Available online at www.sciencedirect.com
SCIENCE DIRECT®
Computers in Human Behavior 21 (2005) 255–272
Computers in Human Behavior
www.elsevier.com/locate/comphumbeh

Preferences toward the constructivist Internet-based learning environments among high school students in Taiwan

Shih-Chyueh Chuang [a], Chin-Chung Tsai [b,*]

[a] *Graduate School of Mass Communication, Fu Jen Catholic University, Taipei Taiwan*
[b] *Institute of Education and Centre for Teacher Education, National Chiao Tung University, 1001 Ta Hsueh Road, Hsinchu 300, Taiwan*

Available online 19 March 2004

Abstract

This paper explored students' preferences toward the constructivist Internet-based learning environments. A Constructivist Internet-based Learning Environment Survey (CILES) was developed. The CILES consisted of six scales, including student negotiation, inquiry learning, reflective thinking, relevance, ease of use and challenge. Questionnaire responses gathered from more than 700 high school students in Taiwan suggested that the survey showed adequate reliability in assessing students' preferences. Students showed stronger preferences for the learning environments, which were easy to use or navigate and integrate complex real-life problems with relevant knowledge in a meaningful way. In addition, males and females shared similar preferences toward the Internet-based learning environments. Students having moderate Internet experiences seemed to be more critical to the preferences of the Internet-based learning environments, in which they may have demanded authentic and facilitated Internet-based learning environments, while their inquiry and reflective thinking should be promoted.

Keywords: Internet; Constructivist; Learning environment; Questionnaire; Survey

* Corresponding author. Tel.: +886-3-5731671; fax: +886-3-5738083.
E-mail address: cctsai@mail.nctu.edu.tw (C.-C. Tsai).

0747-5632/$ - see front matter
doi:10.1016/j.chb.2004.02.015

1. Introduction

Internet-based instruction has been widely spread on the Internet in recent years. In the Internet-based learning environments, students could have a variety of new learning opportunities. For example, with the use of the Internet, distance education has switched from the objectivist approach to the constructivist environments (Passerini & Granger, 2000). Technological improvements in education have taken many forms over the centuries; innovations like radio, television, recorded audio-tapes, CD-ROM products, and computer networks literally have influenced students' learning methods (Chou & Tsai, 2002; Moore & Kearsley, 1996). Indeed, at present, Internet instruction gradually plays an important role in students' learning environments, but students' preferences about these environments still have not been fully investigated. This study proposes that the students' preferences toward Internet-based learning environments may influence their actual learning behaviors and outcomes in such environments. Prior studies have shown that students' attitudes toward computers have interactions with their motivation and performance of using and learning computers (AlKhaldi & AlJabri, 1998; Houle, 1996). Similarly, if the use of the Internet-based learning environments is one of the important trends for the practice of education, it is necessary to probe students' attitudes or preferences toward these environments. Therefore, the purpose of this study is to explore students' possible preferences toward the Internet-based learning environments.

As Tsai (2001) stated, students' preferences toward the Internet-based learning environments could be illustrated through probing the constructivist epistemology. Constructivism is a relatively new educational paradigm. It asserts that learners should be viewed as cognitive subjects engaged in the process of active knowledge construction (Fosnot, 1996; Tsai, 2000; von Glasersfeld, 1993). Moreover, constructivism also "concentrates on learners constructing their personal understandings during social interactions in their learning environment" (Maor, 2000). As a result, a constructivist educator should encourage students to be collaborative in meaning construction through discussion, argumentation and negotiation among teachers, peers, and other students. In other words, from the constructivist perspective, the ideal learning environments should be student-centered, in which teachers are not simply information providers; instead, they become facilitators of students' knowledge construction.

The attributes of the Internet-based learning environments share some similar features with the constructivist epistemology. For example, the Internet-based instruction is an openly distributed system; therefore, students can actively enroll in any given curriculum content or participate learning activities at any time and at any place, where only has to be equipped with a computer and the Internet connection. According to Relan and Gillani's (1997) study, in the student-centered Internet-based learning environments, students could help decide the contents to be organized and learned. In addition, French, Hale, Johnson, and Farr (1999) also considered that, in the Internet-based learning environments, students could have more choices of and control over not only their learning time and pace, but

also the objectives and learning outcomes. Furthermore, because the Internet-based instruction consists of both asynchronous (such as e-mails) and synchronous (such as video conferencing) communication features, it enables learners to be involved in the process of social interactions. This is similar to what the constructivist-oriented learning environments emphasize: based on prior knowledge, learners could justify and elaborate their meanings and share experiences with others through discussion, argumentation and negotiation (Chou & Tsai, 2002; Wen, Tsai, Lin, & Chuang, in press).

