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# University students' self-efficacy and their attitudes toward the Internet: the role of students' perceptions of the Internet

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The attitudes and the self-efficacy that characterize learners relative to the Internet have been identified as important factors that affect learners' motivation, interests and performance in Internet-based learning environments. Meanwhile, learners' perceptions of the Internet may shape learners' attitudes and online behaviours. This study investigates university students' attitudes and self-efficacy towards the Internet, and explores the role that university students' perceptions of the Internet may play in their Internet attitudes and self-efficacy. The results indicate that university students demonstrate positive attitudes and adequate Internet self-efficacy and that these students are more inclined to view the Internet as a functional tool—a functional technology. Gender differences exist in university students' attitudes towards, and perceptions of, the Internet; that is, male students demonstrate Internet attitudes that are more positive than those of their female peers. Furthermore, students who perceive the Internet as a leisure tool (e.g. as a tour or a toy) show more positive attitudes and communicative self-efficacy than students who use the Internet as a functional technology. Educators and researchers need to be aware of these differences and to take them into consideration in their instruction. Lastly, this study serves as a starting-point for research that more broadly explores learners' perceptions of the Internet.

Keywords: *Internet attitude; Self-efficacy; Internet perceptions; Internet-based instruction; Taiwan*

## Introduction

Over the past decade, educators have recognized that their integration of technology into education is one of the important issues for educational reform and innovations (e.g. AAAS, 1989, 1993, 1998; Black & McClintock, 1996; Jonassen *et al.*, 1999).

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Consequently, the Internet is increasingly used for educational purposes and has had a considerable and dramatic effect on contemporary educational practice. In particular, Internet-based learning has received high praise from educators and researchers worldwide, who believe that Internet-based instruction can provide learners with distant, interactive, individualized and inquiry-based learning activities, as well as promote learners' knowledge construction and meaningful learning (e.g. Relan & Gillani, 1997; Leflore, 2000; Miller & Miller, 2000; Tsai, 2001; Chou & Tsai, 2002).

Almost all the students at different school levels have certain experiences of using the Internet. With the broad implementation of Internet-based learning instruction, these students may, consequently, have more and richer Internet experiences in Internet-based learning environments. However, studies about the fundamental nature of learners' Internet use have not kept pace with their usage of the Internet (Metzger *et al.*, 2003).

As the nature of learners' Internet use may affect their learning outcomes in Internet-based learning environments, students' self-efficacy and their attitudes towards the Internet may be two important issues that await an investment of researchers' time and energy. There is no doubt that a better understanding of, and a more appropriate attitude towards, the Internet are prerequisites for successful Internet-based instruction (Liaw, 2002). Previous studies have also suggested that students' attitudes towards the Internet may influence these students' motivation and interests relative to Internet-based learning and vice versa (Coffin & MacIntyre, 1999). Moreover, because researchers can use students' self-efficacy to effectively predict these students' academic performance in conventional learning environments (Lane *et al.*, 2004), students' self-efficacy regarding the Internet may also have a profound effect on students' learning outcomes. While students may have more opportunities to learn by utilizing the Internet in Internet-based instruction, their self-efficacy regarding the Internet should also become an important research topic for educators and researchers. However, not many studies have explored learners' Internet attitudes and learners' Internet self-efficacy. Therefore, one of the purposes of this study is to investigate university students' Internet attitudes and their Internet self-efficacy.

Learners may perceive the Internet differently when they use it, and these perceptions may shape the learners' attitudes and then the learners' online behaviours (Tsai, 2004). However, only scant attention has been paid to students' perceptions of the Internet. In these relevant studies (e.g. Dinet *et al.*, 2003; Tsai, 2004), students' perceptions of the Internet have been defined in different ways. In Tsai's (2004) study, the author defined students' perceptions of the Internet on the basis of both an ontological approach and 4-T categories (namely, the four possible roles, Technology, Tool, Toy and Travel, that the Internet may play), and thus interpreted learners' perceptions of the Internet; these perceptions were derived from Tsai's (2004) qualitative analysis of student interview data. According to Tsai (2004), students in the Technology category are inclined to view the Internet as a technical product that enhances life environment, and students in the Tool category tend to view the

Internet as a functional instrument that facilitates information acquisition, communication and trade. Moreover, students in the Toy category tend to perceive the Internet as a source of pleasure, especially for online games, while students in the Travel category tend to perceive the Internet as a source of tours or a means of navigation (for the details of the 4-T categories see Tsai, 2004). On the basis of Tsai's (2004) study, the present study applies a quantitative questionnaire to the further assessment of university students' perceptions of the Internet. Moreover, the present study probes the role that students' perceptions of the Internet play in the students' Internet attitudes and in their Internet self-efficacy.

