Available online at www.sciencedirect.com
ScienceDirect
Computers & Education 50 (2008) 1284–1303
COMPUTERS & EDUCATION
www.elsevier.com/locate/compedu

Investigating university student preferences and beliefs about learning in the web-based context

Fang-Ying Yang [a], Chin-Chung Tsai [b,*]

[a] Department of Earth Sciences, National Taiwan Normal University, Taipei, Taiwan
[b] Graduate School of Technological and Vocational Education, National Taiwan University of Science and Technology, Taipei 106, Taiwan

Received 22 June 2006; received in revised form 15 November 2006; accepted 8 December 2006

Abstract

Psychological studies have shown that personal beliefs about learning and environmental preferences affect learning behaviors. However, these learner characteristics have not been widely discussed in the web-based context. By developing questionnaires, this study attempted to detect learners' web-based learning environmental preferences (WLEP) and beliefs about web-based learning (BWL). The scope of WLEP focused on the pedagogical dimension of the web-based learning environment, while BWL concerned the attributes and control factors of the web-based learning. There were about five hundreds of Taiwan university students participating in the study. Through factor analysis, the scales discussed in the study revealed a satisfactory validity and reliability in assessing students' preferences and beliefs. Further analyses showed that university students preferred more of individual and structured instructional configurations while expected the outward mode of interaction. In general, students held a rather contextual belief about web-based learning, which was found to be correlated with their environmental preferences.

Keywords: Web-based learning; Learner characteristics; Preferences; Belief about learning; Pedagogical issues; University students

1. Introduction

Although numerous forms of web-based learning environments have been created with the development of online technology (e.g. Chang, Yang, & Tsai, 2005; Linn, Clark, & Slotta, 2003; Mioduser, Nachmias, Oren, & Lahav, 1999; Tobin, 1998), Dillon (2000) found that the web-based hypermedia instructions in fact had not produced desired learning results. In the classroom context, a large body of psychological research highlights that successful learning depends on learner characteristics such as cognitive styles/preferences, learning styles, information processing strategies and epistemological beliefs (e.g. Cano-Garcia & Hughes, 2000; Hofer & Pintrich, 1997; Schommer, 1993; Tamir, 1985; Weinstein, Goetz, & Alexander, 1988). Accordingly, many researchers believe that a major obstacle for the practice of the web-based instruction was the limited

* Corresponding author. Tel.: +886 2 27376511; fax: +886 2 23703217.
E-mail address: cctsai@mail.nctu.edu.tw (C.-C. Tsai).

0360-1315/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.compedu.2006.12.009

understanding of users' characteristics (e.g. Dillon & Gabbard, 1998; Hartley & Bendixen, 2001; Martinez & Place, 2001; Russell, 1997). Hence, this study was designed to explore learner characteristics contributing to learning in the web-based context.

The first learner characteristic examined in the study is the learner preferences about the web-based learning environments. Many studies have shown that students' preferences toward learning environments were significantly associated with academic achievement, learning approaches as well as attitudes toward subject matters (e.g. Chang, Hsiao, & Barufaldi, 2006; Chang & Tsai, 2005; Chuang & Tsai, 2005; Kinchin, 2004; Meyer & Muller, 1990; Wierstra, Kanselaar, Van der Linden, & Lodewijks, 1999, 2003). In some studies, the personal environmental preference was used as an indicator of an individual's epistemological belief (e.g. Moore, 1989; Perry, 1999). However, most of previous studies on this topic were conducted in the traditional classroom with a few exceptions (e.g. Chang & Tsai, 2005; Chuang & Tsai, 2005; Papanikolaou, Grigoriadou, Magoulas, & Kornilakis, 2002; Tsai, 2005; Wang & Newlin, 2002). Besides, the research foci about the environmental preferences usually revolve around classroom settings (e.g. constructivist-oriented vs. positivist-oriented) and/or teacher–student relationships (e.g. teacher-centered vs. student-centered). Hardly any examined the environmental preferences from the pedagogical perspective. Hence, one purpose of the study was to develop a proper instrument to reveal learner preferences about the web-based learning environments in the pedagogical dimension.

Although studies about environmental preferences can be found in literature, few works analyzed the underlying determinants of personal preferences. The second part of the study is thus aimed to explore the psychological factors that might control the displays of personal preferences. Owing to few studies directly addressing this issue, the underlying factors discussed in the study were actually suggested by research concerning elements controlling learning behaviors. Among relevant studies, the personal belief system is the most frequently mentioned feature that is associated with learning. Literature reviews show that personal beliefs can be discussed from various standpoints. From the epistemological point of view, personal epistemology concerning beliefs about knowledge and knowing has been found to regulate human cognitive activities, including learning (e.g. Hofer & Pintrich, 1997; Kardash & Howerll, 2000; Schommer, 1993). Basically, it was found that the more evaluative- or constructivist-oriented personal epistemology, the better results of knowledge construction and reasoning (Kuhn, 1991; Quan & Alvermann, 1995; Schommer, 1993; Tsai, 1998; Tsai, 2000; Yang, 2005). From the motivational perspective, studies indicated that learners' competence-related beliefs and control beliefs predict academic performances (Pintrich, Marx, & Boyle, 1993; Wentzel & Wigfield, 1998). Extended from the motivational perspective, Ajzen (2002) proposed the theory of planned behavior (TPB) which specifies that learning behaviors are mediated by beliefs about learning consequences, control factors and social norms. In light of above research, this study proposed that personal beliefs including epistemological beliefs and beliefs about learning regarding learning consequences and control factors should explain to some extent the learner preferences toward learning environment.

As mentioned in TPB (Ajzen, 2002), beliefs about social norms influence significantly the learning behavior. Since social norms in a society originate from cultural values, another well-recognized factor contributing to learning is culture. The effects of culture have been identified in various areas of research, such as business management, psychology, education, performing arts and even online commercial advertisement (e.g. Chan, 1999; Enz, 1986; Hall, 1976; Korac-Kakabadse, Kouzmin, Korac-Kakabadse, & Saverym, 2001; Marcus & Gould, 2000; Maxwell, Adam, Pooran, & Scott, 2000; Triandis, 1989; Wűrtz, 2006). Basically, these studies pointed out that the cultural rituals and values are reflected on communication styles and social behaviors. Empirically in the research about web-based learning, the cultural differences have also been reported in perceptions toward online discussions, expectations about instructors and students, and styles of interaction and information approach (Cifuentes & Yu-chih, 2001; Macfayden, Chase, Reeder, & Roche, 2003; Morse, 2003). Accordingly, it is in expectation that the cultural difference should result in diverse preferences toward the web-based learning environments.

