The Interaction between Chinese University Students' Computer Use and Their Attitudes toward Computer in Learning and Innovation

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Abstract. A survey study investigated the dynamic interaction between Chinese university students' computer use and their attitudes toward computer in learning and innovation. The relationships among attitudes toward computer in learning (ACL), attitudes toward innovation (ATI), and self-perception on computer skill (SPCS), were also examined. Participants were 292 university students from three universities in Beijing, and all of them had used computer and Internet before. The results showed that: (a) Previous computer use could predict recent computer use with ACL, ATI, and SPCS as mediate variables; (b) males were more confident than females in SPCS, but there was no gender difference in either ACL or ATI; and (c) the participants' notion of innovation was significantly more positive than their innovative action.

Keywords: Computer use; Computer attitude; Attitudes toward innovation; Self-perception on computer skill; Gender difference.

1 Introduction

The 14th Statistical Survey Reports on the Internet Development in China (China Internet Network Information Center, July, 2008) showed that 30.3% of the Internet users' were between the ages of 18 and 24 in China, and 30.0% of the Internet users were students. These data implicated that university students were the biggest group of Internet users in China. In fact, university students were also potentially the biggest group of computer users. Undoubtedly, Computer and Internet have made great influence on Chinese university students' learning during the last decade. However, the relationship among Chinese university students' computer use and the related factors has not yet received enough attention from researchers.

There have been a lot of studies all over the world, especially in Europe and America, which addressed the issues of computer use and the related factors, such as attitudes toward computer, attitudes toward innovation, and self-efficacy [6]. However, it is not easy to know how their results and conclusions can be generalized to Chinese,

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D.D. Schmorrow et al. (Eds.): Augmented Cognition, HCII 2009, LNAI 5638, pp. 620–629, 2009.

because the culture of China is so different from those of other countries. It is necessary to investigate Chinese university students' computer use and the related factors. Recently, computer and internet are more and more popular and widespread in China. The behavior and attitudes toward technology of Chinese are enormously influenced by the use experience. In the present study, the main studies on computer use, attitudes toward computer and innovation are reviewed firstly. And then, this paper reports findings from a questionnaire survey designed to investigate the interaction between Chinese university students' computer use and their attitudes toward computer in learning and innovation.

1.1 Computer Use

Smith, Caputi, Crittenden, Jayasuriya, and Rawstorne [18] have reviewed and evaluated the construct of computer experience. They differentiated objective computer experience and subjective computer experience and proposed a bi-dimensional view of computer experience. The following study [19] provided empirical proof for the bi-dimensional view. Since objective and subjective experience are different concepts, computer use as a measure of objective computer experience was investigated in the present research. According to Smith et al. [18], Computer use in the present study was defined as the totality of externally observable, direct human-computer interactions that transpire across time.

Some researchers consistently found that computer use influenced on computer attitude or had positive relationship with computer attitude [1, 3, 6, 9, 10, 13, 15, 19]. However, most of the previous studies measured computer use by scores of Likert scale, and they didn't differentiate previous computer use and recent computer use. In the present study, previous computer use and recent computer use was differentiated to investigate the effect of previous experience on recent experience. Previous computer use was measured by estimating computer use history, and recent computer use was measured by estimating the time of computer using.

1.2 Attitudes toward Computer

Most theorists agreed that evaluation constitutes a central aspect of attitudes. Affective, cognitive, and behavioral antecedents of attitudes can be distinguished, as can affective, cognitive, and behavioral consequences of attitudes [14]. The affective component of attitude is the emotion or feeling which includes statements of likes or dislikes about some certain objects. The cognitive component is statements of beliefs that a certain object can increase significantly the quality of her/his output. And the behavioral component is what an individual actually does or intends to do [10]. According to this idea, the Computer Attitude Measure (CAM), developed by Kay [7], was composed of demographic information, cognitive, affective, and behavioral attitudes. The Computer Attitude Scale, developed by Loyd and Loyd [11], consisted of computer anxiety, computer confidence, computer liking, and computer usefulness.

