

# Barriers to ICT use in high schools: Greek teachers' perceptions

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**Abstract** This study investigated high school teachers' perceptions of barriers to using computers in class. A 26-item questionnaire was administered to 119 high school teachers in Greece. Lack of funding, lack of internet access and large number of pupils in the class were among the major perceived barriers to the use of computers in high schools. Three barrier-factors were extracted: “lack of support”, “lack of confidence” and “lack of equipment”. Female teachers perceived as a major barrier the lack of support. Literature teachers also perceived as a major barrier the lack of support, in comparison to mathematics and science teachers. The attendance of B-level training in ICT and the fewer the years of teaching experience resulted in teachers' perceiving the “lack of confidence” and the “lack of equipment”, respectively, as minor barriers. Confidence with technology was significantly linked to gender, A-level training in ICT, years of experience with computers, and computer use in class. Confidence with technology was higher for male teachers, as well as for those teachers who had more years of computer experience and A-level technical training. Teachers' confidence with technology and their pedagogical training in ICT (B-level) result in higher probability of computer use in class. Implications of findings for in-service teacher training are discussed.

**Keywords** Computer · ICT · Barriers · High school · Teachers' perceptions

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## Introduction

Information and communication technology (ICT) has become an important tool in education, a tool that offers possibilities to teachers and pupils across the curriculum. While many initiatives, investments and research studies were undertaken worldwide to integrate ICT into education, the effective integration of ICT into education is still occasionally difficult and problematic (Goktas et al. 2013).

Teachers play an important role in supporting and extending pupils' experiences with computers, while governments throughout the world recognize that the success of educational systems rises and falls on the backs of teachers (Davis 2002). A review of the literature has suggested that the integration of technology into teaching and learning is typically affected by teachers' technology skills, teachers' technology beliefs and teachers' perceived technology barriers (Hew and Brush 2007). Teachers' beliefs about the role of ICT for learning are important in teachers' pedagogical reasoning (Webb and Cox 2004) and their beliefs often limit their efforts to integrate ICT into classroom practices (Pelgrum 2001). It is obvious that unless teachers perceive as valuable the new technologies, they will be unwilling or unable to use them meaningfully. Although ICT is now a useful tool in class, many teachers still struggle to integrate technology in their teaching practice. Taken into account that teachers' views are essential for ICT use in class, it is important to investigate their perceptions regarding barriers to the use of computers in classes. The identification of teachers' perceived barriers is important, as some barriers may play a role in excluding technology in classes.

The aim of this paper was to investigate the barriers to the use of computers in high school classes, from the perspective of Greek high school teachers. For the purpose of this paper, we use the term *computers* as synonymous to the terms *ICT* (Information and Communication Technology) and *technology*. The term *barrier* (or *obstacle*) is defined as any factor that prevents or hinders teachers' use of ICT in the classroom. Finally, the term *high schools* is used for secondary schools that attend pupils aged 12–17.

## Theoretical background

### Barriers to using-integrating computers in education settings

Most of the studies regarding barriers to using or integrating computers in class derive from primary and secondary education settings. Research studies (e.g., Jones 2004; Albirini 2006; Al-Senaidi et al. 2009; Bingimlas 2009; Agyei and Voogt 2011; Prestridge 2012; Kopcha 2012; Goktas et al. 2013; Al-Mulhim 2014) have reported a number of barriers teachers experience in the integration of ICT in their classrooms such as lack of access to resources, lack of confidence among teachers, lack of time, lack of training opportunities, technical problems, lack of knowledge about ways to integrate ICT in lessons, poor administrative support and poor fit with

the curriculum. Understanding the extent to which these barriers affect individuals, can help decide how they are to be tackled (Jones 2004). In 2004, the British Educational Communications and Technology Agency commissioned two reviews of the research literature at international level to identify some of the factors which either prevent teachers making full use of ICT in their work, or enable and encourage the uptake of ICT by teachers (across different education levels). The published report (Jones 2004) included the following conclusions: (a) levels of access to ICT are significant in determining levels of use of ICT by teachers, (b) teachers are sometimes unable to make full use of the technology because they lack the time needed to prepare materials for lessons, (c) resistance to change is a factor which prevents the integration of ICT in the classroom, (d) technical faults with ICT equipment are likely to lead to lower levels of ICT usage and (e) teachers who have little or no confidence in using computers in their work, will try to avoid them.