There are many definitions about culture which signal characteristic of various disciplines (e.g. Hall, 1976; Hofstede, 1991; Kluckhohn & Strodtbeck, 1961). Since teaching and learning is directly related to the use of language, this study adopted a popular version defined by Hall (1976). According to Hall (1976), culture can be distinguished into the low- and high-context categories. In low-context cultures, languages as a means of communication should be precisely defined, and a vast of information is needed during communication to pro-

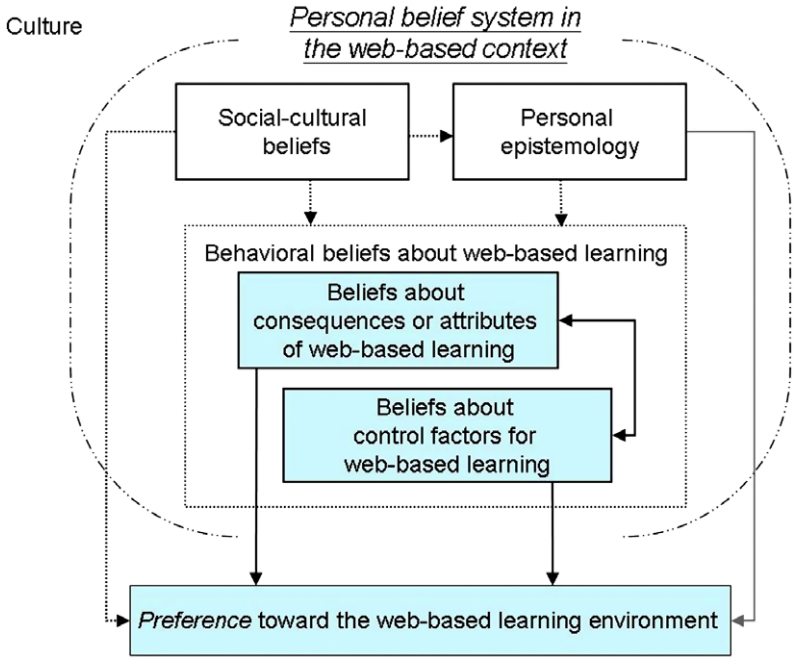

Fig. 1. A hypothetical model about belief and learning in the web-based context. *Note*: The shaded variables and the solid, associated lines are tested in the study.

vide contexts for meaning. In high-context cultures, on the contrary, languages used in communication are usually vague while most of information which provides context for meaning has been internalized over time. Based on Hall's definition, Taiwan with the cultural background strongly connected to Chinese falls in the category of the high-context culture.

Derived from existing theories and empirical studies as discussed above, a hypothetical model about personal beliefs, social–cultural values and environmental preferences was presented in Fig. 1.

As proposed in Fig. 1, the personal epistemology, social–cultural belief and belief about web-based learning constitute the personal belief system which reflects cultural rituals and values. The personal belief system could then affect the displays of personal preferences toward learning environments. Empirically, studies have found links between the environmental preferences and epistemological beliefs about knowledge (Kinchin, 2004; Tsai, 2005). And, since it was assumed in the study that participants of the study shared comment social-culture beliefs, the focus of the study is placed on the beliefs about learning related in particular to the learning consequences or attributes and control factors. It should be noted that it will take another study to in-depth explore the cultural variations. Besides, the study also recognized that the personal belief system might enclose other aspects of beliefs that are not included.

2. Structures of the research constructs

2.1. Preferences about the web-based learning environment

As mentioned previously, the research foci regarding the environmental preferences usually revolve around the classroom settings (e.g. constructivist-oriented vs. positivist-oriented) and the teacher–student relationships (e.g. teacher-centered vs. student-centered). By analyzing hundreds of websites, Mioduser and his colleagues (Mioduser et al., 1999) specified the web-based learning environments in accordance with the following aspects: the pedagogical dimension, the representational means, the link structure and the communication resources. Among these aspects, the representational means, link structure and communication resources have been frequently discussed and much related to the technical/technological issue. Since it is

the instructional design as well as pedagogies used which produced learning instead of the web technology (Alley, 2001; Meyer, 2003; Smith & Dillon, 1999), the environmental preference discussed in the study was focused largely on the pedagogical dimension.

According to Mioduser and others (Mioduser et al., 1999), there are many elements constitute the pedagogical dimension, such as the instructional configuration, the instructional model, the instructional means, the interaction type, the cognitive process, help functions, learning resources and the feedback and evaluation system. The instructional configuration concerns the learning styles (collaborative vs. individual) embedded in the instructional design while the instructional model was differentiated into the direct and inquiry-based types. Instructional means include tools, different types of activities (structured, open-ended and student-modeling). The interaction type indicates the ways of surfing or interacting with the websites and consultation from peers or experts. Cognitive process specifies purposes of the web-based learning tasks, such as information retrieval, memorizing, problem solving, and invention. And, the feedback structure consists of the processes of evaluation and ways of getting advices.

Following Mioduser's study, our previous investigation (Chang et al., 2005) showed similar developing trend in the web-based learning environments in Taiwan. Hence, the elements of the web-based learning environments introduced in the study included most of Mioduser's environmental elements (Mioduser et al., 1999) plus other relevant elements found in literature as will be illustrated below. Through preliminary factor analysis (Yang, Chang, & Tsai, 2005), three pedagogical facets about the web-based learning environments were identified for investigation, namely the instructional approach, the cognitive process and the interaction system.

2.1.1. The instructional approach

In the conventional classrooms, many studies suggest that learners have instructional preferences on the methods, media, strategies, presentation styles, and assessments due to different cognitive and learning styles (e.g. Riding & Rayner, 1998; Sadler-Smith & Riding, 1999). In the web-based context, similar research result was recorded (Papanikolaou et al., 2002). Hence, on account of the apparent association between the instructional format and cognitive style, the environmental aspects directly related to the presentation of teaching and learning materials as well as instructional tactics are identified as elements of "the instructional approach" construct.

In addition, the content structure is another significant element of web-based learning environment that should be taken into discussion. It is a well known fact that many existing learning websites are designed to promote concept learning. That is, the presentation of teaching and learning materials focuses largely on the learning of concepts and knowledge with little emphasis on the development of skills or attitudes. Nevertheless, previous investigations showed that the issue-based content structure that emphasizes the development of skills and attitude have becoming more and more popular (Chang et al., 2005; Mioduser et al., 1999). Therefore, the content structure, that is, whether it is concept-based or issue-based, was also included in the construct of the instructional approach. In short, the elements of "instructional approach" proposed in the study include the instructional configuration, instructional model, instructional means, content structure, help functions and learning resources.

2.1.2. The cognitive process

Another component of the web-based pedagogy discussed in the study is the cognitive processes perceived by learners. According to theories of self-regulated learning which explains how individual learners manage their learning behaviors, different task demands invoke different cognitive strategies (Paris & Paris, 2001; Weinstein & Meyer, 1986). For example, a conventional learning task emphasizes the memorizing process while an inquiry-based design encourages deeper-level cognitive strategies that facilitate knowledge construction (Pintrich & Garcia, 1994; Salovaara, 2005). Given the fact that web-based instructions was organized around diverse task activities, an examination on learner's preferred cognitive processes will reveal the cognitive strategies that the learner would be ready to engage.

By Mioduser's definitions (Mioduser et al., 1999), the constituents of the cognitive process basically comprise the information retrieving, memorizing, problem solving and decision making, creation and invention. Given that concept learning is a major end of many educational websites, two extra elements—making

connections to prior knowledge and forming conceptual models, are also taken-in in the construct of cognitive process.

2.1.3. The interaction system

Perhaps the most significant feature about the web-based learning environment is the interactive function. With the advancement of interactive technology, the designs and implements of the online interactions are becoming more and more complex (e.g. Linn et al., 2003; Meyer, 2003). There were studies reporting that students with different learning styles achieved differently in the interactive web-based environment (Meyer, 2003). And, individual differences in emotions and intentions, as well as cultural difference, also contribute to the online interactive behaviors (Martinez & Bunderson, 2000; Morse, 2003; Vuorela & Nummenmaa, 2004). Accordingly, learners with different cognitive orientations, learning goals and even cultural backgrounds should develop different preferences toward the modes of interaction.

Previous studies (Chang et al., 2005; Mioduser et al., 1999) pointed out that the modes of interaction in the current web-based environments vary from the simple forms, such as browsing and answering simple or multiple-choice questions, to the complex forms, such as information searching/mining and online discussions. Swan (2001) reported that asynchronous interactions with instructions and peers significantly influenced students' perceptions about online learning. These above-mentioned modes of interaction are thus the basic constituents of the construct of interaction system. In addition, as Novak (1998) pointed out that high-quality assessment can facilitate high quality learning but poor assessment can deter or prevent high quality learning, feedback and evaluation actually signify two-way interactions between learners and the learning environments. There is a study showing that the correlational effect of online discussion was found in the written assignment rather than conventional examination (Picciano, 2002). Accordingly, online interactions, feedback and assessment were discussed together in the construct of interaction system.

