

Exploring secondary education teachers' attitudes and beliefs towards ICT adoption in education

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Abstract

The survey presented in this article aims at the investigation of secondary education teachers' attitudes and beliefs about ICT in education. It has been administered to a total of 240 secondary education teachers, coming from the Ioannina prefecture, in Greece. Our results show that the great majority of the teachers in the sample are positive towards acquiring basic skills on ICT, applying ICT tools in their instruction and the role that ICT could play in education. We have recorded differences in teachers' beliefs according to their attributes such as gender, specialty, teaching experience, computer experience, training on ICT, and computer ownership. Our findings have also revealed some parameters, which interfere making thus many teachers cautious or fearful about ICT integration in the educational practice. On the other hand, multivariate analysis has identified three discrete groups of teachers which have exhibited a persistent and rather consistent approach: a group having strongly positive attitudes about ICT in education, a second group of teachers which are in general positive, and a third one with negative or neutral beliefs.

Introduction

The expansion of Information and Communications Technologies (ICT) are increasingly ubiquitous and influences many social aspects such as administration, economy, education, culture etc. Nowadays, there is little doubt that ICT and education are intimately associated. Students' familiarity and confidence with new technology tools, as well as their development on high level ICT skills considered to be within the core of the basic curriculum, equivalent to reading and writing (Unesco, 2000). Moreover, ICT is perceived as an integral part of the educational reform efforts necessary to prepare teachers (Davis, 2003; Niemi, 2003; Pearson, 2003) for the Information Society¹.

1. An interesting approach one could find in the special issue "The preparation of teachers for the Information Society", *THEMES in Education*, 2(4), 2001.

In this framework, ICT have drastically altered what skills in-service and pre-service teachers should have. Teachers not only must be familiar with new possibilities for learning, offered by these new technologies, but also must be able to help children learn about and with ICT through their active engagement to appropriate activities. Today schools gain access to greater numbers of computers, more sophisticated software and connections to the Internet and the Web. Despite that, teachers do not appear to make effective use of ICT tools for instruction (Russel et al., 2003; Zhao and Cziko, 2001). It seems that, teachers' attitudes and skill levels still remain an obstacle to ICT adoption and integration in the educational process (Becker, 1999; Dexter et al., 1999; Lang, 2000; Pelgrum, 2001).

Pajares (1992) stated that teachers' educational beliefs are strong indicators of their planning, instructional decisions and classroom practices. The knowledge of the impact of ICT on teachers is consequently very important, since teachers are at the center of the educational reform efforts, both as active participants and as leaders of students' activities. Given that teachers have a tremendous potential to affect students' beliefs and values, they strongly affect students' attitudes when using computers for educational purposes (Christensen, 1998). Moreover, we need to understand teachers' attitudes, perceptions and beliefs about technology in teaching and learning, in order to improve teacher education and in-service training programs aiming at their preparation to effectively apply ICT in their instruction.

Literature review

Attitude toward computers and ICT is a multi-faced variable. Many instruments exist to measure attitudes toward computers in education (i.e. Rosen and Weil, 1995; Levine and Donitsa-Schmidt, 1998; Ropp, 1999; Evans-Jennings and Okwuegbuzie, 2001). Most of them have reveal four correlated dimensions:

1. Anxiety, fear or cautiousness of using computers and ICT tools
2. Self-efficacy and confidence in the ability to use ICT
3. Liking to use computers and new ICT tools
4. Beliefs and perceptions about the value and usefulness of using ICT in education.

During the past decade a number of studies have investigated students' and teachers' attitudes toward computers and their correlates to various variables such as age, gender and experience (Woodrow, 1994; Busch, 1995; Rosen and Weil, 1995; Christensen, 1997; Levine and Donitsa-Schmidt, 1998; Yaghi and Abu-Saba, 1998; Ropp, 1999; Yildirim 2000; Evans-Jennings and Okwuegbuzie, 2001).

Research has also shown that there are gender differences in teachers' beliefs about ICT and their engagement with ICT. Female teachers tend to have higher levels of computer anxiety (Rosen and Weil, 1995) and to be less confident computer users (Lee, 1997). Shapka and Ferrari (2003) have shown that while gender differences about computers may be diminishing, there are still dramatic differences in the attitudes of teachers related to the various grade-levels. Primary school teachers tend to have higher levels of computerphobia and were more likely to avoid ICT than high school teachers. In contrast, secondary teachers were more likely to use computers in the classroom, but were also more likely to exhibit gender-stereotypical attitudes (Whitley, 1997).

Research findings indicate that many teachers have positive attitudes toward technology but they do not consider themselves qualified to teach with technology (Ropp, 1999). Teacher competence and confidence with ICT is the principal determinant of effective classroom use by students (Collis et al., 1996). It appears that teachers training to teach at the secondary level had higher self-efficacy than elementary teachers and were less likely to predict that they would give up or avoid a challenging task (Rosen and Weil, 1995; Shapka and Ferrari, 2003).

The literature suggests lack of adequate training and experience as one of the main reasons why teachers have negative attitudes toward computers and do not use technology in their teaching. Most findings show that teachers with computer knowledge and experience have a more positive attitude toward the potential of ICT in education (Francis-Pelton and Pelton, 1996; Ropp, 1999; Luan et al., 2005). In addition, training is an important factor in fostering favorable attitudes towards computers (Ropp, 1999; Yildirim, 2000). The impact of effective teacher training about ICT could be measured in terms of changes in attitudes on the part of the teachers (Yildirim, 2000; Kumar and Kumar, 2003) and their students also (Christensen, 1997).

Teachers' attitudes and beliefs towards ICT adoption and ICT integration in the educational process have received particular attention during the last years. Stetson and Bagwell (1999) have analyzed the resistance of many schools, colleges, and departments of education to embrace technological applications into their methods coursework. Most teachers agree that computers constitute a valuable tool and are positive about students' achievement of the relevant skills. They usually perceive ICT as a new area (subject) in schools rather than a new model of teaching strategies and interactions between learners and knowledge (Loveless, 2003). On the other hand, although teachers recognize the importance of introducing ICT in education, they tend to be less positive about extensive use of ICT in the classroom and far less convinced about its potential to improve

instruction (Russel et al., 2003; Waite, 2004). Based on the results of their study, Sugar et al. (2004) have outlined ICT adoption as a personal decision uninfluenced by other people and the presence of resources or impediments in the local school/district. It appears that teacher advances in technology integration occur slowly and proceed through a set of distinctive stages (Rogers, 1995; Russel, 1995; Sherry, 1998; Liu and Huang, 2005), where the highest stages require changes in attitudes more so than skills (Knezek and Christensen, 2000).

As far as the case of Greece concerns, data available show that the majority of the teachers have positive attitudes towards the introduction of ICT in education (Emvalotis and Jimoyiannis, 1999; Tsitouridou and Vrizas, 2003). It has been found in a previous survey, administered to upper secondary education teachers coming from the Ioannina urban area (Emvalotis and Jimoyiannis, 1999), that the majority of the participants had lack of skills and knowledge of using computers. Teachers studied reported low level abilities of using ICT, since they had proper skills to use word processing (at a percentage of 20%), spreadsheets (10%), databases (6%), and Internet and multimedia applications (11%). The great majority of the teachers in the sample (87%) expressed their beliefs that ICT should play a significant role in education, while computer facilities and educational software were perceived as the main obstacles for applying ICT in their teaching.