To summarize, there are many parallels between the Internet-based learning environments and the constructivist-enhanced pedagogies. As described above, both the Internet-based learning environments and the constructivist-oriented pedagogies encourage each individual student's meaningful construction of knowledge and also highlight the social interactions with learning materials, peers or experts. There are certainly indeed some differences between these two. The Internet is a tool/medium and can be constructivist or didactic depending on the intentions of the designer of the Internet-based learning environment. Nevertheless, from the contemporary educators' perspectives, an ideal Internet-based learning environment can be developed through the constructivist pedagogy. Or, the constructivist ideas of teaching can be effectively implemented through the Internet. Similar viewpoints are supported by various authors. For example, Yakimovicz and Murphy (1995) have found that constructivism presented an approach appropriate for the implementation of the Internet-based instruction. In Passerini and Granger's (2000) study, they have also claimed that the Internet shifts distance education from an objectivist approach to education to a constructivist environment. Relan and Gillani (1997) have clearly defined the Internet-based instruction as "the application of a repertoire of cognitively oriented instructional strategies implemented within a *constructivist* and collaborative learning environment, utilizing the attributes and resources of the World Wide Web" (p. 43). Therefore, the constructivist Internet-based learning environments contain a variety of resources which are related to individual students' experiences, facilitate their knowledge construction, and provide various types of social interactions. The environments emphasize prior knowledge, social negotiations, autonomy, and student-centredness (Tsai, 2001).

The popularization of the Internet-based instructional materials, increasing with tremendous speed and numbers on the Internet, has drawn both educational researchers and web content developers' attention. Without doubts, the Internet-enhanced instruction is quickly moving into the educational mainstream (Helmi, 2002). It has become one of the major tools for those learners, who have had intentions to seek more stimulating learning environments. However, at present, students' preferences have not yet been fully investigated. Thus, based on the constructivist-oriented perspective, this study aims to explore students' possible preferences toward the Internet-based learning environments. Previous studies also found that gender and usage experiences may have also played an important role in students' views toward computers or the Internet (e.g., Durndell & Haag, 2002; Hills & Argyle, 2003; Smith, Caputi, & Rawstorne, 2000; Tsai, Lin, & Tsai, 2001). These studies, in

general, support that male students and students with more experiences tend to have more positive views toward using computers and the Internet. This study would also investigate how students' gender and their Internet usage experiences may be related to their preferences toward Internet-based learning environments.

This study, first, developed a questionnaire to survey a group of high school students in Taiwan about their preferences toward the constructivist learning environments. Then, the validity and the reliability of the questionnaire were examined and students' different responses in the questionnaire were analyzed. The role of gender and Internet experiences on the responses were further explored. Finally, some students were interviewed to provide more information about students' preferences toward Internet-based learning environments.

2. Methodology

2.1. Subjects

The initial sample of this study consisted of 727 Taiwanese high school (including both junior and senior high school) students, whose ages were ranged from 12 to 18-year-old. The sample was selected according to three major demographic areas, Northern, Central and Southern Taiwan. From each area, a varied number of individual classes from a number of different high schools were chosen to complete a survey, assessing their preferences toward the Internet-based learning environments. This sample may not have been considered as a national sample, but the selected students were composed of those who had divergent academic backgrounds, came from different demographic areas, and belonged to various socio-economic statuses. The ratio of the selected students was roughly correspondent to the ratio of the actual distribution of high school students across three major demographic areas in Taiwan. Moreover, those, who completed the survey, all had Internet experiences. Thus, to some degrees, the sample in this study could be said to represent major Taiwanese high school students. For students' non-responses, unintentional skips or unidentifiedable marks on some items of the survey, this study processed these as "missing" data. Hence, the valid number of student cases on each item or scales of the survey may have varied. However, the "missing data" for any item or scale was not to excess 7% of the whole data set. The sample included 46% males and 54% females.

2.2. Questionnaire accessing students' perceptions of the Internet

Researchers have developed some methods to assess students' views about the constructivist-oriented learning environments. For example, Taylor and Fraser (1991) and Taylor, Dawson, and Fraser (1995, 1997) designed a Constructivist Learning Environment Survey (CLES) to assess whether a particular classroom was consistent with the constructivist pedagogy. Maor (2000) developed a Constructivist Multimedia Learning Environment Survey (CMLES) to evaluate students' percep-

tions about the inquiry-based and constructivist-oriented multimedia learning environments. Although there have been more and more questionnaires aiming to assess students' perceptions of learning environments (Fraser, 1998), few of them were related to the Internet-oriented learning environments.

