Handbook of Research on Diverse Teaching Strategies for the Technology-Rich Classroom

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A volume in the Advances in Educational Technologies and Instructional Design (AETID) Book Series

Published in the United States of America by
IGI Global
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Names: Tomei, Lawrence A., editor. | Carbonara, David D., 1952- editor.
Title: Handbook of research on diverse teaching strategies for the technology-rich classroom / Lawrence A. Tomei and David D. Carbonara, Editors.
Description: Hershey, PA : Information Science Reference [2020] | Includes bibliographical references. | Summary: “”This book examines theories and applications of diverse teaching strategies”--Provided by publisher”--Provided by publisher.
Identifiers: LCCN 2019018972 | ISBN 9781799802389 (hardcover) | ISBN 9781799802402 (ebook)
Subjects: LCSH: Computer-assisted instruction. | Educational technology. | Education--Experimental methods. | Internet in education.
Classification: LCC LB1028.5 .H31634 2020 | DDC 371.33/4--dc23
LC record available at https://lccn.loc.gov/2019018972

This book is published in the IGI Global book series Advances in Educational Technologies and Instructional Design (AETID) (ISSN: 2326-8905; eISSN: 2326-8913)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

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Pre-Service Teachers and Computers: A (Still) Troubled Relationship

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ABSTRACT

The chapter presents the results of a longitudinal study (years 2013-2018) in which pre-service teachers' actual and perceived competence in computers were examined, together with factors that were hypothesized to affect both. Participants were 1070 senior students, studying at the Department of Primary School Education, University of the Aegean, Greece, and an online questionnaire was used for recording their views. Results analysis, using multiple linear regression, indicated that pre-service teachers do not actually know a lot about computers, while at the same time, they view themselves as average users. Moreover, ICT courses' impact on actual knowledge and skills in computers was minimal; more significant was the impact of additional ICT training and ownership of both a PC and a laptop. On the other hand, participants based their perceived competence in computers almost exclusively on how competent they thought they were in basic computer use. On the basis of the results, recommendations are made in order pre-service teachers to be more adequately prepared to meet the challenges of using ICT as in-service teachers.

INTRODUCTION

Almost all educational systems incorporate various Information and Communications Technologies (ICTs) in the curriculum, in an attempt to provide high quality learning, to connect the learning subjects with daily practices, to release the education of its spatial and temporal limitations, and to foster a number of skills and learning dispositions called the "21st century skills" (Trilling & Fadel, 2009). There is mounting evidence which suggests that the use of ICTs during teaching is steadily increasing (e.g.,

DOI: 10.4018/978-1-7998-0238-9.ch002

Berrett, Murphy, & Sullivan, 2012). Despite this increase, despite the fact that ICT has been introduced in education for quite a while, and despite considerable capital investments in infrastructure and training, ICTs are still underused in education (Mueller, Wood, Willoughby, Ross, & Specht, 2008; Spector, 2010), leading many to believe that the impact of technology on education is yet to be realized (OECD, 2015). For example, teachers, even though quite familiar with computers, confident in using ICTs, and aware of the positive impact of ICTs on students' learning, they still use computers merely to prepare their teaching material (Schoolnet, 2013).

There are many reasons for this apparent failure of ICTs to play a significant role in education, such as insufficient infrastructure, inadequate digital literacy, the tendency of educators to avoid changes, insufficient policy design and implementation strategies, poor understanding of the relationship between ICT and pedagogy, and lack of understanding on how to integrate technology into curriculum (OECD, 2015). Apparently, achieving ICTs' integration in education is a multifaceted process of educational change, not depending exclusively on technology-related factors (Arntzen & Krug, 2011; Kimmons, Miller, Amador, Desjardins, & Hall, 2015). Indeed, the relevant literature suggested that teachers' views, beliefs and attitudes, are major predictors in determining if they will use computers during their teaching (e.g., Celik & Yesilyurt, 2013; Deng, Chai, Tsai, & Lee, 2014; Fokides, 2017; Paraskeva, Bouta, & Papagianni, 2008). In addition, it is theorized that efficacy in using computers (either perceived or actual) and intention to use them are closely related to their actual use (Macharia & Pelser, 2014; Teo, 2011). On the basis of the above, it can be argued that teachers' resistance to fully adopt ICTs is -up to a degree- due to their negative views and beliefs (Teo, 2011) as well as due to their unsatisfactory competence in computers (Fokides, 2016). To cope with these issues, in-service training was suggested (Schoolnet, 2013), but also one should start as early as possible, at the pre-service level.