Demetriadis et al. (2003) have administered a study on secondary teachers who attended a three months training program on general ICT tools and specific educational software. Using data from teacher-mentors' reports and interviews, they have found that teachers were interested in using ICT to attain a better professional profile and take advantage of any possible learning benefits offered by ICT. But they appeared to cautiously adapt ICT usage to the traditional teacher-centered mode of teaching.

ICT in Greek secondary schools

Greek secondary education comprises three types of schools, three grades each:

- Gymnasiums – lower secondary schools (student ages 13-15)
- Lyceums – upper secondary schools (student ages 16-18)
- Technical Vocational Schools (student ages 16-18).

ICT in Greek secondary education have been introduced since 1985 through the establishment of the Informatics subject matter in the Curriculum. Komis and Mikropoulos (2001) have described two different models (approaches) as far as the introduction of ICT in education concerns:

Technocentric model: It was the approach followed when a new subject about

computer science, named Informatics, was introduced in the Curriculum of the Technical Vocational Schools (1985) and Gymnasiums (1992). Teaching was focused on using computers, and learning programming languages and general-purpose applications. There was no correlation or interaction with the other subject matters. This approach is principally different to the *holistic model*, where ICT is diffused into the Curriculum as a teaching and learning tool for every subject matter.

Realistic model: On 1998 a new approach about ICT in the schools has been established, in the framework of extended educational changes concerning upper secondary education (Ministry of Education, 1998). Informatics was introduced in Lyceums too, but still remains an autonomous subject in the Curriculum of the secondary education. On the other hand, various initiatives have been designed in order to promote gradual integration of ICT as a tool for teaching and learning for every subject matter in the Curriculum.

As far as the teachers' preparation concern, it was restricted to traditional, sparse courses carried out by the Peripheral Teacher Training Institutes. Those programs were lasted 39 hours in total and focused on teachers' familiarization with computers and the basic ICT skills. They had very poor results as far as teachers' development on ICT concerns (Emvalotis and Jimoyiannis, 1999), since they were not enrolled in a wider framework aiming at the integration of ICT in the educational process.

The first well-designed effort started on 1996, when Greek Ministry of Education launched an ambitious program for the introduction of ICT in secondary education, named *Odysseia*. This program, funded by Greek and EU authorities, elaborated between 1996 and 2001 in order to produce fundamental changes in Greek educational system (*Odysseia*, 2001). It has been founded on a comprehensive approach towards ICT in education. Computer science is addressed in such a way, so that pupils perceive ICT not only as an independent scientific domain but also as a tool to be used for teaching, learning and communicating. In conclusion, *Odysseia* aimed to create a critical mass of school communities, which could integrate new instructional practices based on ICT. Three basic action lines involved in:

Setting up the necessary infrastructure: Fully equipped computer labs connected to the Greek School Network and continuous technical support for the schools. During 2004 all secondary schools had at least one computer laboratory of 10-12 stations each (there also schools having 2 or more computer labs) and an Internet connection line. Many secondary schools and an increasing number of primary schools have already developed their own school websites and announce their presence in cyberspace. Moreover, all primary and

secondary teachers could have their own e-mail account freely through the Greek School Network.

Developing the appropriate educational material: 52 new educational software titles have been developed (covering various subjects in the curriculum), and 14 well-established titles from the international literature have been adapted into Greek.

Training and support for every teacher: Teachers' ICT training and support should be continuous, within the school environment and directed to the instructional practice.

Odysseas was a pilot project in Odysseia aiming at the introduction of ICT in 19 secondary schools including a teacher-training component also (Odysseas, 2001). Two independent studies (Kynigos et al., 2000; Politis et al., 2000), which investigated the attitudes of the teachers participated in, reported that teachers

- were positive about their training and exhibited positive attitudes about the use of ICT in the schools
- considered that the educational software available was limited both in terms of the quantity and the variety of the subject matter covered
- were not satisfied of the technical and pedagogical support currently available at the schools
- were not satisfied of the didactical and pedagogical scenarios used about ICT application in their subject matter.

In the framework of the *Information Society* initiative, Greek Ministry of Education and EU Commission have funded a large-scale project, aiming at *Teachers' Training on ICT in Education* (Information Society, 2003). This ambitious programme is focused on teachers' acquiring basic ICT knowledge and skills towards ICT application in education. The first phase of this project has been established during 2002-2003 and approximately 84,000 primary and secondary education teachers participated in.

All previous studies in Greece have demonstrated that ICT integration in Greek educational system still has a long way to go through. Although secondary education schools have, at least, one computer lab consisted of 10-12 PCs connected to the Internet, the effort of diffusing ICT in the educational practice has no significant effect yet. For the great majority of the Greek schools ICT is still restricted to a separate subject, named Informatics, which has no correlation with the other subjects in the Curriculum. Although the new Curriculum for the secondary education, launched on 1998 as a result of a general educational reform (Ministry of Education, 1998), favors the use of innovative educational media it appears that ICT has not been incorporated into everyday teaching practice (Demetriadis et al., 2003).

The study

Objectives and research questions

Current literature on teachers' attitudes about ICT in education has given considerable knowledge. There are three main purposes justifying this study:

1. To replicate and extend previous research in this area and to determine whether some of the prior findings still exist (Emvalotis and Jimoyiannis, 1999). We think that past research concerning Greek secondary education teachers may become dated, due to the rapid pace of increasing ICT accessibility in Greek schools and society.
2. The results presented here are, to our knowledge, the first large scale findings concerning Greek secondary education teachers' attitudes and beliefs about ICT in education. We consider that it is of particular educational value to compare our findings with those of similar studies administered to various countries.
3. Last years, EU and Greek authorities have funded two large projects aiming at improving ICT infrastructure in the schools and teachers' technology skills (Odyssea, 2000; Information Society, 2003). Data presented here have been recorded during an intermediate period for the Greek educational system, just before the expansion of the Teachers' Training on ICT in Education project. We think that our results would be valuable for the Greek educational policy authorities as far as ICT integration in the schools concern.

We have used the method of *Multiple Correspondence Analysis (MCA)* to analyze the research data. MCA is a descriptive-exploratory technique designed to analyze and explore the structure of multiple categorical variables (Benzécri, 1992; Greenacre, 1993). It produces a graphical representation of the relationships between input data, suggesting thus unexpected dimensions and relationships in the tradition of exploratory data analysis even if no one expects 'theory' to emerge automatically from those data. The results produced provide information similar to that of principal components or factor analysis, avoiding the unease of those traditional multivariate techniques (Phillips, 1995).

This type of multivariate analysis, employed by SPAD software (SPAD, 2005), allows us to obtain a global view of the teachers' approaches across the items in the questionnaire and to reveal also numerous correlations according to their gender, specialty, age, teaching experience and other characteristics (Jimoyiannis and Komis, 2001). Moreover, MCA yields a topographic representation (correspondence map) of the various parameters making teachers' classification presentable on the basis of their approaches to the instrument items.