Goktas et al. (2013) summarized main barriers (post 2000) to the use of ICT in classes: lack of in-service training, lack of technical support, lack of hardware, lack of basic knowledge/ skills for ICT, lack of appropriate software, lack of appropriate physical environment, lack of appropriate administrative support and lack of time. Their study (Goktas et al. 2013) indicated that lack of hardware, lack of appropriate software materials, lack of in-service training and lack of technical support were among the most important barriers in primary schools in Turkey.

Sánchez et al. (2012) investigated teachers' difficulties in the use of ICT in the classroom, in Spain. The main difficulties reported by the teachers were, lack of educational resources, scarce institutional support and personal issues (e.g., lack of time in class to use computers). Ismail et al. (2010), from the United Arab Emirates, investigated language teachers' perceived barriers when integrating technology in their teaching. They indicated as main perceived barriers the lack of time, lack of training workshops and lack of encouragement and support.

Osei et al. (2014) examined teachers' perceived barriers in high schools in Ghana, and found the following strong barriers to the adoption of ICT in teaching: inadequate time, lack of in-service training on ICT usage, little knowledge about ICT before joining the teaching profession, inaccessibility of computers and management's ignorance about teachers' use of ICT in classroom. Salehi and Salehi (2012), in Iran, found that high school language teachers reported as major barriers preventing them to integrate ICT into the curriculum the insufficient technical support, and the restricted access to Internet and ICT. Kafyulilo et al. (2015) found that science and mathematics teachers encountered some barriers when using technology in their teaching (such as large classrooms, lack of time and lack of technology tools), while the encouragement of school management was a critical factor in teachers' continuation of technology use.

Wood et al. (2005) showed that comfort/ confidence with technology was related to greater computer integration in the classroom. Teachers' confidence with technology was found to be increased via attending relevant ICT professional training courses (Kafyulilo et al. 2015). They identified individual characteristics such as experience with computers and confidence with technology as reasons for why teachers do not use computers (despite increased availability of hardware). The

importance of previous experience with computers is widely recognized (Snoeyink and Ertmer 2001). Negative experiences affect perceptions of the ease of use, reducing confidence and increasing anxiety.

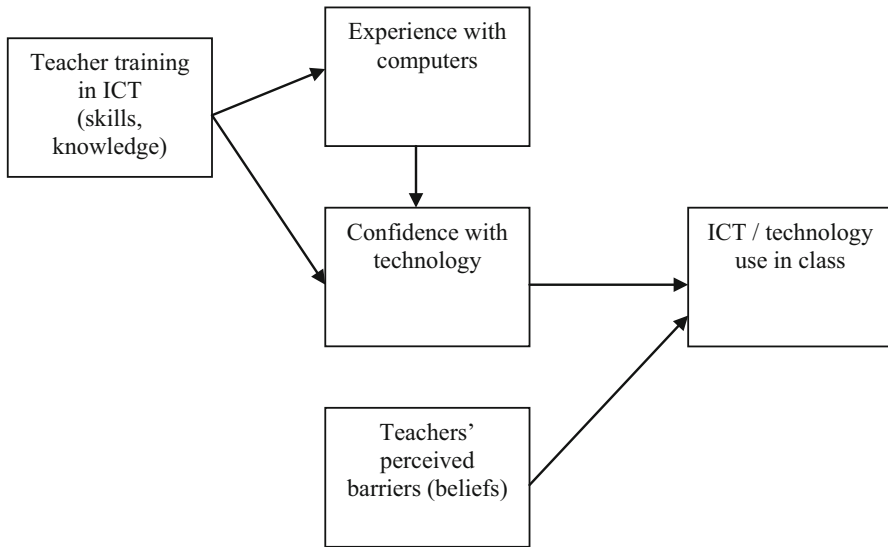
Some barriers are related to the limited resources, lack of time, lack of technical support (the so-called external barriers), while others are related to teachers' negative attitudes and lack of confidence (the so-called internal barriers) (Bingimlas 2009; Al-Senaidi et al. 2009). Researchers also refer to other ways of grouping the barriers: for example, to consider whether the barriers relate to the individual (i.e., teacher level barriers) such as lack of time, lack of effective training and technical problems, or to the institution (i.e., school level barriers) such as lack of time, lack of confidence and resistance to change (Veen 1993). Lim and Khine (2006) reported external (or first order) and internal (or second order) teachers' perceived barriers, in Singapore schools. Among the external obstacles to ICT use in class were the outdated and the limited number of computers, as well as the large amount of time needed to prepare ICT-mediated lessons. Among the external obstacles was the teachers' preference to traditional lessons (their belief that ICT was mere a novelty).