To assess students' perceptions of the Internet-based learning environments, a Chinese learning environment questionnaire, named the Constructivist Internet-based Learning Environment Survey (CILES), was implemented in this study. This questionnaire was slightly modified from the Constructivist Multimedia Learning Environment Survey (CMLES), which had been originally designed by Maor (2000, 2001) to evaluate an interactive multimedia (IMM) program. In this study, CMLES was selected as a model questionnaire, because the IMM program shared similar features presented by the Internet-based learning environments, such as interactivity, social negotiation, and open-ended inquiry. There were two versions of the CMLES (i.e., Maor, 2000, 2001); however, they used jointly in comparable contexts, except that Maor's (2001) questionnaire had an additional scale, called "challenge." In order to acquire a fuller description about students' perceptions, this study chose Maor's (2001) version to be the prototype of the CILES. After the initial construction of the CILES, an expert in the field of Internet-based instruction commented on it for face validity, and 12 students were chosen to clarify the wording of each statement. As a result, the CILES consisted of six scales (five items for each scale), presented with bipolar agree/disagree statements in a five-point Likert scale. A detailed description of the six scales was presented below:

1. *Student negotiation scale*: measuring perceptions of the extent to which students have opportunities to explain and modify their ideas to other students in the Internet-based learning environments.
2. *Inquiry learning scale*: measuring perceptions of the extent to which students have the opportunities to be engaged in inquiry learning in the Internet-based learning environments.
3. *Reflective thinking scale*: measuring perceptions of the extent to which students have the opportunities to produce critical self-reflective thinking in the Internet-based learning environments.
4. *Relevance scale*: measuring perceptions of the extent to which students discern that the Internet-based learning environments are authentic and represent real life situations.
5. *Ease of use scale*: measuring perceptions of the extent to which students discern that the Internet-based learning environments are easy-to-use.
6. *Challenge scale*: measuring perceptions of the extent to which students discern that the Internet-based learning environments are challenging but helpful in problem solving.

The following indicates six sample items from each scale of the CILES:

1. In the Internet-based learning environments, I prefer that I can get the chance to talk to other students.
2. In the Internet-based learning environments, I prefer that I can find out answers to questions by investigation.

3. In the Internet-based learning environments, I prefer that I can think deeply about how I learn.
4. When navigating in the Internet-based learning environments, I prefer that they show how complex real-life environments are.
5. When navigating in the Internet-based learning environments, I prefer that they are easy to use.
6. When navigating in the Internet-based learning environments, I prefer that they are complex but clear.

For a complete survey, please refer to Appendix A.

2.3. Procedure of data collection

After the target students were chosen, they were asked to browse a few selected local Internet-based instructional sites and systems, which had been nominated as the best instructional web sites by the Ministry of Education, Taiwan. During the process, pupils were first asked to evaluate the sites, and later to respond their preferences by using the CILES. These sites, based upon the researchers' perspectives, could be viewed as more constructivist-oriented. They included a variety of information and resources to help students' knowledge construction and social interactions. Since sample students at least obtained such actual Internet learning experiences, involving the navigation of certain local instructional sites before completing the CILES, it could be believed that the variability about students' interpretations of the Internet learning environments would not be very high. That is, their general perceptions toward the features as well as the possible functions of Internet-based learning environments would not be highly divergent. They had some similar experiences and interpretations toward the Internet-based learning environments and thus they all had adequate experiences to show their preferences toward these environments. Consequently, they could show their preferences toward the Internet-based learning environments, especially when compared to their actual navigation experiences.

3. Results

3.1. Factor analysis

This study used exploratory factor analysis, principle component analysis with varimax rotation, to clarify the structure of the perceptions toward the constructivist Internet-based learning environments. Subjects' preferences were grouped into six orthogonal factors, which were: student negotiation, inquiry learning, reflective thinking, relevance, ease of use, and challenge components. All of the six factors were retained in the final version of the survey and they accounted for 74.92% of variance. The eigenvalues of the six factors from principle component analysis were larger than one. An item was retained only when it loaded greater than ± 0.40 on the relevant factor and less than ± 0.40 on the non-relevant factor. Thus, the initial 30 items were reduced to 29 items (as shown in Table 1). This way of selecting items was

Table 1
Rotated factor loadings and Cronbach's alpha values for the six factors (scales) of the CILES

Item	Factor 1: Student negotiation	Factor 2: Inquiry learning	Factor 3: Reflective thinking	Factor 4: Relevance	Factor 5: Ease of use	Factor 6: Challenge
Factor 1: Student negotiation $\alpha = 0.92$						
1	0.660					
2	0.655					
3	0.844					
4	0.827					
5	0.789					
Factor 2: Inquiry learning $\alpha = 0.90$						
6		0.744				
7		0.747				
8		0.754				
9		0.585				
10		0.546				
Factor 3: Reflective thinking $\alpha = 0.92$						
11			0.739			
12			0.760			
13			0.724			
14			0.724			
15			0.661			
Factor 4: Relevance $\alpha = 0.91$						
16				0.767		
17				0.723		
18				0.710		
19				0.722		
20				0.627		
Factor 5: Ease of use $\alpha = 0.93$						
21					0.682	
22					0.778	
23					0.772	
24					0.759	
25					0.778	
Factor 6: Challenge $\alpha = 0.85$						
27						0.797
28						0.791
29						0.531
30						0.593

Total $\alpha = 0.97$, total variance explained is 74.924%.
Note: Loading less than 0.40 omitted.

utilized by some similar studies for developing computer or Internet-related instrument for students (Selwyn, 1997; Tsai et al., 2001).

