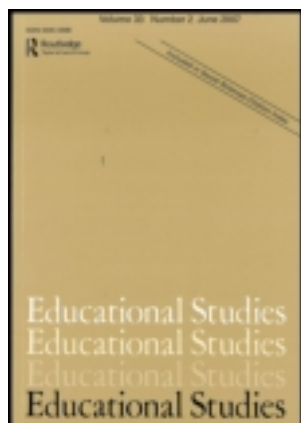


This article was downloaded by: [National Chiao Tung University 國立交通大學]

On: 26 April 2014, At: 05:01

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Educational Studies

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/ceds20>

Exploring high school students' and teachers' preferences toward the constructivist Internet-based learning environments in Taiwan

Min-Hsien Lee & Chin-Chung Tsai

^a National Chiao Tung University , Taiwan

Published online: 07 Oct 2010.

To cite this article: Min-Hsien Lee & Chin-Chung Tsai (2005) Exploring high school students' and teachers' preferences toward the constructivist Internet-based learning environments in Taiwan, *Educational Studies*, 31:2, 149-167, DOI: [10.1080/03055690500095522](https://doi.org/10.1080/03055690500095522)

To link to this article: <http://dx.doi.org/10.1080/03055690500095522>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

Exploring high school students' and teachers' preferences toward the constructivist Internet-based learning environments in Taiwan

Min-Hsien Lee and Chin-Chung Tsai*

National Chiao Tung University, Taiwan

This paper explores high school students' and teachers' preferences towards constructivist Internet-based learning environments. The study proposes a framework, including two dimensions and five aspects, to illustrate the features of the Internet-based learning environments. Based upon this framework, the *Constructivist Internet-based learning environment survey improvement* (CILESI) was developed, which includes the scales of ease of use, multiple sources, student negotiation, reflective thinking, critical judgement and epistemological awareness. Questionnaire responses gathered from 630 high school students in Taiwan suggested that the CILESI showed adequate reliability in assessing students' preferences. Male students placed more emphasis on the student negotiation, critical judgement and epistemological awareness enhanced by the Internet-based learning environments than female students did. In addition, the teachers of the sampled students ($n = 78$) were also surveyed by CILESI. The teachers tended to express stronger preferences on the ease of use of the Internet-based learning environments than did their students. However, students, when compared with their teachers, seemed to express more preferences towards the features of student negotiation, reflective thinking, critical judgement and epistemological awareness of Internet-based learning environments.

Keywords: *Internet; Constructivism; Learning environments; Survey; Taiwan*

Introduction

Rapid advances in technology, particularly the Internet, have led to the availability of various tools to support teaching and learning. Computer networks open new avenues for the design, development, storage, and distribution of and access to learning materials (Chou & Tsai, 2002). The growth of information and communication technology, especially Internet-related technology, has changed how, what, who,

*Corresponding author: Institute of Education, National Chiao Tung University, 1001 Ta Hsueh Road, Hsinchu 300, Taiwan Email: ccttsai@mail.nctu.edu.tw

when, where and why we learn (Chan *et al.*, 2001). Computer networks or the Internet offer many interesting and exciting ways for exploring teaching and learning resources, such as the possibilities for the support of synchronous, asynchronous, autonomous and collaborative modes of teaching and learning activities (Barker, 1999; Neo, 2003). In recent years, Internet-based instruction has increasingly played an important role in students' learning environments. The use of web-based distributed learning is currently experiencing an enormous growth in popularity among those employed in educational practice (Downing, 2001). The Internet is a powerful communication tool in education, whether it is used in a distance-learning environment or within the classroom (Jain & Getis, 2003). Moreover, online learning is increasingly perceived as an effective method of instruction (Downing & Chim, 2004). The differences between the Internet-related learning environments and traditional learning environments has been gradually discussed; one important discussion has focused on the perspective that Internet-based learning environments may be better elaborated by constructivist epistemology (Chou & Tsai, 2002; Chuang & Tsai, 2005). Downing (2001) has also suggested that Internet-based materials not only be regarded as a source of information, but also a basis for more constructivist learning. Recently, researchers in the field of educational technology have also applied the constructivist theory to Internet-based or web-based instruction (e.g. Yakimovicz & Murphy, 1995; Tsai, 2001a). Many studies have emphasized the development of Internet-related instructional materials (e.g. Tsai, 2001a; Tsai *et al.*, 2001, b; Tsai & Chou, 2002; Lea *et al.*, 2002; Jain & Getis, 2003; Koohang, 2004). However, research focusing on how educational practice can be implemented effectively using the Internet is not fairly robust. A careful exploration regarding students' perceptions and preferences towards constructivist-oriented Internet-based learning environments may be an important foundation to develop appropriate Internet-based instruction and then to examine its effectiveness.