More specifically, our MCA analysis aims at a deeper investigation of the teachers' attitudes and beliefs concerning the integration of ICT in the educational practice covering the following directions:

1. What are teachers' beliefs, ideas or perceptions about the role of ICT in education?
2. What are teachers' attitudes toward ICT application in their instruction?
3. What issues do they estimate to be essential for their preparation and support, in order to be able to integrate ICT in the educational process?
4. Are there any differences in teachers' attitudes across their attributes, such as gender, age, specialty or teaching experience?

The sample

The survey presented has been administered to the public upper and lower secondary education schools at Ioannina prefecture, in Greece. A total of 240 secondary education teachers (115 males and 125 females) participated in the research. Subjects approximately represented 17% of the secondary teachers' body in the area. The following six age groups were established: 35 years or less (Age1), 36 to 40 years (Age2), 41 to 45 years (Age3), 46 to 50 years (Age4), 51 to 55 years (Age5), and 56 years or more (Age6). According to their teaching experience, seven teacher groups were established as follows: 1-5 years (TE1), 6-10 years (TE2), 11-15 years (TE3), 16-20 years (TE4), 21-25 years (TE5), 26-30 years (TE6), and more than 30 years old (TE7).

Half of the teachers in the sample (i.e. 119) reported owing a personal computer at home. Among the others, 10 teachers stated that they plan to buy a computer in 2 months, 16 in 6 months, 29 in 1 year and 20 in 2 years. 45 teachers, most of them at the end of their carrier, declare that they have no plan to buy a computer ever.

42.9% of the teachers in the sample have attended some training about computers use. According to their ICT engagement, we have discriminate five different groups of teachers as follows:

CE1: they have no PC experience and do not want to receive any training about (9.17%)

CE2: they have no PC experience but want to receive relevant training (43.75%)

CE3: they use general-purpose software sparsely (22.08%)

CE4: they use general-purpose software for personal purposes (17.08%)

CE5: they use general-purpose software (word processing, Internet) very often, to support conventional daily classroom activities, such as worksheets, tests etc. (7.92%).

The instrument

The instrument was a Likert-type scale containing 26 items that presented statements of attitudes or beliefs toward ICT and ICT application in education. Most of the survey statements were worded positively. We used a 5-point scale anchored by 'strongly agree' and 'strongly disagree'.

There are four dimensions represented in the scale, namely:

- How teachers evaluate the importance of their training and achievement on ICT skills?
- What are their attitudes about the application of ICT in their instruction and the educational practice in general?
- What are the teachers' perceptions and beliefs about the role that ICT could play in education (nowadays and in the near future)?
- How are teachers adopting ICT in education? What types of professional development and support do they require?

Demographic information such as gender, age, years of service experience, specialty, type of ICT training etc. was also requested (questions Q1-Q13). Furthermore, the instrument included a couple of questions aiming at teachers' beliefs about students' acquiring basic ICT skills and using ICT tools for research and learning along the Curriculum. The teachers in the sample stated particularly positive, at a percentage ranging from 87% to 99%, about those items. The relevant data were not incorporated in our multivariate analysis.

The procedure

No intervention took place before the survey. The researcher's role, during teachers' answering, was restricted to elucidating their questions in order to clarify the items under study. To ensure that all questions involved in the questionnaire were clearly understood, a trial run of the research was carried out in three upper secondary education schools. The trial group consisted of 36 teachers. Minor modifications concerning wording of the various statements were produced.

Results

Our findings have been analyzed along four axes, according to the research instrument. Data analysis included two distinct levels. The first level is based on the statistical description of the data and the second one involves their multivariate analysis. In MCA analysis we have used teachers' responses to the various items (Q_i values) as the dependent variables. Seven items have been used as independent variables: teachers' gender, age, specialty, teaching experience, ICT training, computer ownership and computer experience.

Teachers' beliefs about ICT training

The first axis concerns the investigation of teachers' beliefs about the importance of their ICT training. We have identified that the great majority of the teachers in the sample have strongly positive beliefs (Table 1). Their percentages are slightly lowering as far as the significance of the Internet in their job concern.

Table 1. Teachers' beliefs about ICT training

Item	SA 1	A 2	U 3	D 4	SD 5
Q20 I believe that training on ICT basic tools is a waste of time for me	0.83	1.25	3.33	47.92	46.67
Q21 I believe that training on ICT basic tools does not concern my specialty	0.42	3.33	5.00	47.50	43.75
Q22 I believe that it is very important for my job to learn how to use a computer	51.25	38.33	6.67	3.75	0
Q23 I believe that it is very important for my job to learn how to use the Internet	47.92	36.25	12.92	2.92	0

In our multivariate analysis we have used the first and the second factors, which can give 43.51% of the total information produced by MCA. These rates are very high given the number of variables involved in the analysis. The first axis (factor) has eigenvalue $\lambda_1=0.7144$ and coefficient of inertia $\tau_1=25.98\%$ and represents the statistically most significant factor. The second axis has eigenvalue $\lambda_2=0.4822$ and coefficient of inertia $\tau_2=17.54\%$.

The first axis, characterized as the strongly positive-neutral beliefs axis, shows the opposition between strongly positive teachers (Q20=5, Q21=5, Q22=1, Q23=1) and teachers that are neutral (Q20=3, Q21=3, Q22=3, Q23=3) about the four items concerning the importance of their training on ICT. The second axis is characterized as the positive-neutral beliefs axis. This axis opposes teachers with neutral attitudes with their fellows that are positive about their training on ICT (Q20=4, Q21=4, Q22=2, Q23=2).

Fig. 1 shows the graphical representation of our results in the space defined by the first two variance axes. Teachers' responses are represented in the form of item-answer number. The values of the variables projected on the variance plane determine three groups of teachers:

1. The first group (cloud G1) is determined by the values corresponding to the teachers who have strongly positive beliefs about the significance of their training on ICT (values Q20=5, Q21=5, Q22=1, Q23=1). There are mainly placed in this region the economists, the technologists, the science teachers, the social sciences and the foreign languages teachers (English, French and