Thus, the Departments of Education have the responsibility to adapt the curriculum so as to sufficiently prepare pre-service teachers to meet the challenges of using ICTs at school, to instruct them on how technology impacts pedagogy, and to positively influence their views and attitudes (Koehler & Mishra, 2009). However, some important questions are raised:

- What students actually learned after having attended all the ICT related courses? In other words, what is their actual competence in computers?
- Do students consider themselves competent in using computers?
- Which factors influence the above? Do ICT courses play a substantial role?

It is important to give answers to these questions because in case the relevant courses fail to achieve their goals, this will result in students not being skillful in ICT, but also their perceived ICT self-efficacy might be negatively affected. Together, these two factors can lead to the underuse of computers when today's pre-service teachers become in-service teachers (Kumar & Kumar, 2003). The present study is an attempt to clarify these matters. Furthermore, it is a longitudinal study, examining senior students' knowledge, skills, and perceived self-efficacy across the years 2013 to 2018. To the best of the authors' knowledge, there are no previous studies -at least in Greece- longitudinally examining similar parameters.

BACKGROUND

Ertmer (1999) noted two barriers hindering teachers' efforts to implement ICTs in schools: external (first-order) barriers and internal (second-order) barriers. It seems that even if teachers are skilled enough in technology and the first-order barriers are resolved, they still lack the ability to apply, in a meaningful way, appropriate ICTs in their teaching (Tondeur, Aesaert, Prestridge, &Consuerga, 2018). This can be partially explained by various internal barriers, such as teachers' views (Jimoyiannis & Komis, 2007; Sang, Valcke, van Braak, & Tondeur, 2009). Indeed, the relationship between teachers' beliefs and technology has been examined extensively (e.g., Hermans, Tondeur, van Braak, & Valcke, 2008; Prestridge, 2012; Teo & Milutinovic, 2015). Although this relationship still remains unclear (Mueller et al., 2008), a substantial body of literature suggested that teachers' beliefs about their computer efficacy predict if they will use computers during their teaching (e.g., Celik & Yesilyurt, 2013; Macharia & Pelser, 2014), while lack of knowledge and skills in computers, together with low perceived competence, can impede the successful integration of ICTs in teaching (Kumar & Kumar, 2003; Paraskeva et al., 2008). In addition, many studies have focused on other teachers' characteristics associated with their ICT competencies, such as their attitude towards ICTs in education, as well as how easy and useful they perceive that technology is (Holland & Piper, 2016; Teo & Milutinovic, 2015; Tondeur, Van Keer, van Braak, & Valcke, 2008). Moreover, studies suggested that teachers' pedagogical beliefs and early experiences in the use of technology are influenced by broader socio-cultural factors (e.g., van den Beemt & Diepstraten, 2016).

Teachers' knowledge, skills, and subjective competencies can be shaped or influenced either with in-service interventions (e.g., training seminars and workshops) or at the pre-service level while they are still studying to become teachers (Anderson & Maninger, 2007). Thus, it is quite reasonable to examine issues such as students' perceived competence in using computers, how computer literate they actually are, and what factors influence their knowledge, skills, and subjective self-assessment. It is also very useful to examine the impact the ICT-related courses they attended had to the above.

It is true that the curricula of the Departments of Education vary enormously within and between countries (Darling-Hammond & Baratz-Snowden, 2005) and this also holds true for the ICT-related courses and practices (Law, 2003). Nevertheless, five strategies are commonly implemented in order to develop pre-service teachers' ICT skills and capacities in technology, as well as to inform them how ICTs can be effectively applied in teaching: (a) stand-alone technology courses, (b) workshops, (c) integrating ICT in method and foundation courses, (d) modeling how to use ICT, and (e) practicum in schools that include ICT (Davis, 2010). In general, all the strategies indicated by Davis are applied in all Greek Departments of Education by incorporating a number of mandatory as well as elective ICT and ICT-related courses into their curricula. For example, 13% of the courses that are offered at the Department of Primary Education, University of the Aegean, are ICT orientated (Department of Primary Education, 2017). These courses provide students both basic and advanced knowledge and skills in computers and software tools of educational value. Considering the multidisciplinary nature of teachers' studies, this percentage is quite high. Similar is the situation to the other Departments of Education, with percentages varying from 8 to 14%. This indicates that universities acknowledge the importance of adequately preparing pre-service teachers to integrate ICTs into their teaching.