Consequently, in order to explore students' perceptions towards the multimedia, computer-assisted or Internet-related learning environment, some instruments assessing students' perceptions or preferences were developed for this purpose, for instance, the *Constructivist multimedia learning environment survey* (CMLES) (Maor, 2000, 2001) and the *Constructivist Internet-based learning environment survey* (CILES) (Chuang & Tsai, 2005). Chuang and Tsai (2005) have used the CMLES and modified the CILES to investigate students' perceptions towards the constructivist-oriented Internet-based learning environment. This instrument had been validated through a LISREL confirmatory analysis and was revealed to have highly satisfactory validity and reliability to assess students' preferences for constructivist Internet-based learning environments (Wen *et al.*, 2004). However, the CILES still has some shortcomings regarding the illustrating of Internet-based learning environments, which will be described later, and thus it needs to be revised further in order to measure students' preferences.

In general, there are three components in Internet-based learning environments—i.e. the person (learner), the machine/system and the activity (Figure 1). In this sense, Internet-based learning environments may involve two relationships, those of the person-machine and the person-activity. In this paper, the person-machine

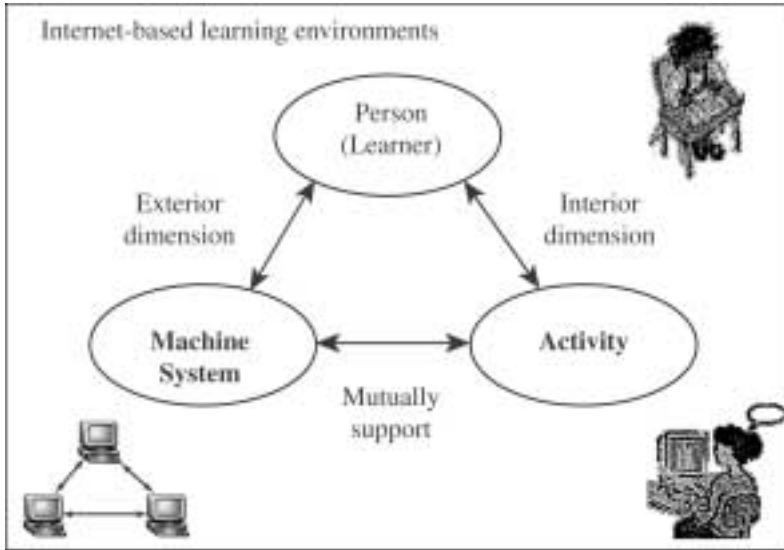


Figure 1. A model for the components of Internet-based learning environments

relationship is perceived as the exterior dimension of Internet-based learning environments, which mainly deals with the interaction between the person (learner) and the system or content provided by the machine. The relationship of person–activity is defined as the interior dimension of Internet-based learning environments, which focuses on how the person engages in the activity. In summary, as shown in Figure 1, the Internet-based learning environment contains exterior and interior dimensions, which involve the relationships of the person–machine and person–activity, and the learner, clearly, plays a central role in the environments.

Wen *et al.* (2004) have categorized the features of Internet-based learning environments into the technical-content aspect and the cognitive-metacognitive aspect. In addition, Tsai (2004) has argued that Internet-based instruction should not only be perceived as a cognitive tool or a metacognitive tool, it could also be regarded as an epistemological tool. Tsai (2004) has suggested that epistemology deals with the nature of knowledge and beliefs, and as learners will acquire large amounts of information and knowledge provided by the Internet, they need to reflectively evaluate the merits of that information and knowledge. Therefore, as Tsai (2004) has asserted, Internet-based learning environments provide adequate opportunities for students to deeply explore the nature or the merits of knowledge. For this reason, Internet-based instruction can be considered as an epistemological tool.

Thus, the aforementioned dimensions of Internet-based learning environments (i.e. exterior versus interior) could be further categorized into certain aspects. In this paper, we integrate the suggestions made by Wen *et al.* (2004) and Tsai (2004), and assert that the features or perceptions regarding Internet-based learning environments should be further categorized into five aspects, namely the technical aspect, the content aspect, the cognitive aspect, the metacognitive aspect and the epistemological

aspect. The technical aspect measured the ease of use for Internet learning systems; the content aspect explored the features of the information or learning materials contained in Internet environments; the cognitive aspect investigated the cognitive activities and strategies involved in Internet-based learning environments; the metacognitive aspect assessed the possibility of promoting metacognitive thinking by Internet-based learning environments; and, finally, the epistemological aspect examined the opportunities of exploring the nature of knowledge as provided by the environments. Moreover, the exterior dimension of Internet-based learning environments, described previously, covers the technical and content aspects, as these aspects mainly cope with the interaction between the user and the machine/system *per se*. The interior dimension of Internet-based learning environments includes the cognitive, metacognitive and epistemological aspects, because the interior dimension focuses on the interaction between the user and the involved activity as provided by the system; thus it deals with the user’s cognitive activity, metacognitive process and epistemological thinking as promoted by the environments. To summarize, a framework illustrating the features of Internet-based learning environments was proposed, and it contained two dimensions and five aspects, as shown in Table 1.