In summary, the preferences toward the web-based learning environment discussed in the study, particular in the pedagogical dimension, are analyzed from three facets including the preferences about the instructional approach, the cognitive process and the interaction system. The instructional approach concerns instructional formats/strategies and learning resources. The cognitive processes specify the goals of the web-based learning tasks. And, the interaction system consists of modes of interaction and types of feedback and assessment that represent different forms of the two-way communication between learner and the learning environment.

2.2. Belief about web-based learning

In the study, the construct of beliefs about web-based learning were organized based on the theory of planned behavior (TPB) proposed by Ajzen (2002) as mentioned earlier. According to TPB, the perceived behavioral control (control belief) and behavioral intention which is a function of the behavioral belief, belief in subjective norms and the control belief, together predict the behavioral achievement. In Ajzen's words, the behavioral belief refers to the likely consequences or other attributes of the behavior. Belief in subjective norms is related to the perceived social pressure. And, the perceived behavioral control indicates factors which could further or hinder behavior. By this framework, it was found that computer usage was accounted for beliefs, attitudes and intentions (e.g. Pancer, George, & Gebotys, 1992; Venkatesh, Morris, & Ackerman, 2000).

As mentioned, since belief in subjective norms which was not included in the current investigation. Hence, the beliefs about web-based learning examined in the study emphasize largely learners' behavioral beliefs about the learning consequences and the perceived behavioral controls.

2.3. Research questions

This study attempted to discuss the following research questions:

1. In a web-based learning environment, what types or forms of instructional approaches, cognitive processes, and interactions do the university students prefer to engage?

2. What beliefs about the web-based learning do the university students have?
3. What associations can be found between students' environmental preferences and beliefs about learning in the web-based context?
4. Will students' background characteristics make any differences about their environmental preferences and beliefs about learning in the web-based context?

3. Method

3.1. Subjects

The participants of the study were 475 Taiwanese university students with 241 females and 234 males. Since the web-based learning in Taiwan is popular in recent 5 years, university students are believed to have enough online learning experiences to complete the survey. Among these participants who came from different national universities, 70 students were freshmen, 97 were sophomores, 83 were junior, 94 were senior and 131 were graduates.

3.2. Procedure

The web-based learning environment preference (WLEP) questionnaire has been developed to assess students' preferences about the web-based environments. The WLEP was initially constructed based on Mioduser's study (Mioduser et al., 1999). Through literature review mentioned in the previous section and pilot tests with factor analysis, the latest version of the WLEP questionnaire reflects three components of the web-based learning environment, namely, the instructional approach, the cognitive process and the interaction system (Yang et al., 2005). These three aspects of the web-based learning environment were tested independently. Followings are sample items for WLEP.

cs4. In a web-based course, I prefer that the information communication is inquiry-based. That is, learners search and/or construct concepts via the open and free-explorative processes of problem solving (*Instructional approach*).
cp26. The web-based instruction should allow me to make connections with what I have learned previously (*Cognitive process*).
is37. In the web-based course, I prefer to obtain instant feedbacks from instructors or experts (*Interaction system*).

The items included in the belief about web-based learning (BWL) questionnaire were originally collected through an open-ended survey with 38 university students. Suggested by TPB (Ajzen, 2002), the survey asked participants to state salient advantages, disadvantages, difficulties and control factors they believed about the web-based learning process. Students' responses were analyzed and transformed into questionnaire items, and then tested and modified through several pilot tests. The latest version of BWL contained 13 items, describing various attributes related to the online, web-based learning process. Examples are as follows.

V50. The online courses can make concrete about abstract concepts with the help of animations or simulations (*positive learning consequence*).
V54. The online learning is more effective for the active students (*control factor*).
V49. The online courses would increase the learning loads (*Perceived difficulty*).

The two questionnaires were posted online and opened for students from several universities in Taiwan. Participants were asked to rate the questionnaire items on a 4-point Likert scale and complete the two questionnaires at a time. The online survey lasted for 2 weeks. More than 570 students registered the online survey and the final valid number of participants was 476.

4. Results

4.1. The development of Instruments

The latest version of WLEP contains 17 items for "the instructional approach" (Alpha = 0.79), five items for "the cognitive activity" (Alpha = 0.88) and 10 items for "the interaction system" (Alpha = 0.73). The alpha value of the whole WLEP questionnaire is 0.87. The other questionnaire, belief about web-based learning (BWL), contains 13 items with an alpha value of 0.62. The factor analyses with Varimax rotation were run separately on the three aspects of WLEP and BWL. The items of the WLEP are briefly described in each factorial table in Tables 1–3, while those of BWL are specified in Table 4. Hatcher and Stepanski (1994) have claimed that, for social science studies, a Cronbach alpha coefficient even low as 0.55 can be recognized and accepted for statistical consideration. Accordingly, except the learning style, all scales satisfied the statistical requirement.

The factor loadings for each of the four factors found underlying the web-based instructional approach were shown in Table 1. These factors explained 53% of the variance and were assigned as the learning style, the concept-based and structured module, the inquiry-based and explorative module and the multiple resources. Noticeably, since the scale of the learning style received unsatisfactory reliability value, (Alpha = 0.53, after reversing the score of cs1, shown in Table 1) the two styles will be discussed separately in the study.

The initial factor analysis on the cognitive activity suggested that all the five types of cognitive activity constituted a whole factor structure (68.5% variance explained). However, to examine if different levels of cognitive processes can be identified, two factors were forced into analysis. The result was two conceptually different forms of cognitive activity, which were classified as the assimilation- and the accommodation-oriented activities as shown in Table 2. The former form focuses on the addition or connections of information while the later implies the construction of new knowledge. The total explained variance was enhanced to

Table 1
Factor analysis about the instructional approach in WLEP

Factor	Item	Loading	Mean	SD
Learning style	cs1. Individual	0.72	2.14	0.61
	cs2. Collaborative	0.73	2.55	0.69
	Factor mean = 2.34, *SD* = 0.54, *Alpha* = 0.53			
Concept-based and structured module	cs3. Directed command	0.74	2.68	0.63
	cs7. Concept-based presentation	0.60	2.85	0.56
	cs8. Structured activities	0.64	2.77	0.68
	cs13. Online helps or directions	0.45	3.17	0.61
	cs12. Worksheets and activity records	0.41	2.98	0.57
	Factor mean = 2.89, *SD* = 0.38, *Alpha* = 0.62			
Inquiry-based and explorative module	cs4. Inquiry-based command	0.75	2.69	0.66
	cs6. Issue-based presentation	0.56	2.91	0.58
	cs9. Open-ended activities	0.75	2.53	0.72
	cs21. Out-of-website links and activities	0.49	2.91	0.60
	Factor mean = 2.76, *SD* = 0.44, *Alpha* = 0.61			
Multiple resources	cs16. Linked other www resources	0.82	3.14	0.48
	cs17. Additional external resources, such as video, music, e-books, etc.	0.77	3.17	0.55
	cs15. Links within the website	0.73	3.09	0.49
	cs18. Real time data	0.71	3.11	0.54
	cs19. Expert consultants	0.59	3.12	0.49
	cs11. Student modeling activities	0.44	3.04	0.57
	Factor mean = 3.11, *SD* = 0.37, *Alpha* = 0.81			

Note:
1. KMO = 0.82.
2. Total Alpha value = 0.79.
3. Explained variance = 54%.