In sum, by analysing questionnaire responses from 1417 university students in Taiwan, we sought to better understand the implications of the four following research questions:

1. What are the university students' Internet attitudes?
2. What is the Internet self-efficacy expressed by the students?
3. What are the university students' perceptions of the Internet?
4. What is the role that university students' perceptions of the Internet (if any) play in students' Internet attitudes and in their Internet self-efficacy?

## Methodology

### *Participants*

The participants of this study consisted of 1417 university students (979 undergraduate students and 438 graduate students) with different Internet experiences. They came from four recognized universities in Taiwan and divided into 915 male students (64.57%) and 502 female students (35.43%).

### *Instruments*

To meet the purposes of this study, we used three instruments: the *Internet attitudes survey* (IAS) for assessing students' Internet attitudes, the *Internet self-efficacy survey* (ISS) for measuring students' Internet self-efficacy and the *Perceptions of the Internet survey* (PIS) for surveying students' perceptions of the Internet.

The IAS, originally developed by Tsai *et al.* (2001), consisted of 18 questionnaire items with four scales: 'perceived usefulness', 'affection', 'perceived control' and 'behaviour'. However, the alpha coefficient in the fourth scale, the behaviour scale, with only three items and reported in Tsai *et al.*'s (2001) study, was 0.49. Tsai *et al.* (2001) also suggested further modifications for the wording of those statements. Therefore, the *Internet attitudes survey* (IAS), implemented in this study, was slightly modified from the one developed by Tsai *et al.* (2001). The IAS consisted of four scales, with five items per scale, and the items of these scales were presented on a six-point Likert scale, ranging from 'strongly agree', 'agree', 'somewhat agree', 'somewhat disagree', 'disagree' to 'strongly disagree'. A description of the four scales and a sample are presented as follows:

1. *Perceived usefulness scale* measures students' perceptions of the positive effects that the Internet has on individuals and society. A sample item of this scale is: 'The Internet can allow me to do more interesting and imaginative work'.
2. *Affection scale* assesses students' feelings and anxiety when using the Internet. A sample item of this scale is: 'I hesitate to use the Internet in case I look stupid'.
3. *Perceived control scale* measures the perceptions that students have of the independence of their Internet-use control. A sample item of this scale is: 'I do not need someone to tell me the best way to use the Internet'.
4. *Behaviour scale* measures students' perceptions of the actual practice and the frequency of the students' Internet use. A sample item of this scale is: 'I use the Internet regularly throughout school'.

To further clarify the structures of IAS, we conducted a series of factor analyses in this study. The principal component analysis method was used as the extraction method, and the rotation method was Varimax with Kaiser normalization. An item was retained only when it loaded with absolute values greater than 0.50 and with an eigenvalue greater than 1 for the scale. The results revealed that the four scales of the IAS in this study—'perceived usefulness scale', 'affection scale', 'perceived control scale' and 'behaviour scale'—were exactly the same as the proposal by Tsai *et al.* (2001). The initial 20 items were reduced to 19, which were respectively 5, 5, 5, and 4 items in these four scales, and they accounted for 60.03% of variance overall. Moreover, the reliability (alpha) coefficients for these four scales respectively were 0.79, 0.83, 0.78 and 0.80, and the overall alpha was 0.87. More important, the alpha in the fourth scale of the IAS in this study (alpha = 0.80) was much higher than that reported in Tsai *et al.* (2001) (alpha = 0.49). In short, these four scales were deemed to be sufficiently reliable for assessing university students' Internet attitudes.

The *Internet self-efficacy survey* (ISS), implemented in this study, was modified from some original items developed by Tsai and Tsai (2003) and Tsai and Lin (2004). Also, the items of these scales were presented with bipolar strongly confident/strongly unconfident statements in a six-point Likert mode. Similarly, we conducted exploratory factor analyses to clarify the structures of the ISS. Students' responses in the ISS were grouped into two factors: 'general self-efficacy' (5 items) and 'communicative self-efficacy' (4 items), and these two scales explained 71% variance. A detailed description of the two scales is as follows:

1. *General self-efficacy scale* measures students' confidence in their use of the Internet in general, such as use of Internet-related tools. A sample item of this scale is: 'I think I know how to use a Web browser like Internet Explorer and Netscape Navigator'.
2. *Communicative self-efficacy scale* measures students' confidence and expectations relative to Internet-based communication or Internet-based interaction. A sample item of this scale is: 'I think I can talk with others in online classrooms'.