METHOD

On the basis of what was presented in the preceding sections, it was considered an interesting endeavor to examine how pre-service teachers' actual and perceived competence in computers are shaped. Thus, the following questions were explored:

RQ1: Which factors have an impact on pre-service teachers' actual competence in computers?
RQ2: Which factors have an impact on pre-service teachers' perceived competence in computers?
RQ3: What is the impact of the ICT courses they attended on their actual and perceived competence in computers?

Participants and Duration of the Study

The target group was students studying at the Department of Primary Education, University of the Aegean, Greece. Given that actual and perceived ICT knowledge and skills were examined, it was quite reasonable to select participants among the Department's senior students. That is because, at this stage, they have already attended most (if not all) of the ICT-related courses, and, consequently, beliefs, views, and actual knowledge and skills should be well-established. Moreover, it was decided to conduct a longitudinal study. Thus, data were collected for six consecutive years (2013 to 2018). As a result, the final sample size was 1070 students (roughly 90% of the Department's cumulative graduates for the abovementioned period of time). Moreover, the sample corresponds to about 7% of the total number of students who graduated from all the Departments of Primary Education in Greece during the last six years. Therefore, the study is a good indicator of the situation in Greece, given that -more or less- all Departments of Primary Education have similar ICT related courses.

Instrument

In an attempt to record pre-service teachers' actual and perceived competencies in computers, a self-reporting questionnaire was designed and used in the study, including the following categories:

- Demographical data (gender and age).
- Computer usage and patterns (20 items). There were questions regarding (a) the number of attended ICT-related courses, (b) additional ICT training (i.e., ECDL), (c) ownership of PC and/or laptop, (d) hours of daily computer usage, (e) ownership of electronic devices (e.g., smartphones, tablets, and game consoles), (f) the number and type of Internet and social networking accounts (e.g., Facebook, Gmail, and Skype), and (g) use patterns (i.e., percentage of use for assignments, social networking, gaming, and entertainment).
- Actual competence in computers (10 items, multiple choice questions). A short test was included for evaluating participants' actual knowledge and skills in computers. All questions were related to common tasks a user has to perform quite often (e.g., install or uninstall a program, end a task, and change his/her password).
- Perceived competence in computers (1 item, 5-point Likert type). Participants were asked to give an overall assessment of their computer competencies (both in terms of knowledge and skills).

- Perceived competence in specific ICT tools (9 items, 5-point Likert type). In many courses, students use diverse ICT tools that have an educational value. Moreover, a mandatory course offers them basic computer skills and knowledge. These courses fall into three major categories (a) basic computer skills (e.g., computer use and office applications), (b) authoring tools related to Internet applications (e.g., blogs, web-pages, and MOOCs, and (c) multimedia authoring tools (e.g., game authoring, digital storytelling, and virtual reality). Participants were asked to evaluate themselves on how skilled they believed they were in each category.

Procedure and Data Processing

The above questionnaire was available online during the last month of each academic year's spring semester. An invitation was posted on the Department's Facebook group as well as on the Department's learning management system, addressed to any senior student interested to participate. Participants were informed that they were going to complete a questionnaire, that the study was conducted on a voluntary basis, and that by submitting their responses consent to participate was deemed to have been given. In order to avoid multiple responses from the same individual, participants were also informed that their IP addresses were recorded. All questions were mandatory and it was checked whether they were answered. A score was computed on the basis of the correct answers in the test. For the Likert type questions, scores were obtained by allocating numerical values to the responses; "Strongly Agree" scored 5, "Agree" scored 4; "Neutral" scored 3; "Disagree" scored 2 and "Strongly Disagree" scored 1. Finally, an average was calculated for each category of ICT tools.

RESULTS

As already mentioned, 1070 pre-service teachers participated in the study. The sample reflected the actual gender and age distribution of all senior students as most were females (81.5%) between 21 to 24 years old ($M = 22.52$, $SD = 3.68$). The majority of participants has attended four to seven ICT related courses ($M = 5.00$, $SD = 2.24$), while 22.1% of them has received additional ICT training (i.e., ECDL courses). Less than 2% did not own a laptop or a PC, 22% possessed both, and the rest (76%) owned either of them (mostly laptops). These devices were used, on a daily basis, for around four hours ($M = 3.97$, $SD = 2.69$). A third of the above time was allocated to entertainment (33%), another third to social networking (32%), around 25% to conducting work related to their studies (e.g., preparing assignments), while gaming took around 8%. Excluding computers, only twelve participants did not have any other kind of an electronic device, the rest owned at least one smartphone (34% two or more). Then again, tablets and gaming consoles were not that common (16% and 6.5% respectively). Most students had two to five Internet and social networking accounts ($M = 3.56$, $SD = 1.49$), with Facebook being the most popular (90.02%), followed by various e-mail accounts (e.g., Gmail and Yahoo mail). Other services (e.g., LinkedIn and Skype) were, by far, less popular (< 2.5%).