Table 2
Factor analysis for the cognitive activities in WLEP

Factor	Item	Loading	Mean	SD
Knowledge accommodation	cp24. Information mining/retrieving	0.77	3.16	0.57
	cp29. Problem solving and reasoning	0.77	3.29	0.57
	cp30. Creating and discovering	0.85	3.29	0.56
	Factor mean = 3.25, *SD* = 0.49, *Alpha* = 0.84			
Knowledge assimilation	cp26. Making connections with prior knowledge	0.80	3.35	0.56
	cp27. Forming conceptual models	0.90	3.29	0.53
	Factor mean = 3.32, *SD* = 0.50, *Alpha* = 0.83			

Note:
1. KMO = 0.85.
2. Total alpha value = 0.88.
3. Explained variance = 79.7%.

Table 3
Factor analysis for the interaction system in WLEP

Factor	Item	loading	Mean	SD
Outward interactions	is42. Alternative assessments such as doing reports, creating products, peer evaluations, etc.	0.82	2.98	0.69
	is38. Complex online actions such as information searching, doing reports, design experiments, online discussions, etc.	0.77	2.79	0.77
	is33. Synchronous feedbacks from instructors or experts	0.62	3.17	0.62
	is40. Discussions with experts via internet	0.46	2.82	0.65
	Factor mean = 2.94, *SD* = 0.49, *Alpha* = 0.68			
Enclosed interactions	is41. Assessment with multiple-choice questions	0.77	2.70	0.67
	is36. Webpage browsing	0.65	2.83	0.70
	is37. Simple online actions such as answering multiple questions, viewing animations or movies, etc.	0.63	3.11	0.59
	is32. Automatic feedback by design	0.62	2.51	0.69
	Factor mean = 2.79, *SD* = 0.46, *Alpha* = 0.64			
Asynchronous feedback	is34. From teachers or experts	0.84	3.07	0.58
	is35. From peers	0.72	2.85	0.60
	Factor mean = 2.96, *SD* = 0.49, *Alpha* = 0.55			

Note:
1. KMO = 0.76.
2. Total alpha value = 0.73.
3. Explained variance = 55%.

79.7%. Noticeably, there is a high correlation between the two factors of cognitive activity ($r = 0.72$), suggesting dependence between the two factors.

Table 3 shows the factor structure of the interaction system which includes the outward mode, the enclosed mode and the asynchronous feedback. The explained variance was 55%.

For the result of BWL, the factor analysis revealed three underlying factors as identified in Table 4, which were assigned to the behavioral belief (adopted from Ajzen's concept), the contextual belief and the perceived difficulty. The correlations among the scales of belief were low ($r < 0.1$), suggesting that the three kinds of beliefs were independent to one another. The low correlations among scales may explain the overall alpha value of BWL at 0.62 that is less satisfactory at the first glance.

Basically, the items for the behavior belief identified in the study indicate the anticipated behaviors and the positive consequences of the online learning. Principally, the higher the scores, the better anticipated outcomes of learning. The contextual belief expresses that the online learning would be more effective under specific conditions or for students with certain ability. In other words, the higher the scores, the more conditional considerations on the web-based learning process. The perceived difficulty points out that the online learning is difficult and confusing. That is, the higher sores, the more complexity that an individual would feel about the web-based learning.

Table 4
Factor analysis for the belief about web-based learning (BWL)

Factor	Item	Loading	Mean	SD
Behavioral belief	V44. I prefer online learning than the conventional learning	0.80	2.34	0.74
	V45. The more online learning, the better learning outcome	0.79	2.17	0.66
	V43. Online learning will dominate the future learning	0.67	2.98	0.69
	V46. Carrying on the online Learning for the whole semester should be fine, if the courses were appropriately designed	0.63	2.32	0.84
	V48. Because of the online communication, the distance between teachers and classmates can be reduced	0.61	2.55	0.71
	V56. The online learning courses allow me to know more about my own learning styles and competences	0.55	2.85	0.59
	V50. The online courses can make concrete the abstract concepts with the help of the animations or simulations	0.49	2.99	0.69
	Factor mean = 2.59, *SD* = 0.45, *Alpha* = 0.78			
Contextual belief	V52. Some contents are good for online learning while others might be suitable for the traditional form of learning	0.79	3.42	0.58
	V54. The online learning is more effective for the active students	0.72	3.26	0.71
	V53. The positive thing about online learning may be that it is able to provide quick information from out of school sources	0.64	3.10	0.53
	Factor mean = 3.26, *SD* = 0.45, *Alpha* = 0.60			
Perceived difficulty	V47. The online courses are playful but can't help me learn	0.84	2.31	0.72
	V49. To me, the online courses would increase the learning loads	0.81	2.43	0.66
	V55. The online links make me feel lost and unfocused	0.61	2.58	0.70
	Factor mean = 2.44, *SD* = 0.52, *Alpha* = 0.60			

Note:
1. KMO = 0.77.
2. Total alpha value = 0.62.
3. Explained variance = 53.7%.

In conclusion, according to the factor analyses, the scales of the two questionnaires (WLEP and BWL) provided a satisfactory validity and reliability in assessing students' preferences about the web-based learning environment and beliefs about the web-based learning.

4.2. Analyses on the preferences about the web-based learning environment

For the instructional approach as shown in Table 1, the paired *t*-test found that participants valued more of the individual than the collaborative style of learning (cs1 vs. cs2, $t = 6.37$, $p < 0.01$; the cs1 mean score before reversing is 2.86). And, they liked to engage in the structured activities more than the open-ended form (cs8 vs. cs9, $t = 4.44$, $p < 0.01$). However, no differences were found between the issue-based and concept-based presentations of teaching materials (cs6 vs. cs7, $t = 1.56$, $p > 0.1$), and between the direct and inquiry-based commands (cs3 vs. cs4, $t = 0.29$, $p > 0.1$). The most significant learning resources favored by students are the additional external resources, such as video, music, e-books and other www links (cs17), while the least favored resources are the personal modeling programs (cs11). Nevertheless, the mean score of cs11 is above 3 on the 1–4 Likert scale, suggesting learners' high demand on various online learning resources. By the paired *t*-test analyses over scale means, it was found that, for the instructional approach, students seemed to favor the concept-based and structured module (the second factor in Table 1) in comparison with the inquiry-based and explorative form (the third factor in Table 1) ($t = 4.83$, $p < 0.01$).

As far as the cognitive activity was concerned as displayed in Table 2, students expected more of the web-based learning environment allowing learners to make connections with what has been learned (cp26, mean = 3.33), experience the problem-solving activities (cp29, mean = 3.29) and go through inventions and discoveries (cp30, mean = 3.29). The information mining/retrieving activity received the lowest mean score (cp24, mean = 3.16). The paired *t*-test over scale (factor) means showed a significant difference between the assimilation- and accommodation-oriented processes ($t = 3.72$; $p < 0.01$).

For the interaction system as indicated in Table 3, students preferred the simple than the complex actions (is37 vs. is38, $t = 8.07$, $p < 0.01$). The instant feedbacks from instructors or experts were favored more than the automatic feedbacks generated from computers (is33 vs. is32, $t = 16.57$, $p < 0.01$). As for the type of assessment, subjects scored higher on the alternative assessment, such as doing reports or group projects, than the multiple-choice tests (is42 vs. is41, $t = 6.33$, $p < 0.01$). In addition, students favored non-instant feedbacks more from the instructors than peers (is34 vs. is35, $t = 7.16$, $p < 0.01$).

The paired t-test analysis on the factorial scales showed that the outward mode of interaction received a higher mean than the enclosed mode ($t = 5.97$, $p < 0.01$). The correlation between the outward and enclosed interactions was median ($r = 0.32$, $p < 0.01$), indicating a moderate dependence between the two modes of interaction. Meanwhile, as mentioned before, students expected more of the asynchronous feedbacks from teachers or experts than their peers. Above findings suggested that the university students in the study preferred the authority figures for supporting their individual web-based learning. Table 5 displayed the result of Pearson correlation analyses over the scales of WLEP.

