lighting, and temperature. The internal consistency of the subscales of the *Learning Style Profile* ranged from .47 to .76, and the average coefficient was .61. The authors attributed this low average reliability to the small number of items that comprise for some sub-scales (Keefe & Monk, 1986).

Gregorc Style Delineator (Gregorc, 2004) measures cognitive preferences related to perception. It classifies cognitive preferences into two dimensions: Concrete-Abstract, Sequential-Random, resulting in four learning styles: Concrete Sequential, Abstract Sequential, Concrete Random and Abstract Random.

The *Index of Learning Styles* was developed by two scholars, Felder and Soloman, in 1991 (Felder &Spurlin, 2005). It is an online instrument and can be automatically scored on the Web after the answers are submitted. It contains 44 items to assess preferences on four dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global). The Cronbach's α of the *Index of Learning Styles* for the four dimensions ranged from .41 to .76; test-retest correlations (4-week, 7-week, and 8-month) were from .50 through .87 (Felder &Spurlin, 2005).

Features of Online Learning
With advances in information technology, online and blended courses unrestricted by time and space are gaining increasing popularity among instructors and learners. Many teachers have also found learning tools effective, such as the use of Web 2.0 technology. For instance, encouraging reports on the use of Information and Communication Technology support the integration of intentional learning (Oshima, Oshima, Yuasa, Konishi, Itoh, & Okada, 2008), the use of weblogs (Juang, 2008; Wan & Tan, 2011), and the use Wiki for learning purposes (Chua, & Chua, 2008; Twu, 2010). A study by Thadphoothon (2002) indicated that "computer-mediated collaborative learning has the potential to enhance critical thinking in language learning" (p. 1491). Instructors can make good use of discussion boards to foster students' critical thinking given the versatile features of these boards, which allow for the integration of writing skills and asynchronous class interaction. Students can assume the role of moderators and carry out collaborative learning through interactive activities.

The unique features of online learning may be more suitable than traditional course features for some types of learners. For instance, shy, independent learners may find online learning more comfortable than traditional learning in face-to-face environments. In addition, as compared with the traditional, systematic, linear teaching courses, online course design may be more appropriate for students with non-traditional and non-linear learning styles (Illinois Online Network, 2008). Communication in online learning environments relies mostly on students' writing abilities, and draws upon students' self-motivation and discipline (due to unfixed classroom and class time) (Mupingo, Nora, & Yaw, 2006).

Without the direct contact and interaction that traditional classroom instruction offers, online instructors may find it difficult to identify online learners' learning preferences (Graf,Kinshuk, & Liu, 2009), which poses a problem: If learners' learning styles are not known, it would not be possible for teachers to tailor the course design and delivery in order to meet learners' individual learning style preferences.

According to Carnevale (as cited in Mupingo, Nora, & Yaw, 2006), it is difficult to identify the specific learning styles of online students, which might often result from too many dispersed learning styles, or assessment tools adopted inappropriately for e-learning environments. Without a doubt, a learning style assessment tool appropriate for students in online learning environments would assist in the design of suitable online courses for all learners.

As we can see, the learning style inventories described in this section were geared toward learning in the traditional settings. Furthermore, many studies which explored on students' learning styles and online/emerging technologies actually employed or adapted one of these learning style inventories (Graf, Kinshuk, & Liu, 2009; Saeed, Yang, &Sinnappan, 2009). Through the current study, we have developed an inventory of online learning style preferences (the development process was published in earlier papers, for details please see Liu, Shih, &Yeh, 2008; 2010).

Learning Styles in Different Cultures
In terms of learning style preferences studies, researchers have examined secondary English as a Second Language (ESL) students' basic perceptual learning style (visual, auditory, kinesthetic, and tactile) learning preferences across Korean, Mexican, Armenian-American, and Anglo cultures (Park, 1997); Armenian, African, Hispanic, Hmong, Korean, Mexican, and Anglo cultures (Park, 2001); and Mexican-American high school and university students (Schaiper& Flores, 1985). These research studies found that all ethnic groups favor kinesthetic, auditory, and tactile learning. With the exception of the Anglo students, all other students were identified as strong visual learners. This is also supported by Ku and Chang's (2011) study on Taiwanese college students, showing that Taiwanese learners are visual learners than verbal learners. In addition, Armenian, Korean, and Anglo students tended to not prefer cooperative learning. University-level students were much more aware of their own preferences than secondary school students. In another study, Sy (1991) administered Reid's Perceptual Learning Style Preference Questionnaire to 220 freshmen, sophomore, and junior English majors in northern Taiwan. The students in Sy's study reported having two major styles (tactile and kinesthetic) and four minor styles (auditory, visual, group, and individual learning).

