A STUDY ON SCIENCE TEACHERS' ATTITUDES TOWARD INFORMATION AND COMMUNICATION TECHNOLOGIES IN EDUCATION

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ABSTRACT
Integration of Information and Communication Technologies (ICT) into education has been an important concern in many countries. Recently, Turkish Ministry of Education has also done great efforts and major financial investments to implement ICT into teaching and learning environments. However, as in many developing countries, ICT tools are provided to teachers without considering their attitudes toward ICT. The purpose of this study was to reveal Turkish primary science teachers' attitudes toward ICT in education and then explore the relationship between teachers' attitudes and factors which are related to teachers' personal characteristics (gender, age, computer ownership at home, and computer experience). In order to collect data, an instrument (STATICTE) was developed by researchers and administered to 1071 science teachers almost uniformly distributed in 7 geographic regions of Turkey. In data analyses, descriptive statistics were used to describe and summarize the properties of the mass of data collected from the respondents. The results indicate that Turkish science teachers have positive attitudes toward ICT and although teachers' attitudes toward ICT do not differ regarding gender, it differs regarding age, computer ownership at home and computer experience. It is hoped that the outcomes of this study can be used in shaping innovational practices in the Turkish Educational System.
Key words: science teacher, attitudes, ICT in education.

INTRODUCTION

The integration of ICT into education has been assumed as the potential of the new technological tools to revolutionize an outmoded educational system (Albrini, 2006). In the last 20 years, initiatives, projects and implications related to use of Information and Communication Technologies (ICT) into education motivate teachers to gain necessary knowledge and skills in using ICT in their instruction. Pelgrum (2001) has noted that ICT is "not only the backbone of the Information Age, but also an important catalyst and tool for inducing educational reforms that change our students into productive knowledge workers" (p. 2).

ICT plays a critical role in information societies' educational systems. In these societies, the stakeholders of educational policy, redesign and reconstruct their educational systems based on the new educational paradigms such as constructivist theory so that both teachers and students develop the necessary knowledge and skills sought in this digital age. Hence, most countries around the world are focusing on approaches to integrate ICT in learning and teaching to improve the quality of education by emphasizing competencies such as critical thinking, decision-making, handling of dynamic situations, working as a member of a team, communicating effectively (Anderson & Weert, 2002). Also governments especially in developing countries have tried to improve their national programs to integrate ICT into education. According to Benzie (1995), national programs have not been so successful to implement ICT into educational systems because they were formulated in non-educational realms and they were not supported with educational research (Albrini, 2006).

The involvement of ICT in Turkish education policies has a very recent past. The first attempt to introduce computers to Turkish schools was done in 1984 by the initiation of a Computer-Aided Education (CAE) Project. Ministry of National Education (MoNE) aimed at spreading computer literacy and the use of computers among teachers to improve quality of learning environment. The MoNE considers the use of new technologies in education as vital and has financed number of projects for supporting the use of ICT in education. Even though, there have been some projects and attempts since 1984, the real consideration of ICT in education policies starts with "e-government" project in 2003 (Bayrakçı, 2005). With this approach, MoNE has conducted major projects some of which are: **"**Catching the Epoch 2000", "Improvement Project of National Education" supported by

World Bank, "Basic Education Project, Phase-I" and **"**MoNE Internet Access Project" (MoNE, 2007). Within the scope of these projects, 2837 technology classrooms were founded in 2451 schools and 2837 server computers, 42205 students computers, 2460 computers for teachers, 2370 administrative computers were bought. And also over 10.000 schools and 300.000 computers have been connected to Internet (MoNE, 2007). In the national policy documents, ICTs was seen as an essential part of lifelong learning in 2004 (European Commission, 2005). The main purposes of using ICT in education were management, teaching and learning facilities (European Commission, 2005). The implementation of technology into the Turkish educational system has not been taken into consideration by enough research projects. It has been observed that in most ICT implementation cases "teachers' attitudes" have not been investigated sufficiently in the early stages. According to Rogers's theory of diffusion of innovation, teachers' attitudes are indispensable to the innovation-decision process (Rogers, 1995). This situation shows similarity with the other developing countries (Koohang, 1989; Selwyn, 1997; Albirini, 2006; Tella et al. 2007).

The new Turkish Science & Technology curriculum requires all science teachers to have necessary knowledge and skills not only on the issues of science, but also on technology as well. Since the tendency in favor of or against using ICT in teaching and learning strongly depends on the attitudes of science teachers, the present study aims at investigating Turkish science teachers' attitudes toward ICT in education.

REVIEW OF THE LITERATURE

In the literature, while there are many definitions of ICT, it can be broadly defined as "technologies that facilitate, by electronic means, the acquisition, storage, processing, transmission, and disseminating of information in all forms including voice, text, data, graphics and video" (Michiels & Van Crowder, 2001; De Alcantara, 2001). This definition mainly focuses on the importance of the intersection of information technology, information content and telecommunications in enabling new forms of knowledge production and interactivity. ICT allows many people to generate and disseminate information, thus playing an active role in the process of interaction between professionals, learners, policy makers, peers and etc. (Leach, Ahmed, Makalima & Power, 2005) In the definition of the ICT in education, four main elements can be taken into consideration; ICT as an object that refers to learning about ICT, an assisting tool, a medium for teaching and learning and finally a tool for organisation and management in schools (Monnen & Kommers, 1995; SER, 1998, Pilot, 1998; cited in Jager & Lokman, 1999).

ICT has very strong effect in education and it provides enormous tools for enhancing teaching and learning. There have been many studies that have highlighted the various ways that ICT may support teaching and learning processes in a range of disciplinary fields such as the construction of new opputinities for interaction between students and knowledge; accesing information and etc. ICT can have a useful effect on teaching and learning if it is used under right conditions including suitable sources, training and support. ICT also offers the potential to meet the learning needs of individual students, to promote equal oppurtinity, to offer learning material, and also promote interdependence of learning among learners (Leach, Ahmed, Makalima & Power, 2005).

Roblyer and Edwards (2000) suggested that there are five important reasons for teachers to use technology in education: (1) motivation, (2) distinctive instructional abilities, (3) higher productivity of teachers, (4) essential skills for the Information Age, and (5) support for new teaching techniques (cited in, Samak, 2006). In order to use of technology in the classroom effectively, teachers' attitude toward technology should be positive and they should be trained in using the modern technologies in the field of education. Chin and Hortin (1994) stated that the teacher clearly must act as the "change agent" in the relationship between technology and the student.