Within the instructional approach, according to Table 5, it was found that the individual learning style had a relatively higher correlation ($r = 0.34$, $p < 0.01$) with the concept-based and structured module in comparison with the inquiry-based and explorative form ($r = 0.12$, $p < 0.05$), while the collaborative style had a significant correlation with the inquiry-based and explorative style ($r = 0.34$, $p < 0.01$). The analyses between the instructional approach and the cognitive activity specified a relatively higher correlation coefficient between the preference toward the inquiry-based and explorative module and the preference toward the accommodation-oriented activity ($r = 0.4$, $p < 0.01$), whereas no statistical correlation was found between the preference toward the inquiry-based and explorative module and the preference toward the concept-based and structured form. Meanwhile, the preference toward the concept-based module seemed to be correlated more with the assimilation-oriented activity ($r = 0.25$, $p < 0.01$). The correlation analysis between the instructional approach and the interaction system showed that the preference toward the inquiry-based and explorative module was associated significantly with the preference toward the outward mode of interaction ($r = 0.45$, $p < 0.01$). Moreover, while the two types of cognitive activity were found to be significantly correlated with both modes of interaction, a fairly high correlation ($r = 0.55$, $p < 0.01$) was found between the preferences toward the accommodation activity and the outward mode of interaction.

4.3. Analysis on the belief about online learning

According to the original scores of BWL, participants tended to score higher to the items (e.g. items V52 and V54) that stated factors controlling learning in web-based environment. In other words, students did not think that web-based learning can be applied without limits. For example, students generally agreed that "some contents are good for online learning while others might be suitable for the traditional form of learning" (V52, mean = 3.42). Based on the factor analysis, three scales of belief were sorted out, namely behavioral belief, contextual belief and perceived difficulty, as displayed in Table 4. By definitions, the behavioral belief in the study conceptually matched with the behavioral belief in the theory of planned behavior (Ajzen, 1991, 2002) while the contextual belief and the perceived difficulty went with the construct of the perceived behavior control (control belief). According to Ajzen (2002), there was a positive relation between the behavioral belief and the behavioral intention. Nevertheless, there was a negative relation between the control belief and the behavioral intention. Given that the scale mean of the behavioral beliefs was only about 2.5 on a 4-point scale, while that of the contextual belief was over 3, it was suggested that students in the study might not have a high intention toward learning in the web-based context.

4.4. Associations between preference and belief

Table 6 showed the Pearson correlation coefficients for the learner preferences about the web-based learning environment and the three scales of belief about web-based learning. In general, the correlational effects of the behavioral belief were stronger on the preferences toward the issue-based instructional module ($r = 0.24$, $p < 0.01$), the accommodation-oriented activity ($r = 0.25$, $p < 0.01$) and the two modes of interaction, especially the enclosed mode ($r = 0.32$, $p < 0.01$). The contextual belief displayed stronger correlational effects

Table 5
Correlation analyses for the WLEP scales

Scales	Inquiry-based organization	Concept-based organization	Multiple resources	Knowledge assimilation	Knowledge accommodation	Outward interaction	Enclosed interaction	Asynchronous feedback
Individual learning	0.12*	0.34**	0.22**	0.02	0.04	−0.18*	−.077	0.05
Collaborative learning	0.34**	−0.02	0.84	0.03	0.11*	0.26**	0.05	0.10*
Inquiry-based organization	1	0.04	0.33**	0.29**	0.40**	0.45**	0.10*	0.20**
Concept-based organization		1	0.49**	0.25**	0.19**	0.04	0.09*	0.26**
Multi-resources			1	0.51**	0.52**	0.33**	0.17**	0.35**
Knowledge assimilation				1	0.72**	0.49**	0.36**	0.33**
Knowledge accommodation					1	0.55**	0.42**	0.33**
Outward interaction						1	0.32**	0.34**
Enclosed interaction							1	0.28**

* $p < 0.05$.
** $p < 0.01$.

Table 6
Pearson correlations between the learner preferences about the web-based learning environment and the beliefs toward the online learning

Preferences about the web-based learning environment		Belief about the web-based learning		
		Behavioral	Contextual	Perceived difficulty
Instructional approach	Individual learning	0.15**	0.29**	−0.17*
	Collaborative learning	0.14**	0.01	0.21**
	Concept-based and structured module	0.23**	0.33**	−0.10*
	Issue-based and explorative module	0.24**	0.17**	0.14**
	Multiple resources	0.22**	0.37**	−0.11*
Cognitive activity	Assimilation	0.13**	0.23**	0.03
	Accommodation	0.25**	0.16**	0.01*
Interaction system	Outward mode	0.25**	0.08	0.21**
	Enclosed mode	0.32**	−0.03	0.12**
	Asynchronous feedback	0.32**	0.11*	−0.06

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

on the preferences toward individual learning ($r = 0.29$, $p < 0.01$), the concept-based instructional module ($r = 0.33$, $p < 0.01$) and the assimilation-oriented activity ($r = 0.23$, $p < 0.01$). Meanwhile, the belief in the perceived difficulty seemed to be associated more with the preferences toward the collaborative learning ($r = 0.21$, $p < 0.01$) and the outward-mode of interaction ($r = 0.21$, $p < 0.01$).

4.5. The cross-analyses for the background characteristics

The WLEP and BWL scores in scales were cross-checked with students' background characteristics such as gender, educational experiences including major in university and year in university, computer facilities, internet usage, previous experiences with the web-based courses, the family socioeconomic status, parents' education and so forth. By One-way ANOVA as shown in Table 7, a significant gender difference was found in the preference toward the collaborative learning, the behavioral belief and the contextual belief. Basically, males scored higher in the behavioral belief and preferred collaborative learning. On the other hand, females scored higher on the contextual belief and seemed to favor individual learning ($p < 0.1$).

For the educational experiences, One-way ANOVA showed significant differences between the social-science and the science majors in the preferences toward the accommodation-oriented process and multiple resources as listed in Table 8. It was the social-science students who scored higher in the two factors.

Considering the sample sizes of different groups for analysis, the year in university was differentiated into three levels. The "Level 1" indicated the freshmen and sophomores, while "Level 2" included junior and senior students. Graduates were assigned to "Level 3". One-way ANOVA as displayed in Table 9 suggested that the group differences were apparent in the preferences toward collaborative learning, the inquiry and explorative module, the accommodation process, and the contextual belief. Further post hoc analyses (Scheffe) suggested that the graduates (level 3) tended to favor collaborative learning and the inquiry-based instructional module than the other two groups. Meanwhile, students in the first and second years (level 1) who gave highest weight on the contextual belief also seemed to prefer more of the accommodation-oriented cognitive process than did level 2.

The analysis on the computer and internet availability was neglected because the majority of the students ($n = 469$) reported the availability of computer at home, and more than 460 students reported the availability of internet service at home. No statistical association was found for hours of using internet per week. As far as the web-based or online learning experience was concerned, about half of the participants ($n = 246$) reported they had experiences in the web-based or online learning. One-way ANOVA revealed that those who had relevant experiences scored significantly higher in the behavioral belief about the web-based learning. In addition, their preference toward the concept-based instructional module seemed to be relatively lower. Table 10 displayed the result.