The alpha coefficients for these two scales were 0.90 and 0.80 respectively, and for the entire ISS questionnaire was 0.91: these figures indicate that these scales were adequately reliable for surveys of university students' Internet self-efficacy.

On the basis of Tsai's (2004) pioneer study, we developed a self-response questionnaire: *Perceptions of the Internet survey* (PIS), in this study, to assess participants' perceptions of the Internet. There are two parts of the PIS. In the first part, the participants were asked to rate their perceptions of four possible roles that the Internet played. The participants expressed their agreement or disagreement with these roles on a six-point Likert scale ('strongly disagree', 'disagree', 'somewhat disagree', 'somewhat agree', 'agree' and 'strongly agree'). The four roles were *Internet as technology*, *Internet as tool*, *Internet as toy* and *Internet as tour* (Tsai, 2004). There are four items in this part, and a sample item of this part is: 'The Internet is a tool to me'. In the second part of the PIS, participants were required to fill out a number (between 1 and 100) that matched the perceived roles that the Internet played on the 1–100 scale. Each participant was asked to allocate 100 points to the four roles and, thereby, to show his or her extent of agreement with each Internet-themed role. For instance, a participant might place the number 20 in 'Internet as technology', 30 in 'Internet as Tool', 30 in 'Internet as toy' and 20 in 'Internet as tour', and these numbers would add up to 100.

## Results

*Students' scores on the IAS and the ISS*

Table 1 presents the mean scores and the standard deviations on the IAS scales. Although students scored relatively low on the perceived control scale (an average of 4.48 per item), all the mean scores on the four IAS scales were over 4 points on the six-point scale. Moreover, students' mean scores on the two ISS scales were over 5 points on the six-point scale. These results indicate that students tended to appreciate the potential usefulness of the Internet, to demonstrate positive feelings when using the Internet, to feel confident about the independent control of their use of the Internet and to use the Internet frequently. Furthermore, students showed adequate Internet self-efficacy for both general and communicative purposes.

Table 1. Students' scores on the scales of the *Internet attitude survey* and the *Internet self-efficacy survey*

| | Mean | S.D. | Range |
|---|---|---|---|
| *Internet attitudes* | | | |
| Perceived usefulness | 5.08 | 0.61 | 1–6 |
| Affection | 5.05 | 0.70 | 1–6 |
| Perceived control | 4.48 | 0.75 | 1.8–6 |
| Behaviour | 5.06 | 0.72 | 1–6 |
| *Internet self-efficacy* | | | |
| General self-efficacy | 5.53 | 0.60 | 1.6–6 |
| Communicative self-efficacy | 5.19 | 0.85 | 1–6 |

Table 2. Gender comparisons on the scales of the *Internet attitude survey* and the *Internet self-efficacy survey*

| | Male ($n$ = 860) (Mean, S.D.) | Female ($n$ = 453) (Mean, S.D.) | $t$-value |
|---|---|---|---|
| *Internet attitude* | | | |
| Perceived usefulness | 5.09(0.63) | 5.06(0.55) | 0.81 (n.s.) |
| Affection | 5.03(0.72) | 5.08(0.65) | −1.28 (n.s.) |
| Perceived control | 4.58(0.75) | 4.30(0.72) | 6.88*** |
| Behaviour | 5.07(0.74) | 5.03(0.68) | 0.89 (n.s.) |
| *Internet self-efficacy* | | | |
| General self-efficacy | 5.56(0.60) | 5.50(0.60) | 1.81 (n.s.) |
| Communicative self-efficacy | 5.24(0.84) | 5.12(0.88) | 2.53* |

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

*Gender differences on Internet attitudes and Internet self-efficacy*

A further examination was performed on the gender differences of university students' mean scores for both Internet self-efficacy and Internet attitudes. Among the variables examined (shown in Table 2), two were found to be significantly different. The perceived control expressed by male students was higher than the perceived control expressed by female students ($p < 0.001$). Also, the communicative self-efficacy expressed by male students was higher than that expressed by female students ($p < 0.05$). That is, the male students expressed not only more confidence in their use of the Internet, but also demonstrated better communicative self-efficacy than the female students did.