Nevertheless, the CILES, as developed by Chuang and Tsai (2005) and Wen *et al.* (2004), seemed not to cover all of the aforementioned aspects. For instance, none of the scales in CILES explored the epistemological aspect. Moreover, some important features of the Internet-based learning environments were also not addressed in the

Table 1. A framework of features in the Internet-based learning environment

Dimension	Aspect	Description	Factor(s) or scale(s) included
Exterior	<i>Technical</i>	Measuring extent of ease of use in Internet-based learning environments	● Ease of use
	<i>Content</i>	Exploring features of the information contained in Internet-based learning environments	● Multiple sources
Interior	<i>Cognitive</i>	Investigating cognitive activities or strategies involved in Internet-based learning environments	● Student negotiation
	<i>Meta-cognitive</i>	Assessing possibility of promoting meta-cognitive thinking in Internet-based learning environments	● Reflective thinking ● Critical judgement
	<i>Epistemological</i>	Examining opportunities of exploring the nature of knowledge as provided by Internet-based learning environments	● Epistemological awareness

CILES; for instance, the multiple information sources can be viewed as an essential component for Internet-based learning environments (Tsai, 2001a). In addition, as Internet-based learning environments contain a variety of information, the ability of critical judgement is necessary for students to evaluate the considerable information gained from the Internet. Flanagin and Metzger (2000) also found that people rarely verified Internet-based information and often believed its credibility. Tsai (2001b) further asserted that the practice of critical judgement in the Internet-assisted classroom was important and could support metacognition; thus, the ability of critical judgement should be regarded as a noteworthy feature for Internet-based learning environments. Thus, there are at least three new scales for the improvement of the CILES: one is related to epistemological thinking involved in Internet-based learning environments, one is related to the feature of multiple sources and, finally, one deals with the usage of critical judgement involved in the environments.

By integrating some important scales already used by the CILES and these three new scales, this study developed a new CILES, namely *CILES-improvement* (CILESI), to survey students' preferences towards constructivist-oriented Internet-based learning environments. The CILESI included the following scales: ease of use scale, multiple sources scale, student negotiation scale, reflective thinking scale, critical judgement scale and epistemological awareness scale. The hierarchical relationships among the dimensions, aspects and scales discussed above are presented in Table 1.

For each aspect, CILESI included one to two scales for exploration. For instance, the scale of ease of use is clearly viewed as the technical aspect in the exterior dimension, whereas the scales of reflective thinking and critical judgement should be classified into the metacognitive aspect in the interior dimension. Therefore, based on the related literature reviews and previous studies, we developed the CILESI to explore the students' preferences towards the constructivist-oriented Internet-based learning environments; obviously, the CILESI is adapted to the framework shown in Table 1.

Fraser (1998) has defined the learning environment in terms of the shared perceptions between the students and the teachers. Not only the students' perceptions, but also the teachers' perceptions about the learning environments constitute an important component to describe the learning environments. Researchers have developed questionnaires to assess both students' and teachers' perceptions about learning environments. For instance, Fisher and Fraser (1983), in an Australian sample, found that there was a significant difference between students' perceptions of classroom learning environments and those expressed by teachers. Tsai (2003) also suggested that there was a gap between students' and teachers' preferences towards the laboratory learning environments in Taiwan. These researchers suggest that the gap existed because of the different roles teachers and students played in the learning environments. It is obvious that teachers and students are in quite different positions in Internet-based learning environments than those in traditional learning environments. For example, Chou and Tsai (2002) have suggested that, in Internet-based learning environments, the teacher is viewed more often as a 'guide on the side' and both the teacher and students are simultaneously 'guides' and 'sages' because they become continual learners and peer-teachers, who swiftly adjust learning objectives

in the light of changing information and advanced computer technology. However, there were almost no prior studies examining teachers' perceptions about Internet-based learning environments, or measuring the gap between students' and teachers' preferences towards Internet-based learning environments. For this reason, we revised the student CILESI survey to the teacher version, in order to further investigate teachers' preferences of Internet-based learning environments and then to explore the possible gap between students' preferences of Internet-based learning environments and those expressed by teachers.

In sum, the main purposes of this paper were to:

1. develop the revised CILES, namely the CILESI, including both the student version and teacher version, to assess a group of Taiwan high school students' and their teachers' preferences towards constructivist Internet-based learning environments.
2. examine the validity and the reliability of the CILESI by factor analysis.
3. explore the role of gender and Internet experiences on the students' responses to the CILESI.
4. investigate the role of gender and teaching experiences on the teachers' responses to the CILESI.
5. compare the students' and teachers' responses to the CILESI.

Method

Subjects

The sample included 630 high school students (329 males and 301 females) from eight high schools across northern, central and southern areas of Taiwan. For each school, two or three classes were selected. These students were in 22 classes and had various social-economic backgrounds in addition to their science achievement. Although this sample could not be viewed as a national sample, the surveyed students came from a variety of high schools in Taiwan, across different demographic areas and backgrounds, and might, to a certain extent, be said to represent many high school students in Taiwan. The selected students' teachers (coming from 22 classes) were also asked to respond to the CILESI and some comparisons were made between students' and their teachers' preferences towards constructivist Internet-based learning environments. The selected teachers were those who taught science, mathematics, language and social studies for the participant students. A total of 78 responded to the CILESI. The teachers had average teaching experiences of 8.37 years, ranging from 1 to 25 years. Among these teachers, 45 of them were female