However, there is not a single accepted classification of barriers, as a barrier could fall under either category. For example, lack of time has been identified as a persistent barrier by teachers in terms of planning ways to use computers in the class, in terms of teacher training and development, or in terms of lack of time in schedule for pupils to use computers.

Furthermore, one barrier to ICT use could influence, and be influenced by, a number of other barriers. For example, confidence with technology may be affected by the amount and quality of training available to teachers. Our recent study (Nikolopoulou and Gialamas 2015) showed that teachers' confidence with technology had a direct significant effect on the factors "lack of support" and "class conditions" (number of computers and number of pupils in class): those teachers who had greater/higher confidence with technology, perceived as minor the barriers related to support and class conditions. Figure 1 expresses the hypothesis model of the study.

### **Computers/ICT in high schools in Greece**

In order to successfully implement the curriculum, it is essential that teachers be provided with the appropriate training and high school classrooms with the appropriate resources. Regarding resources, all high schools are now equipped with computer laboratories, while almost all science labs have one computer (rarely two computers). However, there are no computers in classrooms and the teachers who want to use the computer(s) must book either the computer lab or the science lab. Regarding teachers, they are responsible for translating into practice the expectations/ visions of curricula planners. The most widespread in-service teacher training programme in Greece, the 'Teachers' training on ICT in Education' (YPEPTH - PI 2009), includes two phases. The first phase of the programme (A-level training in ICT use) included training in technical skills and has been attended by many secondary school teachers. However, the second phase of the programme (B-level training in ICT use), which is dedicated to providing teachers with the pedagogical



**Fig. 1** The hypothesis model

skills for ICT integration in class, has been attended by a smaller part of teachers (YPEPTH 2012). This current large scale in-service training initiative aims, among others, to familiarize teachers with appropriate educational software and the skills to adopt/integrate ICT in their everyday teaching practices.

## Methodology

### Objectives of the study

As stated in the first section, the aim of this paper was to investigate the barriers to the use of computers in high school classes, as perceived by high school teachers. The research objectives were:

1. To investigate high school teachers' perceptions of barriers to using computers in class;
2. To confirm the factorial structure of the questionnaire and the relationships among factors regarding teachers' perceptions of barriers;
3. To investigate the impact of teachers' individual characteristics (gender, specialization, years of teaching experience, in-service teacher training in ICT, years of computer experience, confidence with technology) on teachers' perceived barriers;
4. To investigate the impact of teachers' individual characteristics and of barriers on "computer use" in class.

## The sample

The sample consisted of 119 high school teachers who teach in various schools in/around Athens, in Greece. Demographic and individual characteristics of the sample (gender, years of teaching experience, years of computer experience, access to a computer at home, views on computer appropriateness in class, in-service teacher training in ICT), as well as class conditions (computer use in class, frequency of computer use) are shown in Table 1. The questionnaire was administered during the academic year 2014–2015. The responses were anonymous and the teachers were assured that there was not right or wrong answer.

## The research instrument

Data was collected by the use of a questionnaire, which consisted of two sections. Section A involved statements regarding teachers' demographic and individual

**Table 1** Demographic, individual characteristics of the sample (119 teachers) and class conditions

Teachers' characteristics	
Gender	Specialization
Male (38.7%)	Literature teachers (38.7 %)
Female (61.3%)	Mathematics teachers (17.6 %)
	Science teachers (17.6 %)
	Foreign language teachers (6.7 %)
	Information technology teachers (6.7 %)
Years of teaching experience	Years of computer experience
1–5 (3.4 %)	<1 (2.5 %)
6–10 (21.8 %)	1–2 (2.5 %)
11–15 (25.2 %)	3–5 (7.6 %)
16–20 (13.4 %)	5+ (87.4 %)
20+ (36.1 %)	
Views on computer appropriateness	Access to a computer at home
Positive views (81.5 %)	Yes (97.5 %)
Negative views (4.2 %)	
Not sure (14.3 %)	
A-level teacher training in ICT (technical)	B-level teacher training in ICT (pedagogical)
Yes (73.9 %)	Yes (49.6 %)
No (26.1 %)	No (50.4 %)
Class conditions	
Computer use in class (with pupils)	Frequency of computer use
Yes (85.7 %)	Never (14.3 %)
No (14.3 %)	Less than once per month (22.7 %)
	Monthly (2–4 times per month) (28.6 %)
	Weekly (2–4 times per week) (17.6 %)
	Every day (16.8 %)