Table 7
ANOVA for gender differences

Factor	Learning style		Instructional approach			Cognitive process		Interaction system		Beliefs about web-based learning		
Gender\scale	Individual learning	Collaborative learning	Inquiry-based and explorative module	Concept-based and structured module	Multi-resources	Assimilation	Accommodation	Outward interaction	Enclosed interaction	Behavioral belief	Contextual belief	Perceived difficulty
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Male	2.81(0.64)	2.64 (0.69)	2.77 (0.46)	2.86 (0.40)	3.09 (0.41)	3.32 (0.52)	3.25 (0.54)	2.96 (0.49)	2.78 (0.47)	2.63 (0.48)	3.19 (0.48)	2.40 (0.55)
Female	2.91(0.58)	2.45 (0.66)	2.75 (0.41)	2.91 (0.36)	3.13 (0.32)	3.31 (0.49)	3.26 (0.44)	2.91 (0.48)	2.80 (0.45)	2.55 (0.42)	3.32 (0.41)	2.48 (0.48)
F(ANOVA)	$2.97^{(*)}$	**9.69****	0.42	1.93	1.35	0.03	0.07	1.02	0.22	**3.82***	**8.80****	$2.78^{(*)}$

Notes:

1. Male $n = 241$, female $n = 234$.
2. (∗): $p < 0.1$; ∗: $p < 0.05$; ∗∗: $p < 0.0$.

Table 8
ANOVA for the difference in science and social-science majors

Factor	Learning style		Instructional approach			Cognitive process		Interaction system		Beliefs about web-based learning		
Major\scale	Individual learning	Collaborative learning	Inquiry-based and explorative module	Concept-based and structured module	Multi-resources	Assimilation	Accommodation	Outward interaction	Enclosed interaction	Behavioral belief	Contextual belief	Perceived difficulty
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Social	2.89 (0.63)	2.55 (0.63)	2.80 (0.42)	2.92 (0.38)	3.20 (0.36)	0.35 (0.50)	3.32 (0.48)	2.97 (0.53)	2.80 (0.46)	2.62 (0.44)	3.30 (0.47)	2.36 (0.61)
Science	2.85 (0.61)	2.55 (0.71)	2.75 (0.44)	2.88 (0.39)	3.09 (0.39)	0.30 (0.50)	3.22 (0.49)	2.92 (0.47)	2.78(0.46)	2.59 (0.46)	3.25 (0.45)	2.37 (0.58)
F(ANOVA)	0.56	0.00	1.32	1.19	**7.69****	0.66	**3.92***	0.97	0.22	0.49	1.16	0.00

Notes:

1. Social $n = 133$, science $n = 342$.
2. *: $p < 0.05$; **: $p < 0.01$.

Table 9
ANOVA and Scheffe post hoc analysis for the difference in the year level in university

Factor	Learning style		Instructional approach			Cognitive process		Interaction system		Beliefs about web-based learning		
Year level\scale	Individual learning	Collaborative learning	Inquiry-based and explorative module	Concept-based and structured module	Multi-resources	Assimilation	Accommodation	Outward interaction	Enclosed interaction	Behavioral belief	Contextual belief	Perceived difficulty
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Level 1	2.86 (0.65)	2.56 (0.69)	2.73 (0.46)	2.90 (0.40)	3.13 (0.36)	3.37 (0.49)	3.31 (0.46)	2.96 (0.51)	2.82 (0.47)	2.58 (0.43)	3.32 (0.46)	2.43 (0.59)
Level 2	2.85 (0.61)	2.45 (0.71)	2.72 (0.43)	2.88 (0.41)	3.08 (0.42)	3.27 (0.51)	3.18 (0.52)	2.92 (0.47)	2.79 (0.46)	2.56 (0.48)	3.18 (0.48)	2.31 (0.60)
Level 3	2.87 (0.57)	2.66 (0.64)	2.86 (0.40)	2.88 (0.33)	3.14 (0.31)	3.31 (0.51)	3.27 (0.47)	2.94 (0.48)	2.74 (0.45)	2.65 (0.45)	3.29 (0.39)	2.37 (0.57)
F(ANOVA)	0.30	3.90*	4.17*	0.20	1.36	1.95	3.01*	0.24	0.90	1.59	4.61**	1.71
Post hoc		*Level* 3 > *level* 2	*Level* 3 > *level* 2; *Level* 3 > *level* 1				*Level* 1 > *level* 2 ($p < 0.1$)				*Level* 1 > *level* 2	

Notes:

1. Level 1 = Freshmen + sophomore ($n = 167$); level 2 = junior + senior ($n = 177$); level 3 = graduates ($n = 131$).
2. *: $p < 0.05$; **: $p < 0.01$.

Table 10
ANOVA for whether the participants have previous experiences about the web-based learning

Factor	Learning style		Instructional approach			Cognitive process		Interaction system		Beliefs about web-based learning		
Experience\scale	Individual learning	Collaborative learning	Inquiry-based and explorative module	Concept-based and structured module	Multi-resources	Assimilation	Accommodation	Outward interaction	Enclosed interaction	Behavioral belief	Contextual belief	Perceived difficulty
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Yes	2.84 (0.64)	2.56 (0.68)	2.74 (0.44)	2.86 (0.40)	3.11 (0.40)	3.34 (0.51)	3.25 (0.52)	2.96 (0.49)	2.81 (0.47)	2.67 (0.45)	3.26 (0.45)	2.33 (0.62)
No	2.88 (0.59)	2.54 (0.70)	2.78 (0.43)	2.92 (0.37)	3.11 (0.34)	3.29 (0.49)	3.25 (0.46)	2.92 (0.48)	2.77 (0.45)	2.52 (0.44)	3.26 (0.46)	2.41 (0.56)
F(ANOVA)	0.52	0.10	0.99	3.02(*)	0.02	1.13	0.01	0.69	0.87	13.76**	0.03	2.26

Notes:

1. n of "Yes" = 246; n of "No" = 229.
2. (*): $p < 0.1$; *: $p < 0.05$; **: $p < 0.01$.

In summary, among various background characteristics, students' preferences toward the pedagogical dimension of the web-based learning environments, and their beliefs about the online learning were associated in different degrees with gender, the years of higher education, and experiences with the web-based or online courses.

5. Discussion

To explore learners' perspectives on the web-based learning, this study developed two questionnaires to assess university students' preferences about the web-based learning environment and beliefs about the web-based learning. Students' background characteristics were probed for cross-analyses. In general, university students in the study seemed to prefer the web-based instruction to be structured and concept-based. While the individual learning overrode the collaborative learning, the students desired more of outward interactions with teachers or experts than with their peers. They also expected that the online courses would chiefly allow them to experience knowledge assimilation. Clearly, these students were used to a more structured, teacher-driven and hierarchical approach to teaching and learning in the web-based context, which could be the result of prior traditional classroom experiences. Such findings seemed to be more or less contradicting with the evolving trend that the web-based learning environment is becoming more complex, collaborative and constructivist oriented. It should be noted that putting students with traditional teacher-centered learning experiences in the constructivist-oriented learning environments is bound to cause problems, and it takes adjustment for learners to adopt a different frame. In this situation, instructors or designers should offer some help and support, and may need to adjust to different expectations.

In the meantime, the results of factor and correlation analyses implied that students have different favored combinations of the online pedagogical elements. Seemingly, those who expected the structured online instruction favored the simpler concept-based activities, whereas the more explorative type of instructional design is preferred, the more complex and constructivist activities are expected. Moreover, student's background characteristics show that both education and computer/internet experiences contribute to individual's environmental preference. Hence, a coherent design of the web-based learning environment which takes learners' environmental preferences and past experiences into account is recommended to facilitate users' adaptation to the web-based learning environment.

The investigation on beliefs about web-based learning suggested that students' conservative preferences toward the web-based learning environment could be explained by participants' general beliefs that the web-based learning could not be unconditionally applied. And, for many of the participants, the online courses would be successful only if it was incorporated with appropriate topics and/or were participated by active students. The factorial scores of BWL were found to be correlated with those of WLEP at about low to median level, indicating the likely interplay between personal beliefs and environmental preferences. Therefore, it is recommended that if teachers hope to encourage students' engagement in the more collaborative and constructivist-oriented web-based instructions, a fundamental step would be the change or advancement of students' beliefs about the web-based learning.