Over the past 25 years, there have been many studies in local, national and international scopes to integrate ICT in education. These studies aim to improve the effects of teacher training (Cox, Rhodes & Hall 1988), levels of resources (Cox, 1993), teachers' pedagogies and practices (Watson, 1993), and the effects of computers on students' achievement (Cox, Preston, & Cox, 1999; Cavas, 2005). However, the early studies in this field have ignored teacher attitudes toward computer (Harper, 1987). Recent studies indicate that teachers' attitudes toward computers have significant implications for their behaviours in the use of computers for teaching (Davis, 1989; Francis, Katz, & Jones 2000; Kellenberger & Hendricks, 2003; Lawton & Gerschner 1982; Troutman 1991). During the process of combining ICT with education, teachers' attitude towards using knowledge besides their talent and desire will be a crucial point affecting the results of application. The basic agent for establishing and working this system is teachers. It is argued that successful integration of ICT in education enables teachers to transform instruction from teacher-centered to student-centered where learners may interact with their peers and use the computers and Internet for their own learning needs. However, many teachers do not regard themselves

fully-equipped, comfortable and sufficient in using ICT in educational settings, and they feel more confident with their traditional teaching styles (Hawkins, 2002).

Many researchers were interested in developing reliable and comprehensive instruments to measure teachers' attitudes towards the use of computers and these scales differ in many ways in the past 25 years,. Some of these instruments are: *The Attitudes Toward Computers (ATC)* (Raub, 1981), *The Attitudes Toward Computers Scale* (Reece & Gable, 1982), *The Computer Use Questionnaire* (Griswold, 1983), *The Computer Attitude Scale* (Gressard & Loyd, 1986), *The Computer Anxiety Rating Scale (CARS)* (Heinssen, Glass, & Knight, 1987), ATSC *The Attitude Toward Computer Scale* (Francis, 1993), *The Computer Attitude Measure (CAM)* (Kay, 1993), *The Computer Attitude Questionnaire (CAQ)* (Knezek & Miyashita, 1993), *The Computer Attitude Items* (Pelgrum, Janssen Reinen, & Plomp, 1993), *The Computer Attitudes Scale for Secondary Students (CASS)* (Jones & Clarke,1994). One of the well-known instruments in this field is "Computer Attitude Scale (CAS)" and this scale was developed by Loyd & Gressard in 1984. This instrument is seen as providing an appropriate metric for assessing attitudes toward computer use by many researchers (Shapkaa & Ferrarib, 2003; Oosterwegel, Littleton & Light, 2004). The original version of this scale consists of three subscales, each consisting of 10 items. These subscales are: Computer Anxiety, Computer Liking, and Computer Confidence. CAS have been studied and applied in many cultures (Berberoglu & Calikoglu, 1993; Francis, Katz & Jones, 2000). Another widely used instrument in this field is Teachers' Attitudes toward Computers Questionnaire (TAC) developed by Christensen and Knezek in 1996. The major aim of this scale is to measure teachers' attitudes. The TAC was originally constructed as a 10-part composite instrument that included 284 items spanning 32 Likert subscales.

In spite of the fact that there are many studies that attempt to develop instruments for measuring teachers' attitudes toward using computers in general, only a few of them focus specifically on measuring teachers' attitudes toward the use of computers in schooling for instructional and management purposes (Bannon, Marshall, & Fluegal 1985; Allen 1986; cited in, Sadik, 2006). For example, Singapore teachers' attitudes toward using computers in schooling were assessed by Ching (1999) using Selwyn's CAS (1997). Allan and Will (2001) also measured Chinese teachers' attitudes toward the pedagogical use of computers within the theoretical framework proposed by Selwyn. These attitudes also play an important role in the effective investment in computer technology to support instruction and successful integration of computers in teaching (Lawton & Gerschner 1982 and Koohang 1989).

The literature indicates that there are no consistent results on the gender issues (Shapkaa & Ferrarib, 2003). While some studies suggest that male teachers tend to show slightly more favorable attitude toward computer use than do females (Dupagne, & Krendi, 1992; Ertmer, Addison, Lane, Ross, & Woods, 1999), other studies, however, report little or no differences in teacher attitudes on the basis of gender (Gressard & Loyd, 1986; Kramer, P.E., & Lehman, 1990; Woodrow, 1992; Koszalka, 2001).

For the age variable, many studies indicate that there is no significant relationship between age and attitudes (Massoud, 1991; Woodrow, 1992; Handler, 1993). However some studies address that teachers' age have important effects on the attitudes (Chio, 1992; Blankenship, 1998). A study carried out by Chio (1992) revealed that older teachers in the study had more positive attitudes toward computers, had less computer literacy than the younger teachers. Deniz (2005) determined that teachers' age was significantly related to teachers' attitudes and he reported the age of 36 as a "breaking point" for the positive attitudes of primary school teachers.

Computer experience has been the most commonly cited variable correlated to positive attitudes (Dupagne & Krendel, 1992; Woodrow, 1992; Chou 1997; Levine & Donitsa-Schmidt 1998; Ropp 1999; Yang, Mohamed, & Beyerbach, 1999; Winter, Chudoba & Gutek, 1998; Smith, Caputi & Rawstorne, 2000; Yıldırım, 2000; Gaudron & Vignoli 2002). For example, Woodrow (1992) reported correlations between computer experience and attitudes toward technology. Chou (1997) also highlighted that computer experience influenced teacher attitudes toward computers. Ropp (1999) found that there is significant relationship between computer access & hours of computer use per week and computer attitudes.

The effects of computer ownerships on the teachers' perceived computer competence, concentration on improving the quality of current practice and computer attitudes have been investigated in many studies (for example: Wood, Putney & Cass, 1997; Monk, Swain, Ghrist & Riddle, 2003; Roussos, 2007; Sadik, 2006). In summary, computer ownership has been consistently correlated to attitudes toward computers and positive effects for preparing teaching and learning materils.