characteristics (gender, years of teaching experience, years of experience with computers, teachers' in-service training in ICT, access to computer at home, computer self-efficacy), teachers' views about the appropriateness of computer use in class, as well as information about characteristics of the class conditions (use of computer in class and frequency of computer use). Computer self-efficacy was assessed by using the four items of "confidence with technology" subscale (Pierce et al. 2007). In assessing teachers' views /perceptions about the appropriateness of computer use in class, teachers were asked to reply to the question "do you believe computer/ ICT to be an appropriate tool in supporting pupils' learning?" using a three-point rating scale (yes, no, not sure).

Section B (shown in [Appendix](#)) involved 26 statements/ items aiming to investigate teachers' perceived barriers to the integration of computers in high school classes. This section was used in our recent study with early childhood teachers (Nikolopoulou and Gialamas 2015), and the 26 statements were slightly adapted for high school teachers. All statements were taken from the relevant literature, and in particular, from the studies of Franklin (2007), Al-Senaïdi et al. (2009) and Ihmeideh (2009). The rationale and procedure for the factor selection of ICT barriers was that, initially, we identified in the relevant bibliography broad and most commonly reported categories (across time, in different countries). We then chose from the literature specific items/ statements that correspond to these categories/ factors so as to measure these factors. The 26 statements were separated into six groups, as follows: the first group involved four statements (S1, S2, S3, S4) related to lack of access to resources, the second group involved seven statements (S5, S7, S8, S9, S12, S13, S16) related to lack of support (financial/ technical/ pedagogic), the third group involved three items (S6, S10, S24) related to lack of time (e.g., to use computers in class, for in-service training) the fourth group involved three items (S11, S21, S25) regarding disbelief of ICT benefits, the fifth group involved five items (S15, S18, S19, S20, S23) regarding lack of teacher confidence/ skills/ knowledge, and the sixth group involved four items (S14, S17, S22, S26) regarding class conditions (large number of pupils in class, lack of space in locating the computer, curriculum demands, class management when computers are used). Teachers were asked to rate their views on a four-point Likert type scale: 1 (not a barrier), 2 (minor barrier), 3 (moderate barrier) and 4 (major barrier).

As mentioned above, the questionnaire was used in our recent study (Nikolopoulou and Gialamas 2015) and showed satisfactory internal consistency (Cronbach's  $\alpha$  coefficient ranged from .75 to .86), while the "confidence with technology" subscale showed a high Chronbach-a coefficient ( $\alpha = .89$ ). Two major procedures were employed to establish content validity for the instrument. First, a literature review was conducted to ensure that the barriers were based upon established concepts. Second, the instrument was reviewed by a panel of teachers (who did not participate in the main survey) and ICT in education specialists. Regarding this study's reliability, Cronbach's  $\alpha$  coefficient ranged from .76 to .84 (discussed in "[results](#)" section). The factorial validity of the questionnaire is also discussed in the "[results](#)" section.

## Data analysis

Structural equations models fitted in this study, were based on the appropriate covariance matrices using maximum likelihood estimation in AMOS 20 (Arbuckle 2007). The statistical software SPSS version 20.0 (IBM 2011) was also used in conducting the statistical analyses (descriptive statistics, factor analysis, correlation analysis).

## Results

### Descriptive measures for barriers and factorial structure of the questionnaire

In order to evaluate the importance of teachers' perceived barriers to the use of computers in class, mean values and standard deviation were calculated and are shown in Table 2.