As presented in a preceding section, ten questions assessed the participants' actual knowledge and skills in computers. On the basis of the correct answers, it is evident that they failed to answer correctly to half of them ($M = 4.97$, $SD = 1.95$). Indeed, a number of questions had quite high percentages of wrong answers. For example, 52.5% of the participants did not know how to install or uninstall a program and 50% did not know whether the "My Documents" folder is private or not. As a result, it can be

concluded that their actual competence in computers was not satisfactory. Then again, the participants' overall perceived competence in computers was exactly to the midpoint (M = 2.99, SD = 0.83), meaning that they viewed themselves as "average" users. Perceived competence in basic computer use was quite high (*max* = 15, *M* = 9.47, *SD* = 2.90). Considerably lower was perceived competence in multimedia authoring tools (*max* = 15, *M* = 6.11, *SD* = 2.75) and perceived competence in authoring tools related to Internet applications (*max* = 15, *M* = 6.07, *SD* = 2.89).

In order to discover what might explain the scores in actual and perceived competence in computers, the data were analyzed using multiple linear regression. Two separate analyses were conducted using the stepwise method; in the first, actual competence served as the dependent variable, while, in the second, the dependent variable was perceived competence. The following questionnaire's items were used as independent variables: (a) the year that the questionnaire was filled, (b) gender, (c) hours using computers, (d) ownership of PC, laptop or both, (e) the number of accounts one has, (f) the number of electronic devices one owns, (g) the number of ICT courses one has attended, (h) if one has received additional ICT related training, (i) the percentage of computer usage for assignments, entertainment, social networking, and games, and (j) the scores in perceived competence in basic computer use, in multimedia authoring tools, and in authoring tools related to Internet applications. Also, perceived competence served as an independent variable when actual competence was the dependent variable and vice versa.

Before proceeding with the analyses, it was checked whether the data met the assumptions for linear regression. It was found that:

- There were no missing or unengaged (with no variance) responses.
- The rule of thumb for at least 20 participants for every independent variable (Hair, Anderson, Tatham, & Black, 2006), was satisfied since there were 1070 participants and sixteen independent variables.
- An analysis of standard residuals demonstrated that there were no outliers, given that there were no values exceeding the |3| limit (Field, 2013) (Std. Residual min = -2.79, Std. Residual max = 2.71 for actual competence in computers, and Std. Residual min = -2.81, Std. Residual max = 2.79 for perceived competence in computers).
- The data met the assumption for independent errors as indicated by the Durbin-Watson statistic (1.84 for actual competence and 1.95 for perceived competence).
- The histograms of standardized residuals indicated that the data contained approximately normally distributed errors, as did the normal P-P plots of standardized residuals, which showed that points were not completely on the line, but very close to it (Figures 1-4).
- Variance Inflation Factor (VIF) and tolerance were used for checking multicollinearity. The largest value of VIF that was observed was 2.10, well below the recommended value of 4 as a maximum (Hair et al., 2006; O'brien, 2007). Similarly, the minimum value of tolerance that was observed was .46, well above the minimum recommended value of .25 (Hair et al., 2006).
- Finally, heteroscedasticity was checked using the Breusch-Pagan test (Breusch & Pagan, 1979). It was found that in both cases heteroscedasticity was an issue [$\chi^2(16) = 2.03$, $p = .002$ for actual competence and $\chi^2(16) = 6.56$, $p < .001$ for perceived competence]. Since there was heteroscedasticity in the residuals of both scores, heteroscedasticity-consistent standard errors were estimated for the independent variables that were included in the final models (Hayes & Cai, 2007).

After conducting the analyses, it was found that:

Figure 1. Histogram for actual competence

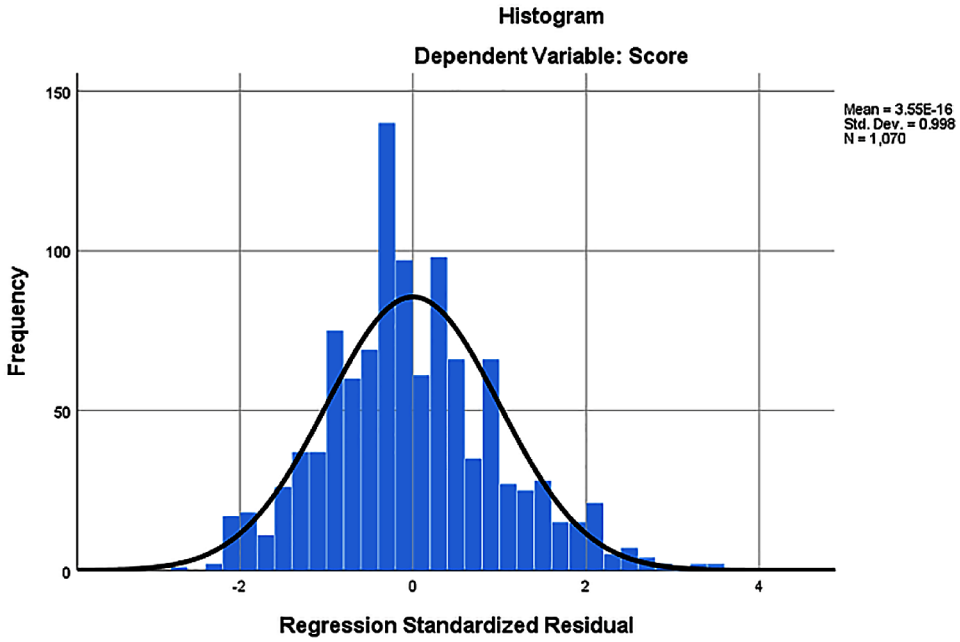


Figure 2. P-P Plot for actual competence

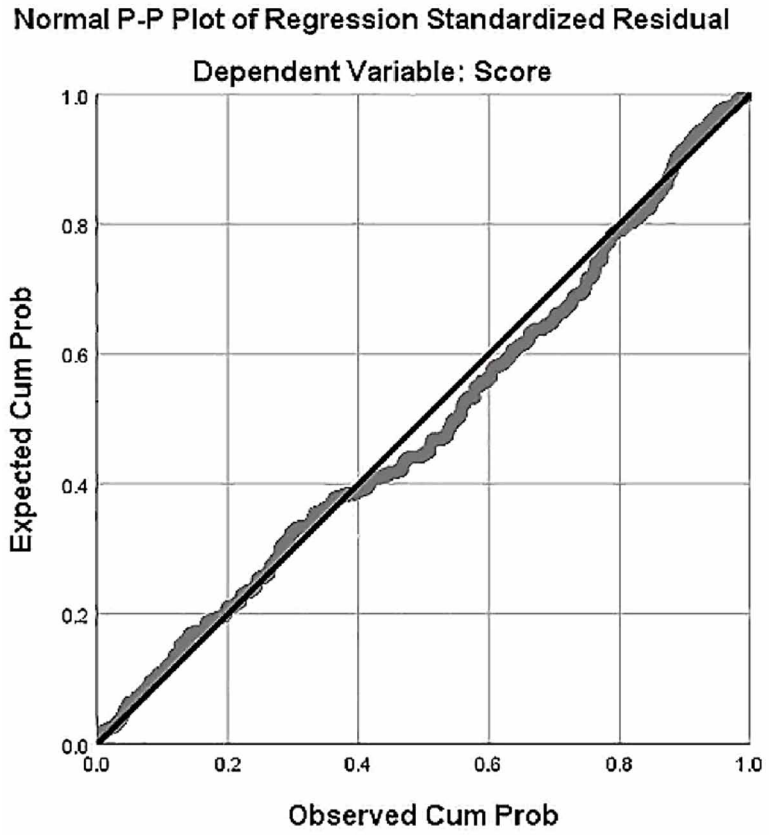


Figure 3. Histogram for perceived competence

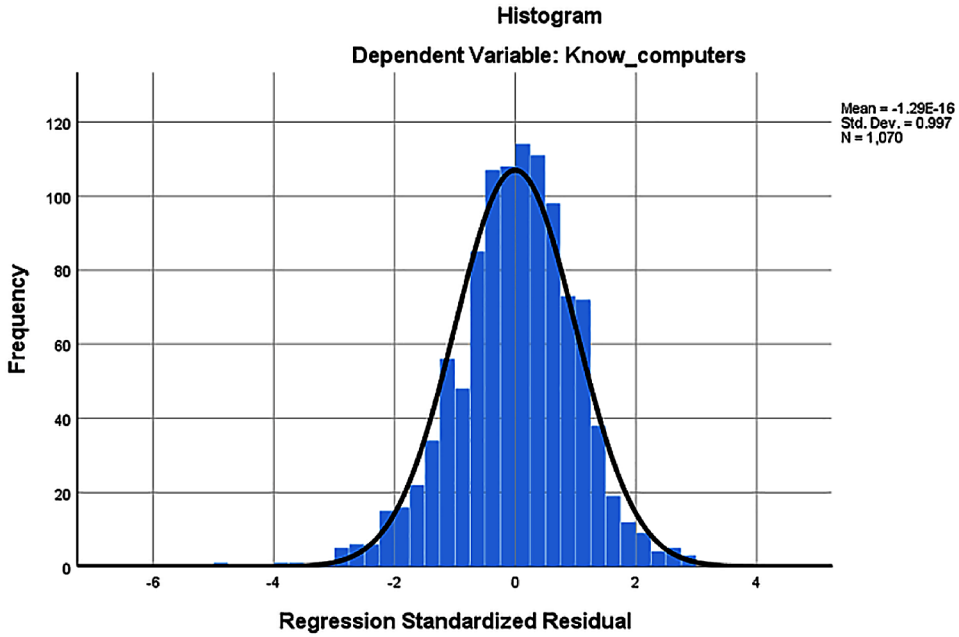
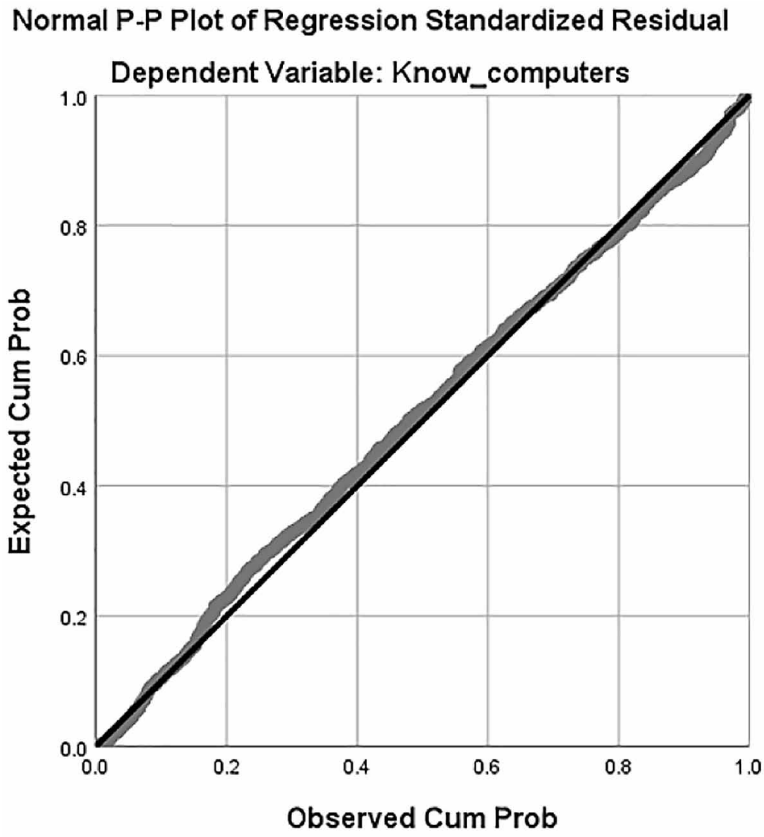


Figure 4. P-P Plot for perceived competence



- The number of ICT courses one has attended, if one has received additional ICT training, ownership of both a PC and a laptop, and the year the questionnaire was filled, explained a small amount of the variance in actual knowledge and skills in computers [$F(16, 1053) = 18.79$, $p < .001$, $R2 = .23$, $R^2_{Adjusted} = .22$]. Detailed results are shown in Table 1. Thus, RQ1 cannot be adequately answered.
- As for RQ2, gender, the number of ICT courses one has attended, the number of accounts one has, the use of computers for playing games, perceived competence in basic computers' use, and perceived competence in authoring tools related to Internet applications, explained a satisfactory amount of the variance in perceived knowledge and skills in computers [$F(16, 1053) = 66.36$, $p < .001$, $R2 = .55$, $R^2_{Adjusted} = .54$], as presented in Table 2.
- Coming to RQ3, it seems that the ICT courses had a small positive impact on actual competence in computers, while, at the same time, they had a small negative impact on perceived competence in computers.

The above findings will be further elaborated in the coming section.