The cross-analysis with the background characteristics found that gender was associated with beliefs about web-based learning in which females scored higher on the contextual belief. Moreover, the mean scores likely pointed to a trend that the more years of higher education, the higher scores on behavioral belief and lower scores on the contextual belief about online learning. Such a trend indicated that students would become more and more adaptive to the online learning after years of higher education. In addition, those who have experiences on the web-based courses scored higher on the behavioral belief about online learning. In all, an individual's belief about web-based learning was found to coincide with his/her educational experiences. Accordingly, learners need to gain more relevant experiences to strengthen their behavioral belief so as to enhance their behavioral intention toward the web-based learning.

Alternatively, the result of the study can be further discussed from the cultural perspective. As mentioned in the literature review section, the phenomenon of cultural difference on the communication style has been widely reported in psychology, management, and education including teaching and learning in the web-based environment (e.g. Chan, 1999; Enz, 1986; Hall, 1976; Korac-Kakabadse et al., 2001; Marcus & Gould, 2000; Maxwell et al., 2000; Triandis, 1989; Wűrtz, 2006). It is therefore highly likely that culture difference would

bring about different preferences toward means of communication or interaction in the web-based environment. By Hall's definitions (Hall, 1976), learning in the low-context culture emphasizes learning outcomes such as student-center learning, attitudinally based deep learning and the development of personal skills. Whereas in the high-context culture, learning is focused on teaching inputs (students as information recipients) and content-based learning (Entwistle, 1991; Maxwell et al., 2000). Moreover, students in low-context culture see teachers as facilitators in the learning process while those in high-context culture depend on teacher knowledge. Given that the main stream culture of Taiwan is strongly connected to Chinese that has been identified as the high-context culture, the university students' conservative preferences toward the interactive web-based learning environment are therefore theoretically predictable.

In conclusion, personal preferences toward the designs of the web-based learning environment were intervened with gender, educational experiences, and personal belief about the web-based learning. And, the influences of these background characteristics could be the reflection of cultural values and rituals. As Newis and Orton (2000) pointed out, the information about learner preferences should not be taken as the only principle for the online instructional design because very often users do not understand all the variables and features of the instruction. The study on the learner preferences provides instructors or course designers with information about learners' environmental expectations and learning approaches that a given task might evoke. Besides, the information regarding personal beliefs about the web-based learning reveals whether learners are holding relevant beliefs that may signify their intentions. With these understandings along with a consideration on cultural effect, instructors or designers have a starting point to consider what treatments or special designs will be needed for their students/learners to adapt to the innovative web-based learning environments. Still, one should keep in mind that part of the difficulty of learning in the web-based environments lies also in the structures and technical affordances of the particular learning environments which are not easy to get at via a large-scale questionnaire method.

6. Future work

In this study, we attempted to develop adequate questionnaires to assess learners' preferences toward learning environments and beliefs about learning in the online, web-based context, and also tested the associations between the two constructs. The research designed was based on a hypothetical model regarding personal belief system as displayed in Fig. 1. The result shows that the two questionnaires have gained satisfactory validities and reliabilities. Associative analyses suggested that learners' preferences toward the web-based learning environments were found to be correlated with their beliefs about the consequences or attributes of and control factors for the web-based learning. With the questionnaires, follow-up investigations can be put into practice to examine the interplays among beliefs, preferences and learning behaviors such as study approaches, learning strategies, and even academic achievement in the web-based context. Such studies will help to evaluate and predict the efficiency of web-based instructions, and furthermore, make comparisons between web-based and conventional situations.

Technically, the use of questionnaires for examining preferences about web-based learning environments and beliefs about web-based learning may suffer from the lack of strong validity. To explore more about students' preferences and beliefs about web-based learning, researchers can place students in a real web-based learning environment. Through gathering data when they are experiencing the web-based learning activities, researchers may know more about students' real perceptions about the new type of learning.

Furthermore, as mentioned previously, what is currently missing from our hypothetical model is the in-depth discussion on the cultural dimension. One may argue that the result derived from the present study would be every similar to the non web-based situations when the effect of culture is taken into account. An interesting topic is thus to compare learner preferences and beliefs with respect to different types of learning environments. By this way, the role of culture may be clarified.

Acknowledgement

Funding of this research work was supported by National Science Council, Taiwan, under grant numbers NSC 92-2524-S-003-002 and NSC 93-2524-S-003-002.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211.

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control and the theory of planned behavior. *Journal of Applied Social Psycnology, 32*, 1–20.

Alley, L. R. (2001). What makes a good online course? *Converge, 4*, 50–53.

Cano-Garcia, R., & Hughes, E. H. (2000). Learning and thinking styles: analysis of their interrelationship and influence on academic achievement. *Educational Psychology, 20*, 413–430.

Chan, S. (1999). The Chinese learner – a question of style. *Education + Training, 41*, 294–304.

Chang, C. C., Yang, F. Y. & Tsai, C. C. (2005). An analysis of the web-based learning environment for earth science education in Taiwan. Paper presented in the 2005 ED-MEDIA – World conference on educational multimedia, hypermedia & telecommunications, Montreal, CA.

Chang, C. Y., Hsiao, C. H., & Barufaldi, J. P. (2006). Preferred-actual learning environment "spaces" and earth science outcomes in Taiwan. *Science Education, 90*, 420–433.

Chang, C. Y., & Tsai, C. C. (2005). The interplay between different forms of CAI and students' preferences of learning environment in the secondary science class. *Science Education, 89*, 707–742.

Chuang, S. C., & Tsai, C. C. (2005). Preferences toward the constructivist Internet-based learning environments among high school students in Taiwan. *Computers in Human Behavior, 21*, 255–272.

Cifuentes, L., & Yu-chih, D. S. (2001). Teaching and learning online: a collaboration between US and Taiwanese students. *Journal of Research on Computing in Education, 33*, 456–474.

Dillon, A. (2000). Designing a better learning environment with the web: problems and prospects. *Cyperpsychology & behavior, 3*, 97–101.

Dillon, A., & Gabbard, R. (1998). Hypermedia as an educational technology: a review of the quantitative research literature on learner comprehension, control, and style. *Review of Educational Research, 68*, 322–349.

Entwistle, N. (1991). *The impact of teaching on learning outcomes in higher education. A literature review*. Washington, DC: US Government Printing Office.

Enz, C. A. (1986). New directions for cross-cultural studies: linking organizational and societal cultures. *Advances in International Co-operative Management, 2*, 173–189.

Hall, E. T. (1976). *Beyond culture*. NY: Doubleday.

Hartley, K., & Bendixen, L. D. (2001). Educational research in the internet age: examining the role of individual characteristics. *Educational Researcher, 30*, 22–26.

Hatcher, L., & Stepanski, E. J. (1994). *A step-by-step approach to using the SAS system for univariate and multivariate statistics*. Cary, NC: SAS Institute.

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research, 67*, 88–140.

Hofstede, G. (1991). *Cultures and organizations: Software of the mind*. Maidenhead, UK: McGraw-Hill.

Kardash, C. M., & Howerll, K. L. (2000). Effects of epistemological belies and toic-specific beliefs on undergraduates' cognitive and strategic processing of dual positional text. *Journal of Educational Psychology, 92*, 524–535.

Kinchin, I. M. (2004). Investigating students' beliefs about their preferred role as learners. *Educational Research, 46*, 301–312.

Kluckhohn, F., & Strodtbeck, F. (1961). *Variations in value orientations*. Evanston, IL: Row, Peterson and Company.

Korac-Kakabadse, N., Kouzmin, A., Korac-Kakabadse, A., & Saverym, L. (2001). Low- and high-context communication patterns: towards mapping cross-cultural encounters. *Cross Cultural Management—An International Journal, 8*, 3–24.