Findings from these highlight the need for teachers to identify their students' learning styles and match their own teaching styles to their students' learning styles. The identification of students' learning styles in online environments can be enhanced through use of versatile tools such as multimedia and multi-sensory materials (Park, 2001).

A study by Hsiao (2000), investigated the use of the first language (L1) or the second/foreign language (L2/FL) when adopting Likert-scales to measure L2 strategies. Participants completed the ESL/EFL version of Oxford's Strategy Inventory for Language Learning (SILL). Half of the participants took the L1 (Chinese) version, and the other half took the L2 (English) version. Through statistical analyses, Hsiao found no conclusive evidence on whether one should present questionnaire items in L1 or L2. He concluded (a) the differences found in reliability for L1 and L2 inventories are negligible; (b) for validity, neither method has factors with over 50% of variance explained; and (c) the goodness-of-fit indices indicated neither L1 nor L2 method produced a well fit to the data. This study shows that bilingual versions of an inventory is reliable and can be filled out by respondents of different cultures.

Dr. Geert Hofstede has developed culture theories based on people of different cultures. In his theory, Hofstede's (2001) originally described four cultural dimensions based on his study of international work related values. Later, he expanded his theory to encompass five cultural dimensions in light of findings from studies conducted on 50 different countries. Hofstede's original four dimensions are: power distance, individualism versus collectivism, uncertainty avoidance, masculinity versus femininity, and short-term versus long-term orientation. *Power distance* is defined as the degree to which the inequality between the less powerful people and more powerful people in the society is accepted. In terms of the second cultural dimension, *individualism* is identified as an opposite characteristic to *collectivism*. An individualistic culture emphasizes the independence of the individuals. In contrast, a collectivistic culture indicates that people emphasize human relationship and seek harmony with their fellow countrymen. The third cultural dimension is *uncertainty avoidance* and it defines the degree to which people of a culture can handle unstructured or unpredictable situations. Cultures that are high on the *uncertainty avoidance* dimension are perceived as intolerant of changes. On the other hand, cultures that are rated low on the *uncertainty avoidance* dimension are perceived as relaxed, unemotional, and risk-taking. With regard to the fourth cultural dimension, Hofstede posited that *masculine* societies clearly differentiate between the social roles for men and women. The feminine societies allow overlapping roles for both sexes. Finally, the fifth dimension, *short-term* versus *long-term orientation* contends (as does *Confucian work dynamism)* that Asian cultures tend to be long-term oriented (i.e., the people maintain the Confucian values), while Western cultures tend to be short-term oriented.

Most of the studies in Taiwan relating to online learning focused on local students' learning preferences and academic performance in different disciplines (Shih, 2002). Through search of the literature, we noticed that most of the studieson students' online learning preferences weredone in the single cultural settingwithout involving the comparison of students of different cultures. For example,in the area of Engineering (Chuang,

2010), social sciences (Su, 2007), and mathematics (Wang, 2011).Many cross-cultural connections and teaching were conducted in L2/FL language learning. However, these studies explored the utilization of learning strategies and pre-connection trainings in foreign language learning per se (Takaya, 2009; Takaya & Shih, 2012).In terms of learning strategies, a study by Hsiao (1997) had 165 Taiwanese college students complete the *Strategy Inventory for Language Learning*. Factor analyses and regression analysis on the data yielded six factors: social strategies, compensation-affective strategies, memory strategies, cognitive strategies, formal practice strategies, and functional practice strategies. Results suggested that two of the six factors had predictive power – the compensation-affective and formal practice strategies. The former includes significant predictors such as negative attitudes toward the English class, self-esteem, and motivation. The latter has a significant predictor of attitude toward learning English.

