

## Examining Teachers' CBT Use in the Classroom: A Study in Secondary schools in Taiwan

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### ABSTRACT

The purpose of this study was to analyze the current status of computer-based technology (CBT) use in secondary schools in Taiwan. A questionnaire was developed to investigate teachers' attitudes toward computers and their application of CBT in instruction. We randomly sampled 100 secondary school science teachers and found that in general they did use CBT for accessing the internet and other teaching-related work. The surveyed teachers had a very positive attitude toward computers, yet we found their attitude was significantly correlated with their age and seniority. The older and more senior teachers generally held a less positive attitude toward computers. As for the application of computer-based technology in classroom instruction, most teachers claimed at least a moderate degree of implementation of CBT in the classroom. In gender difference, male teachers in general used more CBT in their instructional strategies than did female teachers. As far as age was concerned, middle-aged and more experienced teachers tended to integrate more CBT into their instruction than younger and novice teachers, even though the latter group held a more positive attitude toward computers. In correlation analysis we discovered that with male but not with female teachers, there was a direct correlation between degree of positive attitude toward computers and degree of application of CBT in classroom instruction.

### Keywords

Computer-based technology (CBT), Computer-based instruction, Attitudes toward computers, Secondary school teachers

### Introduction

This article starts with a brief review of attitude toward computer and computer-based technology (CBT) application in instruction. We then introduce a self-developed questionnaire investigating the current status of teachers' attitude toward computers and their different kinds of CBT use. The relevant personal variables such as gender, age, teaching seniority and number of "computer hours" per week were further analyzed to generate more data for discussion. Finally, the correlation between teachers' attitude toward computers and their actual application of CBT in their instruction was examined in order to attain greater clarity on this issue.

During the last two decades, the use of CBT has developed rapidly. Ravitz, Wong and Becker (1999) showed that more than 80% of all teachers were using computers at home or in their schools in America. Cuban showed that in 2001, CBT was still generally underused as an instructional tool by teachers at all levels of education in the U.S.A., despite the widespread use of computers outside the classroom in daily life. Meanwhile, in 1996 the Ministry of Education in Taiwan decided there would be at least one computer, and also access to the internet, in every classroom (<http://140.111.1.22/tanet/tan-intro/3.html>). However, even though there has been since then a significant increase in the number of computers in schools on the island, the extent to which CBT directly affects classroom teaching still remains unknown.

The teacher's role in the integration of CBT into classroom instruction is an important issue. Yet whether teachers use CBT in their classrooms will depend on their attitude toward computers (Mortz and Nash, 1997). Generally speaking, attitude can be regarded as a multidimensional construct which includes cognition, affection and conation (Hewstone, Stroebe, & Stephenson, 1996). Moreover, affection is considered to be the core element of attitude. In fact, when we set out to evaluate a person's attitude toward X we must first consider how this person would evaluate his/her own attitude toward X—in terms of subjective feelings like anxiety, confidence and so forth (Ajzen, 1988)—and then secondly consider the degree to which this person consistently acts regarding X in conformity with his/her attitude toward X (Shringley, 1990). That is, both of these measures must be taken into account if we are to accurately predict a person's behavior from his/her attitudes.

Thus, while we have reason to believe that teachers' attitude toward computers will be an important factor in their CBT application to classroom instruction (Lloyd and Gressard, 1984; Yildirim, 2000), we also know it will not be such a simple matter to precisely measure attitude and its effect on behavior. Indeed, much research has already been done on attitudes toward computers (Beaudion, 1990; Gardner, Discena & Dukes, 1993; Mortz and Nash, 1997; Yildirim, 2000). Some of the most frequently investigated constructs include "computer liking," "computer anxiety," "computer confidence," the sense of "computer usefulness," and "computer enjoyment."

As to other variables regarding attitude toward computers, gender has been the one most often analyzed (Woodrow, 1994). Most studies have pointed out that males have in general a more positive attitude toward computers than do females (Comber et al., 1997; Shashaani, 1997). Besides gender, Lloyd and Gressard (1984) have claimed that age is the most significant determinant of attitude toward computers. Comber et al. (1997) found that younger people tend to have a more positive attitude and thus also more experience (despite their age) in using computers. Therefore, in studies of computer use by school teachers the teacher's seniority, which directly correlates with age, becomes a significant factor. Russell et al. (2003) showed that new teachers had in general a higher level of comfort with technology than the more experienced teachers. Besides gender and age/seniority (though also to a degree correlated with these), personal acceptance of technological innovation is also a predictive factor of attitude toward computers (von Braak, 2001). Although there have been a number of research instruments, most scales have measured attitudes toward computers in the general sense, without differentiating specific computer applications.

There has been, then, a lot of research focusing on teachers' use of CBT during the past two decades. Across these researches, the definition of teachers' application of technology varied widely. According to Russell et al. (2003) teacher technology use may be divided into six categories: delivery, preparation, student use, accommodation, grading, and communication. What happens when applications of technology take place inside the classroom? What are the actual roles of CBT when teachers apply them in the classroom? Sometimes teachers just use CBT to deliver traditional means of instruction. For example, a teacher might use a computer connected to a liquid-crystal display projector to show lecture sheets or pictures. Some teachers even regarded their computers as CD-ROM players. But others regarded the integration of CBT as a mind-tool in teaching, using computers to design educational software, integrate teaching resources on the internet and help students learn by themselves (Salomon, Perkins, and Globerson, 1991; McKenzie et al., 1996; Hakkarainen et al., 2001).