DISCUSSION

In order to examine pre-service teachers' actual and perceived competence in computers, a longitudinal study was conducted having as a target group 1070 senior students. As they were about to complete

Table 1. Linear model of predictors of actual competence in computers

Predictor	b	se B (HC3)	t	p	β
Year	0.13 (0.02, 0.23)	.05	2.35	.019	.10
ICT courses	0.12 (0.05, 0.19)	.04	3.45	< .001	.15
Other ICT training	1.37 (1.10, 1.64)	.14	9.99	< .001	.29
Ownership of PC and/or laptop	1.28 (0.98, 1.57)	.15	8.56	< .001	.29

Notes. 95% confidence intervals reported in parentheses; only the statistically significant predictors are presented

Table 2. Linear model of predictors of perceived competence in computers

Predictor	b	se B (HC3)	t	p	β
Gender	-0.13 (-0.22, -0.03)	.05	-2.64	.008	-.06
ICT courses	-0.04 (-0.06, -0.02)	.04	-3.55	< .001	-.12
Number of accounts	0.05 (0.03, 0.08)	.05	3.84	< .001	.09
Use computers for playing games	0.007 (0.001, 0.01)	.003	2.15	.032	.09
Perceived competence in basic computer use	0.18 (0.16, 0.19)	.01	22.14	< .001	.62
Perceived competence in authoring tools related to Internet applications	0.03 (0.01, 0.04)	.01	3.63	< .001	.10

their studies, it can be assumed that their actual and perceived competencies in computers were already well-established. In addition, the sample size represents a noteworthy percentage of the total number of senior students in all Greek Departments of Primary Education. Therefore, reasonably safe conclusions can be drawn.

With the exception of a handful of participants, they all own at least one computer (mostly laptops), while a fifth of them own both a laptop and a PC. Smartphones are also owned by all, with a third of the participants owning two or more. On the basis of the results, it seems that pre-service teachers are quite active computer users; they spend around 4 hours a day using them ($M = 3.97$, $SD = 2.69$) and they have more than three social networking accounts (Facebook being the most popular one). Two-thirds of the above time is allocated for recreational purposes (e.g., social networking, watching movies, and listening to music); the use for assignments is limited to 25%. More or less, the participants can be characterized as typical undergraduate students who use computers for socializing and for entertainment, far more frequently than for academic purposes, as previous studies have demonstrated (Sim & Butson, 2013; Margaryan, Littlejohn, & Vojt, 2011).

Given that more than ten courses offered at the Department of Primary Education are ICT-related, the fact that the participants attended around five of them during their studies ($M = 5.00$, $SD = 2.24$) probably indicates that they are not so interested in ICTs' educational applications. What is more important is that their scores regarding actual competence in computers, although very close to the midpoint ($max = 10$, $M = 4.97$, $SD = 1.95$), were -to some extent- disappointing. The results were expected to be far better considering that the questions were simple and related to tasks and problems a user often faces when using computers. This finding is not only unsatisfactory but also alarming for two reasons. First, it indicates that pre-service teachers' knowledge and skills in computers is rather superficial, they do not actually know much about computers. Even though they use computers for four hours per day conducting some basic activities, their technological background is shallow and problematic, as other studies have pointed out (Dahlstrom & Bichsel, 2014; Kvavik, 2005). Second, all the relevant questions reflected issues discussed in courses aiming to provide basic computer knowledge and skills to students. Therefore, one can argue that the low scores indicate that these courses failed to reach their objectives.

Students' perceived competence in computers was exactly to the midpoint ($M = 2.99$, $SD = 0.83$), meaning that students view themselves as "average" computer users. Taken together with the results in actual competence, it can be supported that pre-service teachers overestimate their skills. This result is consistent with the findings of other studies which have concluded that pre-service teachers inaccurately self-assess their digital competencies (Maderick, Zhang, Hartley, & Marchand, 2015). Perceived competence in basic computer use was well above the midpoint ($max = 15$, $M = 9.47$, $SD = 2.90$). In contrast, perceived competencies in multimedia authoring tools and in authoring tools related to Internet applications were considerably lower ($max = 15$, $M = 6.11$, $SD = 2.75$ and $M = 6.07$, $SD = 2.89$ respectively). This means that pre-service teachers do not consider themselves capable of using such authoring tools. Once again, this finding is alarming as it suggests that the relevant courses did not influence students' perceived self-efficacy in these tools.