In terms of learning styles and learning with technology, Pi-Ching Chen (2004) conducted a study to identify National Cheng Kung University freshman and sophomore students' preferred learning styles and attitudes toward technology-integrated EFL instruction. Chen developed an instrument of *The Scale of Educational Technology Attitudes* which included 44-item *Index of Learning Styles* and 30-item *Scale of Technology Attitudes*. Independent sample t-tests showed students with active, intuitive, verbal, and global learning styles revealed more positive attitudes toward educational technology use for EFL instruction than those with reflective, sensing, visual, and sequential learning styles.

In terms of research on cross-cultural learning, Shih and Cifuentes (2003) conducted a study with U.S. pre-service teachers and Taiwanese college-level EFL learners. This project engaged U.S. and Taiwanese students in an intercultural exchange through the use of telecommunication whereby students practiced the teaching and learning of the English language. Shih and Cifuentes' study reported cultural issues and phenomena noted by the Taiwanese students. These issues included: the need for visual images, bewilderment, excessive expression of gratitude, disparate expectations, direct vs. indirect writings, and misinterpretation. Their study stressed the importance to acquaint students with cross-cultural communication principles and online communication tips during the planning phase of projects involving cross-cultural telecommunication exchanges.

Table 1 shows the theoretical framework of this study.

Table 1. Theoretical Framework of the Current Study

Areas	Dimensions	Literature
Learning Styles	Perceptual Cognitive Social	Dunn, Dunn, & Price, 1981; Felder &Spurlin, 2005; Gregorc, 2004; Keefe, 1987; Kolb (1976)
Culture	Individualism vs. collectivism; Power distance; Masculinity vs. femininity; Uncertainty avoidance; Long-term vs. short-term orientation	Hofstede (2001)

METHODOLOGY
Selection of Online Learning Style Categories
Unlike traditional face-to-face learning, online learning does not restrict the time or location to access the course. Online learning, however, does require student's self-management of their own learning. Online learning contents allow multiple media features such as audio-visual elements, graphics, textual information, and hyperlink functions. Students' preferred ways of learning when they are dealing with the online setting may differ from the traditional face-to-face setting, i.e., when they access materials in the online Learning Management Systems (LMS) and studying/interacting with online materials. In considering the nature of online learning and the learning style categories present in commonly used learning style tests (for example, those from Dunn, Kolb, Keefe, Gregorc, Felder and Soloman), we identified three categories consisting of a total of 15 factors, which provided the framework for the learning styles inventory in the online settings developed by the present study:

  (i)   Perceptual types (this refers to the predominant use of a particular perceptual sense in learning): 1. Text: preference for textual information in learning; 2. Visual: preference for figures and charts information; 3. Auditory: preference for sound and voice information; 4. Active: preference for touch, hands-on operation, and self-experience.
  (ii)   Cognitive processing types (this refers to the cognitive tendency for processing information): 1.

Abstract: preference for abstract or conceptual methods for information processing; 2. Concrete: preference for daily experience or concrete examples; 3. Serial: preference for serial and linear learning; 4. Random: preference for learning in a non-linear sequence or order; 5. Holistic/Global: preference for overall understanding of the information; 6. Analytic: preference for detailed analysis of every component of the reading material or information.

(iii) Personality types (this refers to preferences in social interaction and personal traits in learning condition): 1. Study Alone: preference for solitary in learning; 2. Study with Group: preference for interaction with peers; 3. Guided: preference for guidance or supervision by an instructor; 4. Persistence: the tendency to focus in learning in a lengthy amount of time; 5. Observer: preference for observation rather than active involvement in discussion or interaction with others.