## **Aims of this study**

In order to provide valuable insights into the application of CBT in secondary education, this study employed a questionnaire to find out the current status of secondary school teachers' attitude toward computers and CBT use. We then further identified the detailed states of different groups of teachers regarding their demographic background (gender, age, teaching seniority, school level and hours of computer using). At last, the correlation between teachers' attitude toward computers and their application of CBT in instruction was explored to better understand this vital educational issue. This study will provide information about current trends of computer attitudes and classroom applications by teachers in Taiwan. It can help both administrators and researchers better understand the needs of teachers' professional development for CBT use in classroom.

## **Method**

This study employed a survey method to investigate (1) teachers' attitudes toward computers and (2) the extent of CBT integration in the classroom.

## **Subjects**

The subjects of this study were a randomly selected group of 100 secondary high school teachers who taught earth science, mostly in Taiwan, from August 2002 to July 2003. According to the latest educational statistics, there were at that time nearly 1000 schools in Taiwan, 30% of them junior high schools and 70% senior high schools. We sorted these schools into four areas island-wide and sampled 10% of the schools in each area. This may then be considered as a national sample.

The questionnaires were returned by 77% of the intended teacher population. Unfortunately, 7 teachers answered abnormally whose questionnaires were left over 20% unfinished. We then further divided the responding subjects, of which 66% were junior high school teachers and 34% were senior high school teachers, into groups based on four major factors: gender, age, teaching seniority and hours of computer use per week. There were 43 male and 27 female in the valid sample. As for age, there were 34 teachers (49%, the mode) between the ages of 31 and 40; 17 (24%) between the ages of 21 and 30; 11 (16%) between the ages of 41 and 50; and 8 (11%) between the ages of 51 and 65. Thus 73% of all the teachers were under 40 years of age.

Four groups were also created based on degree of teaching seniority: less than 4 years of service as a teacher, between 4 and 10 years, between 11 and 20 years, and more than 21 years. The corresponding number of teachers for each group were 12 (17%), 24 (34%), 25 (36%) and 9 (13%). Since secondary education in Taiwan has two levels, junior high school and senior high school, there are three years in each level. A secondary teacher was supposed to take three years to get acquainted with whole curriculum in each level. So those who had been teachers for less than 4 years were relatively new to the field and were considered “novices.” Those who had been teachers for 4-10 years were considered intermediate-level teachers; the others had taught for more than 10 years were deemed expert or experienced teachers.

After reviewing domestic literatures and undergoing several discussions, we considered that as for hours of computer use per week there were five groups: less than 3 hours, 3 to 5 hours, 6 to 10 hours, 11 to 20 hours, and over 21 hours. The first two groups are the teachers who averagely used computers less than 1 hour per day, and the last group who used computers over 21 hours per week was averagely more than 3 hours in using computer per day. The corresponding number of teachers was found to be 6 (9%), 17 (24%), 13 (19%), 12 (17%), and 22 (31%). Thus over 30% of all the teachers averaged at least 3 hours of computer use per day; conversely, there were also more than 30% who averaged less than 1 hour per day.

## **Instrument**

For this study we developed a questionnaire, “The Integration of CBT into Instruction Questionnaire.” It was divided into three sections: (1) demographic background and general nature of teachers’ computer use, (2) teachers’ attitude toward computers (3) the extent of integration of CBT into their instruction. The first section was demographic background included information about age, gender, teaching seniority and school level taught. The rest of this section included type of CBT use (purpose and place, e.g. only at home or also at school) and number of “computer hours” per week. And the last two sections consisted of 20 items: each item had a five-point Likert scale with choices ranging from “I fully agree” (5 points) to “I fully disagree” (1 point). Thus, 3 points would imply moderate extent.

As for the items regarding “attitude toward computers,” we emphasized three factors that had been found to be crucial by earlier researchers: liking computers, having confidence in computers, and feeling anxiety about computers. However, Mortz and Nash (1997) found that “computer confidence” and “computer anxiety” had a high negative correlation, so that they might be considered two opposite poles of the same component. Thus we decided that “attitude toward computers” could be analyzed in terms of two factors: “computer liking” and “computer anxiety.” In the rest part of this subscale we also took personal acceptance of technological innovation to be a general and antecedent factor which helped to determine attitude toward computers (Braak, 2001). Thus there were 10 items on the “attitude toward computers” subscale, including 7 which described teachers’ feeling, reception and anxiety about computer use and 3 which described teachers’ acceptance of technology in their daily life.

Section three also included a subscale for application of technology in instruction, designed to examine to what extent teachers used CBT in their instructional practice inside the classroom. We tried to see whether teachers used CBT primarily as a basic instructional tool for doing things like playing videos, demonstrating instructional contents with the word processor and applying instructional software to help students learn. The more advanced instructional uses we set out to investigate were, for instance, use of CBT to craft new curricula and teaching methods. Furthermore, we wanted to see if there might be some teachers who regarded CBT as a mind-tool for creating a student-centered learning environment that could enhance learning (Salomon, Perkins, and Globerson, 1991).