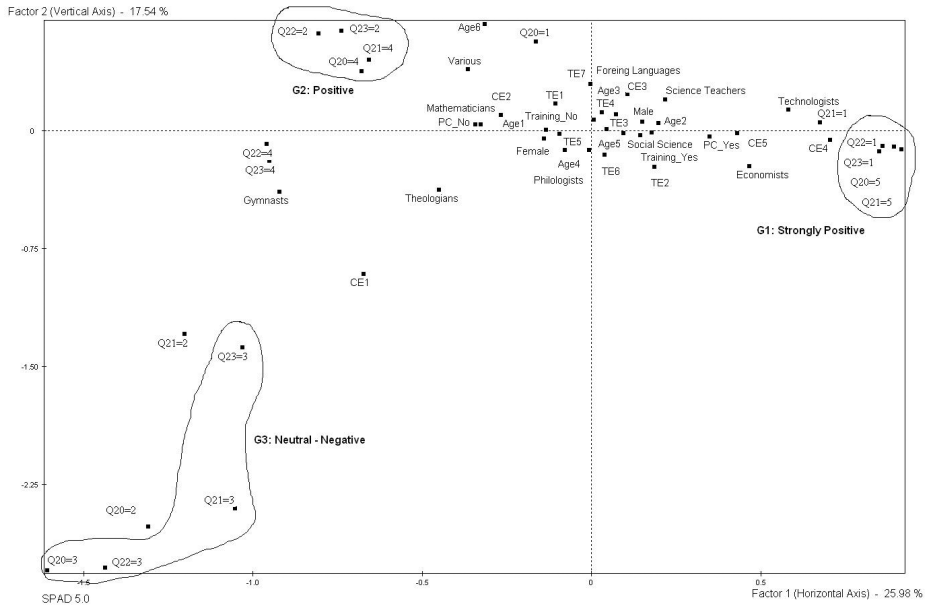


Figure 1. Variance graph of teachers' beliefs about ICT training

- Germany). Near G1 are placed the teachers who believe that training on ICT tools does not concern their specialty (value Q21=1). There are also located the males, the teachers with their own PC, the teachers using computers frequently, those that have attended training about ICT and their fellows with middle age (30-40 and 45-55 years old) and middle service experience (5-20 years).
2. Cloud G2 is determined by the values corresponding to the teachers with positive beliefs about their training on ICT (values Q20=4, Q21=4, Q22=2, Q23=2). Near G2 are placed the teachers who believe that training on ICT tools is a waste of time (value Q20=1). There are also located here the mathematics and various specialty teachers, the teachers which have not a PC, the teachers with no training about ICT, those having no computer experience but want to receive training about ICT, the younger teachers (up to 30 years old), and their fellows with low (up to 5 years) and high (more than 30 years) service experience (TE1, TE7).
 3. Cloud G3 gathers neutral-negative beliefs. There are located the teachers with neutral or non-expressed ideas about ICT training (values Q20=3, Q21=3, Q22=3, Q23=3). Near cloud G3 are also placed the teachers with negative beliefs about training on ICT skills (Q20=2, Q21=2, Q22=4, Q23=4). The females, the Greek language and literature teachers, the theologians, and the

gymnasts are, in general, negative about the significance of their ICT training, since they are placed near cloud G3. There are also placed near G3 the teachers having no ICT experience but do not wish to receive any training about, the teachers aged between 40 and 45 years and their fellows with 25-30 years of service experience (TE6).

As one could see in Figure 1, there is strong correlation between the values of the variables determining the three clouds above. This case is referred in the literature as the Goultman effect (Lebart, Morineau, and Pitron, 1998) indicating that the teachers within various groups exhibited a highly cohesive and persistent approach, as far as the items of this research axis concern.

Teachers' attitudes towards ICT in their instruction

The second research axis deals with teachers' attitudes about the application of ICT in their instruction. There are nine items in the questionnaire describing this axis (Table 2).

Table 2. Teachers' attitudes towards ICT in their instruction

Item	SA 1	A 2	U 3	D 4	SD 5
Q14 I am satisfied of my teaching and the approach followed in my subject matter	6.14	49.12	19.74	23.68	1.32
Q26 Using new technological tools in my teaching is very interesting to me	33.89	53.56	11.72	0.84	0
Q27 I do not want to ever use ICT in my educational career	0	3.75	7.92	42.92	45.42
Q28 I am cautious about using ICT in education, because I believe that ICT restrict social interaction and isolate people	0.83	9.17	13.33	57.92	18.75
Q29 I want to be trained on ICT but I am afraid that I will not succeed	5.00	27.92	10.00	35.00	22.08
Q30 I believe that I will not be able to use ICT in my instructional practice, because I feel insecure about its application in education	1.26	12.61	13.87	43.70	28.57
Q31 If I had a computer in my class I could use it in the instruction of my subject matter	23.33	45.83	22.92	6.67	1.25
Q32 I would use computers in the instruction of my subject but it frightens me that students are more skilled than me	3.75	15.42	12.50	46.67	21.67
Q34 I need to try ICT tools many times before their application in the instructional process	25.00	56.25	8.75	7.08	2.92

Question Q14 aims at teachers' perceptions about traditional teaching approach, which is prevalent in most Greek schools. More than one out of two teachers in the sample appeared to be satisfied of their teaching and the conventional approach of their subject matter. On the other hand, the majority of the teachers are, in general, positive about using ICT tools in the educational process. A significant number of the teachers tend to be cautious or insecure about the application of ICT in their instruction practice.

The first two factors of MCA analysis have $\lambda_1=0.4617$, $\tau_1=13.85\%$ and $\lambda_2=0.4822$, $\tau_2=7.76\%$ correspondingly giving 21.61% of the total information produced. The first axis shows the opposition between strongly positive teachers and their fellows that are negative or neutral about the items given in Table 2. The second axis juxtaposes teachers with positive attitudes with their fellows that stated negative or neutral about the items above.

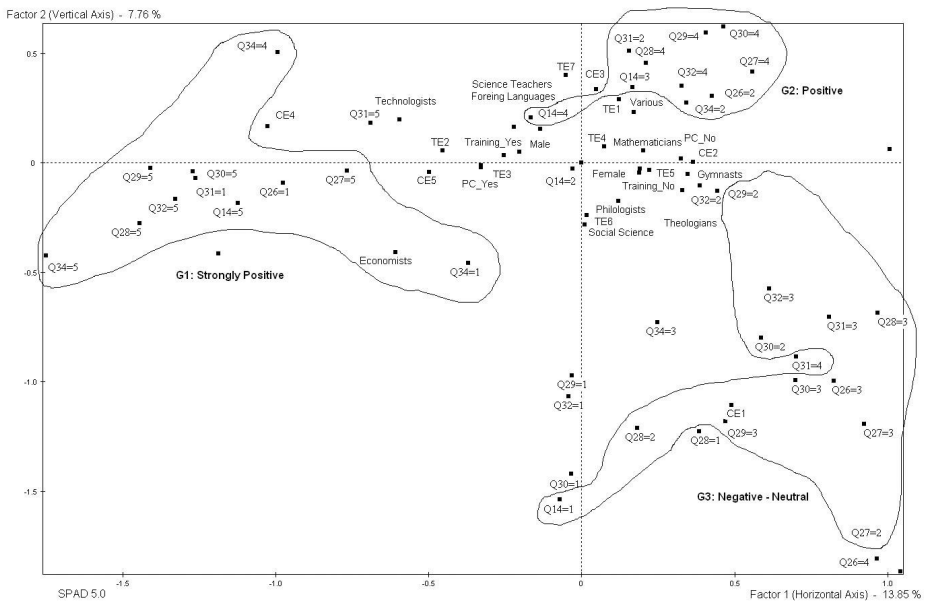


Figure 2. Variance graph of teachers' attitudes towards ICT in their instruction

Fig. 2 shows the correspondence map in the space defined by the first two axes. There are three discernible groups of teachers defined by the values projected on the variance plane:

1. The first group (G1) is determined by the values that correspond to the teachers who have strongly positive attitudes about using ICT tools in their instruction (values Q26=1, Q27=5, Q28=5, Q29=5, Q30=5, Q31=1,