CILESI development

For the initial development of the CILESI, the scales of ease of use, student negotiation and reflective thinking used in the original CILES were utilized.¹ The scales of multiple sources, critical judgement and epistemological awareness were newly

added. All of these scales were designed to investigate students' preferences towards constructivist Internet-based learning environments. A detailed description of the six scales, with a sample item, is presented below:

1. *Ease of use scale*—measuring perceptions of the extent to which students prefer that Internet-based learning environments are easy to use; e.g. When navigating in Internet-based learning environments, I prefer that they take only a short time to learn how to use.
2. *Multiple sources scale*—assessing perceptions of the extent to which students prefer that Internet-based learning environments contain various information sources and interpretations; e.g. When navigating in Internet-based learning environments, I prefer that they can connect to rich web resources.
3. *Student negotiation scale*—exploring perceptions of the extent to which students prefer to have opportunities to explain and modify their ideas to other students in Internet-based learning environments; e.g. In Internet-based learning environments, I prefer that I can get the chance to talk to other students.
4. *Reflective thinking scale*—measuring perceptions of the extent to which students prefer to have the opportunities to promote critical self-reflective thinking in Internet-based learning environments; e.g. In Internet-based learning environments, I prefer that I can think deeply about new ideas.
5. *Critical judgement scale*—assessing perceptions of the extent to which students prefer to have opportunities to critically evaluate information; e.g. In Internet-based learning environments, I prefer that I can critically judge the value of different perspectives.
6. *Epistemological awareness scale*—assessing perceptions of the extent to which students prefer to have opportunities to explore the value, source, merit or nature of knowledge; e.g. When navigating in Internet-based learning environments, I prefer that I can explore deeply about the nature of knowledge.

In this study, each scale included five items, presented in a five-point Likert mode, ranging from 'strongly agree' to 'strongly disagree'. Two experts in the field of Internet-based instruction commented on the items for content validity, and six high school students were selected to clarify the wording of each item. Students' responses were scored as follows: the 'strongly agree' response was assigned a score of 5, while the 'strongly disagree' response was assigned a score of 1. Hence, students gaining higher scores in a certain scale showed stronger preferences towards the specific feature of constructivist Internet-based learning environments.

Results

Factor analysis

To validate the CILESI, exploratory factor analysis with varimax rotation was performed to clarify the structure of the preferences towards constructivist Internet-based learning environments. Subjects' preferences were grouped into six orthogonal

factors, which were: ease of use, multiple sources, student negotiation, reflective thinking, critical judgement and epistemological awareness. The eigenvalues of the six factors from principal component analysis were larger than 1, while items with factor loading less than 0.50 should be omitted from the survey. As a result, only one item in the critical judgement scale was omitted; there was thus a total of 29 items retained in the final version of the CILESI (shown in Table 2), and total variance explained was 73.27%. A full list of the CILESI items is presented in Appendix 1.

The reliability (Cronbach's alpha) coefficients respectively for these scales were 0.89, 0.90, 0.89, 0.90, 0.83 and 0.89 and the overall alpha was 0.95, suggesting that these scales had high reliability in assessing the students' preferences towards constructivist Internet-based learning environments.

Students' mean scores on the scales of the CILESI

Table 3 shows the 630 students' average item scores and standard deviations on the six scales of the CILESI. According to the table, students attained high scores on the multiple sources scale (an average of 4.23 per item), reflective thinking scale (an average of 4.22 per item) and the ease of use scale (an average of 4.20 per item). Their scores on the critical judgement scale, at an average of 3.86 per item, were relatively lower when compared to those of other scales.

Gender comparisons on the students' scores on the CILESI

In order to explore whether there had been a difference between male students' and female students' preferences towards the Internet-based learning environment, this study further analysed the responses by the two genders. Prior computer or Internet-related learning environment studies have suggested that female students were usually more anxious and showed relatively unfavourable attitudes towards computer-related learning environments, whereas male students often more readily adapted to them (Brosnan & Lee, 1998; Chua *et al.*, 1999; Tsai *et al.*, 2001a; Durndell & Haag, 2002). As shown in Table 4, the results of the present study revealed that male students had significantly higher preferences on the student negotiation scale ($t = 4.82, p < 0.001$), the critical judgement scale ($t = 2.58, p < 0.05$) and the epistemological awareness scale ($t = 2.97, p < 0.01$) than female students. Males expressed greater preferences than females on the student negotiation scale, suggesting that males had greater interest in online discussions and wanted to interact with others about their ideas or to build consensus with others. In addition, male students more than female students tended to prefer Internet-based learning environments where they could have more opportunities to promote their critical judgement and epistemological awareness.