Initially, a PCA (Principal Component Analysis) using 26 items of the barriers' questionnaire was conducted. PCA revealed a three factor structure of the administrated questionnaire based on the screen plot of factor variances (Table 2). Each item had a factor loading over the threshold 0.35 on only one factor. The first factor (F1), labeled "lack of support", was associated with eleven items: lack of support regarding ways to integrate technology into the curriculum, lack of time for teachers to learn/ practice/ plan ways to use computers (in the class), lack of time for in-service training, lack of time in schedule for pupils to use computers in class, many demands of the curriculum, inadequate training opportunities, concern about pupils' access to inappropriate material, lack of technical support, lack of information about educational software and its appropriateness/ quality, lack of administrative support and lack of funding. The second factor (F2), labeled "lack of confidence", loaded by ten items: fear of using technology, lack of confidence in using computers, negative teachers' attitudes, uncertainty about usefulness of technology, managing equipment, lack of knowledge of the possible use of computers in class (with the pupils), lack of teachers' technology skills, lack of interest of the school (principal) about computer use, class management when computers are used, and lack of space in locating the computer(s). The third factor (F3), labeled "lack of equipment", loaded by five items: outdated/ incompatible/ unreliable computers, lack of internet access (or internet is not easily accessible), not enough computers, lack of good educational software, and large number of pupils in the class. Two items (S17 and S14) had loadings under the cutoff but were associated with the appropriate factors. The three factors (also called barrier-factors) showed satisfactory internal consistency: Cronbach's  $\alpha$  coefficient ranged from .76 to .84 (Table 2). Inter-factor correlations were small to mediocre with a positive sign (Table 3). "Confidence with technology" scale showed a high Chronbach-a coefficient ( $\alpha = .89$ ). It is noted that the second barrier-factor (F2), labeled "lack of confidence", is distinct/different from the "confidence with technology" subscale (described in the research instrument).



**Table 2** Factor loadings, means and standard deviation per item (26 items: S1–S26)

	Factors			Mean	SD
	F1	F2	F3		
S8 Lack of support regarding ways to integrate technology into the curriculum	.775			2.70	.89
S6 Lack of time for teachers to learn/ practice/ plan ways to use computers (in the class)	.713			2.96	.91
S24 Lack of time for in-service training	.708			2.60	.99
S10 Lack of time in schedule for pupils to use computers in class	.683			3.08	.90
S22 Many demands of the curriculum	.522			3.03	.98
S5 Inadequate training opportunities	.486			2.82	.94
S11 Concern about pupils’ access to inappropriate material	.451			2.81	1.05
S9 Lack of technical support	.381			3.14	.84
S16 Lack of information about educational software and its appropriateness/ quality	.369			2.68	.85
S7 Lack of administrative support	.361			2.55	.97
S12 Lack of funding	.354			3.29	.87
S25 Fear of using technology		–.846		2.31	.97
S23 Lack of confidence in using computers		–.760		2.41	1.00
S19 Negative teachers’ attitudes		–.760		2.61	1.04
S21 Uncertainty about usefulness of technology		–.541		2.44	1.02
S20 Managing equipment		–.521		2.46	.99
S18 Lack of knowledge of the possible use of computers in class (with the pupils)		–.467		2.76	.84
S15 Lack of teachers’ technology skills		–.444		2.85	.95
S13 Lack of interest of the school (principal) about computer use		–.396		2.36	1.11
S26 Class management when computers are used		–.355		2.18	.91
S17 Lack of space in locating the computer(s) and its peripherals				2.57	.97
S2 Outdated, incompatible, or unreliable computers			.785	3.21	.97
S3 Lack of internet access, or internet is not easily accessible			.720	3.29	.84
S1 Not enough computers			.614	3.11	.99
S4 Lack of good educational software			.428	2.84	.90
S14 Large number of pupils in the class				3.23	.94
Cronbach-a	.84	.84	.76		

All responses ranged from 1 (not a barrier) to 4 (major barrier)

Factor 1 (F1) lack\_of\_support, Factor 2 (F2) lack\_of\_confidence, Factor 3 (F3) lack\_of\_equipment

Although “confidence with technology” was not linked to any barrier-factor, it was significantly linked to the following individual characteristics: gender ( $r = -.197, p < 0.05$ ), A-level training in ICT ( $r = -.228, p < 0.05$ ), years of experience with computers ( $r = .442, p < 0.01$ ) and computer use in class ( $r = .311, p < 0.01$ ) (Table 4). This means that, female teachers and teachers