Since there were not enough samples to perform factor analysis on the third section of the questionnaire, this study still used exploratory factor analysis, and principle component analysis with varimax rotation, to clarify the

underlying structure of the two primary constructs of these two subscales individually. In the first subscale, subjects' attitudes toward computers were grouped into three factors: "computer affection," "computer anxiety" and "acceptance of technological innovation." They accounted for 67.35% of variance. The second subscale, subjects' application of computer technology to their classroom instruction, was divided into two factors: basic instructional use and advanced instructional use. They accounted for 67.38% of variance. The *eigen* value of these factors from principle component analysis was larger than one. The overall reliability of this questionnaire was given a Cronbach's alpha coefficient of 0.89; in addition, the two subscales were given values of 0.82 and 0.89. Table 1 shows the factor loadings and Cronbach's alpha coefficient for each item in the questionnaire.

Table 1: Questionnaire Items and Rotated Factor Loadings

No	Item and Factors	Factor Loading	Variance Explained	Cronbach's alpha coeff.
<u>Construct 1: Attitude Toward Computers</u>			0.67	0.82
<u>Factor 1: Affection for Computers</u>				
1	I enjoy using computers..	0.796		
2	I feel bored and time-wasting when I use a computer.	0.864		
3	I like to surf the internet with my computer.	0.656		
4	I feel confident in using computer.	0.695		
<u>Factor 2: Computer Anxiety</u>				
5	I feel nervous and uncomfortable when learning a computer software application.	0.858		
6	I feel nervous and uncomfortable when leaning about computer hardware.	0.855		
7	I feel anxious about using computers because I have never taken any computer-related course.	0.663		
<u>Factor 3: Acceptance of New Information Technology</u>				
8	I consider myself less able to adjust to the newest high-tech (IT) devices than most other people.	0.639		
9	I am curious about the most recent high-tech devices (new home appliances, audio-video entertainment equipment)..	0.719		
10	I try to avoid operating high-tech devices that seem too complicated (like home appliances, audio-video entertainment equipment).	0.631		
<u>Construct 2: Application of Technology in Instruction</u>			0.67	0.89
<u>Factor 1: Basic Instructional Use</u>				
11	I have played a film (VCD/DVD) using a computer CD-ROM and a projector in the classroom.	0.802		
12	I have used computer software, such as Microsoft Word and PowerPoint, to demonstrate lesson contents.	0.830		
13	I have adopted educational software, which was bought or downloaded from the internet, to enhance students' leaning.	0.763		
<u>Factor 2: Advanced Instructional Use</u>				
14	I have collected and evaluated students' works through the internet.	0.721		
15	I have developed and applied instructional software in the classroom.	0.677		
16	I have developed on-line courses for students with computer-based technology.	0.823		
17	I have applied computer-based technology to integrate different discipline lessons.	0.714		
18	I have promoted students' cooperative learning through computer-based technology and the internet.	0.851		
19	I have enhanced students' problem-solving ability by integrating computer-based technology into instruction.	0.803		
20	I have assisted students in their individual learning through computer-based technology.	0.853		

## Results

### Current status of CBT use

This survey investigated the frequency of different types of teacher computer use in daily life, including the editing of documents, accessing the internet, using E-mail, and other teaching-related jobs. Figure 1 shows that 65 teachers (93%) used computers to access the internet in order to search for information: this is the most common type of computer use. About 60 teachers (87%) reported that they used computers to deal with teaching-related jobs like lesson preparation, grading and so on. Other uses include playing games, chatting, and other forms of relaxation and entertainment.

To further explore teachers' computer use for teaching-related jobs, this survey investigated five different types of instructional use in particular: making spreadsheets of students' grades (Grading); developing instruction-related contents (Preparation); using computers for teaching (Computer-Aided Instruction or CAI), encouraging students to go on the internet in order to seek information (Student Use for Information Searching), and encouraging student use of the internet for collaborative learning (Student Use for Collaborative Learning). We found that 63 teachers used computers for spreadsheet grading. This was a relatively high percentage (90%) because it is now official school policy that teachers should put students' grades on a computer website in most areas of Taiwan. 53 teachers (76%) used computers to develop instruction-related contents, for instance by making a syllabus or handouts with Microsoft Word, using Powerpoint to organize lecture contents, and using graphic software to display data. When teachers integrated CBT in their classroom teaching, they sometimes used CBT for teaching and sometimes tutored their students in employing CBT as self-learning tools. According to teachers' self-report, there were 56 teachers (80%) exhorted their students to access the internet for information-searching, but only 10 % directed their students to conduct collaborative learning on the internet. The results are illustrated in Figure 1.