*The role of grade levels in Internet attitudes and Internet self-efficacy*

In order to compare the possible differences derived from grade levels, we categorized participants into three groups: the freshman and sophomore group, the junior and senior group, and the graduate-student group. The ANOVA tests indicated that grade levels played a role in the four attitude subscales, with a significance level of 0.01 and 0.05. However, grade levels did not show significant differences in students' general and communicative self-efficacy. Following the ANOVA tests, a series of *post hoc* tests (Scheffé tests) were performed, so that group differences could be compared. The results of these tests are presented in Table 3.

In general, the scores that graduate students attained in the four factors of Internet attitudes were higher than the corresponding scores that the other two groups attained. Scores for the graduate students' perceptions of usefulness were higher than the corresponding scores for juniors and seniors ($F = 4.16$, $p < 0.05$). Scores for the graduate students' affection were higher than the corresponding scores for (1) the junior and senior group, and (2) the freshman and sophomore group ($F = 4.79$,

Table 3. Students' Internet attitudes and Internet self-efficacy among groups of different grades

| Grade | Perceived usefulness (Mean, S.D.) | Affection (Mean, S.D.) | Perceived control (Mean, S.D.) | Behaviour (Mean, S.D.) | General self-efficacy (Mean, S.D.) | Communicative self-efficacy (Mean, S.D.) |
|---|---|---|---|---|---|---|
| (1) Freshman & sophomore ($n$ = 320) | 5.06(0.69) | 5.02(0.64) | 4.30(0.80) | 5.08(0.75) | 5.51(0.65) | 5.21(0.85) |
| (2) Junior & senior (n = 573) | 5.04(0.57) | 5.01(0.72) | 4.42(0.75) | 5.00(0.72) | 5.52(0.58) | 5.17(0.86) |
| (3) Graduate ($n$ = 420) | 5.15(0.57) | 5.14(0.69) | 4.72(0.66) | 5.12(0.68) | 5.57(0.58) | 5.20(0.85) |
| F (ANOVA) | 4.16* | 4.79** | 34.58*** | 4.00* | 0.99 | 0.27 |
| Scheffé test | (3)>(2) | (3)>(2)<br>(3)>(1) | (3)>(2)>(1) | (3)>(2) | | |

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

$p$ <0.01). Moreover, a hierarchical relationship was found in terms of the perceived-control scores among these three groups. Scores for the graduate students' perceived control were higher than those for the junior and senior group, while these scores for the junior and senior group were higher than those for the freshman and sophomore group. And with regard to the behaviour scale, graduate students earned scores that were higher than those earned by the junior and senior group. These comparisons indicate that students at the advanced-grade level had a stronger tendency to appreciate the potential usefulness of the Internet, express more positive feelings towards the Internet and frequently use the Internet than students at the lower-grade level.

*Students' scores on the PIS*

On the basis of Tsai's (2004) pioneering study, we developed the PIS in this study to assess participants' perceptions of the Internet. Students' responses on the PIS are summarized in Table 4. In the first part of the PIS, university students, on average, attained relatively higher scores on the two items: 'Internet as tool' (5.56) and 'Internet as technology' (5.26). These results indicate that students were more orientated to perceive the Internet as technology and a tool. Similarly, the students placed much higher values in 'Tool' (40.70) and 'Technology' (30.42) among the four categories (Technology, Tool, Toy, and Tour) in the second part of the PIS. Therefore the results derived from the PIS reveal that the university students perceived the Internet as 'technology' or 'tool'. These findings are consistent with the corresponding findings described by Tsai (2004).

Table 5 shows the inter-correlation matrix among the perception scores measured on the two parts of the PIS. Each role corresponding to its counterpart

Table 4. Students' responses on the *Perceptions of the Internet survey* (PIS)

| | Mean | S.D. | Range |
|---|---|---|---|
| *The first part (6-point Likert scale)* | | | |
| Technology | 5.26 | 0.77 | 1–6 |
| Tool | 5.56 | 0.69 | 1–6 |
| Toy | 4.11 | 1.15 | 1–6 |
| Tour | 4.39 | 1.08 | 1–6 |
| *The second part (1–100 scale)* | | | |
| Technology | 30.42 | 12.17 | 1–90 |
| Tool | 40.70 | 12.78 | 1–97 |
| Toy | 14.28 | 9.03 | 0–80 |
| Tour | 14.60 | 8.71 | 1–97 |

(e.g. Technology–Technology) between the two parts of the PIS reached significant levels of 0.001; thus it appears that these two scales measure university students' perceptions of the Internet in a coherent way. The results provide evidence of the reliability of the measurements. However, the 1–100 scale can comparatively distinguish between students' perceptions in a more detailed way than can the six-point Likert scale. Therefore we applied students' responses on the second part of the PIS chiefly to our further analysis of students' perceptions of the Internet.