The reliability (alpha) coefficients respectively for these scales were 0.92, 0.90, 0.92, 0.91, 0.93, and 0.85, suggesting that these scales had satisfactory reliability in assessing students' preferences toward the constructivist Internet-based learning environments.

3.2. Students' scores on the scales

Table 2 shows students' average item scores and standard deviations on the six scales of the CILES. A further examination of mean differences among these six scales is presented in Table 3. According to Table 2, students scored highest on the relevance scale (an average of 4.21 per item), followed by the ease of use scale (an average of 4.19 per item), the reflective thinking scale (an average of 4.13 per item), the inquiry learning scale (an average of 4.09 per item), the challenge scale (an average of 3.97 per item), and the student negotiation scale (an average of 3.96 per item).

Table 3 illustrates the paired *t*-test results, comparing the scores of these scales. The results indicated that the relevance scale had a highest mean score. It showed a significant difference with other scales of the CILES, except the ease of use scale and the reflective thinking scale. Thus, this result may have suggested that students appreciated the authentic learning environments, presented with realistic tasks and a

Table 2
Students' scores on the scales of the CILES

Scale	# of items	Item mean	SD
Student negotiation	5	3.96	0.75
Inquiry learning	5	4.09	0.73
Reflective thinking	5	4.13	0.74
Relevance	5	4.21	0.74
Ease of use	5	4.19	0.79
Challenge	4	3.97	0.73

Table 3
Paired *t* tests for the means of six scales of CILES

	Mean difference	SD	*t* value
Negotiation-inquiry	−0.14	0.61	−5.78***
Negotiation-thinking	−0.17	0.64	−6.96***
Negotiation-relevance	−0.25	0.69	−9.48***
Negotiation-ease of use	−0.23	0.73	−8.19***
Negotiation-challenge	−0.05	0.73	−0.2
Inquiry-thinking	−0.04	0.55	−1.79
Inquiry-relevance	−0.12	0.3	−5.11***
Inquiry-ease of use	−0.09	0.68	−3.53***
Inquiry-challenge	0.13	0.65	5.04***
Reflective thinking-relevance	−0.07	0.6	−3.26
Reflective thinking-ease of use	−0.05	0.67	−2.07
Reflective thinking-challenge	0.17	0.64	6.80***
Relevance-ease of use	0.02	0.59	0.92
Relevance-challenge	0.24	0.65	9.74***
Ease of use-challenge	0.22	0.66	8.81***

*** $p < 0.001$.

wide range of information. They may have also preferred the learning environments, integrating complex real-life problems with relevant knowledge in a meaningful way.

Students scored second highest on the ease of use scale, which showed a significant difference among the comparisons of the six scales of the CILES, in spite of those scales of reflective thinking and relevance. This result may have thus implied that most students preferred that the design of the web page was user-friendly and could be easily used to navigate. Moreover, they may have not only preferred to have an interesting screen design, but also preferred to learn how to readily operate it in a short time.

On the contrary, students scored lowest on the student negotiation scale. This scale had a significant difference with most of the scales of the CILES, except the challenge scale. Although the student negotiation scale achieved 3.96 in a 1–5 scale, it remained comparatively low when it was in comparison with others. Thus, it could be proposed that, while learning in the Internet-based environments, there were, at least, a certain group of students, who may have not wanted to pay much attention to the opportunities to discuss with each other on how to conduct investigations or to build consensus with others. Instead, they would rather be involved in the processes of independent learning.

The result of the challenge scale reached the second lowest score. It showed a significant difference with other scales of the CILES, except the student negotiation scale. This may have hence suggested that, learning in the Internet-based environments, some students may have not expected to generate new questions or new ideas. Besides, they may have not wished to be engaged in challenging and complex environments, either. The lower score of this scale was somewhat related to the higher score of the ease of use scale, suggesting students' preferences toward a facilitated structure of the Internet-based learning environments.