The inventory was developed in both Chinese and English languages simultaneously. The two versions were reviewed by experts specialized in the fields of learning psychology, e-learning, and assessment for clarity of the items prior to the inventory was administered to the participants in this study. Our *Inventory of Online Learning Styles* included 64 items on learning styles preferences and 10 items on learners' personal background. The whole inventory was 8 pages long. Sample items from the Perceptual, Cognitive, and Personality categories included: for the *Perceptual* type, "When learning online, I learn better if the materials are presented through videos or animation" (Visual/Non-Text), and "When learning online, I like to work on hands-on activities such as online puzzle" (Active); for the *Cognitive* type, items included "When searching for information online, I get a deeper understanding if the information is presented through concrete examples or numbers" (Concrete), and "I usually get lost if the web pages contain many hyperlinks on them" (Serial); and finally, items for the *Personality* type included "I learn better when I can discuss learning materials with my classmates" (Study with Group) and "When learning online, I read the posts on the message board but never express my thoughts (if it's not required)" (Observer). The last part of the inventory asks for the personal information and online learning background of the respondents. For example, the age, nationality, the name of the university attended, and the format of the online courses taken.

Subjects
Data from a total of 739 usable surveys were used for analysis. In Taiwan, 368 valid sets of the inventory were completed by students with humanities, science, business, engineering, medicine and agriculture majors from 10 universities in different areas of Taiwan. These college students reported having been learning English over 10 years. In the United States, 371 valid sets of the inventory were collected from the American students in the southern parts of the country. These college students were also majors from different fields such as humanities, science, medicine, and business.

Experts' Evaluation of the Inventory and the Pilot Study
At the onset of this study, we developed a total of 168 items. Items were assessed twice by three scholars in the fields of psychometrics, learning styles, and online learning respectively. After items were modified according to their feedback, the content validity of the scales was therefore assumed. In addition, the first draft of inventory was administered to five undergraduate students from different fields in different universities in Taiwan. Then, from their responses and suggestions, 105 items were selected for the pilot study. Factor analysis was used in the pilot study to allow us to improve and reduce the items in the inventory. When we reduced the items from 105 to 64, the low Cronbach's α for some factors such as "Auditory," "Concrete," "Serial," and "Random" increased. This indicated the reduction of items improved the reliability of internal consistency of our instrument. Test-retest reliability was also conducted. Other development procedures of the inventory are discussed in Liu, Shih, &Yeh (2008; 2010).

Data Analysis
Data including participants' personal information, and responses on online learning style preferences were analyzed using the computer statistics program entitled Statistical Package for the Social Sciences (SPSS),Version 17.0. Because some of the items in our inventory were negatively stated in agreement with the feedback from the expert reviews, the negative items were reversed when we analyzed them. Rating as "1" was reversed to rating as "5," "2" to "4," "4" to "2," and "5" to "1."

Descriptive statistics (frequencies, means, percentages, and standard deviations) portrayed a profile of the characteristics of the participants and their responses on the learning style preferences and the type of Internet-assisted learning method. Furthermore,Multivariate Analysis of Variance (MANOVA)was used to gauge any statistical significance in the analysis of data obtained from the Taiwanese and USA students on the 15 factors assessed by the inventory. In addition, a discriminant analysis was also applied to distinguish any predominant factors surfacing in either group of students. The absolute value of the standardized discriminant function

coefficient was greater than .30. Lastly, Two-way repeated measures ANOVAs were applied to the two groups of students, the four perceptual learning styles (Visual/Text, Visual/Non-Text, Auditory, and Active), and some other pairs of learning styles, Abstract vs. Concrete, Serial vs. Random, Holistic vs. Analytic, and Study Alone vs. Study with Group. When an interaction effect was found, further repeated measures ANOVA and paired *t-test* were run on the data of each country separately for further analysis.

RESULTS AND DISCUSSION

Three hundred and sixty eight valid inventories from the Taiwanese participants and 371 valid inventories from the American participants were collected respectively. The Cronbach's α coefficients of these two result sets were .76 and .79. Since alpha coefficients of above .80 are considered high (Anastasi&Urbina, 1997), and the coefficients we obtained were slightly lower than .80, this study's alphas were considered moderately high.

A MANOVA was conducted to identify the differences between the Taiwanese and USA students (nationality) in terms of the 15 factors. Results were significant for nationality, with a Wilk's Lambda = .623, $F(15, 608)= 24.49$, $p=.000$, $Eta^2= .377$. Several learning styles were statistically significant: Text, Visual, Auditory, Active, Abstract, Concrete, Random, Holistic, Analytic, Study Alone, Study with Group, and Persistence. Three factors were non-statistically significant: Serial, Guided, and Observer (see Table 2).