- Q32=5). It seems that this group is internally cohesive, since its members are strongly positive about all items in this research axis. There are also placed the economists and the teachers who exhibited various beliefs (positive or negative) about their need to try ICT tools many times before applying them in the instructional process (item Q34). There are also placed the teachers that are totally unsatisfied of the traditional teaching (value Q14=5). Near G1 are mainly placed the technology teachers, the males, the teachers with their own PC and the teachers having 6-10 years of service experience (TE2). Near to this group are also placed the science and the foreign languages teachers.
2. Cloud G2 is determined by the values corresponding to the teachers with positive attitudes about using ICT tools in their instruction (values Q26=2, Q27=4, Q28=4, Q29=4, Q30=4, Q31=2, Q32=4). This group of positive teachers has a well-distinguished approach towards the items investigated in this direction. Their approach is characterized by the need to try ICT tools many times before applying them in the instructional process (Q34=2). There are also placed the teachers that are not satisfied with the traditional teaching approach (value Q14=4). Near G2 are mainly placed the mathematicians and the various specialties, the teachers having no PC, the teachers that did not ever used a computer but want to be trained on ICT skills, and their fellows with low or middle service experience (TE1, TE4).
 3. Cloud G3 gathers teachers with negative and neutral attitudes about using ICT tools in their instruction (values Q26=3, Q27=2,3, Q28=2,3, Q29=2,3, Q30=2,3, Q31=3, Q32=3). There are also located the teachers that are absolutely satisfied with traditional teaching (value Q14=1) and those teachers with no PC experience that do not want to attend any training on ICT (CE1). Near group G3 are also placed the teachers with negative attitudes (values Q26=4, Q27=3, Q28=1, Q29=1, Q30=1, Q31=4, Q32=2), the females, the Greek language and literature teachers, the social sciences teachers, the theologians, the gymnasts, the teachers that do not have their own computer, the teachers attending no training on ICT and their fellows with 21-30 years of service experience (TE5, TE6).

There is a strong correlation between the values of the variables determining the three groups G1, G2 and G3, indicating that the network of teachers' beliefs is greatly cohesive (Goultman effect).

Teachers' beliefs about the role of ICT in education

The third research axis deals with teachers' beliefs about the role that ICT could play in education. Our results along the items of this axis are presented in Table 3. The majority of the teachers are aware that ICT applications can be

used for instruction and learning for all subject matters in the Curriculum. 1 out of 5 teachers have not convinced about ICT usefulness in the instructional process. 7 out of 10 teachers (71.66%) believe that ICT will produce radical changes in the schools. This percentage is slightly lower (64.59%) as far as the teachers' role concern. On the other hand, only 37.92% of the teachers in the sample do believe that books will stop playing their preferential role in education, and that new media based on ICT will replace them.

Table 3. Teachers' beliefs about the role of ICT in education

Item	SA 1	A 2	U 3	D 4	SD 5
Q24 ICT could be a tool for teaching and learning for all subject matters in the Curriculum	32.50	45.42	17.92	4.17	0
Q25 I know ICT applications that could be used for teaching and learning in my subject matter	30.00	55.83	12.92	1.25	0
Q33 I need more reasons to be convinced about ICT usefulness in the instructional process	5.00	20.42	13.75	41.67	19.17
Q35 I believe that, because of ICT, schools' role will be radically changed within next years	28.33	43.33	14.58	12.92	0.83
Q36 I believe that, because of ICT, teachers' role will be radically changed within next years	21.67	42.92	13.75	21.25	0.42
Q37 I believe that books' preferential role in education will be replaced by new ICT based media	10.42	27.50	22.08	34.58	5.42

The first two factors of MCA analysis represent the most significant factors and give 28.16% of the total information produced. They have $\lambda_1=0.5327$, $\tau_1=16.82\%$ and $\lambda_2=0.3591$, $\tau_2=11.34\%$ respectively.

The first axis is the strongly positive-neutral beliefs axis. This factor shows the opposition between strongly positive teachers (Q24=1, Q25=1, Q33=5, Q35=1, Q36=1, Q37=1) and the teachers that are neutral or positive (Q24=2, Q25=2, Q35=3, Q24=3, Q35=2, Q36=3, Q36=4) about the items concerning the role of ICT in education.

The second axis (factor) is characterized as the negative-positive beliefs axis. This axis opposes teachers with negative or neutral attitudes (Q24=4, Q35=4, Q33=1, Q37=5, Q36=4, Q35=3, Q24=3) with their fellows that are positive (Q24=2, Q35=2, Q33=4, Q36=2, Q37=2) about the role of ICT in education.

The values of the variables projected on the variance plane are explicitly grouped around three poles (Fig. 3). The first pole (cloud G1) is defined by those teachers, which have strongly positive attitudes about the role of ICT in education. The second pole (cloud G2) is determined by the teachers, which are

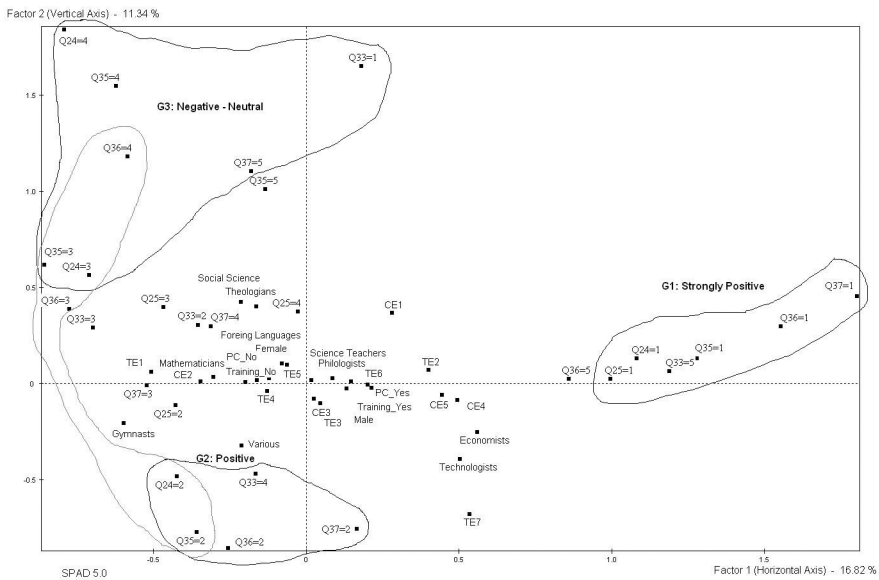


Figure 3. Variance graph of teachers' beliefs about the role of ICT in education

positive, while the third pole (cloud G3) by those who are negative or neutral about the role of ICT in education.

Fig. 3 shows that strongly positive and positive attitudes about the role of ICT in education are well-structured and more stable than the neutral and the negative ones. On the other hand, there is a strong correlation between clouds G2 and G3. This indicates that the teachers described by those values vacillate between negative, positive and neutral beliefs about the role of ICT in education.