Kuhn, D. (1991). *The skill of argument*. Cambridge: Cambridge University Press.

Linn, M. C., Clark, D., & Slotta, J. D. (2003). WISE design for knowledge integration. *Science Education, 87*, 517–583.

Macfayden, L. P., Chase, M. M., Reeder, K., & Roche, J. (2003). Matches and mismatches in intercultural learning: design and facilitation of an online intercultural course. In *UNESCO conference on intercultural education*, Jyvaskyla, Finland, June.

Marcus, A., & Gould, E. W. (2000). Crosscurrents: cultural dimensions and global web user-interface design. *Interactions, 7*, 32–46.

Martinez, M., & Bunderson, C. V. (2000). Building interactive World Wide Web (Web) learning environments to match and support individual learning differences. *Journal of Interactive Learning Research, 11*, 163–195.

Martinez, M., & Place, T. (2001). Mass customization: Design for successful learning. IJET, 2.

Maxwell, G., Adam, M., Pooran, J., & Scott, B. (2000). Cultural diversity in learning: developing effective learning for South East Asian hospitality Management students. *Cross Cultural Management—An International Journal, 7*, 3–12.

Meyer, K. A. (2003). The web's impact on student learning. *THE Journal, 30*, 14–18.

Meyer, J. H. F., & Muller, M. W. (1990). Evaluating the quality of student learning: an unfolding analysis of the association between perceptions of learning context and approaching to studying at an individual level. *Studies in Higher Education, 15*, 131–154.

Mioduser, D., Nachmias, R., Oren, A., & Lahav, O. (1999). Web-based learning environments (WBLE): current implementation and evolving trends. *Journal of Network and Computer Applications, 22*, 233–247.

Moore, W. S. (1989). The "Learning Environment Preferences": exploring the construct validity of an objective measure of the Perry Scheme of intellectual development. *Journal of College Student Development, 30*, 504–514.

Morse, K. (2003). Does one size fit all? Exploring asynchronous learning in a multicultural environment. *Journal of Asynchronous Learning Networks, 7*, 37–55.

Newis, N. J., & Orton, P. (2000). The five attributes of innovative e-learning. *Training & Development, 56*, 47–50.

Novak, J. D. (1998). *Learning, creating and using knowledge: Concept maps as facilitative tools in schools and corporations*. Mahwah, NJ: Lawrence Erlbaum Association.

Pancer, M., George, M., & Gebotys, R. (1992). Understanding and predicting attitudes toward computers. *Computers in Human Behavior, 8*, 211–222.

Papanikolaou, K. A., Grigoriadou, M., Magoulas, G. D., & Kornilakis, H. (2002). Toward a new forms of knowledge communication: the adaptive dimension of a web-based learning environment. *Computers and Education, 39*, 333–360.

Paris, S. G., & Paris, A. H. (2001). Classroom application of research on self-regulated learning. *Educational Psychologist, 36*, 89–101.

Perry, W. G. (1999). *Forms of intellectual and ethical development in the college years*. San Francisco, CA: Jossey-Bass.

Picciano, A. G. (2002). Beyond student perceptions: issues of interaction, presence, and performance, and performance in an online course. *Journal of Asynchronous Learning Networks, 6*, 21–40.

Pintrich, P. R., & Garcia, T. (1994). Self-regulated learning in colleague students: knowledge, strategies, and motivation. In P. Pintrich, D. Brown, & C. Weinstein (Eds.), *Student motivation, cognition and learning* (pp. 113–133). Hillsdale, NJ: Erlbaum.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: the role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63*, 169–199.

Quan, G., & Alvermann, D. (1995). Role of epistemological beliefs and learned helplessness in secondary school students' learning science concepts from text. *Journal of Educational Psychology, 87*, 282–292.

Riding, R., & Rayner, S. (1998). *Cognitive styles and learning strategies*. London: David Fulton Publishers.

Russell, T. (1997). Technology wars: winners & losers. *Educom Review, 32*, 44–46.

Sadler-Smith, E., & Riding, R. (1999). Cognitive style and instructional preferences. *Instructional Science, 27*, 355–371.

Salovaara, H. (2005). An exploration of students' strategy use in inquiry-based computer-supported collaborative learning. *Journal of Computer Assisted Learning, 21*, 39–52.

Schommer, M. (1993). Epistemological development and academic performance among secondary student. *Journal of Educational Psychology, 85*, 406–411.

Smith, P., & Dillon, C. (1999). Comparing distance learning and classroom learning: conceptual considerations. *The American Journal of Distance Education, 13*, 6–23.

Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education, 22*, 306–331.

Tamir, P. (1985). Meta-analysis of cognitive preferences and learning. *Journal of Research in Science Teaching, 22*, 1–17.

Tobin, K. (1998). Qualitative perceptions of learning environments on the world wide web. *Learning Environment Research, 1*, 139–162.

Triandis, H. C. (1989). The self and social behavior in differing cultural contexts. *Psychological Review, 96*, 506–520.

Tsai, C. C. (1998). An analysis of Taiwanese eighth graders' science achievement, scientific epistemological beliefs and cognitive structure outcomes after learning basic atomic theory. *International Journal of Science Education, 20*, 413–425.

Tsai, C. C. (2000). Relationships between student scientific epistemological beliefs and perceptions of constructivist learning environments. *Educational Research, 42*, 193–205.

Tsai, C. C. (2005). Preferences toward internet-based learning environments: high school students' perspectives for science learning. *Educational Technology & Society, 8*, 203–312.

Venkatesh, V., Morris, M. G., & Ackerman, P. L. (2000). Long-term development of motivation and cognition in family and school context. In S. Volet & S. Jarvela (Eds.), *Motivation in Learning Contexts: Theoretical advances and methodological implications* (pp. 295–315). Amsterdam: Pergamon Press.

Vuorela, M., & Nummenmaa, L. (2004). Experienced emotions, emotion regulation and student activity in a web-based learning environment. *European Journal of Psychology of Education, 19*, 423–436.

Wang, A. Y., & Newlin, M. H. (2002). Predictors of web-student performance: the role of self-efficacy and reasons for taking an on-line class. *Computers in Human Behavior, 18*, 151–163.

Weinstein, C. E., Goetz, E. T., & Alexander, P. (Eds.). (1988). *Learning and study strategies: Issues in assessment, instruction, and evaluation*. NY: Academic Press.

Weinstein, C. E., & Meyer, R. E. (1986). The teaching of learning strategies. In M. Wittrock (Ed.), *Handbook of research in teaching* (pp. 315–327). NY: Macmillan.

Wentzel, K. R., & Wigfield, A. (1998). Academic and social motivational influences on students' academic performance. *Educational Psychology Review, 10*, 155–175.

Wierstra, R. F. A., Kanselaar, G., Van der Linden, J. L., & Lodewijks, H. G. L. C. (1999). Learning environment perceptions of European university students. *Learning Environment Research, 2*, 79–98.

Wierstra, R. F. A., Kanselaar, G., Van der Linden, J. L., Lodewijks, H. G. L. C., & Vermunt, J. D. (2003). The impact of university context on European students' learning approaches and learning environment preferences. *Higher Education, 45*, 503–523.

Wűrtz, E. (2006). Intercultural communication on web sites: a cross-cultural analysis of web sites from high-context cultures and low-context cultures. *Journal of Computer-Mediated Communication, 11*, 274–299.

Yang, F. Y. (2005). Student views concerning evidence and the expert in reasoning a socio-scientific issue and personal epistemology. *Educational Studies, 31*, 65–84.

Yang, F. Y., Chang, C. C. & Tsai, C. C. (2005). Exploring learner preferences about the web-based learning environment: the content structure, the cognitive process and the forms of interaction. Paper presented in the 2005 ED-MEDIA – World conference on educational multimedia, hypermedia & telecommunications, Montreal, CA.