Internet experiences and preferences towards Internet learning environments

Many previous studies focusing on students' use of computers have indicated that there were some relationship between their computer experience and their attitudes

Table 2. Rotated factor loadings and Cronbach's alpha values for the six factors (scales) of the CILESI instrument

Item	Factor 1: Ease of use	Factor 2: Multiple sources	Factor 3: Student negotiation	Factor 4: Reflective thinking	Factor 5: Critical judgement	Factor 6: Epistemological awareness
Factor 1: Ease of use $\alpha = 0.89$						
1	0.612					
2	0.697					
3	0.752					
4	0.791					
5	0.839					
Factor 2: Multiple sources $\alpha = 0.90$						
6		0.706				
7		0.748				
8		0.672				
9		0.829				
10		0.710				
Factor 3: Student negotiation $\alpha = 0.89$						
11			0.627			
12			0.703			
13			0.769			
14			0.797			
15			0.775			
Factor 4: Reflective thinking $\alpha = 0.90$						
16				0.605		
17				0.679		
18				0.609		
19				0.795		
20				0.585		
Factor 5: Critical judgement $\alpha = 0.83$						
21					0.834	
22					0.780	
23					0.702	
24					0.671	
Factor 6: Epistemological awareness $\alpha = 0.89$						
25						0.509
26						0.646
27						0.732
28						0.779
29						0.599

Notes: Loadings less than 0.50 omitted.
Total $\alpha = 0.95$; total variance explained is 73.27%.

Table 3. Students' scores on the scales of the CILESI ($n = 630$)

Scale	No. of items	Item mean	S.D.
Ease of use	5	4.20	0.70
Multiple sources	5	4.23	0.66
Student negotiation	5	4.02	0.67
Reflective thinking	5	4.22	0.64
Critical judgement	4	3.86	0.73
Epistemological awareness	5	4.11	0.64

towards Internet learning environments (e.g. Levin & Gordon, 1989; Smith *et al.*, 2000; Tsai *et al.*, 2001a, b). This study also explored the role of Internet experience on the CILESI scores.

The length of time of using the Internet per week was defined as an indicator for students' Internet experiences. This study divided the sample students into three groups with different levels of Internet experiences: less than 5 hours per week ($n = 264$), 5–15 hours per week ($n = 193$) and over 15 hours per week ($n = 173$). The ANOVA tests, as shown in Table 5, revealed that Internet experience played a role in the ease of use scale ($F = 7.86, p < 0.001$), the student negotiation scale ($F = 3.44, p < 0.05$) and the critical judgement scale ($F = 15.54, p < 0.001$). With a series of Scheffé tests (*post hoc* tests), it was further indicated that students having greater experience tended to have statistically higher scores on the ease of use scale than those having less experience of Internet usage. The students with mild experience of Internet usage tended to be significantly more critical towards the student negotiation feature

Table 4. Gender comparisons on the scales of the CILESI

Scale	Gender	Mean	S.D.	<i>t</i> -value
Ease of use	Male	4.23	0.61	0.98 (n.s.)
	Female	4.17	0.78	
Multiple sources	Male	4.24	0.62	0.55 (n.s.)
	Female	4.22	0.70	
Student negotiation	Male	4.14	0.55	4.82***
	Female	3.88	0.75	
Reflective thinking	Male	4.26	0.59	1.59 (n.s.)
	Female	4.17	0.69	
Critical judgement	Male	3.93	0.75	2.58*
	Female	3.78	0.70	
Epistemological awareness	Male	4.18	0.59	2.97**
	Female	4.03	0.68	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

n.s.: not significant.

Male $n = 329$, female $n = 301$.

Table 5. An analysis between students' hours of Internet usage (per week) and six scales of the CILESI

Scale	Ease of use	Multiple sources	Student negotiation	Reflective thinking	Critical judgement	Epistemological awareness
	Mean, S.D.	Mean, S.D.	Mean, S.D.	Mean, S.D.	Mean, S.D.	Mean, S.D.
(1) <5 h	4.08 (0.73)	4.25 (0.59)	3.95 (0.69)	4.20 (0.67)	3.80 (0.71)	4.10 (0.62)
(2) 5–15 h	4.29 (0.67)	4.29 (0.68)	4.11 (0.65)	4.28 (0.62)	4.09 (0.66)	4.19 (0.66)
(3) >15 h	4.30 (0.64)	4.13 (0.72)	4.01 (0.64)	4.18 (0.62)	3.69 (0.78)	4.03 (0.65)
<i>F</i> (ANOVA)	7.86***	2.79	3.44*	1.30	15.54***	2.81
Scheffé test	(2) > (1) (3) > (1)		(2) > (1)		(2) > (1) (2) > (3)	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

of the Internet-based learning environment than those with less experience. The results also indicated that moderate users showed stronger preferences on the critical judgement scale than the other two groups of students. The findings derived from this study, in many cases, were consistent with those revealed by Chuang and Tsai (2005) that the moderate Internet users tended to be more critical towards some features of constructivist Internet-based learning environments.

Teachers' mean scores on the scales of the CILESI

Table 6 shows the CILESI scores gathered from the teachers of the surveyed students; a total of 78 teachers were involved. According to Table 6, teachers scored highest on the ease of use scale (an average of 4.39 per item), followed by the multiple sources scale (an average of 4.18 per item). Their scores on the critical judgement scale (an average of 3.68 per item), similar to that of their students, was relatively lower among all of the CILESI scales.