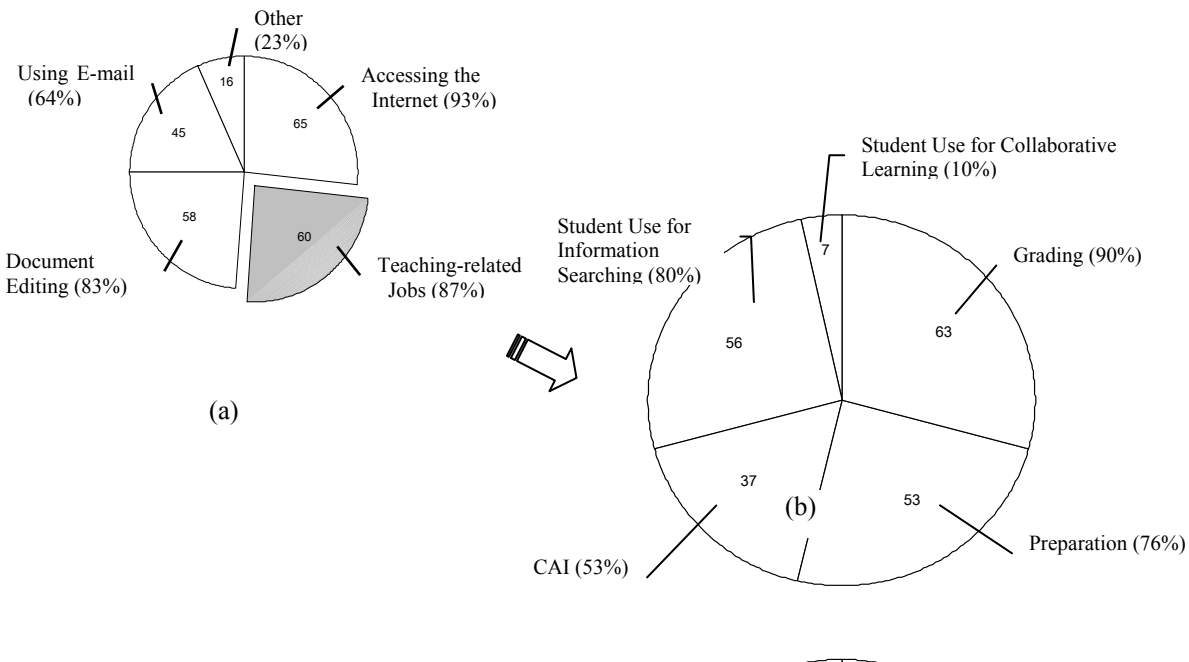


Figure 1: Percentage of (a) Types of Computer Use (b) Types of Teaching-related Jobs

If we consider these various teaching-related jobs, we could divide all of them (except for grading) into two categories, those used to support teaching and those used to support learning. As for teaching, we found most teachers still preferred to develop their own instructional contents rather than use CAI software. Perhaps CAI was considered by some teachers to be inadequate or insufficient for their instructional purposes, and perhaps some were

still not familiar with its use; in any case, more data is still needed to provide greater clarity on this issue. As for learning, we found that 80% of the teachers asked students to search for information *via* CBT, but only 10% conducted collaborative learning projects with their students on the internet. The main reason for this might be that teachers regarded CBT as a teaching tool, a supplement to instruction, rather than as a higher-level cognitive tool for the enhancement of students' learning.

### Analysis of “Attitude toward Computers”

The mean for “attitude toward computers” was 4.04, with a standard deviation of 0.59. This rather high mean indicated that the teachers generally held a positive attitude toward computer use. Furthermore, after the Independent Sample t test was conducted at the significant level  $\alpha=0.05$ , we found that gender ( $t=1.20, p < 0.234$ ) and school level ( $t=0.581, p < 0.563$ ) had no significant effect on “attitude toward computers” scores. But age ( $F_{(3,66)}=3.837, p < 0.014$ ) and teaching seniority ( $F_{(3,66)}=4.088, p < 0.01$ ) reached the significant level when ANOVA was also conducted at the significant level  $\alpha=0.05$ . The Post Hoc showed that teachers above 51 years of age tended to have a less positive attitude than the other two groups, the 21-30 age group and the 31-40 age group. Yet there was no significant difference between the over-50 group and the 41-50 group. As for teaching seniority, teachers who had been teaching for more than 21 years generally held a less positive attitude toward computers than all the other groups. From the ANOVA analysis we also found, as could easily be predicted, a significant correlation between number of hours of computer use per week and attitude toward computers ( $F_{(3,66)}=13.297, p < 0.001$ ). The Post Hoc showed that teachers using computers more than 21 hours per week had a more positive attitude toward computers than all the other groups.

Table 2: Analyses of Different Variables Related to Attitude toward Computers

Related variable	Number	Mean	SD	t-test / F (ANOVA)	Post hoc test
Gender				1.20	
Male	43	4.11	0.67		
Female	27	3.94	0.43		-
School Level				-0.58	
Junior High	46	4.02	0.54		
Senior High	24	4.10	0.69		-
Age				3.837*	
21- 30	17	4.18	.55		
31- 40	34	4.17	.53		21-30 > 51-65
41- 50	11	3.83	.71		31-40 > 51-65
51- 65	8	3.53	.41		
Teaching Seniority				4.088*	
Below 4 years	12	4.21	.63		
4-10 years	24	4.18	.47		All the others >
11-20 years	25	4.05	.63		Above 21 years
Above 21 years	9	3.47	.41		
Hours of Computer Use per Week				13.297**	
Below 3 hours	6	3.53	.53		
3- 5 hours	17	3.75	.50		
6- 10 hours	13	3.84	.41		Over 21 hours >
11- 20 hours	12	3.92	.44		All the others
Over 21 hours	22	4.61	.41		