Table 2.Results of Differences between Taiwanese and USA students in the 15 learning styles

Factors of Learning Style	Mean Taiwan (N=368)	USA (N=371)	SS	df	F	p.
Text	3.22	3.59	21.51	1	55.68***	.000
Visual	3.77	3.47	12.62	1	36.61***	.000
Auditory	3.72	3.52	6.19	1	17.25***	.000
Active	3.69	3.84	3.41	1	8.02**	.005
Abstract	3.29	3.40	2.20	1	4.92*	.027
Concrete	3.94	3.82	1.46	1	4.56*	.033
Serial/Linear	3.53	3.51	.003	1	.01	.911
Random	3.36	3.23	3.86	1	10.76**	.001
Holistic/Global	3.47	3.33	4.43	1	14.82***	.000
Analytic	3.22	3.50	11.87	1	45.85***	.000
Study Alone	3.26	3.64	23.85	1	36.81***	.000
Study with Group	3.47	3.31	5.51	1	10.84**	.001
Guided	3.41	3.30	1.30	1	3.07	.080
Persistence	2.94	2.47	33.49	1	118.42***	.000
Observer	3.09	3.14	1.11	1	3.21	.074

$^*p <.05$ $^{**}p <.01$, $^{***}p <.001$

With regard to the discriminant analysis performed, the standardized discriminant function coefficients obtained indicated that the factors that can best distinguish the learning style preferences of both countries are Persistence, Analytic, Text, Study Alone, and Visual (coefficient is greater than .30) (see Table 3).

Table 3.Discriminant Analysis on the online learning style preferences by nationality

Predictor	Standardized Function Coefficient
Text	-.314
Visual	.255
Auditory	.156
Active	-.331
Abstract	.183
Concrete	.179
Serial/Linear	.032
Random	.173
Holistic/Global	.301
Analytic	-.546
Study Alone	-.204
Study with Group	-.026
Guided	.073
Persistence	.653
Observer	-.068

A two-way repeated measures ANOVA was conducted using the variables nationality and perceptual styles (a 2x2 factorial design) to identify any differences in terms of learning styles (text, visual, auditory, and active) between the two countries. Since Mauchly'ssphericity assumptions were violated, adjustments were made to the ANOVA results by using the Geisser-Greenhouse epsilon. We were interested in looking at the interaction effect. The result revealed a statistical significant interaction effect, F (2.739, 1873.327)= 47.55, p= .000 (see Figure 1).
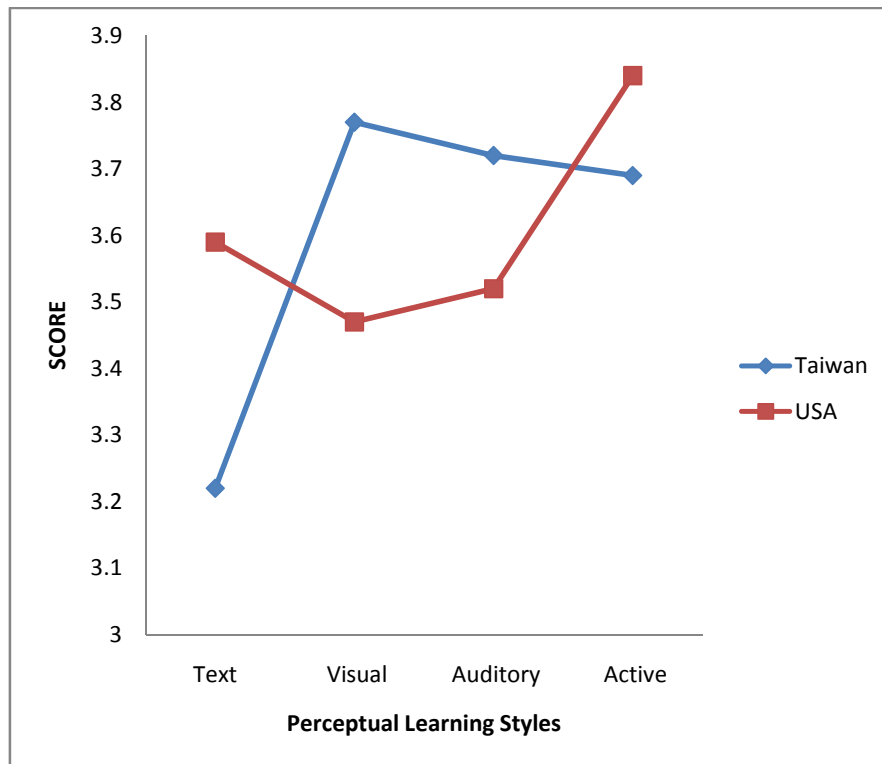