**Table 3** Factor intercorrelations, factor means and standard deviations, and reliability indices

Component	(F1)	(F2)	Mean	SD	Cronbach $\alpha$
Lack_of_support (F1)			2.8766	.57794	.84
Lack_of_confidence (F2)	.447		2.4874	.64742	.84
Lack_of_equipment (F3)	.416	.266	3.1134	.70767	.76

**Table 4** Correlations among “confidence with technology” and individual characteristics

	Confidence with technology
Gender	-.197*
A-level training in ICT	-.228*
B-level training in ICT	-.049
* Correlation is significant at the 0.05 level	Years of experience with computers .442**
	Years of teaching experience -.166
** Correlation is significant at the 0.01 level	Computer use in class -.311**

who did not participate in A-level teacher training in ICT have lower confidence with technology. On the other hand, confidence with technology was higher for those teachers who have more years of computer experience and use the computer in class/ lab (with their pupils).

### Impact of individual characteristics on barriers

In order to explore the impact of specific individual characteristics (“gender”, “years of teaching experience”, “years of computer experience”, “A-level training in ICT”, “B-level training in ICT”, “confidence with technology”) on the barrier-factors extracted above (F1, F2 and F3), an estimation of correlation coefficients was conducted (Table 5). The “lack of support” factor was significantly correlated with “gender” ( $r = .240, p < .01$ ). The “lack of confidence” factor was significantly correlated with “B-level training in ICT” ( $r = -.180, p < .05$ ). The “lack of equipment” factor was correlated to “years of teaching experience” ( $r = -.209, p < .05$ ).

A series of one way ANOVAS were performed with dependent variables the three barrier-factors (i.e., “lack of support”, “lack of confidence” and “lack of equipment”) and independent (grouping) variable the “specialization”, consisted of the following three groups: literature teachers, mathematics and science teachers, others -excluding the information technology teachers, as they have to use the computer in their lessons. The specialization groups showed significant differences on the “lack of support” barrier-factor ( $F(3.115) = 3.83, p = 0.012$ ). Literature teachers showed significantly higher scores on “lack of support” in comparison to other groups of teachers: means 3.09, 2.78 and 2.07 for literature group, mathematics and science group and other group, respectively. The “confidence

**Table 5** Correlations among factors and other individual characteristics

	Gender	A-level training in ICT	B-level training in ICT	Years of computer experience	Years of teaching experience	Confidence with technology	Computer use in class
Lack_of_support (F1)	.240**	-.015	-.065	-.023	.021	-.171	.163
Lack_of_confidence (F2)	.056	.092	-.180*	.001	.048	-.064	.051
Lack_of_equipment (F3)	.073	.115	-.025	.074	-.209*	.050	-.057

\* Correlation is significant at the 0.05 level (2-tailed)

\*\* Correlation is significant at the 0.01 level (2-tailed)

**Table 6** Logistic regression of “computer use” on barrier-factors and individual characteristics

Variables in the equation	B	SE	Wald	df	Sig.	Exp(B)
Step 1 <sup>a</sup>						
Gender (1): female	-.447	.741	.364	1	.546	.639
Specialization			1.824	2	.402	
Maths and science teachers	.643	.784	.672	1	.412	1.902
Other	1.164	.925	1.584	1	.208	3.204
Years of teaching experience	.478	.259	3.401	1	.065	1.612
Lack_of_confidence	-.504	.635	.629	1	.428	.604
Lack_of_support	-.637	.797	.638	1	.424	.529
Lack_of_equipment	.449	.490	.840	1	.359	1.567
Confidence_with_technology	1.258	.507	6.155	1	.013	3.517
A-level training (1): yes	-.890	.856	1.080	1	.299	.411
B-level training (1): yes	1.810	.799	5.127	1	.024	6.111
Constant	-2.014	2.705	.554	1	.457	.133

<sup>a</sup> Variable(s) entered on step 1: B-level training, specialization, years of teaching experience, lack\_of\_confidence, lack\_of\_support, lack\_of\_equipment, confidence with technology, A-level training, gender

with technology scale” was not significantly related to any of the three specialization teacher groups.