Near G1 (strongly positive attitudes) are mainly placed the males, the economy, the science and technology teachers, and also the Greek language and literature teachers. There are also gathered the teachers having a PC, those having attended some training about ICT, the teachers that use general-purpose software often and their fellows that use computers to support their instruction. In general, the teachers having 6-15 years of service experience (TE2, TE3) and those at the fall of their carrier (TE6, TE7) are positive that ICT will produce changes in the educational system. Near cloud G2 (positive attitudes) are placed the gymnasts and the various specialty teachers, and also their fellows with service experience between 16-20 years (TE4).

On the other hand, the mathematics teachers, the social sciences, the foreign languages teachers, and the theologians are negative or neutral about the role of

ICT in education, since they are placed near cloud G3. There are also placed the females, the teachers who have no PC, those attending no training about ICT and their fellows that have never used a PC. In this area also belong the teachers with low (up to 5 years) or high (21-25 years) service experience (TE1, TE5).

Teachers' perceptions of ICT integration in education

The last research axis concerns teachers' perceptions of ICT integration in education. As we can see in Table 4, negative beliefs are trivial and the great majority of the teachers (up to 88%) are positive about the various items in this axis.

Table 4. Teachers' views about ICT integration in education

Item	SA 1	A 2	U 3	D 4	SD 5
Q39 I believe that training on ICT pedagogical development issues is necessary for me	35.83	51.67	9.58	2.50	0.42
Q40 I believe that well organized supporting and collaborating processes should be established, in order to be able to integrate ICT in the Curriculum	35.56	53.14	9.62	1.67	0
Q41 I believe that well organized collaborating processes with my specialty fellows should be established, in order to be able to integrate ICT in the Curriculum	32.08	53.33	12.08	2.08	0.42
Q42 I believe that collaboration with the other teachers in my school is necessary, in order to integrate ICT in the Curriculum	28.75	51.25	15.00	5.00	0
Q43 I believe that I need more effective educational software that could cover various subjects in the Curriculum	28.15	45.38	24.37	1.68	0.42
Q44 I believe that ICT infrastructure development is necessary for the schools, in order to integrate ICT in the Curriculum	47.50	44.58	6.67	1.25	0

The first two factors of the multivariate analysis represent the most significant factors, which can give 47.86% of the total information produced by MCA. They have $\lambda_1=0.6902$, $\tau_1=27.61\%$ and $\lambda_2=0.5063$, $\tau_2=20.25\%$ respectively.

The first factor corresponds to the strongly positive-positive beliefs axis. This axis shows the opposition between strongly positive (Q39=1, Q40=1, Q41=1, Q42=1, Q43=1, Q44=1) and positive teachers (Q39=2, Q40=2, Q41=2, Q42=2,

Q44=2), as far as the items concerning ICT integration in education. The second factor is characterized as the negative or neutral-positive beliefs axis and juxtaposes teachers with negative or neutral attitudes (Q39=4, Q40=3, Q41=3, Q42=3, Q43=3, Q44=3) with the teachers that are positive (Q39=2, Q40=2, Q41=2, Q42=2, Q43=2, Q44=2) about the items concerning ICT integration in education.

It is evident that the teachers in the sample are explicitly grouped around three poles according to their responses (Figure 4). The first pole (cloud G1) is defined by those teachers, which have strongly positive beliefs about the integration of ICT in education. The second pole (cloud G2) is determined by the teachers, which are positive about the items above. The third pole (cloud G3) is determined by those teachers, which are negative or neutral about ICT integration in education.

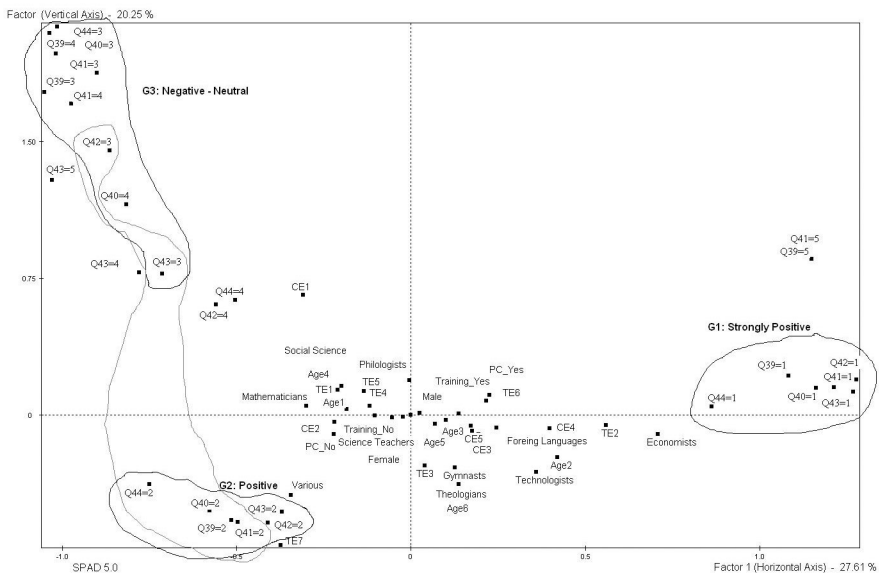


Figure 4. Variance graph of teachers' views about ICT integration in education

As is shown in Fig. 4, it seems that strongly positive attitudes are well-structured and more stable. On the other hand, there is a strong correlation between the values of the variables within clouds G2 and G3, indicating that the teachers described by those values vacillate between positive, negative, and neutral beliefs as far as ICT integration in education concern.

Near G1 (strongly positive beliefs) are mainly placed the males, the economists, the technology and foreign languages teachers, the theologians and

the gymnasts. There are also placed the teachers having their own computer, the teachers that use computers frequently, those attended some training about ICT, their fellows that often use general-purpose software and those that use a PC to support their instruction. In general, teachers having 6-15 years of service experience (TE2, TE3) and those with 26-30 years (TE6) are positive about the role of ICT in education. Positive beliefs exhibited the younger (31-40 years old) and the oldest teachers (51-60 years aged).

Near cloud G2 (positive beliefs) are mainly placed the females, the science and the various specialty teachers, the teachers who have not a PC, their fellows that have not attended any training about ICT, and those that have never used computers before.

On the other hand, the mathematics teachers, the Greek language and literature, and the social sciences teachers are negative or neutral about ICT integration in education, since they are placed near cloud G3. There are also located the teachers with no computer, those attending no training about ICT and their fellows that do not want to be trained about computer basics. In general, the younger (up to 30 years old) and the middle-aged teachers (40-45 years), those at the beginning (less than 6 years of service experience) and in the middle (16-25 years of service experience) of their career are positive about the research items concerning ICT integration in education.

Summary and discussion

The results presented here exhibited some critical parameters as far as ICT integration in the Greek educational system concern. Firstly, we have found that approximately 25% of the teachers in the sample use ICT tools rather for preparation and communication than for delivering instruction or assigning ICT based learning activities for their students. This finding is in accordance with the results of a similar study in the USA (Russel et al., 2003).

Secondly, our study has recorded increase in teachers' positive attitudes about ICT in education comparing with previous research findings (Emvalotis and Jimoyiannis, 1999). We have found that, although most of the teachers in the sample lack confidence in their skills and abilities to use ICT tools, the great majority exhibited positive attitudes and beliefs towards

- the importance of their training on ICT
- the general role that ICT can play in education
- the application of ICT tools in the instruction process.