\*  $p < 0.05$

\*\*  $p < 0.01$

By the same token, we could see a clear tendency for attitude toward computers to become less positive with increasing teachers' age and seniority, as shown in Figure 2(a) and 2(b). Thus the mean for "attitude" decreased sharply when we moved from the 11-20 year seniority group to the above-21 year seniority group and, as could easily be predicted, the oldest and most senior teachers tended to embrace the least positive attitude toward computers. On the other hand and again quite predictably, those teachers who used computers more than 21 hours per week got relatively high scores (around 4.6) on attitude toward computers. Yet while it may seem obvious that the more time someone spends using computers the more positive his/her attitude toward computer use will tend to be (Beckers and Schmidt, 2003), the "direction of causality" here (better attitude promotes more use or more use promotes better attitude, or both?) may not be so certain.

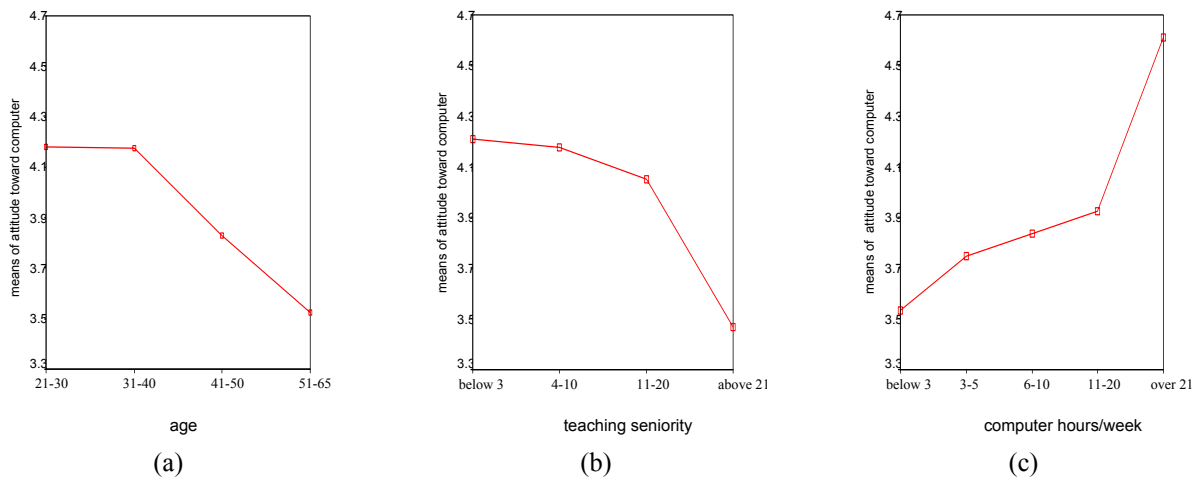


Figure 2: Means for Attitude toward Computers against (a) Age (b) Teaching Seniority (c) Hours of Computer Use per Week

### Analysis of "Application of Technology to Instruction"

There were 11 teachers who had never used CBT in actual practice. After their scores were excluded, we found the mean score for "application of technology in instruction" was 3.13 and the standard deviation was 0.75. This indicated that teachers had a slight tendency to like to implement CBT in their own teaching. The "application of technology in instruction" scores showed different means for males and females: 3.34 for males and 2.86 for females. This suggests a clear gender difference. After the t-test was conducted at the significant level  $\alpha=0.05$ , we found that gender ( $t=2.504$ ,  $p<0.015$ ) indeed contributed significantly to the "application of technology in instruction" scores. In a survey of information and communication technology (ICT) use in Finland, Hakkarainen et al. (2001) pointed out that male teachers got higher scores than female teachers in ICT use in education for all age groups. Supporting the argument of Hakkarainen et al. (2001), our findings suggested that male teachers applied more CBT in their instructional strategies than females did, though they did not show a significant difference in attitude toward computers. The school level taught ( $t=0.05$ ,  $p>0.963$ ) also had no significant impact on "application of technology in instruction" scores.

From the analysis of ANOVA also at the significant level  $\alpha=0.05$ , we also found that, in general, teaching seniority ( $F_{(3,55)}=0.991$ ,  $p<0.404$ ) and hours of computer use per week ( $F_{(3,55)}=1.506$ ,  $p<0.214$ ) had no significant impact on "application of technology in instruction" scores. But age ( $F_{(3,55)}=3.128$ ,  $p<0.033$ ), as predicted, reached the significant level. The Post Hoc showed that teachers in the 31-40 age group integrated CBT in their classroom teaching significantly more than those in the 41-50 age group. Also as seen in Figure 3(a), and quite interestingly, those between 21 and 30 years of age, most likely because they were still "novices" in teaching, tended to adopt less CBT for instructional purposes than did those in the 31-40 age group. We also found that teachers with a seniority of above-21 years had a distinctively low mean (2.68) for technology use in teaching, as seen in Figure 3 (b). Moreover and quite predictably, mean scores for technology use tended to steadily rise with hours of computer use, as shown in computer hours in Figure 3(c), though the differences are not significant.