A considerable study about teachers' attitudes towards technology use in Turkey has been conducted by many researchers (Akkoyunlu, 1996; Altun, 2003; Asan, 2003; Bayhan, Olgun & Yelland, 2002; Cavas & Kesercioglu,

2003; Deniz, 2005; Gomleksiz, 2004). In these studies, relationships between attitude toward technology and teachers' characteristics were investigated. In Asan's (2003) study, primary teachers' perceptions and awareness level about specific technologies, and about the role of technology in education, and how they see the technological problems that are faced by basic education school systems in Turkey were investigated. The results showed that many teachers were not computer users and lacked a functional computer literacy background upon which to build new technology and skills. The study also indicated that the use of computer and related technologies was not routine part of their teaching and learning environment (Asan, 2003). Another study conducted by Cavas and Kesercioğlu (2003) aimed to investigate the science teachers' attitudes toward computer assisted learning (CAL). The results showed that the majority of science teachers had positive attitudes toward CAL and no gender difference exists between science teachers' computer-assisted learning attitudes. Altun (2003) found that pre-service teachers' cognitive styles were not affected by their attitudes toward computers. Gulbahar (2008) reported that lack of in-service training and insufficient technological infrastructures were the factors that have a significant influence on the effective use of technology by instructors. Deniz (2005) indicated that male teachers have more positive attitudes than their female counterparts. According to Akkoyunlu (1996), there was a meaningful relationship between pre-service teachers' knowledge about technology and their attitude towards technology. She also found that pre-service teachers with more information about technologies have more positive attitude towards the use of technologies in teaching and learning environments. A study carried out by Ocak & Akdemir (2008) revealed that science teachers' computer literacy level is related to their computer use. And also computer literacy level of the teachers increases their integration of computer applications in their teaching. In the study, most of the teachers use Internet, email, and educational software CDs as computer applications in the classrooms. They found statistically differences in the integration of computer applications as an instructional tool.

PURPOSE OF THE STUDY

In the light of research literature on importance of teachers' attitudes toward information and communication technologies in education, the main aim of this study was to find out Turkish primary science teachers' attitudes toward ICT in education and then explore the relationship between teachers' attitudes and other variables which are related to teachers' personal characteristics: gender, age, computer ownership at home and computer experience.

METHODOLOGY

Sampling

The target population for this study was Turkish science teachers enrolled in primary schools during the school year 2004-2005. Stratified sampling was used to obtain data from 1071 science teachers of primary. Three cities from each of seven geographic region of Turkey were selected with three levels (high, medium, low) of socio-economic status reported by Turkish State Planning Organization (http://ekutup.dpt.gov.tr/bolgesel /gosterge/2003-05.pdf). An official permission is attained from the Turkish MoNE and the questionnaires were officially posted to schools by the Directorate of City National Education of the selected cities. In some cities where the Directorate of City National Education was not cooperative and we had to find a responsible person to administer the questionnaires. The questionnaires were administered to 70 science teachers in each city, thus giving a total sample of 1470 primary science teachers for this study. A total of 1071 questionnaires (giving a return rate of 80 %) were returned from either the responsible person or the Directorate of City National Education to be used in data analysis.

Instrument

The survey instrument was developed by the researchers after an extensive review of literature and scales used in different educational backgrounds guided by the theoretical base of the study. This instrument was sent to seven experts who were working in the field of ICT in education in different Turkish universities to determine its face and content validity. The instrument was improved in the light of the feedback from these experts. A pilot study was conducted with 151 volunteer science teachers to establish its internal consistency and reliability. After analyzing the data resulting from the pilot study, three items were removed from the instrument. The final instrument consists of three parts. The first part, which consist 23 questions, focuses on the demographic information about science teachers including gender, age, length of teaching experience, school type, etc. The second part consists of 11 questions related to using computers and teachers' experience with ICT. The last part is the Science Teachers' Attitudes toward ICT in Education (STATICTE) scale with 31 Likert-type items (Likert, 1932) developed to measure attitudes of science teachers toward ICT in education. This scale consists of two subscales which are "Effect of ICT on Teaching and Learning" and "Obstacles to ICT Implementation". In order to determine reliability of the STATICTE instrument, Cronbach alpha coefficients were calculated and are as shown in Table1.

Table 1. Cronbach's-alpha reliability for the scales

Subscale	Scale Label	N	A	Mean
1	Effect of ICT on Teaching and Learning	20	0.92	4.20
2	Obstacles to ICT Implementation	11	0.79	3.73
	Total	31	0.91	4.04

Data Analysis

The data were analyzed via SPSS 13.0 for Windows. Descriptive statistics were used to describe and summarize the properties of the mass of data collected from the respondents. Parametric statistics like ANOVA and t-test pair-wise comparison were conducted to analyze any differences between teachers' attitudes and other dependent variables. A level of 0.05 was established a priori for determining statistical significance

Factor Analysis

The 31-item scale was designed to measure science teachers' attitudes toward ICT. The subjects were asked to respond using a five-point scale (strongly agree, agree, neutral, disagree, and strongly disagree). The score 1 represented the option "strongly disagree" while score 5 on the scale represented the category "strongly agree". 11 of the items were negatively worded and the rest were positively worded. For the analysis of the data, all negatively worded items were reversed so that a higher numbered response on the Likert scale would represent positive attitudes.

The 31 items of the attitude scale was analyzed using principal component analysis (PCA) method from SPSS. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser-Meyer-Oklin value was 0.95, exceeding the recommend value of 0.6 and the Barlett's Test of Sphericity reached statistical significance, supporting the factorability of the correlation matrix. An inspection of the scree plot revealed a clear break after the second component. Using Catell's (1966) scree test, it was decided to retain two components for further investigation. To aid in the interpretation of these two components, Quartimax rotation was performed. The two factor solution explained a total of 39.7 % of the variance, with Factor 1 contributing 29 % and Factor 2 contributing 10.7.

The data revealed that Turkish science teachers have a favorable attitude towards ICT (M=4.04). The teachers agreed with the 20 positively statements about the effect of ICT on teaching and learning statements (e.g. "I believe that the students will be more interested in the courses that are implemented with ICT", "I believe that audio-visual tools enhance the learning permanence"). They disagreed with all 11 "negative" value statements (e.g. "I think that the usage of ICT restricts the creativity of the students", "The usage of ICT in the courses brings too much overload"). Science teachers got highest scores from Effect of ICT on Teaching and Learning factor (M=4.20) and moderately high from Obstacles to Implementation of ICT factor (M=3.73). Detailed results are summarized in Table 2. All items indicate largely positive attitudes toward the use of ICT in education.