Exploring teachers' gender differences on the CILESI scales

This study further compared male and female teachers' scores on the six scales of the CILESI. The results of *t*-tests are presented in Table 7, indicating that there was no

Table 6. Teachers' scores on the scales of the CILESI ($n = 78$)

Scale	No. of items	Item mean	S.D.
Ease of use	5	4.39	0.70
Multiple sources	5	4.18	0.48
Student negotiation	5	3.86	0.62
Reflective thinking	5	3.96	0.61
Critical judgement	4	3.68	0.54
Epistemological awareness	5	3.89	0.52

Table 7. Gender comparisons on the teachers' scores of the CILESI

Scale	Gender	Mean	S.D.	<i>t</i> -value
Ease of use	Male	4.38	0.81	-0.15 (n.s.)
	Female	4.40	0.62	
Multiple sources	Male	4.24	0.50	1.02 (n.s.)
	Female	4.13	0.47	
Student negotiation	Male	3.83	0.57	-0.32 (n.s.)
	Female	3.88	0.67	
Reflective thinking	Male	3.90	0.57	-0.67 (n.s.)
	Female	4.00	0.63	
Critical judgement	Male	3.67	0.57	-0.07 (n.s.)
	Female	3.68	0.53	
Epistemological awareness	Male	3.82	0.48	-0.96 (n.s.)
	Female	3.94	0.54	

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

n.s.: not significant.

Male $n = 33$, female $n = 45$.

significant difference between male and female teachers' responses on any CILESI scale. Thus, male and female teachers tended to share similar preferences towards Internet-based learning environments as assessed by this study.

Teaching experiences and preferences towards Internet learning environments

This study also examined the correlation between the teachers' teaching experiences and their preferences towards Internet-based learning environments. As shown in Table 8, teachers' years of teaching had significantly positive relationship to their preferences on the ease of use scale ($r = 0.27$, $p < 0.05$) and the epistemological awareness scale ($r = 0.44$, $p < 0.001$) of the CILESI. Teachers with more teaching experience tended to show stronger preference towards ease of use learning environments where students' epistemological awareness was also enhanced. Many studies have suggested that teachers' teaching experience had some correlation with technological use; for instance, Yaghi's (2001) study suggested that teachers with more years of teaching had a lower level of confidence in using computers. The present study seemed to propose that teachers having greater teaching experience tended to emphasize more the ease of use of the Internet-based learning environments, a somewhat similar finding to Yaghi's (2001) study, as their lower confidence in using the technology might drive them to demand user-friendly Internet environments. However, research on the correlation between teachers' teaching experiences and the epistemological aspect regarding Internet-related learning environments has not yet been fully investigated. This study showed an initial finding that teachers with more teaching experience emphasized more the in-depth exploration of the nature of knowledge when students navigated in Internet-based learning environments.

Table 8. The correlation between teaching experiences and the scores of the CILESI scales
($n = 78$)

Scale	Ease of use	Multiple sources	Student negotiation	Reflective thinking	Critical judgement	Epistemological awareness
Years of teaching	0.27*	0.09 (n.s.)	0.12 (n.s.)	0.20 (n.s.)	0.20 (n.s.)	0.44***

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.
n.s.: not significant.

Students' versus teachers' scores of the CILESI

The research findings about the possible gap between teachers' and students' preferences towards Internet-based learning environments are limited; therefore, this study analysed the differences between students' and teachers' responses on the CILESI by a series of *t*-tests, as shown in Table 9. The table indicates that teachers scored significantly higher than the students on the ease of use scale ($p < 0.05$). However, on the scales of student negotiation, reflective thinking, critical judgement and epistemological awareness, opposite findings were revealed. Students in these scales attained higher scores than their teachers.

As shown in Table 1, the scales on the CILESI were classified into five aspects and two dimensions. Thus, the results of the present study seemed to indicate that teachers showed higher preferences for a better technical features in the Internet-based learning environments (i.e. ease of use) than their students. On the other hand, students expressed higher preferences for more cognitive, metacognitive and epistemological activities (such as the student negotiation, reflective thinking, critical judgement and epistemological awareness) in Internet-based learning environments than their teachers. In other words, teachers highlighted the technical aspects in Internet-based learning environment, while students, interestingly, emphasized the advanced aspects in preferred Internet-based learning environments.

Table 9. The differences between students' and teachers' responses on the CILESI

Scale	Student		Teacher		<i>t</i> -test
	Mean	S.D.	Mean	S.D.	<i>t</i>
Ease of use	4.20	0.70	4.39	0.70	-2.24*
Multiple sources	4.23	0.66	4.18	0.48	0.88 (n.s.)
Student negotiation	4.02	0.67	3.86	0.62	2.00*
Reflective thinking	4.22	0.64	3.96	0.61	3.40**
Critical judgement	3.86	0.73	3.68	0.54	2.62*
Epistemological awareness	4.11	0.64	3.89	0.52	2.94**

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.
n.s.: not significant.

Discussion and conclusion

Learning environments are the social-psychological contexts within which learning occurs (Fraser & Walberg, 1991). In the past few decades, many questionnaires have been developed and used for assessing students' perceptions of learning environments (Fraser, 1998). However, students' preferences towards Internet-based learning environments have not yet been fully investigated. For this reason, Chuang and Tsai (2005) used the CILES instrument to explore students' preferences towards constructivist-oriented Internet-based learning environments. However, as shown in the framework presented in Table 1, some important aspects and features of Internet-based learning environments were not addressed by the CILES. Therefore, by integrating some important scales already used in the CILES together with three new scales, this study developed a questionnaire (CILESI) to assess students' preferences towards Internet-based learning environments.