Table 3: An Analysis of Different Variables Related to Application of Technology in Instruction

Related Variable	Number	Mean	SD	t-test / F (ANOVA)	Post hoc test
Gender				2.504*	
Male	33	3.34	0.83		Male > Female
Female	26	2.86	0.56		
School Level				0.256	
Junior High	41	3.14	0.75		-
Senior High	18	3.09	0.78		
Age				3.128*	
21- 30	13	3.15	.33		31-40 > 41-50
31- 40	31	3.34	.79		
41- 50	10	2.60	.91		
51- 65	5	2.78	.50		
Teaching Seniority				0.991	
Below 4 years	8	3.05	.35		-
4- 10 years	21	3.12	.51		
11- 20 years	24	3.27	.96		
Above 21 years	6	2.68	.89		
Hours of Computer Use per Week				1.506	
Below 3 hours	3	2.57	1.21		-
3- 5 hours	12	2.88	.70		
6- 10 hours	12	2.98	.42		
11- 20 hours	12	3.27	.75		
Over 21 hours	20	3.37	.83		

\*  $p < 0.05$

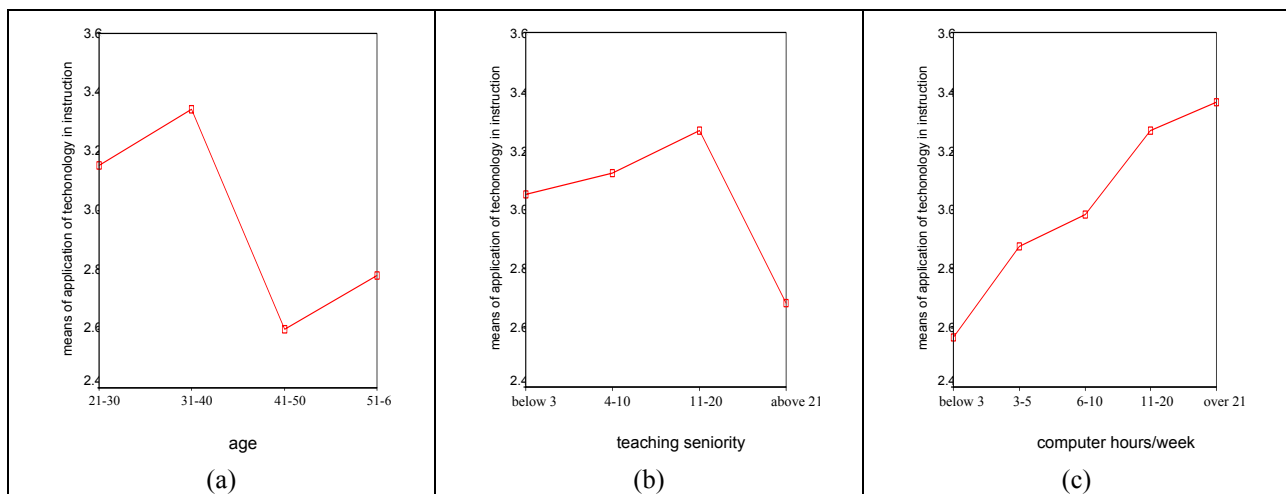


Figure 3: Means for Application of Technology in Instruction against (a) Age, (b) Teaching Seniority, (c) Computer Hours per Week

As might have been predicted, we found that attitude toward computers tended to decrease in positive with teachers' increasing age and teaching experience seniority which was closely correlated with age. This is clear from Figure 2



(a) and Figure 2 (b). However, as is clear from Figure 3 (a) and Figure 3 (b), the situation was different with regard to “application of technology in instruction.” Here it appears to be the teachers “in the middle range” of age and experience who scored highest for “application”. More specifically, in Table 4 we see that the teachers in the 31-40 age group with 11-20 years of teaching experience owned the highest mean “application” score: 3.58. Moreover, there were 16 teachers, the majority, in this seniority group. And this would cause a higher mean: 3.26 in this group.

Table 4: Crossing Age and Teaching Seniority with the Means for Application of Technology in Instruction

	Teaching Seniority				Sum
	Below 4 Years	4-10 Years	11-20 Years	Above 21 Years	
Age					
21-30	3.04 (7)	3.28 (6)	0	0	3.15 (13)
31-40	3.10 (1)	3.08 (14)	3.58 (16)	0	3.34 (31)
41-50	0	2.70 (1)	2.58 (6)	2.60 (3)	2.60 (10)
51-65	0	0	2.80 (2)	2.77 (3)	2.78 (5)
Sum	3.05 (8)	3.12 (21)	3.26 (24)	2.68 (6)	3.12 (59)

Note: number of teachers was in the parentheses

All the above results are summarized in Table 5. We might note that the age of (around) 40 years appeared to be a critical “cut-off point” for both attitude toward computers and application of technology in instruction. This might be because CBT has been used in secondary school teaching in Taiwan for almost 20 years. Thus teachers less than 40 years old would likely have been exposed to this trend at a point much nearer the beginning of their teaching careers, where the new trend would have had a much more formative influence on them, a more profound impact on their whole conception of classroom teaching.