Figure 1. The Interaction Effect of the Perceptual Learning Styles of Taiwanese and American Students.

When a one-way repeated measures ANOVA was run on the Taiwanese and the USA data respectively, for the Taiwanese data, results revealed a statistical significant effect, $F(2.765, 970.487)= 87.10$, p= .000. Post hoc analyses using Bonferroni showed a difference between text learning style and the other three styles (visual, auditory, and active). There was no statistical difference among these three learning styles, however. Results suggested that Taiwanese students had a lower preference of particularly the text learning style (M= 3.22, SD=.56). As for the USA data, results revealed a statistical significant effect, $F(2.708, 901.715)= 21.42$, p= .000. Post hoc Bonferroni analyses indicated this statistical significant difference existed between active learning style and all other three styles, but there was no difference among text, visual, and auditory learning styles. The American students in this study tended to employ more of active learning style than the other perceptual styles (M=3.84, SD=.70).

Two-way repeated measures ANOVAs were applied to the pairs of learning styles: Abstract and Concrete, Linear and Random, Holistic and Analytic, and Study Alone and Study with Group. Results yielded a statistical significance on the interaction effect of Abstract and Concrete ($F(1, 721)= 14.73$, p= .000), Holistic and Analytic ($F(1, 712)= 85.18$, p= .000), and Study Alone and Study with Group ($F(1, 726)= 31.82$, p= .000). In other words, only the pair of Linear and Random learning styles did not have a statistical significant interaction effect, which means there were no differences country-wise.

Lastly, paired *t-test* were calculated on pairs of learning styles with statistical significant interaction effects within the data sets for each country. For the Taiwanese data, the statistical significant learning styles included: Abstract vs. Concrete ($t(361)$=-15.73, p<000), with a higher mean score on Concrete; Holistic vs. Analytic ($t(359)$=7.82, p<000), with a higher mean score on Holistic; and Study Alone vs. Study with Group ($t(362)$=-3.47, p=001), with a higher mean score on Study with Group (see Table 4). We can note from the obtained outcomes that Taiwanese learners preferred learning with concrete materials, had a holistic learning style, and preferred learning with a group instead of by themselves.

Table 4. Results of online learning styles of Taiwanese students

	1st Mean	2nd Mean	Paired Differences		t	df	p
			Mean (1st-2nd)	SD			
Abstract vs. Concrete	3.29	3.94	-.65	.79	-15.73***	361	.000
Holistic vs. Analytic	3.47	3.22	.25	.60	7.82***	359	.000
Alone vs. Group	3.26	3.47	-.20	1.12	-3.47**	362	.001

Note. 1st Mean stands for the mean score of the first factor on each pair of factors. Similarly, 2nd Mean stands for the mean score of the second factor of the pair.

˙˙p <.01, ˙˙˙p <.001

Regarding the data from the United States, the statistical significant cognitive learning styles includes: Abstract vs. Concrete (t(360)=-9.74, p<000), with a higher mean score on Concrete; Holistic vs. Analytic (t(353)=-5.24, p<000), with a higher mean score on Analytic; and Study Alone vs. Study with Group (t(364)=4.45, p<000), with a higher mean score on Study Alone (see Table5). The USA students preferred learning through concrete materials, they were more analytical, and tended to study alone.