These studies measured attitudes toward computer from three components, but the central aspect of attitudes, evaluation, was neglected. Eagly and Chaiken (1992) claimed attitudes do not form until individuals respond evaluatively to an entity (see 14). Based

on this opinion, attitudes toward computer in learning (ACL) were consisted of evaluation, cognitive, affective, and behavioral component in the present study.

Whitely [20] found that males specifically rated themselves higher than females on the following two components: Computer competence and gender-appropriateness (see 13). Therefore, self-efficacy was separated from computer attitude and was measured as self-perception on computer skill (SPCS) in the present study.

1.3 Attitudes toward Innovation

The relationship among attitudes toward innovation, computer attitude, and computer use has attracted some researchers' attention [2, 4, 5, 12]. Adaption-innovation theory [8] assumed a continuum of cognitive styles on which individuals were positioned according to their preference for a manner of decision-making, problem-solving, and creativity that emphasized relative continuity and incremental change (the adaptive pole) or relative discontinuity and radical change (the innovative pole) (see 5). Researchers (e.g., 4; 5) found that the number of applications to which the computer was put and the frequency of computer using correlated with total scores on the Kirton Adaption-Innovation Inventory. Another innovativeness theory described innovativeness as a personality characteristic that indicated how relatively early an individual was in adopting an innovation relative to others in a social system (see Braak, 2001).

Attitudes toward innovation (ATI) were defined based on Braak's research [2] in the present study. Different from the previous studies, innovativeness was measured from two dimensions in the present study: Notion of innovation and action of innovation. In Chinese culture, golden mean is canonized. Although foreign cultures had great influence on Chinese students' notion, their behavior should be a little conservative. Therefore, the hypothesis was that Chinese students' notion of innovation may be at variance with their action of innovation.

1.4 Research Questions in Present Study

Based on the previous research reviewed above, the specific research question in the present study was addressed as follow:

(1) What kind of the distribution of hours on computer using of Chinese university students differed in gender, grade, and major?
(2) Which of the three variables, gender, grade, and major, were possible factors to influence attitudes toward computer and innovation, and self-perception on computer skills?
(3) What kind of possible relationship was among these three aspects and computer use?

In the present study, previous computer use (years of computer using) and recent computer use (hours per day on computer recently) were differentiated. The hypotheses were that previous computer use may influence ACL, ATI, and SPCS, and then the three aspects may influence recent computer use in turn.

2 Method

2.1 Participants

The questionnaires were distributed to three hundred university students in random at the main libraries and classrooms of three universities in Beijing. The percentage of valid participants was 97.3%. In these 292 students (162 males and 130 females), 100 were from Peking University, 99 from Tsinghua University, and 93 from Beijing Normal University. Their ages ranged from 16 to 25 years (M = 20.28). All participants had experience of using computer.

2.2 Instruments

The survey questionnaire consisted of investigation of basic information and three sub-scales.

Basic information. Basic Information consisted of gender, age, major, grade, years of computer using, hours on computer per day recently.

Three sub-scales. Computer Attitude Scale, Self-Perception Scale, and Innovativeness Scale were used. All of the 106 items used 6-point Likert scale (strongly disagree, much disagree, little disagree, little agree, much agree, and strongly agree). All of odd number items were positive statements, and even number items were negative statements. The data of the negative statements were reversed before statistical disposing. The split-half reliability of the whole scale was 0.86.

a) Computer Attitude Scale. It measured ACL, and included four dimensions: cognitive component (22 items, α = .90), behavioral component (22 items, α = .87), affective component (16 items, α = .87), and evaluation (22 items, α = .90).
b) Self-perception Scale. It measured SPCS, and consisted of 4 items (α = .81).
c) Innovativeness Scale. It measured ATI from two different dimensions: Notion (11 items, α = .69) and action (9 items, α = .70).