*Clustering students' perceptions of the Internet*

On the basis of students' scores for the second part of the PIS (i.e. the 1–100 scale), we used a *k*-means clustering analysis method ($k = 4$) to classify university students into four approximately equivalent groups.

Table 6 shows the numbers and the percentages of the university students in each cluster. In order to determine the unique attribute of each cluster, we compared the mean scores within each cluster to the total mean score within the whole dataset. For example, the mean score of Technology in cluster 1 (36.25) showed the greatest

Table 5. Correlations between students' responses on the two parts of the PIS

| | Technology (1–100 scale) | Tool (1–100 scale) | Toy (1–100 scale) | Tour (1–100 scale) |
|---|---|---|---|---|
| Technology (6-point Likert scale) | 0.22*** | –0.11*** | –0.09** | –0.05 |
| Tool (6-point Likert scale) | –0.16*** | 0.30*** | –0.15*** | –0.06* |
| Toy (6-point Likert scale) | –0.18*** | –0.15*** | 0.46*** | –0.00 |
| Tour (6-point Likert scale) | –0.16*** | –0.16*** | 0.04 | 0.42*** |

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

Table 6. Four clusters of students' perceptions towards the Internet

| | Cluster 1 ($n$ = 397) (Mean, S.D.) | Cluster 2 ($n$ = 369) (Mean, S.D.) | Cluster 3 ($n$ = 294) (Mean, S.D.) | Cluster 4 ($n$ = 357) (Mean, S.D.) |
|---|---|---|---|---|
| Technology | 36.25 (11.88) | 29.95 (11.78) | 25.35 (9.69) | 28.61 (12.18) |
| Tool | 38.98 (12.38) | 39.74 (11.47) | 49.58 (11.99) | 36.28 (11.65) |
| Toy | 12.21 (6.63) | 10.69 (6.22) | 13.35 (7.46) | 21.06 (11.17) |
| Tour | 12.56 (6.91) | 19.62 (8.88) | 11.72 (6.40) | 14.05 (9.79) |

difference from the total mean score of Technology (30.42 in Table 4), weighed against other comparisons in cluster 1. It was found that university students in cluster 1 (Technology cluster) showed the tendency to perceive the Internet as Technology. Following the same logic, participants in cluster 2 (Tour cluster), cluster 3 (Tool cluster) and cluster 4 (Toy cluster) tended to perceive the Internet as Tour, Tool and Toy, respectively.

*Gender comparisons of students' perceptions of the Internet*

This study compared the number of male and female students within each cluster, as shown in Table 7. The results, in general, showed statistical differences on their distribution in the four clusters of perceptions of the Internet ($\chi^2 = 21.93$, $p < 0.001$). After conducting a series of *post hoc* analyses, we found that significantly more female students in this study were orientated to perceive the Internet as 'tool' ($\chi^2 = 5.97$, $p < 0.05$), while significantly more male students were orientated to perceive the Internet as 'toy' ($\chi^2 = 20.60$, $p < 0.001$). In short, when using the Internet, the male and the female students may have different perceptions of the Internet, suggesting a divide between females and males.

*The role of grade level in perceptions of the Internet*

Table 8 presents the student distribution in different grade levels in these four clusters. No statistically significant differences were found among these three groups. One could reasonably interpret this result to mean that students at different grade levels show a similar tendency in perceiving the role of the Internet.

Table 7. Gender comparisons on students' perceptions towards the Internet

| | Technology cluster ($n$, %) | Tour cluster ($n$, %) | Tool cluster ($n$, %) | Toy cluster ($n$, %) |
|---|---|---|---|---|
| Male | 248 (27.1) | 229 (25) | 172 (18.8) | 266 (29.1) |
| Female | 149 (29.7) | 140 (27.9) | 122 (24.3) | 91 (18.1) |

$\chi^2 = 21.93$; $p < 0.001$.