### Identification of variables predicting computer use

The impact of specific individual characteristics and of barrier-factors on “computer use (yes/no)” was investigated by logistic regression analysis (Table 6). The independent variables entered in the logistic regression model were the three barrier-factors F1, F2 and F3 (i.e., “lack of support”, “lack of confidence” and “lack of equipment”), “confidence with technology” scale, “A-level training”, “B-level training”, “specialization”, “years of teaching experience” and “gender”. We decided not to include the “years of computer experience” because of its high correlation with “confidence with technology”. In order to investigate differences among specializations that are not ‘obliged’ to use computers in class, the eight information technology teachers did not participate in this analysis. The Result of Omnibus test of model coefficients show the existence of significant effect ( $\chi^2(9) = 19.51, p = 0.021, \text{Cox \& Snell } R^2 = 0.16, \text{Nagelkerke } R^2 = 0.28$ ). The barrier-factors had no significant effect on “computer use”. “Confidence with technology” scale showed a significant positive effect on “computer use” ( $B = 1.26, \text{Wald} = 6.16, p = .013$ ). The higher/greater the teachers’ confidence, the higher was the probability of “computer use” in class. “B-level training” had a significant positive effect on “computer use” ( $B = 1.81, \text{Wald} = 5.13, p = .024$ ). There was a higher probability of computer use in class among trained teachers in comparison with untrained teachers.

## Discussion and conclusions

This study investigated the main barriers to using computers in high school classes, as perceived by Greek teachers. The findings of this study contribute to the existing body of the literature by adding evidence of the current status of high school teachers' perceived technology barriers.

With regard to the first objective, to investigate teachers' perceptions of barriers to using-integrating computers in high schools, teachers' perceived major barriers were: lack of internet access and lack of funding (items S3 and S12, each with mean  $M = 3.29$ ), large number of pupils in the class (item S14,  $M = 3.23$ ), outdated/incompatible/unreliable computers (item S2,  $M = 3.21$ ) and lack of technical support (item S9,  $M = 3.14$ ) (see Table 2). Despite the prevalence of technology in secondary education, the computer equipment issues are still relevant in Greek classes, and this is reflected in teachers' perceived barriers. Thus the lack of technical, financial and administrative support together with the lack of funding was perceived by teachers as barriers to their use of technology. Our findings are in agreement with earlier studies (Goktas et al. 2013; Jones 2004; Agyei and Voogt 2011) which reported lack of technical support among teachers' perceived ICT barriers, as well as lack of hardware, lack of training opportunities and restricted access to internet (Salehi and Salehi 2012).

With regard to the second objective (to confirm the factorial structure of the questionnaire and the relationships among factors regarding teachers' perceptions of barriers), the analysis demonstrated that there were three barrier-factors in the 26-item questionnaire: "lack of support" (F1), "lack of confidence" (F2), and "lack of equipment" (F3) (see Table 2). This indicates that literature-originated constructs of barriers do not differ among different education levels (primary, secondary and higher education). In particular, there is an agreement with the study of Al-Senaidi et al. (2009), as the three factors extracted in our study ("lack of support", "lack of confidence" and "lack of equipment") were similar to the factors extracted in their study (conducted in higher education sector). Another interesting similarity between the two studies was that the factors extracted had small correlations, suggesting that the major barriers were separate in the current sample. Furthermore, there is an agreement with the barrier-factors extracted in our earlier study carried out in early childhood education (Nikolopoulou and Gialamas 2015). There is also agreement with the study of Sánchez et al. (2012) who reported the scarce institutional support and the lack of resources as main difficulties encountered by teachers in the use of ICT in class. The lack of support was also reported as a perceived barrier by Ismail et al. (2010), while the lack of equipment by Lim and Khine (2006). Therefore, there is a similarity of perceived barriers across time and different cultures.

With regard to the third objective, to investigate the impact of teachers' individual characteristics (gender, specialization, teacher training in ICT use, years of computer experience, years of teaching experience, confidence with technology) on teachers' perceived barriers, we found that: (a) the characteristic "gender" had a statistically significant effect on the factor "lack of support", (b) the individual characteristic "B-level training in ICT" had a statistically significant effect on the

factor “lack of confidence”, and (c) the characteristic “years of teaching experience” was statistically linked to the factor “lack of equipment” (see Table 5). The above findings mean that female teachers (in comparison to their male colleagues) perceived as a major barrier the lack of support. Also, the attendance of B-level training in ICT and the fewer the years of teaching experience (a characteristic which is typically linked to younger teachers), result in teachers’ perceiving the “lack of confidence” and the “lack of equipment”, respectively, as minor barriers. Thus, teachers who attended B-level teacher training tend to have greater confidence with the technology and do not perceive it as a major barrier. This has implications for in-service teacher training and is discussed later in the section. It was also shown that literature teachers perceived as a major barrier the lack of support, in comparison to mathematics and science teachers.