Table 2. Descriptive Statistics, Factor Loadings and Item-Total Correlations of STATICTE Scale

Factors	Items	Mean	SD	Factor Loadings	Correlations
F1	1.	4.4439	.6460	.548	.4607
	3.	4.2653	.7558	.674	.5664
	4.	4.3988	.7193	.676	.5833
	8.	4.2560	.6940	.692	.6179
	9.	4.4243	.6787	.664	.5568
	10.	4.3546	.6911	.783	.6697
	11.	4.2032	.7906	.722	.6409
	12.	4.2968	.6636	.776	.6500
	13.	4.3112	.7392	.653	.5930
	15.	4.2015	.7637	.655	.5812
	18.	4.4260	.7273	.594	.5172
	19.	3.7806	.9540	.458	.3683
	20.	4.2679	.7030	.595	.5284
	23.	4.0306	.7293	.658	.6091
	24.	4.2764	.6724	.726	.6510
	25.	4.0009	.7790	.647	.6022
	27.	4.0867	.7212	.666	.5983
	28.	3.7764	1.0503	.452	.3284

	29.	4.1488	.7246	.686	.6082
	30.	4.0808	.7986	.516	.4445
F2	2. *	3.4490	1.0896	475	.3551
	5. *	3.7959	1.0376	493	.3518
	6. *	3.4592	1.0232	604	.3458
	7. *	3.7696	1.0316	613	.4541
	14. *	3.9549	.9740	521	.4848
	16. *	3.9014	1.0049	557	.2971
	17. *	3.7160	1.0102	503	.4647
	21.*	4.0153	.9325	537	.4658
	22. *	3.7364	1.1864	414	.2537
	26. *	3.7509	.9580	565	.4545
	31. *	3.5111	.9614	553	.4738

Note:* Represent negative items.

FINDINGS

One of the objectives of this study was to describe the demographic characteristics of science teachers. These characteristics are presented Table 3. As seen in Table 3, almost half (41.6%) of the teachers' ages change between 26-35 and over half are male. 71.7% of these teachers possessed the bachelor's degree while only 6.1 hold master's degree. Almost all (85 %) of the science teachers instructed in the state schools. Only 7.5 % of the teachers have administrative duty in their schools.

Table 3. Characteristics of the participants

	%
Gender	
Male	56.9
Female	43.1
Ages	
Less than 25	13.9
26-35	41.6
36-45	20
46 and above	24.1
School type	
Private	6
State	85
Other	3
Years of teaching experience	
Less than 4	22.9
5-9	21.4
10-14	24.1
15-19	6
20 and above	24.7
Highest Degree Held	
Bachelors (graduated from faculty of education)	48.3
Bachelors (graduated from other faculties like science)	23.4
Masters	6.1
Institutions of Education(two- or three-year higher education institutions)	21.6
Administrative duty in the school	
Yes	7.5
No	90.7

The second aim for this study was to investigate the science teachers' ICT experiences. Nearly half of the science teachers have attended in-service training regarding ICT; 84 % of them have shown willingness to participate if an ICT training course was to be organized; 63 % of the teachers have computer laboratories in their schools; 48% of them use computers in their courses. Although almost half of the teachers felt confident in using tools such as Word, PowerPoint and Excel, the figure falls to about 20% in using graphic programs such as Paint, Photoshop, etc. Most teachers had access to the Internet from their homes (52%) and from their schools (53%) while 61.8% of the teachers had e-mail addresses and 8 % of them had their own web pages.

An independent sample t-test was conducted to compare the mean scores of Factor 1, Factor 2 and overall attitude by gender (male vs. female teachers). As seen in Table 4, there were no significant differences between females' and males' mean scores of F1, F2 and STATICTE.

Table 4. Independent-samples t-test: Attitudes towards ICT by Gender

Scales	Gender	N	Mean	SD	t	P
F1*	Male	507	4.17	0.458	-.1.774	.076
	Female	664	4.22	0.499		
F2*	Male	507	3.73	0.552	0.65	.234
	Female	664	3.74	0.576		
Overall Attitude	Male	507	4.02	0.439	-1.191	.948
	Female	664	4.05	0.459		

* Subscales, F1= Effect of ICT on Teaching and Learning, F2=Obstacles to ICT Implementation

A one-way between-groups analysis of variance was conducted to explore the impact of age on levels of attitudes towards ICT and results are presented in table 5. Subjects were divided into three groups according to their age (Group 1: 20 to 35; Group 2: 36 to 49; Group 3: 50 and above). Means and standard deviations comparing Science Teachers' ages are shown at Table 6.

Table 5. Means and Standard Deviations Comparing Science Teachers' Ages

Age	**N**	**F1**		**F2**		**Overall Attitude**	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
20-35	654	4.23	.445	3.78	.536	4.07	.426
36-49	443	4.17	.528	3.67	.636	3.99	.480
50-+	75	4.15	.508	3.68	.614	3.98	.463
Total	1172	4.21	.482	3.73	.583	4.04	.451

As it can be seen from Table 6, there was statistically significant difference at the $p<.05$ level in total attitude and F2 subscale scores for the three age groups. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group 1 was significantly different from Group 2 and Group 3 regarding F2 and overall attitude. However it was not found any difference in F1 scores regarding teachers' age.

Table 6. Comparisons Science Teachers' Mean Scores According to Their Ages

Scales	df	SS	MS	F	P	Significant difference
F1						
Between groups	2	1.164	.582			
Within groups	1169	271.564	.232	2.51	.082	-
Total	1171	272.728				
F2						
Between groups	2	3.286	1.643			20-35/36-49
Within groups	1169	394.593	.338	4.87	.008	20-35/50+
Total	1171	397.879				
Overall Attitude						
Between groups	2	1.766	.883	4.37	.013	20-35/36-49
Within groups	1169	236.238	.202			20-35/50+
Total	1171	238.004				

An independent-samples t-test was conducted to compare science teachers' attitudes towards ICT by computer ownership at home. As seen in Table 7, there was significant difference in scores for computer ownership and non-computer ownership. For the factors, we found significant difference in Factor 1 whereas we did not find any significant difference in Factor 2. The magnitude of the differences in the means was small (eta squared=.01). It also means, only 1 percent of the variance in attitudes is explained by computer ownership.