Table 8. Students' perceptions towards the Internet among different grade level groups

| | Technology cluster (*n*, %) | Tour cluster (*n*, %) | Tool cluster (*n*, %) | Toy cluster (*n*, %) |
|---|---|---|---|---|
| (1) Freshman & sophomore | 102 (29.2) | 91 (26.1) | 64 (18.3) | 92 (26.4) |
| (2) Junior & senior | 175 (27.8) | 170 (27.0) | 144 (22.9) | 141 (22.4) |
| (3) Graduate | 120 (27.4) | 108 (27.0) | 86 (19.6) | 124 (28.3) |

$\chi^2 = 7.24$; $p = 0.30$ (n.s.).

*The role that perceptions of the Internet play in Internet attitudes and Internet self-efficacy*

In this study, the relationships between students' perceptions of the Internet (divided into four clusters, as shown in Table 6) and the students' Internet attitudes and Internet self-efficacy were also explored. We conducted a series of ANOVA test analyses to evaluate the possible interactions between students' perceptions of the Internet and the students' Internet attitudes as well as Internet self-efficacy. The results of the analyses between different Internet perception clusters and Internet attitudes as well as Internet self-efficacy are presented in Table 9.

The ANOVA tests show that students' perceptions of the Internet played a role in all four scales of the IAS ($p < 0.05$). The Scheffé tests reveal that students who tended to perceive the Internet as tour (i.e. those who belonged to the Tour cluster) scored significantly higher than students who were in the other three clusters on the 'perceived usefulness' scale ($F = 10.10$, $p < 0.001$), and these students in the Tour

Table 9: The role of students' perceptions on their Internet attitudes as well as their and Internet self-efficacy

| Cluster | Perceived usefulness (mean, S.D.) | Affection (mean, S.D.) | Perceived control (mean, S.D.) | Behavior (mean, S.D.) | General self-efficacy (mean, S.D.) | Communicative self-efficacy (mean, S.D.) |
|---|---|---|---|---|---|---|
| (1) Technology Cluster | 5.08(0.57) | 5.03(0.67) | 4.42(0.76) | 5.01(0.66) | 5.51(0.63) | 5.14(0.89) |
| (2) Tour Cluster | 5.20(0.57) | 5.12(0.64) | 4.45(0.73) | 5.13(0.71) | 5.54(0.58) | 5.21(0.81) |
| (3) Tool Cluster | 4.96(0.51) | 4.96(0.65) | 4.51(0.71) | 4.96(0.65) | 5.51(0.56) | 5.09(0.90) |
| (4) Toy Cluster | 5.05(0.73) | 5.08(0.80) | 4.58(0.80) | 5.12(0.81) | 5.58(0.61) | 5.32(0.81) |
| F (ANOVA) | 10.10*** | 3.32* | 3.48* | 4.69** | 1.16 | 4.81** |
| Scheffe Test | (2)>(1)<br>(2)>(3)<br>(2)>(4) | (2)>(3) | (4)>(1) | (2)>(3)<br>(4)>(3) | | (4)>(1)<br>(4)>(3) |

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

cluster also expressed significantly more positive feeling towards the Internet than those who were in the Tool cluster ($F = 3.32$, $p < 0.05$). Students in the Toy cluster showed significantly more confidence in their sense of control over their Internet use than did students who were in the Technology cluster ($F = 3.48$, $p < 0.05$). Students in the Tool cluster tended to use the Internet less frequently than those who were in the Tour cluster and the Toy cluster ($F = 4.69$, $p < 0.01$). In short, those who perceive the Internet as tour and possibly toy may have Internet attitudes that are more positive than the attitudes held by others.

Table 9 also presents the four-cluster comparison of Internet self-efficacy regarding Internet perceptions. The ANOVA tests showed that students' perceptions of the Internet played a role only in their communicative self-efficacy ($p < 0.01$). Through a series of Scheffé tests, it was found that students in the Toy cluster tended to attain significantly higher scores than students who were in the Technology cluster and Tool cluster in relation to 'communicative self-efficacy'. That is, students who tended to perceive the Internet as a toy may show higher communicative self-efficacy than those who tended to perceive the Internet as a technology or a tool. According to Tsai (2004), learners in the Toy category tend to perceive the Internet as a source of pleasure, especially for online games. Therefore, for students in the Toy cluster, their high confidence in communication may be due to the fact that they frequently played computer games.