According to the results of the exploratory factor analysis, the CILESI had highly satisfactory validity and reliability to evaluate students' preferences. Consequently, the items in this questionnaire were grouped into six scales, which corresponded to the framework in Table 1 used to illustrate the various features of Internet-based learning environments.

This study explored gender differences in students' preferences towards Internet-based learning environments, and the results implied that males and females held similar preferences on the technical and content aspects, the exterior dimension of Internet-based environments (as suggested in Table 1). However, male students placed more emphasis on the interior dimension of Internet-based learning environments than did female students. This result, to a certain degree, was related to Tsai *et al's* (2001a) suggestion that female students were often more anxious and showed relatively negative attitudes towards Internet-based environments, since the students' attitudes would impact their cognitive or mental involvement in Internet-related activities.

The study also explored the relationships between students' Internet experience and their preferences towards Internet-based learning environments. The result reported by this study was similar to that by Chuang and Tsai (2005), which suggested that students having moderate Internet experience seemed more critical in their preferences concerning Internet-based learning environments. However, further studies are required to explore how Internet experience influences preferences towards Internet-based learning environments.

Moreover, this study conducted an initial investigation concerning teachers' preferences towards Internet-based learning environments. The results suggested that senior teachers emphasized more the technical aspect of Internet-based learning environments than did younger teachers. Senior teachers might have less Internet experience than junior teachers, and thus demand a more facilitated Internet environment. In addition, this study revealed that senior teachers seemed to stress the epistemological aspect when students were involved in Internet-based learning environments. This suggests that teachers with greater teaching experience tended to expect Internet-based

learning environments to offer more opportunities for students to deeply explore the nature of knowledge. The teachers' richer teaching experience might help them to be more highly aware of the importance of epistemological issues in educational processes, and they believed that Internet-based learning environments could mark out some avenues of approach.

The study further explored the possible gap between teachers' and students' preferences towards Internet-based learning environments. The results reveal that teachers seemed to express stronger preferences on the exterior dimension of Internet-based learning environments (e.g. ease of use) than did their students. In other words, teachers tended more to emphasize the relationship between the learner and the machine/system provided by the Internet-based learning environment. However, the results also showed that students, when compared to their teachers, seemed to express a greater preference towards the interior dimension of Internet-based learning environments (e.g. student negotiation, critical judgement), implying that students highlighted the interaction between the learner and the activity involved in the Internet-based learning environment. The results, to a certain extent, were similar to those in Tsai's (2003) study, which explored Taiwanese science students' and teachers' perceptions of laboratory learning environments. Tsai (2003) suggested that students preferred a much more 'student-cohesive' and open-ended laboratory environment than their teachers expected, and that teachers showed higher preferences for better equipment and the material environment than did their students. That is, teachers in both studies focused more on the technical support within the learning environment, whereas students highlighted the cognitive activities involved. One plausible interpretation of these results may stem from the idea that teachers believe students were more able to engage in higher-level learning activities (e.g. cognitive or metacognitive) in traditional learning environments; and that teachers probably perceive Internet-based learning environments simply as technical support or a content resource for teaching. Thus, they focused more on the exterior dimension, such as technical aspects, in the students' Internet-based learning environments. However, students were often more frequent Internet users than their teachers, so that they placed more emphasis on the interior dimension while involved in Internet-based learning environments. Clearly, more research is necessary to fully investigate possible factors causing the differences between the students and teachers. Developers of the Internet-based learning environments also need to pay attention to such differences to create a learning environment that is favoured by both teachers and students.

The sample in this study included only students and teachers in Taiwan. The results derived from this study describe some Taiwanese high school students' and teachers' general preferences towards Internet-based learning environments. Further investigation sampled from higher grade levels, such as university students, or from different countries using the CILESI instrument, will provide more information for those wishing to establish better Internet-based learning environments. In addition, the paper has proposed a framework to illustrate the diverse features of the Internet-based learning environment; and based upon this framework, researchers should be able to further elaborate aspects of Internet-based learning environments. Finally, the

CILESI instrument includes only six scales, viewed here as only some representative features in the framework. Other scales, in addition to those included in the CILESI, should be developed in the future.

Acknowledgement

Funding of this research was, in part, supported by the National Science Council, Taiwan, under grants NSC 92-2524-S-009-003 and NSC 93-2524-S-009-003.

Note

1. In a pilot study with a smaller sample of students, it was found that other scales of the CILES instrument (such as 'inquiry learning') were overlapping with some scales used in the current study. Therefore, only three scales originally used in the CILES were selected for this study.