Table 5: Summary of Results

Related Variables	Attitude toward Computers	Application of Technology in Instruction
Gender	-	Male > Female
School level	-	-
Age	21-30 years old > above 50 years old 31-40 years old > above 50 years old	31- 40 years old > 41-50 years old
Teaching Seniority	All the others > Above 21 years	-
Hours of Computer Use per Week	Over 21 hrs > all the others	-

### Correlation analysis

What was the general relationship between teachers’ attitude toward computers and their behavior with regard to CBT use in the classroom? As seen in table 6, the correlation coefficient between “attitude toward computers” and “application of technology in instruction” was 0.47 ( $p < 0.01$ ). Though this correlation coefficient was significant, there was only a medium degree of correlation between teachers’ attitude and CBT application. The usual way to approach an understanding of correlation coefficient  $r$  is to consider  $r^2$ , since the square of the correlation coefficient is the proportion of variance. In this case we found  $r = 0.47$ ,  $r^2 = 0.21$ , so that 21% of the variance in teachers’ application of technology in instruction might be attributed to differences among them with regard to attitude toward computers.

As we examined the correlation between attitude toward computers and application of technology in instruction in the context of the related variables, we came upon several interesting findings. These results are listed in Table 6. First, the correlation coefficient for male teachers, at 0.59, is significant; on the other hand this coefficient is quite low, at 0.006, for female teachers. This indicates that more clearly for males than for females, a more positive attitude toward computers means there will be greater application of technology in instruction. After examining computer use and attitudes among college students, Mitra et al. (2001) found that females held less positive views of computers and used them less often than males, but our point here is that even a positive attitude on the part of females seems to be a less clear determinant of greater classroom computer use than is a positive attitude on the part

of males. Secondly, as far as age was concerned, there was a high and significant correlation,  $r = 0.725$ , between attitude toward computers and application of technology in instruction among 41-50 year old teachers. Yet after cross checking, we found this group of teachers had relatively low scores in both attitude toward computers and application of technology in instruction, therefore the two were highly correlated. When teaching seniority was considered, we also found there was only one group, those with 11-20 years of teaching experience, with a significant correlation- the coefficient was 0.58- between attitude and application. Third, there were no significant correlations when teachers were grouped according to hours of computer use per week. Although there was a high correlation—with a coefficient of 0.805—for those who spent less than 2 hours using computers per week, it was not significant due to the small number of people, only 3, in the group.

Table 6: Pearson Correlation Coefficients for Attitude toward Computers and Application of Technology

Related variable	Attitude toward Computers * Application of Technology	Effect Size
Total	0.470**	0.51
Gender		
Male	0.590**	0.68
Female	0.006	0.00
Age		
21- 30	0.259	0.27
31- 40	0.341	0.36
41- 50	0.725*	0.92
51- 65	-0.610	-0.70
Teaching Seniority		
Below 4 years	0.581	0.68
4-10 years	0.255	0.26
11-20 years	0.581**	0.68
Above 21 years	0.254	0.26
Hours of Computer Use per Week		
Below 3 hours	0.805	1.11
3- 5 hours	0.397	0.42
6- 10 hours	0.362	0.42
11- 20 hours	0.426	0.45
Over 21 hours	0.365	0.42

\*  $p < 0.05$

\*\*  $p < 0.01$

## Discussion

### Factors influencing CBT use

Successfully integrating CBT into teachers' classroom instructions is influenced by many factors, including environmental factors and personal factors. Environmental factors, or institutional factors, are primarily coming from school context like insufficient number of computers, lack of technical assistance, insufficient peripherals and software, and technological infrastructure (Pelgrum, 2001). The other school contextual factors are administrative leadership and norms from peers.

As to teachers' personal factors, Ravitz et al. (1999) suggested that teachers' attitudes and beliefs regarding technology were of great importance in their decisions to adopt and frequently use technology in the classroom. Hung, Hsu & Tsou (2004) also showed the importance of teachers' attitude toward computers as an important predictor of technology use in instruction. We wanted to explore this as a central construct but we were also interested in the possible impact of such related variables as age and teaching seniority, as well as normal (including non-instructional) amount of time spent per week using computers, on teachers' attitude toward computers and/or toward their classroom application of computer technology.

Though there were documented literatures suggested that teachers' attitude toward computers often was a key factor associated with their CBT uses (Becker, 2000; Hadley & Sheingold, 1993; Sandholtz *et al.*, 1997; Zhao & Frank, 2003). Through this study, we found there was merely a medium degree of correlation between teachers' attitude and CBT application in classroom instruction, that is, the relation between attitude and use is not as straightforward as it seems. Meanwhile, Sugar, Crawley and Fine (2005) indicated both teachers' attitude toward computers and their teaching attitude should altogether put into consideration when examining their CBT application in instruction, for these two kinds of attitude were in dynamic relationship. That is, teachers who increased the applications of CBT in the classrooms tended to also hold more constructivist teaching attitude, and *vice versa* (Ertmer *et al.*, 2001; Rakes *et al.*, 1999). This viewpoint will provide additional insights in future researches.