3.3. Exploring gender differences on the scales

In order to find out whether there had been a difference between male students and female students' preferences toward the Internet-based learning environments, this study further analyzed the responses of two genders. In prior studies, females showed a distinctive difference in computer anxiety, computer attitudes and computer behaviors from males (Brosnan & Lee, 1998; Chua, Chen, & Wong, 1999; Durndell & Haag, 2002). These studies suggested that females were usually more anxious and showed negative attitudes toward the computer-related learning environments, in which males were often more adapted to them. However, as shown in Table 4, the results of this study did not reveal any significant differences between males and females. As a result, males and females tended to share similar preferences toward the Internet-based learning environments. This result is worthy of noting, because it contradicted to most studies regarding the relationship between technology and gender, suggesting computing as a masculine dominated technology (e.g. Durndell & Thomson, 1997; Schumacher & Morahan-Martin, 2001; Tsai et al., 2001). Thus, this result may have implied preferred or well-established Internet-based learning environments should make no difference and be equally appreciated by both genders.

Table 4
Gender comparisons on the scales of Constructivist Internet-based Learning Environment Survey

Scale	Gender	Mean	SD	*t* value
Student negotiation	Male	3.98	0.78	0.75 (n.s.)
	Female	3.94	0.72	
Inquiry learning	Male	4.15	0.75	1.72 (n.s.)
	Female	4.05	0.71	
Reflective thinking	Male	4.14	0.75	0.25 (n.s.)
	Female	4.12	0.74	
Relevance	Male	4.23	0.75	0.54 (n.s.)
	Female	4.19	0.74	
Ease of use	Male	4.21	0.82	0.58 (n.s.)
	Female	4.17	0.76	
Challenge	Male	4.02	0.77	1.64 (n.s.)
	Female	3.93	0.69	

n.s.: not significant.

3.4. Internet experiences and preferences toward Internet learning environments

Previous research has revealed that students' computer experiences were related to their attitudes toward computers (e.g., Levin & Gordon, 1989; Smith et al., 2000). Therefore, it was interesting to explore the relationships between the Internet experiences and preferences for the Internet learning environments. The Internet experiences, in this study, were defined as the length of time, of which students used the Internet per week. This study divided the sample students into three groups of different levels of the Internet experiences: less than 8 h/week, 9–16 h/week, and over 17 h/week. In the sample, about 37% of the students self-reported that they had spent, in average, less than 8 h on the Internet every week, 38% for 9–16 h per week, and 25% for over 17 h per week. Table 5 displays an analysis between different Internet experience groups and their perceptions toward the Internet-based learning environments. The ANOVA tests showed that the Internet experiences played a role on

Table 5
An analysis between hours of Internet usage (per week) and six scales of CILES

Scale	Student negotiation (mean, SD)	Inquiry learning (mean, SD)	Reflective thinking (mean, SD)	Relevance (mean, SD)	Ease of use (mean, SD)	Challenge (mean, SD)
(1) <8 h	3.96 (0.79)	4.01 (0.80)	4.01 (0.80)	4.08 (0.85)	4.06 (0.88)	3.86 (0.79)
(2) 9–16 h	4.07 (0.68)	4.26 (0.68)	4.24 (0.71)	4.36 (0.61)	4.35 (0.68)	4.04 (0.65)
(3) >17 h	4.01 (0.84)	4.12 (0.72)	4.12 (0.74)	4.20 (0.76)	4.25 (0.82)	4.04 (0.82)
F (ANOVA)	0.94	5.62**	4.31*	6.84**	6.42**	3.31*
Scheffe test		(2) > (1)	(2) > (1)	(2) > (1)	(2) > (1)	

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

the inquiry learning scale, the reflective thinking scale, the relevance scale, the ease of use scale, and the challenge scale. However, students of different Internet experiences did not show significant differences on the scale of the student negotiation. With a series of Scheffe tests (post hoc tests), it further indicated that students having a fair time of exposure to the Internet tended to have statically higher scores on the inquiry learning scale, the reflective thinking scale, the relevance scale, and the ease of use scale, despite that the students having the longest time of Internet usage did not show a significant difference with those having an average or less time of using the Internet. [1] This result indicated that moderate users showed stronger preferences on certain scales (i.e., inquiry learning scale, the reflective thinking scale, the relevance scale, and the ease of use scale). Students having mild Internet experiences seemed to be more critical to the preferences of the Internet-based learning environments. A possible explanation of this outcome may come from the fact that students with maximum Internet experiences could facilitate and adjust their usages and navigations through their rich computing skills, while students with minimum experience were far from being critical to the Internet-based learning environments due to the lack of related knowledge. In general, moderate users are considered the most likely target audiences for most instructional systems. Thus, it was meaningful to investigate their preferences, and then to provide their perspectives for the Web system designers to construct more usable and favorable learning environments.

3.5. Follow-up study – interviews with selected students

In order to obtain more information of students' preferences toward the Internet-based learning environments, 12 students across different scores of CILES were chosen to conduct independent in-depth interviews by one of the authors. The interview questions mainly explored students' views about successful Internet-based learning environments. All of the interviews were recorded by a digital recorder. Because the interviews were conducted in Chinese-language, all of the data presented in this paper had to be transcribed after the authors' translation and was further examined by an independent listener.