Table 7. Independent-samples t-test: Attitudes towards ICT by Computer Ownership at home

Scales	Ownership	N	Mean	SD	t	P
F1*	Yes	845	4.24	.476	4.175	.000**
	No	315	4.11	.488		
F2*	Yes	845	3.74	.585	1.522	.128
	No	315	3.69	.581		
Overall Attitude	Yes	845	4.06	.445	3.593	.000**
	No	315	3.96	.456		

* Subscales, F1= Effect of ICT on Teaching and Learning, F2=Obstacles to ICT Implementation, ** $p<0.05$

ANOVA test were used to analyze the differences between computer experience groups and their ICT attitudes. Computer experience scores were categorized into four groups: Group 1: 0-1 years; Group 2: 1-3 years; Group 3: 3-5 years and Group 4: 5 years and up. Means and standard deviations comparing Science Teachers' computer experiences are shown at Table 8.

Table 8. Means and Standard Deviations Comparing Science Teachers' Computer Experience

Computer Experience	**N**	**F1**		**F2**		**Overall Attitude**	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
0-1 Years	124	4.16	.419	3.59	.559	3.96	.394
1-3 Years	325	4.19	.429	3.71	.584	4.02	.398
3-5 Years	280	4.21	.499	3.70	.568	4.03	.463
5 Years and up	321	4.28	.484	3.86	.588	4.13	.469
Total	1050	4.22	.465	3.74	.584	4.05	.441

Comparisons of Science Teachers' mean scores according to computer experience are shown at Table 9. There was statistically significant difference at the $p<.05$ level in STATICTE and F2 scores for the four groups. Despite reaching statistical significance, the actual difference in mean scores between the groups was quite small. The effect size, calculated using eta squared, was .02. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for Group 4 was significantly different from Group 1, Group 2 and Group 3. The results showed that teachers' computer experience affected ICT attitudes.

Table 9. Comparisons Science Teachers' Mean Scores According to Computer Experience

Scales	df	SS	MS	F	P	Significant difference
F1						
Between groups	3	1.848	.616			
Within groups	1046	225.667	.216	2.855	.056	
Total	1049	227.525				
F2						
Between groups	3	8.556,	2.852			0-1 / 5-+
Within groups	1046	349.486	.334	8.536	.000	1-3 / 5-+
Total	1049	358.041				3-5 / 5-+
Overall Attitude						0-1 / 5-+
Between groups	3	3.667	1.222	6.365	.000	1-3 / 5-+
Within groups	1046	200.838	.192			3-5 / 5-+
Total	1049	204.505				

CONCLUSIONS AND RECOMMENDATIONS

In this study, we investigated the Turkish science teachers' ICT experiences, attitudes toward ICT and relationships between teachers' attitudes and the selected variables such as gender, age, computer ownership and computer experiences.

In many studies, "computer experience" has been found as an important factor for influencing teachers' instructional computer use (Asan, 2002; Braak, 2001; Jenson, Lewis, & Smith, 2002; Zhao & Cziko, 2001, Sahin & Thompson, 2006). Teachers' computer knowledge and experience are especially important for effective usage of ICT in their classroom. Because, generative learning begins at the knowledge stage of diffusion, which is the first stage (Rogers, 1983, p. 165). In the present study, approximately 80 percent of science teachers were at least 1-3-years computer user. This result can be interpreted that most science teachers have enough experience in computer use and they can be expected to adopt computer technologies into their instruction.

The results of the study showed that almost half of the Turkish science teachers use computers in their courses and they had high levels of computer access, especially in their school and at their homes. Computer access in classrooms is important for the successful adoption of computers in using instructional purposes (Sahin & Thompson, 2006; Tella et al, 2007). According to Medlin (2001) and Surendra (2001), the accessibility and availability of computers was an important factor affecting the use of computers for instructional purposes. Rogers (2003) indicated that trialability and observability are the two attributes of an innovation that might increase the rate of adoption of innovations. If science teachers are aware of computer technologies and have opportunity to access computers, their level of using technology in their courses might be rise.

According to Loyd & Gressard (1986), positive attitudes towards computers are positively correlated with teachers' extent of experience with computer technology (cited in Christensen, 2002). This result could be anticipated due to the importance placed on the use of technology in all parts of our life. Several studies conducted in other countries also found similar findings about teachers' attitudes toward ICT in education (Albirini, 2006; Sadik, 2006; Samak, 2006; Yunus, 2007). In our study, almost all Turkish science teachers have showed positive attitudes toward ICT in education. This situation can be explained by the fact that almost 65% of the Turkish primary science teachers consist of young individuals who are below the age of 35. One might expect that younger teachers will be open to the use of ICT and have experienced ICT during their education. Although there seems some problems with using ICT in classrooms like insufficient ICT tools, teachers' lack of computer confidence in teaching (Asan, 2003) and etc. teachers' positive attitudes are promising for Turkey

The science teachers reported that they (almost half of them) had enough opportunity to attend in-service training related to use of ICT in classroom. It is the responsibility of administration to provide school with a social environment that includes these attributes of innovations. The science teachers (83% of them) reported that they would like to attend a course related to ICT in education. This outcome is a kind of important point for Rogers' (2003) trialability and observability attributes of innovations. The findings revealed the need for training in the integration of technology in curriculum.

The findings of the study revealed no significant differences between ICT attitudes of Turkish science teachers in terms of gender. This would suggest that male and female science teachers in Turkey have the same perception about the use of ICT in education. There are some research reports that bring to light gender differences in ICT attitudes (Shapkaa & Ferrarib, 2003). While some studies have found no gender differences in attitudes towards computers (Gressard & Loyd, 1986; Woodrow, 1992), the results of other studies found that females manifested higher levels of anxiety in relation to computers than males (Sadik, 2005; Samak, 2006). According to North & Noyes (2002), using ICT tools is widely perceived as a masculine activity and their research provided evidence for a linkage between gender and technophobia (cited in, Samak, 2006). Female teachers have been found to be more anxious and less confident computer users in most of the studies. In addition, male teachers have been found to have more prior experience with computers and to be much more likely to implement computer use in their classrooms than female teachers.