### **Teaching seniority and CBT use in instruction**

Somehow as we compare Figure 2 with Figure 3 and Table 4, the most obvious explanation of what might seem an anomaly is this: while the youngest teachers may have the most positive attitude toward computers they will nonetheless, because relatively new to the teaching profession and inexperienced in the classroom, be less inclined or indeed less able to apply CBT to their actual teaching than will teachers in the "middle range" of age and teaching experience. More specifically in the present context, many teachers began their teaching careers around 25 years old in Taiwan and became "experienced teachers," with roughly 10 years of experience, in around their mid-thirties. While this group might hold a less positive attitude toward computers than the novices, since after all attitude-toward-technology is largely generation-based or "generational," these teachers in the middle-range of age and experience have a better knowledge (as compared with the novice teachers) of the curriculum they are teaching, of the students in their classrooms, of pedagogical principles and practical classroom management strategies.

We consider it to be a significant finding that the more experienced (but not most experienced) teachers applied more CBT in their teaching, even though they had a less positive attitude toward computers, than the novice teachers. A report by the U.S. National Center for Education Statistics (NCES) (2000) suggests that new teachers, having grown up with computers, should have both high comfort computer level and computer skills to enhance their classroom instructional practices with CBT. Yet we have found that although novice teachers do score high on attitude, they apparently cannot translate their very positive attitude toward computers into higher degree of application of computer technology into their classroom instruction. This supports the argument of Russell *et al.* (2003) that although new teachers reported higher levels of comfort with technology, more experienced teachers reported using technology more often in the classroom.

### **Implications for enhancing CBT use in instruction**

Although the novice teachers, as mentioned above, were generally familiar with working or studying with computers when they were students, they had not been exposed to regular applications of CBT in instruction by their teachers. Thus, when becoming a teacher in the classroom, their teachings mostly based on their prior experiences as students did not comprise the integration of technology. Moreover, their teacher education programs would put more emphasis on how to use CBT rather than on how to teach with CBT and then further add to their comfort with CBT (Russell *et al.*, 2003). Based on the above, one approach to preparing novice teachers actually apply CBT in their classroom instructions is to move away from focusing on teaching CBT and instead focus on teaching with CBT in their teacher-training programs. That is, we must provide the pre-service teachers with all kinds of experiences necessary to prepare them to use CBT in their future teachings beyond what the traditional teaching methods were.

As for those teachers whose teaching seniority were above 21 years, they might had better behavior management techniques toward students, became familiar with the curriculum and adapted to the school culture, yet held less positive toward computers and had less CBT applications in instruction. The way to improve their attitudes and applications is to increase their experiences getting along with computers with the help from school colleagues and administrative. Because they were not familiar and comfortable with using computers so that they might be afraid of using them, needless to say, applying them in classroom instruction. Once they could be accustomed to using computers, they might change their attitudes and try to apply CBT in their teachings.

## Conclusion

This study examined the current status of teacher computer-technology use in Taiwan's secondary schools, in their daily life and especially in their teaching-related jobs. We found that most teachers were using computers mainly for accessing the internet, writing documents, sending email and dealing with teaching-related jobs—primarily grading. Although they of course encouraged students to seek information on the internet, most teachers used CBT mainly in connection with their own teaching rather than in connection with their students' learning. That is, they still regarded CBT primarily as a supplemental tool in instruction and in establishing a teacher-centered environment.

As for “attitude toward computers,” the findings showed that the teachers had a quite positive attitude. While gender and the school level taught (junior or senior high) had no significant impact here, age and years of teaching experience (seniority) were significant factors. That is, with increasing age and years of experience the attitude toward computers became, in general, increasingly less positive. We also found that, predictably, the more time teachers spent using computers the more positive their attitude toward computers—though there was no way to determine the “direction of causality” here.

As for “application of technology in instruction,” the over-all findings suggested a moderate degree of CBT application in the classroom. Gender and age both had a significant impact here. Male teachers tended to integrate more CBT into their instructional strategies than did female teachers, even though, interestingly enough, there was no significant difference in attitude toward computers. Regarding age and seniority there was a very significant finding: the group most inclined to apply CBT to their classroom instruction was the “middle-range” group, middle-aged teachers with a medium level of teaching experience. Although the younger teachers had grown up in a technology-rich environment and had the most positive attitude toward computers, they adopted less CBT in instruction.

There was, significantly, just a medium degree of correlation between teachers' attitude toward computers and their application of technology into classroom instruction. Upon further examination we discovered that the more positive the attitude of male teachers toward computers, the more they would apply CBT in their teaching. As for female teachers, this same correlation was found to be significant only among those in the 41-50 age brackets. With female and novice teachers over-all it became clear that a positive attitude toward computer technology while it might be a necessary one, is not a sufficient cause or determinant of the desire and/or ability to apply CBT to classroom teaching.

As the use of computer-based technology continues to increase rapidly in schools as well as homes, it seems inevitable that CBT will impact not only practical classroom teaching and learning strategies, but even the pedagogical theories which stand behind them, with an ever greater force. No doubt the attitude of teachers toward computer technology, as well as their attitude toward the practice of teaching and the subject(s) they teach, will be an important factor in the degree to which CBT may be increasingly integrated directly into classroom teaching. Efforts to further explore and clarify this complex web of issues will surely be needed.

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