Thirdly, we have also identified three main issues, which interfere making thus many teachers skeptical, cautious or fearful about ICT integration in the educational practice, named

- need for more convincing reasons about ICT usefulness in the instructional process
- insecurity about success in their training on ICT
- fear that students are more skilled on ICT than themselves.

The multivariate analysis has revealed significant differences in teachers' attitudes across the questionnaire according to their attributes such as gender, specialty and teaching experience. It seems that the males, the economists, the science and technology teachers, and the teachers who have attended some training about ICT are, in general, positive about ICT integration in education. On the other hand, the females, the mathematicians, the Greek language and literature teachers, the foreign languages teachers, the theologians, and the gymnasts are neutral or negative about ICT in education.

We could point out that the traditional specialty teachers (e.g. mathematicians, Greek language and literature, foreign languages, theologians, and gymnasts) are more conservative and cautious about ICT in education by contrast with the new ones (such as the economy and technology teachers), which seems to use ICT tools in their instruction framework. On the other hand, the science teachers - and especially the physics teachers - are more positive about ICT in education than the other traditional specialty teachers. One of the reasons explaining this may be their awareness about ICT in science education, which is mainly influenced by the presence of valuable educational software (e.g. Interactive Physics, Modellus etc.).

There is also recorded a clear difference between the teachers in the middle of their career (having 6-20 years of service experience), which are positive, and their fellows with low (up to 5 years) or high (more that 20 years) service experience. This behavior, surprising as far as the younger teachers, has also been found in a similar study concerning French teachers (Baron and Bruillard, 1997).

Moreover, our analysis revealed that teachers' attitudes are strongly related to their satisfaction of the traditional teaching approach. The teachers who responded less satisfied with this way of teaching are more positive about using ICT applications in their instruction than their fellows. This finding constitutes a very important factor influencing teachers' ICT adoption and needs to be further investigated.

As far as their professional development and support concerns the teachers in the sample indicated two critical issues: *ICT pedagogical context* and *partnership*. Confirming the results of a recent study, concerning a successful paradigm about ICT adoption in a Finnish secondary school (Ilomaki et al., 2004), the teachers have pointed out the following issues:

- pedagogical development about ICT in teaching and learning processes

- support and collaboration with ICT specialists
- partnership (collaboration with specialty fellows and the other teachers in their school)
- disposal of qualitative educational software in the schools
- ICT infrastructure development in the schools.

We consider that teachers constitute the critical factor as far as ICT adoption in the schools concern. Teachers must be able, not only to use ICT tools and access new technology resources, but to principally reorganize their instruction and to plan learner-centered activities using available ICT applications. This effort needs a new type of skills determined by ICT. Teachers' *ICT integration skills* could be defined into an integrated framework, determined by their ability to use ICT combined with traditional and innovative teaching strategies to enhance students' learning.

ICT integration in everyday educational practice is a difficult and multi-faceted process. Our results could be helpful to the Greek authorities, in order to design and administer new initiatives aiming to prepare teachers to effectively apply ICT tools in their instruction. We believe that teachers' ICT education and in-service training programs must not be restricted to conventional seminars in order to be alphabetized on using general purpose software. We should also teach them how to incorporate ICT into their teaching strategies and activities.

It is imperative to determine an effective ICT integration model, appropriate to the Greek educational system. An integrated framework, based on the adaptation of well-established models (Somekh, 1998; Sherry, 1998; Dooley, 1999; Davis, 2002; Unesco, 2003) to the Greek socio-educational reality, is suggested. This framework, aiming at successful teachers' preparation on ICT in education, could be defined into a two-dimension space determined by a *technological* and a *pedagogical* dimension. A number of cohesive initiatives, directed to the following parameters, could further specify these dimensions above:

- ICT application in education must be adequately justified to the teachers, in order to adopt them as effective tools for supporting teaching and learning processes.
- Teachers' training must be focused on life-durable ICT skills combined with continuing technical and pedagogical support.
- Cultivation of a *new educational culture* in the schools based on effective ICT tools.
- Teachers' preparation and readiness to participate in well-designed procedures of ICT pedagogical integration in their instruction.
- Teachers' communication, collaboration and interaction about ICT in education.

Research studies, which increase the depth and breath of information about teachers' attitudes and beliefs, associated with ICT tools and their integration into teaching and learning processes, would help us to find new ways to support

teachers in order to effectively apply technology in their classrooms. Our current study has been directed to the investigation of the effect of the Teachers' Training on ICT in Education project on teachers' perceptions about ICT in education. Furthermore, we plan to include selective individual interviews about specific aspects of ICT application into the educational practice.

References

- Baron, G. L. and Bruillard, E. (1997), Information technology in French education: implications for teacher education, *Journal of Information Technology for Teacher Education*, 6(3), 241-253
- Becker, H. J. (1999), *Internet use by teachers*, Center for Research on Information Technology and Organizations, available at <http://www.crito.uci.edu/tlc/findings/Intenet-Use/startpage.htm>
- Benzécri, J. P. (1992), *Correspondence Analysis Handbook*, New York: Marcel Dekker
- Busch, T. (1995), Gender differences in self-efficacy and attitudes towards computers, *Journal of Educational Computing Research*, 12, 147-158
- Christensen, R. (1998), *Effect of technology integration education on the attitudes of teachers and their students*, Doctoral dissertation, Denton: University of North Texas
- Collis, B., Knezek, G., Lai, K., Miyashita, K., Pelgrum, W., Plomp, T. and Sakamoto, T. (1996), *Children and computers in school*, NJ: Lawrence Erlbaum
- Davis, N. (2002), Leadership of Information Technology for teacher education: a discussion of complex systems with dynamic models to inform shared leadership, *Journal of Information Technology for Teacher Education*, 11(3), 253-272
- Davis, N. (2003), Technology in teacher education in the USA: what makes for sustainable good practice, *Technology, Pedagogy and Education*, 12(1), 59-84
- Demetriadis S., Barbas A., Molohides A., Palaigeorgiou G., Psillos D., Vlahavas I., Tsoukalas I. and Pombortsis A. (2003), "Cultures in negotiation": teachers' acceptance/resistance attitudes considering the infusion of technology into schools, *Computers & Education*, 41(1), 19-37
- Dexter S. L., Anderson R. E. and Becker H. J. (1999) Teachers' views of computers as catalysts for changes in their teaching practice. *Journal of Research on Computing in Education*, 31(3), 221-239.
- Dooley, K. E. (1999), Towards a holistic model for the diffusion of educational technologies: an integrative review of educational innovation studies, *Educational Technology & Society*, 2(4), available at http://ifets.ieee.org/periodical/vol_4_99/kim_Dooley.html
- eLearning (2001), available at http://europa.eu.int/comm/education/programmes/elearning/intro_en.html
- Emvalotis, A. and Jimoyiannis, A. (1999), Teachers' attitudes towards Informatics and the New Technologies in Lyceum, in A. Jimoyiannis (ed.), *Proceedings of the (1st) Panhellenic Conference "Informatics and Education"*, 203-212, Ioannina (in Greek)
- Evans-Jennings, S. and Okwuegbuzie, A. (2001), Computer attitudes as a function of age, gender, math attitude, and developmental status, *Journal of Educational Computing Research*, 25(4), 367-384
- Francis-Pelton, L. and Pelton, T. W. (1996), *Building attitudes: how a technology course affects preservice teachers' attitudes about technology*, available at <http://www.math.byu.edu/~lfrancis/tim's-page/attitudesite.html>
- Greenacre, M. J. (1993), *Correspondence Analysis in Practice*, London: Academic Press.
- Information Society (2003), available at <http://en.infosoc.gr>