References

- Barker, P. (1999) Using intranets to support teaching and learning, *Innovations in Education and Training International*, 36, 3–10.
- 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.
- Chan, T.-W., Hue, C.-W., Chou, C.-Y. & Tzeng, O. J. L. (2001) Four spaces of network learning models, *Computers and Education*, 37, 141–161.
- 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.
- 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.
- Downing, K. (2001) Information technology, education and health care: constructivism in the 21st century, *Educational Studies*, 27, 229–235.
- Downing, K. & Chim, T. M. (2004) Reflectors as online extraverts? *Educational Studies*, 30, 265–276.
- 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.
- Fisher, D. L. & Fraser, B. J. (1983) A comparison of actual and preferred classroom environment as perceived by science teachers and students, *Journal of Research in Science Teaching*, 20, 55–61.
- Flanagin, A. J. & Metzger, M. J. (2000) Perceptions of Internet information credibility, *Journalism and Mass Communication Quarterly*, 77, 515–540.
- Fraser, B. J. (1998) Classroom environment instrument: development, validity and applications, *Learning Environment Research*, 1, 7–33.
- Fraser, B. J. & Walberg, H. J. (Eds) (1991) *Educational environments, evaluation, antecedents and consequences* (London, Pergamon).
- Jain, C. & Getis, A. (2003) The effectiveness of Internet-based instruction: an experiment in physical geography, *Journal of Geography in Higher Education*, 27, 153–167.

- Koohang, A. (2004) Students' perceptions toward the use of the digital library in weekly web-based distance learning assignments portion of a hybrid programme, *British Journal of Educational Technology*, 35, 617–626.
- Lea, M., Rogers, P. & Postmes, T. (2002) Evaluation of a system to develop team players and improve productivity in Internet collaborative learning groups, *British Journal of Educational Technology*, 33, 53–63.
- 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* (Perth, Curtin University of Technology). Available online at: <http://www.curtin.edu.au/curtin/dept/smec/forms/> (accessed 17 March 2001).
- Neo, M. (2003) Developing a collaborative learning environment using a web-based design, *Journal of Computer Assisted Learning*, 19, 462–473.
- Smith, B., Caputi, P. & Rawstorne, P. (2000) Differentiating computer experience and attitudes toward computers: an empirical investigation, *Computers in Human Behavior*, 16, 59–81.
- Tsai, C.-C. (2001a) 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. (2001b) A review and discussion of epistemological commitments, metacognition, and critical thinking with suggestions on their enhancement in Internet-assisted chemistry classrooms, *Journal of Chemical Education*, 78, 970–974.
- Tsai, C.-C. (2003) Taiwanese science students' and teachers' perceptions of the laboratory learning environments: exploring epistemological gaps, *International Journal of Science Education*, 25, 847–860.
- Tsai, C.-C. (2004) Beyond cognitive and metacognitive tools: the use of the Internet as an 'epistemological' tool for instruction, *British Journal of Educational Technology*, 35, 525–536.
- Tsai, C.-C. & Chou, C. (2002) Diagnosing students' alternative conceptions in science, *Journal of Computer Assisted Learning*, 18, 157–165.
- Tsai, C.-C., Lin, S. S.-J. & Tsai, M.-J. (2001a) Developing an Internet attitude scale for high school students, *Computers and Education*, 37, 41–51.
- Tsai, C.-C., Lin, S. S.-J. & Yuan, S.-M. (2001b) Students' use of web-based concept map testing and strategies for learning, *Journal of Computer Assisted Learning*, 17, 72–84.
- Wen, L. M. C., Tsai, C.-C., Lin, H.-M. & Chuang, S.-C. (2004) Cognitive–metacognitive and content–technical aspects of constructivist Internet-based learning environments: a LISREL analysis, *Computers and Education*, 43, 237–248.
- Yaghi, H. M. (2001) Subject matter as a factor in educational computing by teachers in international settings, *Journal of Educational Computing Research*, 24, 139–154.
- 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.

Appendices

Appendix 1: The questionnaire items in the CILESI instrument

Ease of use scale:

When navigating Internet-based learning environments, I prefer that they...

1. have an interesting screen design.
2. are easy to navigate.
3. are fun to use.
4. are easy to use.
5. take only a short time to learn how to use.

Multiple sources scale:

When navigating Internet-based learning environments, I prefer that they can...

1. provide a variety of relevant web links.
2. discuss a learning topic through various perspectives.
3. present a learning topic by different methods.
4. offer various information sources to explore a learning topic.
5. connect to rich, relevant web resources.

Student negotiation scale:

In the Internet-based learning environment, I prefer that...

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.
5. other students can discuss their ideas with me.

Reflective thinking scale:

In the Internet-based learning environment, I prefer that...

1. I can think deeply about how I learn.
2. I can think deeply about my own ideas.
3. I can think deeply about new ideas.
4. I can think deeply about how to become a better learner.
5. I can think deeply about my own understanding.

Critical judgement scale:

In the Internet-based learning environment, I prefer that...

1. I can critically evaluate web content.
2. I can critically judge the value of different perspectives.
3. I can examine a variety of information and then make my judgement.
4. I can evaluate the features of various information sources.

Epistemological awareness scale:

When navigating Internet-based learning environments, I prefer that they can...

1. display the source of knowledge.

2. enable deep exploration about the nature of knowledge.
3. evaluate the merits of knowledge.
4. present the process of knowledge development.
5. display the hidden value of knowledge.