After examining the qualitative data, it was found that most of the interviewed students shared a consistent point of view, considering "relevance" to be the most important factor for the success of the Internet-based learning. For example, when asked what they thought to be the most important determinant for the success Internet-based learning, some of their answers are listed below:

ST3: It should contain attractive material, such as games or other useful information, of which I can apply to an authentic context.

ST9: I think the content is the most important factor. It has to be relevant to our lives. For instance, if I want to learn something about dancing, I will look up the relevant information on the Internet first.

[1] The *F*-value of the challenge scale was statistically significant; however, with a further examination of the post hoc test, it did not reveal any statistical difference. This part of the result may require further exploration.

ST7: Successful Internet-based instruction should always provide opportunities for us to practice, as well as offer information relating to school subjects or our daily lives.

ST1: The instruction has to include rich information with lots of pictures, but the downloading speed must be fast. Moreover, the content should also be relevant to our everyday lives.

ST10: I think a successful Internet-based learning environment should provide something relevant to our daily lives or something we do not know. Besides, it has to be fun, easy to navigate, and easy to be understood. The screen design had better be 3D-animated and the sound effects should be well established as well.

Based upon the interview responses above, students highlighted the importance of "relevance" for Internet-based learning environments. Some students, for example, ST1 and ST10, also mentioned about the importance of "ease of use." Such preferences could also be found when the subjects were asked to describe more details about the features of successful Internet-based instruction. For example, ST9 considered a successful educational Web site should be "well planned, clear, without too many bugs, and updated." Similarly, ST10 thought successful Internet-based instruction should be "fun, easy to navigate, and easily understood." Moreover, ST12 presumed an important determinant for the success of Internet-based learning was to "allow students to receive the information without interruptions and difficulties."

Still a few students expressed the preferences likely related to CILES's "reflective thinking" scale. The following student, ST5, is an example for this.

ST5: The (Internet-based) instruction must be interesting. Besides, I can learn by following my own thoughts, and think during the process of learning. Most of all, it must be authentic, and the content should not be constrained within textbooks.

In general, most students preferred the Internet-based learning environments with authentic content relevant to their daily lives. At the same time, some subjects showed their demands for an easy-to-navigate or facilitated Internet-based instructional system. Nevertheless, none of the interviewed subjects mentioned their preferences for the features of "challenging" and "student negotiation" of the Internet-based learning environments. The findings were highly consistent with the quantitative results shown in Tables 2 and 3. The results in Tables 2 and 3 revealed that students attained highest scores on the CILES "relevance" and "ease of use" scores, but had lowest scores on the "student negotiation" and "challenging" scales. Such a high consistency between quantitative results and qualitative details may, to a certain extent, also show the (content) validity of the CILES.

4. Discussion and conclusion

Researchers have developed many methods to assess learners' views and preferences about their learning environments. The CILES was one of the pioneering questionnaires, which aimed to evaluate the Internet-based learning environments. With the implementation of the CILES, this study found that the results were similar

to what Maor (2000) had reported about the preferences for interactive multimedia instructional programs by an Australian sample. According to his report, respondents scored highest on the authenticity scale (renamed as the relevance scale in this and later studies), second highest on the complexity scale (renamed as the ease of use scale in this and later studies), lowest on the student negotiation scale, and second lowest on the inquiry learning scale. Most of these outcomes were corresponding to the results of this study, except the second lowest scale. [2]

It may be worthwhile to further note the similarities of the results between these two studies. First, they both indicated respondents' solid preference on the relevance scale. This may have thus suggested that learners preferred the Internet-based instruction (or interactive multimedia programs) to reflect authentic environments, in which the information and knowledge could be presented in meaningful contexts. This suggestion was parallel to what the constructivist epistemology asserted, even though one may have argued a conflict between "authentic" experiences and the "virtual" world provided by the Internet. In fact, recent technology development in sound effects and animation on the Internet (e.g., JAVA or the use of virtual reality) has been immensely improved. Thus, due to the limits of certain circumstance constraints (e.g., observing the happening of an earthquake), the "virtually authentic" learning environments offered by the Internet, as proposed by Tsai (2001), were often considered as a better alternative for the instruction of certain materials.

It was also worth to be noted that, for both studies, the scores of "social negotiation" scale were relatively low when compared with other scales. That is, both Taiwanese and Australian instructional system users showed relatively stronger concerns for other preferences, such as the need for relevance and ease of use, when compared with the need of social negotiation.

This study examined the relationships between the length of time on Internet experiences and preferences toward Internet-based learning environments. It was found that the students having moderate Internet experiences seemed to be more critical to the preferences of the Internet-based learning environments. Perhaps, one more important study is to explore how the kinds of Internet experiences may play an important role in the preferences toward the learning environments. Clearly, more research is necessary to address this issue.