3 Results

3.1 Computer Use

Most of participants had been using computer for a few years (M = 5.28 years, SD = 2.66). A 2×2×3 analysis of variance (ANOVA) was performed on the years of computer using with gender, grade, and major as factors. The results showed that females had used computer significantly longer than males, 5.60 vs. 4.90, F (1, 279) = 4.47, p < .05. The students in high grades had used computer longer than the students in low grades, 5.55 vs. 4.95, F (1, 279) = 3.26, p = .07. The main effect of major was also significant, F (2, 279) = 5.02, p < .01. The post hoc test revealed that the students who majored in Natural Science had used computer significantly longer than the students either in Humanity and Social Science or in Engineering (6.05 vs. 4.80, 4.90, respectively). All the interactions were not significant, Fs < 2.00, ps > .05.

The average time of using computer per day was 1.61 hours (SD = 1.37). The results showed that the main effect of gender was not significant, F (1, 272) = 2.87, p = .09. The main effect of grade was significant, F (1, 272) = 22.38, p < .001. The students in high grades spent significantly more hours on computer than the students in low grades (1.84 vs. 1.03). The main effect of major was significant, F (2, 272) = 6.30, p < .01. The post hoc test revealed that the students majoring in Engineering spent significantly more hours on computer per day than those either in Humanity and Social Science or in Natural Science (1.89 vs. 1.34, 1.39, respectively). All the interactions were not significant, Fs < 1.70, ps > .05.

3.2 Three Sub-scales

The data showed Chinese university students' attitudes toward computer in learning were slightly positive (M = 4.36, SD = 0.64), their attitudes toward innovation were apt to positive (M = 3.99, SD = 0.59), and their self-perceptions of computer skill were slightly negative (M = 2.98, SD = 1.16).

A 2×2×3 multivariate analysis of variance (MANOVA) was conducted to determine the effects of gender, grade, and major on the average of the three sub-scales: ACL, ATI, SPCS. The differences between gender were significant, the value of Pillai's Trace is 0.04, F (3, 278) = 4.08, p < .01. Significant differences were found between grades on the dependent measures, the value of Pillai's Trace is 0.11, F (3, 278) = 11.86, p < .001. The differences among majors were also significant, the value of Pillai's Trace is 0.06, F (6, 558) = 2.93, p < .01. Analysis of variance (ANOVA) on each dependent variable was conducted as follow-up tests to the MANOVA. The difference between gender was significant on self-perception on computer skill, F (1, 280) = 10.22, p < .01. Males were more confident than females (3.15 vs. 2.80). The difference between grades was significant on self-perception on computer skill, F (1, 280) = 35.82, p < .001. The students in high grades were more confident than the students in low grades (3.33 vs. 2.51). The differences among majors were also significant on self-perception on computer skill, F (2, 280) = 4.81, p < .01. The post hoc test revealed that students majoring in Natural Science were more confident than students majoring in Humanity and Social Science (3.33 vs. 2.81). The differences among majors were also significant on innovativeness, F (1, 280) = 3.45, p < .05. The students majoring in Engineering and in Natural Science were more innovative than those in Humanity and Social Science (4.02, 4.05 vs. 3.82, respectively). All the other main effects were not significant, Fs < 3.35, ps > .05. All the interactions were not significant, Fs < 2.10, ps > .05.

The comparison between notion and action of Innovation was reliable, t (291) = 23.36, p < .001. The scores of notion were higher than scores of action (4.54 vs. 3.60).

3.3 Path Analysis to Explain the Relationship among Computer Use and the Three Sub-scales

Path analysis was used to examine the relation among computer use, ACL, ATI, and SPCS. The basic model and results of the path analysis are presented in Figure 1.