Table5. Results of online learning styles of USA students

	1st Mean	2nd Mean	Paired Differences		t	df	p
			Mean (1st-2nd)	SD			
Abstract vs. Concrete	3.40	3.82	-.42	.83	-9.74***	360	.000
Holistic vs. Analytic	3.33	3.50	-.17	.60	-5.24***	353	.000
Alone vs. Group	3.64	3.31	.33	1.43	4.45***	364	.000

Note. 1st Mean stands for the mean score of the first factor on each pair of factors. Similarly, 2nd Mean stands for the mean score of the second factor of the pair.

˙˙˙p <.001

Table 6 shows a summary table listing the online learning style preferences of Taiwanese and USA students. The results are summarized from the mean of the learning styles results from the inventories of both countries and the statistical analyses illustrated in the previous paragraphs. The "Observer" learning style is not included in the table because the mean outcome was only slightly over 3.0 and the MANOVA results showed no statistical significant differences in the two groups. It should be noted that this outcome does not mean that students of these two countries have no preference in terms of the styles not identified in the table. The results simply show the degree of preference in terms of certain learning styles. Our results do not indicate that, for instance, the Taiwanese students do not adopt Text learning style at all, nor do results conclude that the American students do not learn through visual or audio materials.

Table6. Results of Comparison of Online Learning Style Preferences of Taiwanese and US students

Taiwan	USA
Perceptual Type	
Visual	Active
Auditory	
Active	
Cognitive Type	
Concrete	Concrete
Serial	Serial
Holistic	Analytic
Personality Type	
Study with Group	Study Alone
Guided	Guided

According to the results obtained by the present study, when compared to American students (who prefer more active learning), Taiwanese students preferred to learn through Visual, Auditory, and Active learning styles. Park (1997; 2001) and Schaiper& Flores (1985) found that except the Anglo students, students of other cultures appeared to be predominantly visual learners. Shih (2009) also found similar results. She administered the *Inventory of Online Learning Styles* to 101 Taiwanese humanities students and concluded that students' least

preferred style was to learn through reading (the Visual/Text learning style) compared to Visual/Non-Text, Auditory, and Active styles. The outcome from the Taiwanese data set in the current study again obtained a similar finding, and based on results from the discriminant analysis conducted, both the Visual/Text and Visual/Non-Text learning styles are among the ones that could assist best in distinguishing between the two cultures. This finding may pose a concern for instructors of online courses because reading is an important skill for learning in general and for the learning of foreign languages. In addition, the cyber world and broadcast video used in online learning environments are full of visual components. Taiwanese youngsters have open access to the Internet and 24-hour cable TV. As of February 2010, around 16,200,000 people have been accessing the World Wide Web. Especially the number of people above 12 years old who have accessed the Internet are up to 14,669,915 people, which represents 72.56% of this population (Taiwan Network Information Center, 2010), and this might have influenced people's ways of learning. Along with the rise in the number of individuals accessing the Internet, a growing interest in improving the reading skills of Taiwanese students has surfaced. The Ministry of Education in Taiwan has stressed the importance of reading education since year 2000 when the former Minister of Education, Dr. Ovid J. L. Tseng, started to urge and promote extensive reading instruction for children.

The current study suggested that in terms of cognitive processing, both the Taiwanese and American students had no differences in their preference of the learning styles of Serial vs. Random. MANOVA results showed no significant difference in their serial learning style, but the Taiwanese students do lean more towards Random learning style when compared with the Americans on the Random learning style (Taiwan M=3.36, SD=.57; USA M= 3.23, SD=.61). Both groups appeared to prefer learning through the use of concrete materials. In Kim and Bonk's (2002) study, a cross-culture asynchronous web-based conference project was implemented where American students were less concerned with theories and more interested in practice regarding the topic of discussion. The present study suggests that Taiwanese students appeared to like learning holistically (by looking at the overall picture) rather than analytically (by focusing on the details of every part) compared to USA learners. This finding is not consistent with a previous study's by Rao (2001), which concluded that East Asian learners tended to be analytical and field-independent. The inconsistency between the present study and Rao's findings may be due to the pervasive use of learning via the Internet, which may now be influencing the ways in which people learn. Taiwanese students often times search for information on the WWW and seek a quick overview of information from the websites. American students, on the other hand, tend to focus more on details in the information offered on the websites or online coursework.