In the research literature, there are different findings from different studies in terms of teachers' attitudes and teachers' age. For example, while some studies found that there is no significant relationship between teacher's age and attitudes (Massoud, 1991; Woodrow, 1992 & Handler, 1993), other studies found that teachers' ages have critical effects on the teachers' attitudes (Chio, 1992; Blankenship, 1998). In our study, statistically significant difference was found between teachers' age and attitudes. Young Turkish science teachers in the group 1 (age group:20-35) have more positive attitudes and significantly differ than the teachers in other groups (36-49 / 50- +). The mean scores of the science teachers gained from Effect of ICT on Teaching and Learning subscale does not significantly differ with their ages. This result can be an indicator that all science teachers aware of the importance of ICT usage in teaching and learning environments. However, Chio (1992) shown that old teachers have more positive attitudes toward computer use in education than young teachers but he found that young teachers are more computer literate people than the old teachers. Deniz (2005) has also found that the age of 36 is the breaking point for the positive attitudes of primary school teachers. We consider the fact that science teachers in Turkey are coming from a young population as an important factor in the outcome of their positive attitudes towards the use of ICT in the classrooms.

There are many studies that investigate the relationship between teachers' personal computer ownership and various variables. According to Wood, Putney & Cass (1997) study, computer ownership and access to computers were the best predictors of perceived computer competence. Monk, Swain, Ghrist & Riddle (2003) found that Egyptian teachers with personal computers have tended to concentrate on improving the quality of current practice, through better preparation and student testing, rather than introducing major, paradigmatic,

changes to their teaching. Roussos (2007) found that computer ownership had a significant effect on the participants' computer attitudes. In particular, significant differences were evident for those who owned a computer in terms of positive computer attitudes. In the Sadık's study (2006), it is found that the majority of the Egyptian teachers did not own a computer and for this reason, high usage of computers for low-level purposes (such as word processing and playing audio records) was seen. In our study, we found that the Turkish science teachers who own computers had more positive attitudes than those that did not.

In the literature, positive correlations have been shown between various computer experiences and attitudes (Dupagne & Krendel, 1992; Levine & Donitsa-Schmidt 1998; Winter, Chudoba & Gutek, 1998; Smith, Caputi & Rawstorne, 2000; Yıldırım, 2000; Gaudron & Vignoli 2002). According to Gardner, Dukes & Discenza (1993), computers can play important role to reduce computer anxiety which is seen as a teacher resistance to integrate ICT in teaching and learning environment. Yang, Mohamed, & Beyerbach (1999) searched the relationship among computer experience and various demographic variables, specifically learning style, age, gender, ethnicity/culture, subject area, educational level, and type of school. They found that teachers' negative attitudes towards computers change after receiving formal training about computer use (Dupagne & Krendel, 1992; Koohang, 1987). In our study, we found that science teachers' attitudes toward ICT differs with computer experience and prior computer experience is one of the important factors that effects teachers attitudes toward ICT in education. We also found that teachers in the fourth group (5 years and up) have more positive attitudes than the teachers in the other groups.

Using ICT in education should not be understood as using it as a tool to transfer instructional material and rehearsal but as a medium for learning, discovering, sharing and creating knowledge. However, the infrastructure issues are given more importance than in improving learning and teaching (Becta, 2008) and often investment are done in the latest technologies without considering the target group's needs and interests (Albirini, 2006; Usun, 2004). Being the prime actors in implementing ICT in learning and teaching, teachers should be in the center of attention. They should be involved in all stages of the implementation and meanwhile be assured that this approach is advantageous over the previous one, is compatible with their teaching practices and they will be given any technical help and training. As a consequence of integrating ICT in education a change is expected to occur in the style of teaching and learning as noted by Harris et al (2002) ".. it is not necessarily the technology that has to be innovative, but the approach to teaching and learning must be" (p. 35). For this to be realized the teachers must be supported with instructional materials and teaching models. Courses related to instructional technologies at the faculties of education should be re-constructed and made compulsory. Finally, further researches that specifically use qualitative methods are needed to validate and elaborate quantitative findings. We think that this study will enlighten projects developed by the Ministry of Education in order to use ICT in education besides expecting it to serve as a reference for different studies in this field.

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REFERENCES

Akkoyunlu, B. (1996) Öğrencilerin bilgisayara karşı tutumları. *Eğitim ve Bilim.* 20(1), 15-29.

Albirini, A. (2006) Teachers' attitudes toward information and communication technologies: the case of Syrian EFL teachers. *Computers and Education*, 47(4), 373–398

Allan, Y., Will, M. (2001). Teachers' computer attitudes: Factors influencing the instructional use of computers. Paper presented at the International Conference on Computers in Education, Seoul, Korea.

Altun, A. (2003) Ögretmen adaylarının bilişsel stilleri ile bilgisayara yönelik tutumları arasındaki ilişkinin incelenmesi**.** *The Turkish Online Journal of Educational Technology.* 2(1), Retrieved from www.tojet.net

Altun, T. (2007). Information And Communications Technology (ICT) In Initial Teacher Education: What Can Turkey Learn From Range of International Perspectives? *Journal of Turkish Science Education*, 4 (2), 45-60.

Anderson, J., Weert, V, T. (2002). *Information and Communication Technology in Education. A Curriculum for schools and Programme of Teacher Development*. Division of Higher Education. UNESCO.

Asan, A. (2002). Preservice teachers use of technology to create instructional materials: A school-college partnership. *Journal of information Technology for Teacher Education 11*(2), 217–232.

Asan, A. (2003) Computer Technology Awareness by Elementary School Teachers: A Case Study from Turkey. *Journal of Information Technology Education*. 2, 150-163.

Bayhan, P., Olgun P. & Yelland, J. N. (2002). A study of pre-school teachers' thoughts about computer-assisted instruction, *Contemporary Issues in Early Childhood*, 3(2), 298-303.

Bayrakçı, M. (2005). Avrupa Birliği ve Türkiye Eğitim Politikalarında Bilgi ve İletişim Teknolojileri ve Mevcut Uygulamalar. Retrieved from http://yayim.meb.gov.tr/dergiler/167/index3-bayrakci.htm

Becta, (2008). Harnessing Technology Review 2008: The role of technology and its impact on education, BEC1-15587. Retrieved: http://publications.becta.org.uk/display.cfm?resID=38751&page=1835

Berberoglu, G., and G. Calikoglu. (1993). Factorial validity of the Turkish Computer Attitude Scale. *Studies in Educational Evaluation* 19(3), 257-63.

Blankenship, S. E. (1998). Factors related to computer use by teachers in classroom instruction. Doctoral Dissertation, Virginia Polytechnic Institute and State University.

Braak, J.V. (2001). Individual characteristics influencing teachers' class use of computers. *Journal of Educational Computing Research, 25*(2), 141–157.