The fourth objective aimed to investigate the impact of teachers’ individual characteristics (gender, specialization, years of teaching experience, teacher training in ICT use, years of computer experience, confidence with technology) and of barriers on “computer use” in class/lab. As shown in Table 1, around 85 % of the sample reported that they make computer use in class with the pupils. We found that two individual characteristics (confidence with technology and B-level training) had a significant effect on “computer use” in class (see Table 6). This finding means that the higher/greater teachers’ confidence with technology and their pedagogical training in ICT result in higher probability of computer use in class. There is an agreement with earlier research (Pelgrum 2001; Hew and Brush 2007; Ihmeideh 2009; Nikolopoulou and Gialamas 2015) which has shown that teachers’ perceived technology barriers greatly affects computer use-integration into teaching and learning. The study of Wood et al. (2005) showed that primary and secondary teachers’ comfort with technology was the only significant predictor of technology use-integration in the classroom. Additionally, this study’s finding supported our earlier research finding (Gialamas and Nikolopoulou 2010): the higher teachers’ confidence with technology, the higher was their intention to use a computer in kindergarten class. Although the education level was different, a link was found between teachers’ confidence with technology and their intention to use a computer in class.

The findings of this study have implications for in-service teacher training. Teachers’ confidence with technology can be increased via attending appropriate in-service teacher training. In-service teacher training programmes should be carefully designed as these are expected to provide teachers with skills to evaluate and integrate the appropriate educational software. A number of secondary school teachers in Greece are now attending the B-level training in ICT and this is expected to help them, among others, develop their confidence with technology. Taken into account the low budgets of schools, we suggest all Greek state schools to be equipped with one computer lab available to different specializations. All educational sectors need to be aware of the possibilities and importance of technology in developing pupils’ learning in order to overcome the barriers which prevent technology use in high schools (so that pupils can benefit effectively from computer use). In parallel with in-service teacher training, technical, financial and administrative support is needed. Within the broader area of ICT, there is a

widespread recognition of the need for ongoing professional development and support to integrate technologies effectively (Pelgrum 2001; Van Melle et al. 2003).

Limitations of this study include the size of the sample, its origin from only one city (capital of Greece) and the use of a quantitative inquiry only. Teachers’ perceived barriers can be further explored with larger and more diverse samples. Additionally, this study could be enriched by using a mixed method (e.g., quantitative and qualitative approaches) in order to obtain a better understanding of the situation. When teachers respond to closed survey items, only the issues questioned can be identified. While open-ended questions may reveal, for example, how some previously reported barriers have changed and may help understand the importance of barriers when it comes to using technology in the classroom.

Identifying teachers’ perceptions of barriers to the integration of computers in class is not an end by itself. Future research is needed on how these barriers are overcome to support effective integration of technology in high schools. The rapid advances in computer technology and the changes within schools regarding the presence of technology (class conditions etc) make it challenging to evaluate the impact of potential barriers over time (Wood et al. 2005). Future research is suggested to investigate (i) how high school teachers’ perceptions of technology barriers change over time and (ii) the link between teachers’ perceptions and their classroom practices. The questionnaire was a reliable and valid instrument to use with high school teachers. In the future, it could be used with other target populations in different countries in order to identify possible similarities and differences across time and cultures.

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## Appendix

“Confidence with technology” subscale (Pierce et al. 2007)

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1. I am good at using computers			
[strongly agree]	[agree]	[disagree]	[strongly disagree]
2. I can fix a lot of computer problems			
[strongly agree]	[agree]	[disagree]	[strongly disagree]
3. I am quick to learn new computer software needed for school			
[strongly agree]	[agree]	[disagree]	[strongly disagree]
4. I am good at using things like VCRs, DVDs, MP3 s and mobile phones			
[strongly agree]	[agree]	[disagree]	[strongly disagree]

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