## Discussion

Coffin and MacIntyre (1999) have proposed that learners' attitudes towards the Internet may influence the motivation and the interest that learners apply to their use of the Internet, a scenario that may in turn affect their performance in Internet-based learning environments. In addition, Tsai and Tsai (2003) have pointed out that students with high Internet self-efficacy may perform Internet-based learning tasks better than would students with lower self-efficacy. Tsai (2004) and Tsai and Lin (2004) also proposed that learners' perceptions of the Internet may shape the learners' attitudes and then the learners' online behaviours. These relevant findings regarding the nature of learners' Internet use have suggested the effect that learners' Internet attitudes, Internet self-efficacy and their perceptions of the Internet have on learners' performance in Internet-based learning environments. However, the results in this study showed that students, in general, scored relatively low on the 'perceived control' scale among the four scales of the IAS and that the students had lower mean scores on the 'communicative self-efficacy' scale among the two ISS scales. In addition, the students tended to perceive the Internet as 'tool' or 'technology'. Therefore the above results merit greater attention from educators and researchers. Educators might apply knowledge of students' attitudes and self-efficacy towards the Internet, along with students' perceptions of the Internet, to the design of instructional supports for students. In order to promote students' performance in Internet-based learning environments, educators should attempt to improve both students' independent control of Internet use and students' Internet-based communication and interaction skills by adequate support, such as training courses or programmes suggested by

Torkzadeh *et al.* (2002). Also, educators should try to shape students' perceptions of the Internet by providing students with more Internet-themed learning opportunities.

This study revealed that the male students, particularly in relation to perceived control and communicative self-efficacy, held Internet-based attitudes that were more positive than the corresponding attitudes held by the female students. These results largely replicated those of a previous study (Tsai *et al.*, 2001) on adolescents, and this replication suggests that gender differences in Internet attitudes may exist as early as the high school level. We also found that, in relation to Internet perceptions, students were divided in accordance with gender: male students tended to perceive the Internet as a toy, while female students tended to perceive the Internet as a tool. These findings suggests that, when designing Internet-based learning environments, educators should, in particular, try to enhance female students' perceived Internet control and Internet self-efficacy, and should try to narrow the gap of any gender differences that underlie students' perceptions of the Internet.

As already mentioned, Tsai (2004) proposed that when using the Internet learners may perceive it differently, and that these perceptions may shape the learners' attitudes and then the learners' online behaviours. Moreover, we found in this study that learners who perceived the Internet as tour or toy, in general, exhibited attitudes that were more positive than—and a sense of communicative self-efficacy that was better than—learners who simply perceived the Internet as technology or tool. This finding may provide partial initial evidence in support of Tsai's (2004) proposal. In other words, there may be interplay between, on the one hand, students' perceptions of the Internet and, on the other hand, students' Internet attitudes or students' Internet self-efficacy. However, a careful examination of the possible relationships between learners' perceptions of the Internet, learners' Internet attitudes and learners' Internet self-efficacy has yet to appear in the literature.

Moreover, students' perceptions of the Internet may shape certain guiding beliefs about how to use the Internet and how to behave in Internet-based environments (Tsai, 2004). The guiding beliefs may be similar to learners' epistemological beliefs discussed in educational research. For example, educators have found that students' epistemological beliefs about science—namely, their perceptions of the nature of science—are related to students' cognitive processes and outcomes in these students' efforts to learn science (e.g. Hewson, 1985; Hofer & Pintrich, 1997; Tsai, 1998, 1999). In a similar manner, learners' perceptions regarding the nature of the Internet may be related to the learners' behaviours, as well as to the learners' psychological and cognitive activities, in Internet-based environments. Therefore, with the broad implementation of Internet-based instruction, educators should pay more attention to the role that students' perceptions of the Internet play in the students' learning outcomes in these learning environments.

This study also makes a call for future research based on the analysis of learners from various grade levels and of the learners' Internet perceptions. The use of the quantitative instrument may provide a general view of learners' Internet perceptions. Similar to what has been suggested by researchers who have studied related epistemological beliefs (Hofer & Pintrich, 1997; Duell & Schommer-Aikins, 2001;

Schommer-Aikins, 2002; Wood & Kardash, 2002), the use of supplementary approaches, such as observation or interviews, may present a more thorough picture of learners' perceptions of the Internet.

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