Cagiltay, K., Cakiroglu, J., Cagiltay, N. and Cakiroglu, E. (2001). Teachers' perspectives about the use of computers in education. *Hacettepe Universitesi Egitim Fakultesi Dergisi*, 21, 19-28.

Catell, R.B. (1966). The scree test for the number of factors. *Multivariate behavioral research*, 1, 245-276.

Cavas, B. (2005) Designing Learning Environment Integrated with Technology. Unpublished Doctoral Thesis. Institute of Educational Sciences, Dokuz Eylul University.

Cavas, B. and Kesercioglu, T. (2003). Primary Science Teachers' Attitudes toward Computer Assisted Learning. *Ege Journal of Education*, 3(2), 35-43.

Ching, O. (1999). *Assessment of staff attitudes towards computers and its implications on the use of IT in school*. Suntec City, Singapore: Ministry of Education.

Chio, Y. K. (1992). Attitudes toward and knowledge of microcomputers used for instruction among commercial high school teachers in Korea. Unpublished EDD dissertation. University of Georgia. AAT 9316322.

Chou, T. R. (1997). The relationships among computer usage, experience with the computer, computer anxiety, and attitudes toward computers for secondary agricultural education teachers in the United States. Mississippi State University: Dissertation.

Christensen, R. (1998). Effect of Technology Integration Education on the Attitudes of Teachers and their Students. Doctoral dissertation, University of North Texas. Retrieved from http://www.tcet.unt.edulresearch/dissert/rhondac.

Christensen, R. (2002). Effect of Technology Integration Education on the Attitudes of Teachers and their Students. *Journal of Research on Technology in Education*, 34 (4), 411-433.

Christensen, R. and Knezek, G. (1996) Constructing the Teachers' Attitudes Toward Computers (TAC) Questionnaire. (ERIC Document Reproduction Service No. ED398244).

Cox, M.J., Preston, C., and Cox, K. (1999) What Motivates Teachers to use ICT? Paper presented at the British Educational Research Association Conference. Brighton. September

Davis, D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 13 (3): 319-40.

Deniz, L. (2005). İlköğretim Okullarında Görev Yapan Sınıf ve Alan Öğretmenlerinin Bilgisayar Tutumları. *The Turkish Online Journal of Educational Technology*. 4(4). Retrieved from www.tojet.net

Dupagne, M., and Krendel, K. A. (1992). Teachers' attitudes towards computers: A review of literature. *Journal of Research on Computing in Education*, 24(3), 420-429.

European Commission (2005) "Implementing the Education and Training 2010 Work Programme". European Commission. Retrieved: http://europa.eu.int/comm/education/news/what/index_en.html

Francis, J. (1993). Measuring attitude toward computers among undergraduate college students: The affective domain. *Computers and Education*, 20(3), 251-55.

Francis, L., Y. Katz, and S. Jones. (2000). The reliability and validity of the Hebrew version of the Computer Attitude Scale. *Computers and Education*, 35(2), 149-59.

Gardner, D. G., Dukes, R. L. and Discenza, R. (1993). Computer Use, Self-Confidence and Attitudes: A Causal Analysis. *Computers in Human Behavior*. 9(3), 427-440.

Gaudron J.-P. and Vignoli E. (2002) Assessing computer anxiety with the interaction model of anxiety: development and validation of the computer anxiety trait subscale. *Computers in Human Behavior* 18, 315–325.

Gomleksiz, M. N. (2004). Use of education technology in English classes. *The Turkish Online Journal of Educational Technology*. 3(2). Retrieved from www.tojet.net

Gressard, C. P., and Loyd, B. H. (1986). Validation studies of a new computer attitude scale. *Association for Educational Data Systems Journal*, 18, 295–301.

Griswold, P. A. (1983). Some determinants of computer awareness among education majors. *Association for Educational Data Systems Journal*, 16(2), 92-103.

Gulbahar, Y. (2008). ICT Usage in Higher Education: A Case Study on Preservice Teachers and Instructors. *The Turkish Online Journal of Educational Technology*. 7(1). Retrieved from www.tojet.net

Handler, M.G. (1993). Preparing new teachers to use computer technology: Perceptions and suggestions for teacher educators. *Computer Education*, 20(2), 147-156.

Harper, D. O. (1987). The creation and development of educational computer technology. In R. M. Thomas, and V. N. Kobayashi (Eds.), *Educational technology – its creation, development and cross-cultural transfer* (pp. 35–64). Oxford: Pergamon Press.

Harris, S., Kington, A., Lee, B. (2001) ICT and innovative pedagogy: examples from case studies in two schools collected as part of the Second Information Technology in Education Study (SITES) in England. British Educational Research Association Annual Conference, University of Leeds.

Hawkins, R. (2002) Ten Lessons for ICT and Education in the Developing World. World Links for Development Program The World Bank Institute. 38-43

Heinssen, R. K., Jr., Glass, C. R., and Knight, L. A. (1987). Assessing computer anxiety: Development and validation of the computer anxiety rating scale. *Computers in Human Behavior*, 3, 49-59.

Jager, A.K., Lokman, A.H. (1999) Impacts of ICT in education. The role of the teacher and teacher training. European Conference on Educational Research, Lahti, Finland 22 - 25 September 1999

Jenson, J., Lewis, B., & Smith, R. (2002). No one way: Working models for teachers' professional development. *Journal of Technology and Teacher Education.* 10(4), 481–496.

Jones, T., and Clarke, V. A. (1994). A computer attitude scale for secondary students. *Computers Education*, 22(4), 315–318.

Kay, R.H. (1993). An exploration of theoretical and practical foundations for assessing attitudes toward computers: The computer attitude measure (CAM). *Computers in Human Behavior*, 9, 371-386.

Kellenberger, D., and S. Hendricks. (2003). Predicting teachers' computer use for own needs, teaching, and student learning. Paper presented at Hawaii International Conference on Education,

Knezek, G., Miyashita, K. (1993). Handbook for the Young Children's Computer Inventory. Denton, TX: Texas Center for Educational Technology.

Koohang, A. (1989). A study of attitudes toward computers: Anxiety, confidence, liking and perception of usefulness. *Journal of Research on Computing in Education* 22(2), 137-50.

Koohang, A. A. (1987). A study of the attitudes of pre-service teachers towards the use of computers. *Educational Communication and Technology Journal*, 35(3), 145-149.