- Jimoyiannis, A. and Komis, V. (2001), Computer simulations in physics teaching and learning: a case study on students' understanding of trajectory motion, *Computers & Education*, 36, 183-204
- Knezek, G. and Christensen, R. (2002), Impact of New Information Technologies on teachers and students, *Education and Information Technologies*, 7(4), 369-376
- Komis, V. and Mikropoulos, A. T. (2001), *Informatics in Education*, Patras: Greek Open University (in Greek)
- Kumar, P. and Kumar, A. (2003), Effect of a Web-base project on preservice and inservice teacher' attitude toward computers and their technology skills, *Journal of Computing in Teacher Education*, 19(3), 87-92
- Kynigos, P., Karageorgos, D., Vavouraki, A. and Gavrilis, K. (2000), "Odysseas" project teachers' beliefs of about new technologies in education, in V. Komis (ed.), *Proceedings of the 2nd Panhellenic Conference "Information and Communication Technologies in Education"*, 593-600, Patras: University of Patras (in Greek)
- Lang, M. (2000), Teacher development of computer use in education in Germany, *Education and Information Technology*, 5(1), 39-48
- Lebart, L., Morineau, A. and Pitron, M. (1998), *Statistique exploratoire multidimensionnelle*, Paris: Dunod Editeur
- Lee, K. (1997), Impediments to good computing practice: some gender issues, *Computers & Education*, 28, 251-259
- Levine, T. and Donitsa-Schmidt, S. (1998), Computer use, confidence, attitudes, and knowledge: a causal analysis, *Computers in Human Behavior*, 14, 125-146
- Liu, Y. and Huang, C. (2005), Concerns of teachers about technology integration in the USA, *European Journal of Teacher Education*, 28(1), 35-47
- Loveless, A. M. (2003), The interaction between primary teachers' perceptions of ICT and their pedagogy, *Education and Information Technologies*, 8(4), 313-326
- Luan, W. S., Fung, N. S., Nawawi, M. and Hong, T. S. (2005), Experienced and inexperienced Internet users among pre-service teachers: Their use and attitudes toward the Internet, *Educational Technology and Society*, 8(1), 90-103.
- Ministry of Education (1998), *Curriculum's Unified Framework*, Athens: Pedagogical Institute (in Greek)
- Niemi, H. (2003), Towards a Learning Society in Finland: information and communications technology in teacher education, *Technology, Pedagogy & Education*, 12(1), 85-103
- Odysseia (2001), available at <http://odysseia.cti.gr>
- Odysseas (2001), available at http://odysseia.cti.gr/e11_odysseas/e11_odysseas.htm
- Pajares, M. F. (1992), Teacher beliefs and educational research: cleaning up a messy construct. *Review of Educational Research*, 62, 307-332
- Pearson, J. (2003), Information and Communications Technologies and teacher education in Australia, *Technology, Pedagogy & Education*, 12(1), 39-58
- Pelgrum, W. J. (2001), Obstacles to the integration of ICT in education: results from a worldwide educational assessment, *Computers & Education*, 37, 163-178
- Politis, P., Roussos, P., Karamanis, M. and Tsaousis, G. (2000), Assessment of teachers' training in the framework of the "Odysseas" project, in V. Komis (ed.), *Proceedings of the 2nd Panhellenic Conference "Information and Communication Technologies in Education"*, 583-592, Patras: University of Patras (in Greek)
- Rogers, E. (1995), *Diffusion of innovations*, New York: 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), 402-423
- Rosen, L. and Weil, M. M. (1995), Computer availability, computer experience, and technophobia among public school teachers, *Computers in Human Behavior*, 11, 9-31
- Russel, A. L. (1995), Stages in learning new technology: naïve adult email users, *Computers & Education*, 25(4), 173-178
- Russell M., Bebell D., O'Dwyer L. and O'Connor, K. (2003), Examining teacher technology use. Implications for preservice and inservice teacher preparation, *Journal of Teacher Education*, 54(4), 297-310
- Shapka, J. D. and Ferrari, M. (2003), Computer-related attitudes and actions of teacher candidates, *Computers in Human Behavior*, 19, 319-334
- Sherry, L. (1998), An integrated technology adoption and diffusion model, *International Journal of Educational Telecommunications*, 4(2), 113-145
- Somekh, B. (1998), Supporting Information and Communication Technology Innovations in Higher Education, *Journal of Information Technology for Teacher Education*, 7(1), 11-32
- SPAD (2000), available at http://www.decisia.com/SPAD_Presentation.html
- Stetson, R. and Bagwell T. (1999), Technology and teacher preparation: An oxymoron?. *Journal of Technology and Teacher Education*, 7(2), 145-152.
- Sugar, W., Crawley F. and Fine, B. (2004), Examining teachers' decisions to adopt new technology, *Educational Technology and Society*, 7(4), 201-213
- Tsitouridou, M. and Vryzas K. (2003), Early childhood education teachers' attitudes towards computer and information technology: the case of Greece, *Information Technology in Childhood Education Annual*, 187-207
- Unesco (2000), *Informatics for Secondary Education. A Curriculum for Schools*, Paris: Unesco
- Unesco (2002), *Information and Communication Technologies in Teacher Education*, Paris: Unesco
- Vosniadou, S. and Kollias, V. (2001), Information and Communication Technology and the problem of teacher training: myths, dreams, and the harsh reality, *Themes in Education*, 2(4), 341-365
- Waite S. (2004), Tools for the job: a report of two surveys of information and communications technology training and use for literacy in primary schools in the West of England, *Journal of Computer Assisted Learning*, 20, 11-20.
- Whitley, B. E. (1997), Gender differences in computer-related attitudes and behavior: a meta-analysis, *Computers in Human Behavior*, 13, 1-22
- Woodrow, J. E. J. (1994), The development of computer-related attitudes of secondary students, *Journal of Educational Computing Research*, 11, 307-338
- Yaghi, H. M. and Abu-Saba, M. B. (1998), Teachers' computer anxiety: an international perspective, *Computers in Human Behavior*, 14(2), 321-336
- Yildirim, S. (2000), Effects of an educational computing course on preservice and inservice teacher: a discussion and analysis of attitudes and use, *Journal of Research on Computing in Education*, 32(4), 479-496
- Zhao, Y. and Cziko, G. A. (2001), Teacher adoption of technology: a perceptual control theory perspective, *Journal of Technology and Teacher Education*, 9(1), 5-30