Results obtained from analyses of several of the items in our instrument are consistent with Hofstede's theory. For instance, Taiwanese students appeared to prefer group learning (Study with Group), while USA students preferred individualistic learning (Study Alone). This finding is in line with Hofstede's theory that the Taiwanese culture rates "low" on individualism, while the USA culture rates "high" the Individualism scale (Hofstede, 1986). The non-statistically significant results obtained on the Guided learning style were unexpected in light of Lee's (2004) finding that Asian students tend to prefer teacher-centered environments that provide ample guidance in the learning process. We hypothesize that the lack of consistency between our findings and Lee's may be due to the increasing use of the Internet and the growing promotion of online learning at the university level by the Ministry of Education in Taiwan, which may have prompted changes in the roles of the teacher and students. Taiwanese students have been identified as rating higher on Persistence compared to American students, and Hofstede (2001) indicated that Asian cultures are long-term oriented, which also means they are persistent. However, results of the present study revealed that both groups of students yielded a mean score lower than 3.0 on Persistence (Taiwan M= 2.94, SD=.40; USA M= 2.47, SD=.66). This finding suggests that online instructors could, for example, offer online lectures featured on various shorter video clips instead of using one single and long video clip. Lastly, our study indicated that students of both countries had no differences in terms of their roles of observers in cyber environments. Both groups obtained a mean score of around 3.0 on this Observer factor. Scholars have noted that many students may lurk in online chats, but shy learners may also turn out to be "talkative" and active in online situations. An online mode of interaction allows learners to input information at their own leisure and from an unspecified location; as a result, the frequency of interactivity increases. Kroonenberg (1994/95) found that shy learners interacted more frequently online than in face-to-face modes, and Montgomerie and Harapnuik (1997) found that students became more open in discussions and reflected their thoughts in depth while taking an online course.

The present study employed the *Inventory of Online Learning Styles* which consists of 15 factors (in three large categories) related to online learning situations. The inventory can assist instructors or online course designers in gathering data that can shed light on online students' preferred learning styles within three dimensions (perceptual, cognitive, and personality). The information derived from these data can then serve as a basis for the design of courses that meet students' needs and the adoption of appropriate teaching methods. Although the

outcomes of the present study are indicative of learning styles preferences of participating Taiwanese and USA students, instructors could use inventory outcomes of particular groups of learners within a single online learning environment in order to design materials geared towards meeting students' individual needs. Oftentimes, students coming from multiple cultural backgrounds participate in one single online course. In this case, if students prefer to learn through auditory materials, the online course could include audio files with teachers' lectures and guest speakers' talks; for learners who prefer active learning, instructors could offer more materials such as 3D animations and/or online puzzles; for students who like to study with peers, teachers could increase the opportunities for synchronous discussion (e.g, via MSN Messenger or JoinNet videoconference programs); for holistic learners, clear objectives, overviews of online course contents, and benefits of online coursework could be outlined clearly; and for the learners who need to be monitored constantly in their learning processes, course designers could include checklists and assessments as means of guidance. In addition to meeting the needs of online learners, results from the administration of our inventory can be compared with students' learning performance scores in order to improve the design of online courses.

CONCLUSION

This paper reported on the results obtained from the administration of an inventory designed to assess online learning style preferences. It was found that the Taiwanese students and USA students participating in this study showed different patterns of preferences in their online learning styles. The researchers of this study currently continue to analyze data in order to further validate the inventory. It is expected that the inventory will encourage instructors to explore the perceptual, cognitive, and personality styles of their students so as to design suitable online instruction. In addition, the results from the inventory can also assist participants of cross-cultural telecommunication exchanges, some of which have been launched internationally for second/foreign language and cross-cultural learning.

The limitation of this study is that even though there were over 350 valid sets of the inventory collected from the United States, the majority were from college students in the southern part of the country. Future studies should collect samples from other parts of USA. It could also go beyond the college learners of the countries of Taiwan and USA, for instance, data can be collected on British students, African students, or Australian students. Learners at the levels other than the college-level could also be a target, as suggested by Bozkaya, Aydin, and Kumtepe (2012). Furthermore, the exploration of other additional factors such as environmental and emotional factors related to students' online learning would also offer additional insights to practitioners of online teaching.

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