Lawton, J., and T. Gerschner. (1982). A review of the literature on attitudes towards computers and computerized instruction. *Journal of Research and Development in Education* 16(1), 50-55.

Levine T. and Donitsa-Schmidt S. (1998) Computer use, confidence, attitudes and knowledge: a causal analysis. *Computers in Human Behavior* 14, 125–146.

Likert, R.A. (1932) A Technique for the measurement of attitudes. *Archives of Psychology*, 140, 1-55.

Loyd, H., and P. Gressard. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Management.* 44, 501-505.

Massoud, S. L. (1991). Computer attitudes and computer knowledge of adult students. *Journal of Educational Computing Research*, 7(3), 269-291.

Medlin, B.D. (2001). The factors that may influence a faculty member's decision to adopt electronic technologies in instruction (Doctoral dissertation, Virginia Polytechnic Institute and State University, 2001). *ProQuest DigitalDissertations*. (UMI No. AAT 3095210).

Michiels, S.I. and Van Crowder, L. (2001). *Discovering the "Magic Box": Local appropriation of information and communication technologies (ICTs).* Sustainable development Department, Food and Agriculture Organisation of the United Nations (FAO).

MoNE (2007) MEB İnternete Erişim Projesi. Retrieved: http://www.meb.gov.tr/ADSL/adsl_index.html

Monk, M., Swain, J., Ghrist, M., Riddle, W. (2003) Notes on Classroom Practice and the Ownership and Use of Personal Computers Amongst Egyptian Science and Mathematics Teachers. *Education and Information Technologies*, 8(1).

Ocak, M. A. and Akdemir, O. (2008). An Investigation of Primary School Science Teachers' Use of Computer Applications. *The Turkish Online Journal of Educational Technology,* 7(4), Retrieved from www.tojet.net

Oosterwegel, A., K. Littleton, and P. Light. (2004). Understanding computer-related attitudes through an idiographic analysis of gender- and self-representations. *Learning and Instruction* 14(2), 215-33.

Pelgrum, W.J., Janssen Reinen, I.A.M, Plomp, Tj (1993). Schools, teachers, students, and computers: A Cross-national perspective. Twente, Netherlands: I.E.A.

Raub, A. C. (1981). Correlates of computer anxiety in college students. Unpublished doctoral dissertation, University of Pennsylvania, Philadelphia.

Reece, J., and K. Gable (1982). The development and validation of a measure of general attitudes toward computers. *Educational and Psychological Measurement* 42, 913-916.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed.). New York; London: Free Press

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: London: Free Press

Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York, London: Free Press

Ropp, M. M. (1999). Exploring individual characteristics associated with learning to use computers in preservice teacher preparation. *Journal of Research on Computing in Education*, 31(4), 402-425.

Roussos, P. (2007) The Greek computer attitudes scale: construction and assessment of psychometric properties. *Computers in Human Behavior*. 23(1), 578-590

Sadik, A. (2005). Factors influencing teachers' attitudes towards personal use and schools use of computers: New evidence from a developing nation. *Evaluation Review, 2*(1), 1-29.

Sadik, A. (2006) Factors Influencing Teachers' Attitudes toward Personal use and school Use of Computers New Evidence From A Developing Nation, *Evaluation Review*, 30(1), 86-113

Sahin, I. and A. Thompson (2006). "Using Rogers' Theory to Interpret Instructional Computer Use by COE Faculty." *Journal of Research on Technology in Education*. 39(1), 81-104.

Samak, Z. A. (2006) An Exploration of Jordanian English Language Teachers'attitudes, Skills, and Access As Indicator of Information and Communication Technology Integration in Jordan. Unpublished Doctoral Thesis. Florida State University.

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16-19 education. *Computer and Education* 28(1), 35-41.

Shapkaa, J., and M. Ferrarib (2003). Computer-related attitudes and actions teacher candidates. *Computers in Human Behavior* 19(3), 319-34.

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

Surendra, S. S. (2001). Acceptance of Web technology-based education by professors and administrators of a college of applied arts and technology in Ontario (Doctoral dissertation, University of Toronto, 2001). *ProQuest DigitalDissertations*. (UMI No. AAT NQ58603).

Tella, Adeyinka., Tella, Adedeji., Toyobo, O.M., Adika, L.O., Adeyinka, A.A. (2007). An Assessment of Secondary School Teachers Uses of ICT's: Implications for further Development of ICT's Use in Nigerian Secondary Schools. *The Turkish Online Journal of Educational Technology*. 6(3). Retrieved from www.tojet.net

Troutman, A. 1991. Attitudes toward personal and school use of computers. *Technology and Teacher Education Annual* 284-87.

Usun, S. (2004) Factors Affecting the Application of Information and Communication Technologies (ICT) in Distance Education. Turkish Online Journal of Distance Education, 5(1), Retrieved: http://tojde.anadolu.edu.tr/tojde13/articles/usun.html

Watson, D.M. (Ed.) (1993) *IMPACT - An evaluation of the IMPACT of the Information Technology on Children's Achievements in Primary and Secondary Schools*. King's College London

Winter S., Chudoba K. and Gutek B. (1998) Attitudes toward computers: when do they predict computer use? Information and Management 34, 275–284.

Wood, T. L., P, D., Cass, M. A. (1997) Accessibility: The Main Factor Influencing Special Education Teachers' Perceived Level of Computer Competence. *Journal of Computing in Teacher Education*, 13(4), 20-24.

Woodrow, J. E. (1992), The influence of programming training on the computer literacy and attitudes of pre-service teachers. *Journal of Research on Computing in Education*, 25(2), 200-218.

Yang, H. H., Mohamad, D. A., and Beyerbach, B. A. (1999). An investigation on computer anxiety among vocational-technical teachers. *Journal of Industrial Teacher Education*, 37, 64-72.

Yildirim, S. (2000). Effects of an educational computing course on pre-service and inservice teachers: A discussion and analysis of attitudes and use. *Journal of Research on computing in Education*, 3, 479-495.

Yunus, M. M. (2007). Malaysian ESL teachers' use of ICT in their classrooms: expectations and realities. *ReCALL*, 19(1), 79-95.

Zhao, Y., & Cziko, G. A. (2001). Teacher adoption of technology: A perceptual-control-theory perspective. *Technology and Teacher Education* 9(1), 5–30.