As indicated in Figure 1, previous computer use influenced SPCS, and then SPCS and ACL directly influenced recent computer use. Although ACL and ATI had no

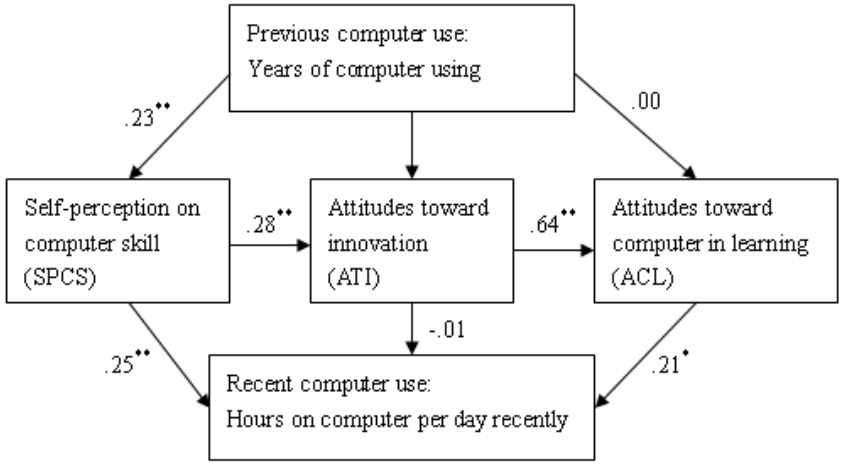

Fig. 1. Path-analytic model: The relationships among computer use, ACL, ATI, and SPCS. Paths are standardized coefficients. *$p < .05$, **$p < .01$.

significant relationship with previous computer use, previous computer use had indirect influence on ACL and ATI by SPCS. Previous computer use could predict recent computer use with ACL, ATI, and SPCS as mediate variables. Six indices used to evaluate the hypothetical model supported this conclusion, $\chi^2(2) = 1.293$, $p = .524$; root mean square error of approximation (RMSEA) = 0.000; comparative fit index (CFI) = 1.000; Tucker-Lewis index (TLI) = 1.001; Incremental fit index (IFI) = 1.000; Normed fit index (NFI) = 1.000. Except the paths from previous computer use to ACL and ATI, and the path from ATI to recent computer use, the standardized parameters of other paths in the model were statistically significant ($p < .05$).

4 Discussion

The present study found that previous computer use could predict recent computer use with ACL, ATI, and SPCS as mediate variables. Males were more confident than females in SPCS, but there was no difference between males and females on either ACL or ATI. These university students' notion of innovation was more radical than their action.

4.1 Computer Use

The present study found that the university students in this survey general spent 1.61 hours per day on computer. In contrast, Male students in American university spent 1.32 hours on computer per day, and female students in American university spent 0.86 hours on computer per day as reported in the study by Schumacher and Morahan-Martin [16]. Comparatively, the Chinese university students as measured by this survey had much more experience on computer. The explanation for this finding can perhaps be attributed to the rapid popularization of computers in China recently.

Females had used computer significantly longer than males (5.64 vs. 4.98 years). But no gender difference was found on hours spent on computer and Internet. The differences among majors were significant. The students majored in Natural Science had used computer significantly more years than the students either in Humanity and Social Science or in Engineering. But the students majoring in Engineering spent significantly more hours per day on computer and Internet than those either in Humanity and Social Science or in Natural Science. Comparison across grades showed that the students in higher grades spent more hours than those in lower grades. It seems that the students may use computer more and more along with the difficulty and profundity of courses increases.

The results of path model indicated previous computer use influenced SPCS, and then SPCS directly influenced recent computer use. Although ACL and ATI had no significant relationship with previous computer use, previous computer use had indirect influence on ACL and ATI by SPCS. ATI influenced recent computer use through ACL. Overall, previous computer use could predict recent computer use with ACL, ATI, and SPCS as mediate variables.