This study also conducted some student interviews to explore their preferences toward Internet-based learning environments. The interview responses showed that students highlighted the importance of "relevance" and "ease of use," but they seldom mentioned the "challenging" and "student negotiation" features of Internet-based learning environments. The interview findings were highly consistent with the quantitative results, and such a consistency also showed the validity of CILES questionnaire.

The sample in this study only included the students, who were aged between 12 and 18 years old, in Taiwan. Therefore, the results derived from this study could only

[2] The result of the challenge scale was not presented in Maor's (2000) report. Thus, it could not be compared with the results of this study. Excluding the challenge scale, the second lowest outcome of the study was the inquiry learning scale, which was parallel to what Maor had revealed in his study.

be used to describe Taiwanese high school students' general preferences toward the Internet-based learning environments. Further investigations on students from higher levels (such as university students) or from different demographic areas (such as Europe and America) using the CILES will provide additional data for those who wish to accomplish a better Internet-based instructional program for different purposes. Moreover, in a series of studies conducted by Fraser (1998), learners' expectations were often different from the learning environments in reality. Consequently, it is suggested to develop an actual form of the CILES, which may help instructors or web designers to be aware of students' perceptions and perspectives toward certain existing Internet-based learning environments. Besides, only learners' perceptions toward the Internet-based learning environments were revealed in this study. With the results of the CILES, collected from instructors or web content developers, it may also be valuable to investigate their preferences in order to construct the better Internet-based learning environments.

Acknowledgements

Funding of this research work was, in part, supported by National Science Council, Taiwan, under grant number NSC 91-2511-S-009-006.

Appendix A. Constructivist Internet-based Learning Environment Survey (CILES) student preferred form

What I wish happened in the Internet-based learning environments

Sex : ◯ Male ◯ Female

Please select ***how often*** you PREFER each of the following statements to happen in the Internet-based learning environments

Student Negotiation *In the Internet-based learning environments, I prefer that...*	Almost never	Seldom	Sometimes	Often	Always
1. I can get the chance to talk to other students	◯	◯	◯	◯	◯
2. I can discuss with other students how to conduct investigations	◯	◯	◯	◯	◯
3. I can ask other students to explain their ideas	◯	◯	◯	◯	◯
4. Other students can ask me to explain my ideas	◯	◯	◯	◯	◯

Appendix A (*continued*)

5. Other students can discuss their ideas with me	○	○	○	○	○
Inquiry Learning					
6. I can find out answers to questions by investigation	○	○	○	○	○
7. I can carry out investigations to test my own ideas	○	○	○	○	○
8. I can conduct follow-up investigations to answer my new questions	○	○	○	○	○
9. I can design my own ways of investigating problems	○	○	○	○	○
10. I can approach a problem from more than one perspective	○	○	○	○	○
Reflective Thinking					
In the Internet-based learning environments, I prefer that...	Almost never	Seldom	Sometimes	Often	Always
11. I can think deeply about how I learn	○	○	○	○	○
12. I can think deeply about my own ideas	○	○	○	○	○
13. I can think deeply about new ideas	○	○	○	○	○
14. I can think deeply how to become a better learner	○	○	○	○	○
15. I can think deeply about my own understanding	○	○	○	○	○

Please select ***how often*** you PREFER each of the following statements to happen under the Internet-based instruction

Relevance					
When navigating in the Internet-based learning environments, I prefer that they...	Almost never	Seldom	Sometimes	Often	Always
16. Show how complex real-life environments are	○	○	○	○	○

(*continued on next page*)

Appendix A (*continued*)

17. Present data in meaningful ways	◯	◯	◯	◯	◯
18. Present information that is relevant to me	◯	◯	◯	◯	◯
19. Present realistic tasks	◯	◯	◯	◯	◯
20. Have a wide range of information	◯	◯	◯	◯	◯

Ease of use

When navigating in the Internet-based learning environments, I prefer that they...	Almost never	Seldom	Sometimes	Often	Always
21. Have interesting screen designs	◯	◯	◯	◯	◯
22. Are easy to navigate	◯	◯	◯	◯	◯
23. Are fun to use	◯	◯	◯	◯	◯
24. Are easy to use	◯	◯	◯	◯	◯
25. Take only a short time to learn how to use	◯	◯	◯	◯	◯

Challenge

When navigating in the Internet-based learning environments, I prefer that they...	Almost never	Seldom	Sometimes	Often	Always
26. Make me think	◯	◯	◯	◯	◯
27. Are complex but clear	◯	◯	◯	◯	◯
28. Are challenging to use	◯	◯	◯	◯	◯
29. Help me to generate new ideas	◯	◯	◯	◯	◯
30. Help me to generate new questions	◯	◯	◯	◯	◯

This survey is also used and presented in Wen et al.'s (in press) study.