Such results are consistent with the findings from a lot of previous research (e.g. 3; 9), which showed that computer use had positive relationship with computer attitude, self-efficacy, and attitudes toward innovation. In the present study, probably because the Chinese university students had used computer for a long time, and the three universities were well equipped advanced computers and Internet hardware, their computer experience made them feel confident in computer technology. Their self-efficacy and confidence would improve the level of their attitudes toward innovation from both of notion and action. If they were willing to accept new computer technology, then they should realize the importance of mastering technology. Once they had fairly positive attitudes toward computer so that they were willing to use computer. According to attitude-behavior theory (see 9), attitude is an important precursor of behavior. The positive attitudes toward computer will arise more positive behavior on computer using in learning. Therefore, colleges and universities should pay more attention to computer education in order to shape the positive attitudes of students toward computer and further facilitate their behavior on computer using in learning.

4.2 Attitudes toward Computer in Learning

Overall, the results of present study indicated that the participants were willing to take positive attitudes toward computer in learning. There was no difference between males and females on attitudes toward computer in learning. Both of males and females had much experience on computer and recognized that technology was very serviceable to them. Consequently, they were willing to use technology and felt fairly comfortable and satisfied with using technology. It strongly suggests that females and males would have equal opportunity to enjoy the convenience from hi-tech equipment.

4.3 Self-perception on Computer Skill

The participants' self-perceptions of computer skill were a little bit negative, though they had used computer for a few years. But this result does not necessarily mean that

Chinese university students were not confidence in their computer skill. Such result might have something to do with the Chinese culture. In China, humility is usually an expected virtue for everyone, especially in the education of the youngsters. In Chinese traditional culture, youngsters are required to be modest, humble, and open. So, the participants in the present research didn't give higher rating to the computer skill of themselves.

It is worth noting that, although females had used computer previously for a longer time, and they felt as same comfortable and satisfied with using technology as males, but they were short of confidence in their computer skill. The results are consistent with Whitely's [20] finding. Considering the custom that females are (or culturally perceived to be) more modest than males in eastern Asia, we may understand that there was no gender difference in attitudes toward computer, while there was gender difference in self-perception on computer skill. In Chinese traditional culture, the virtue of females that people praised is goodness, peaceful, humility, and forbearing. Based on the tradition, the female participants in the present research would be more modest than the male participants, and give even lower rates in their computer skill.

The results also showed major difference and grade difference in self-perception on computer skill. Students in Natural Science were more confident than those in Humanity and Social Science. It is not surprised because the students in Natural Science usually have more opportunities to use computer and Internet. Seniors were more confident in their computer skill. It is true that college time is an important stage, specifically as access to hi-tech learning method, for most of Chinese students. As their experience and knowledge enriched gradually, the students may improve their skills in computer and become more confident. However, the details of the explanation need further investigation.

4.4 Attitudes toward Innovation

The results showed that participants' attitudes toward innovation were inclined to positive, and had a significantly effect on ACL. It is consistent with Braak's [2] findings and suggests that attitudes toward innovation may be a strong predictor of ACL.

We found, most notably, the notion of innovation of these university students was more radical than their action. Such pattern may emerge from the fact that the students are really willing to adopt all kinds of new hi-tech products, but they have no much chance to access them. Although this hypothesis still need testing, it is highly possible that more opportunities supplied to the university students would have positive influence on making their potential of actions become true. On the other side, such results might indicate that the university students' attitudes to innovation could be affected by the radical innovative action of their peers; therefore reliable instruction should be given to the students and lead them to reasonably use new technology.

The present study showed computer use experience had significant influence on Chinese undergraduates' attitudes toward technology and innovation. The implications of the result may lie in twofold. First, Chinese students are inclined to accept new technology, and this is very positive to the promote computer use in China. Second, there should be some reliable restricts to avoid their using computer and Internet too much. Nowadays, the addiction to Internet becomes a serious problem in adolescents, and it is another important social issue.

Acknowledgements

This research was supported in part by grants from 973 Program (Grant No. 2006CB303101), the National Natural Science Foundation of China (Grant No. 30700233), and the Project for Young Scientists Fund, Institute of Psychology, Chinese Academy of Sciences (07CX132013). The authors wish to thank Dr. Winton AU Wing Tung of Chinese University of Hong Kong for his valuable comments and suggestions on the early draft of this manuscript.

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