References

AlKhaldi, M. A., & AlJabri, I. M. (1998). The relationship of attitudes to computer utilization: New evidence from a developing nation. *Computers in Human Behavior, 14*, 23–42.

Brosnan, M., & Lee, W. (1998). A cross-cultural comparison of gender differences in computer attitudes and anxieties: The United Kingdom and Hong Kong. *Computers in Human Behavior, 14*, 559–577.

Chou, C., & Tsai, C.-C. (2002). Developing Web-based curricula: Issues and challenges. *Journal of Curriculum Studies, 34*, 623–636.

Chua, S., Chen, D., & Wong, P. (1999). Computer anxiety and its correlates: A meta-analysis. *Computers in Human Behavior, 15*, 609–623.

Durndell, A., & Haag, Z. (2002). Computer self efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior, 18*, 521–535.

Durndell, A., & Thomson, K. (1997). Gender and computing: A decade of change? *Computers and Education, 28*, 1–9.

Fosnot, C. T. (Ed.). (1996). *Constructivism: Theory, perspectives and practice*. New York: Teachers College Press.

Fraser, B. J. (1998). Classroom environment instrument: Development, validity and applications. *Learning Environment Research, 1*, 7–33.

French, D., Hale, C., Johnson, C., & Farr, G. (Eds.). (1999). *Internet based learning: An introduction and framework for higher education and business*. Sterling, VA: Stylus.

Helmi, A. (2002). An analysis on the impetus of online education Curtin University of Technology, Western Australia. *The Internet and Higher Education, 4*, 243–253.

Hills, P., & Argyle, M. (2003). Uses of the Internet and their relationships with individual differences in personality. *Computers in Human Behavior, 19*, 59–70.

Houle, P. A. (1996). Toward understanding student differences in a computer skill course. *Journal of Educational Computing Research, 14*, 25–48.

Levin, T., & Gordon, C. (1989). Effect of gender and computer experience on attitudes toward computers. *Journal of Educational Computing Research, 5*, 69–88.

Maor, D. (2000). A teacher professional development program on using a constructivist multimedia learning environment. *Learning Environments Research, 2*, 307–330.

Maor, D. (2001). Constructivist Multimedia Learning Environment Survey. Curtin University of Technology, Perth Australia. Available at: http://www.curtin.edu.au/curtin/dept/smec/forms/. Retrieved on Mar. 17, 2001.

Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view*. Belmont, CA: Wadsworth.

Passerini, K., & Granger, M. J. (2000). A development model for distance learning using the Internet. *Computers and Eduation, 34*, 1–15.

Relan, A., & Gillani, B. B. (1997). Web-based instruction and the traditional classroom: Similarities and differences. In B. H. Khan (Ed.), *Web-based instruction* (pp. 41–46). Englewood Cliffs, NJ: Educational Technology Publications.

Schumacher, P., & Morahan-Martin, J. (2001). Gender, Internet and computer attitudes and experiences. *Computers in Human Behavior, 17*, 95–110.

Smith, B., Caputi, P., & Rawstorne, P. (2000). Differentiating computer experience and attitudes toward computers: An empirical investigation. *Computers in Human Behavior, 16*, 59–81.

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers and Education, 28*, 35–41.

Taylor, P. C., Dawson, V. & Fraser, B. J. (1995, April). Classroom learning environments under transformation: A constructivist perspective. *Paper presented at the annual meeting of the American Educational Research Association*, San Francisco, CA.

Taylor, P. C., Fraser, B. J. (1991, April). CLES: An instrument for assessing constructivist learning environments. *Paper presented at the annual meeting of the National Association for Research in Science Teaching*, Lake Geneva, WI.

Taylor, P. C., Fraser, B. J., & Fisher, D. L. (1997). Monitoring constructivist classroom learning environment. *International Journal of Educational Research, 27*, 293–302.

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

Tsai, C.-C. (2001). The interpretation construction design model for teaching science and its applications to Internet-based instruction in Taiwan. *International Journal of Educational Development, 21*, 401–415.

Tsai, C.-C., Lin, S. S. J., & Tsai, M.-J. (2001). Developing an Internet attitude scale for high school students. *Computers and Education, 37*, 41–51.

von Glasersfeld, E. (1993). Questions and answers about radical constructivism. In K. Tobin (Ed.), *The practice of constructivism in science education* (pp. 23–28). Washington, DC: AAAS.

Wen, L.M.C., Tsai, C.-C., Lin, H.-M., Chuang, S.-C. (in press). Cognitive-metacognitive and content-technical aspects of constructivist Internet-based learning environments: A LISREL analysis. *Computers and Education*.

Yakimovicz, A. D., & Murphy, K. L. (1995). Constructivism and collaboration on the Internet: Case study of a graduate class experience. *Computers and Education, 24*, 203–209.