The results from the regression analysis were challenging. The variation in actual competence in computers was not adequately explained ($R^2_{Adjusted} = .22$, 22%). If one has received additional ICT training and ownership of both a PC and a laptop, were the predictors with the most significant impact ($\beta = .29$ both). The number of ICT courses one has attended ($\beta = .15$) and the year the questionnaire was filled ($\beta = .10$), were the other two predictors. Interestingly enough, variables such as gender and hours of computer usage were not included in the final model. Since the model has limited explanatory power

and the number of ICT courses one has attended explained a fifth of the variance, it can be concluded that the ICT courses did play a role in one's knowledge and skills in computers, but the impact was relatively small. In support of this finding are the results in students' scores regarding actual competence in computers. An encouraging finding was that the year the questionnaire was filled had a positive impact, though a small one, signifying a positive change through the years.

In contrast, a sufficient amount of the variation in perceived competence in computers was explained ($R^2_{Adjusted} = .54$, 54%). Although six variables contributed, one stands out as it had a remarkable impact. Indeed, perceived competence in basic computer use can almost by itself explain one's perceived competence in computers as a whole ($\beta = .62$). Gender had a small negative impact ($\beta = -.06$), meaning that females feel that they are less competent in computers than males. There is no common consensus in the literature regarding how females view their ICT-related competencies or their attitudes toward computers (e.g., Baturay, Gökçearslan, & Ke, 2017; Yuen & Ma, 2002). The number of accounts one has and if computers are used for playing games had a small positive impact ($\beta = .09$ both). Finally, perceived competence in authoring tools related to Internet applications had a positive impact ($\beta = .10$), while the number of ICT-related courses one has attended had a negative one ($\beta = -.12$). Although this seems to be a contradictory finding, it is not totally irrational. Courses examining authoring tools related to Internet applications are elective and rather difficult; not a lot of students attend them and usually are the ones with a well-developed technological background. On the other hand, the ICT-related courses offered by the Department cover a large variety of subjects and applications. It is plausible that students who have attended a large number of them to have realized that what they actually know is far less than what it can be learned or used in education and this revelation had a negative impact on their perceived competence in computers.

Probably the study's most significant finding was the dominant role of perceived competence in basic computer use in shaping one's perceived competence in computers. It has to be reminded that this variable was the sum of courses related to basic computer skills (e.g., computer use and office applications). It is also important to keep in mind that office applications are not used just in ICT related courses, but, virtually, in all courses (e.g., for assignments and students' presentations). This means that students use them all the time Evidently, if students consider themselves competent in office applications, this, in turn, makes them feel computer literate, leading them to believe that they are competent in computers in general.

Putting together the results, they formulate the ICT-related profile of pre-service teachers. They consider themselves "average" computer users because they use word processors and presentation programs, and they are Internet and social media users. The more of the above, the more they feel that they are computer literate. Alas, they do not actually know much about computers. Moreover, since the scores in actual knowledge and skills were low and could not predict the scores in perceived computer competence, it seems that students overestimate their skills. In addition, they base their assessment virtually on a single factor: how good they think they are in office applications. Therefore, it is doubtful whether subjective self-assessment can be used as an accurate stand-alone predictor of digital competence, which was also highlighted by Maderick et al. (2015).

As for the ICT courses, they seem to be unsuccessful in shaping pre-service teachers' knowledge and skills. That is because a significant portion of the variance in actual knowledge and skills was left unexplained and ICT courses were just 15% of the explained variance. Not only that, but they had a negative impact on subjective competence. Taking into account that the study lasted for six years and that the relevant variable was included as a weak predictor only in actual competence in computers, it seems

that the situation has not really changed through the years; pre-service teachers become in-service teachers having little knowledge and skills and overestimated beliefs regarding their computer competency. Logically enough they will use computers just to prepare their teaching (e.g., lessons' plans and students' tests) and will hardly get involved in more complex and demanding tasks, as Schoolnet's survey (2013) has pointed out. It is also quite logical difficulties in incorporating ICT into their practice to force them to revert to traditional teaching methods (Tziafetas, Avgerinos, & Karakiza, 2013) and in-classroom computer usage to become occasional or even non-existent (Koustourakis & Panayiotakopoulos, 2008). Unfortunately, the aspiration of rendering teachers proficient ICTs users or even capable of designing educational applications (OECD, 2015), is far from being accomplished.

Implications for Practice

Although the study was limited to one Department of Education in Greece, it can be argued that the findings can be of use to other Departments of Education as well. That is because they all have a number of mandatory and elective ICT courses in their curricula and they implement -more or less- the same strategies in order to develop pre-service teachers' competence in ICTs as Davis (2010) suggested. As already presented, teachers need specific professional development opportunities in order to increase their ability to use ICTs for motivating students, for providing personalized instruction, and for fostering 21st-century skills. Although the general idea is that such training in ICTs positively impacts teachers' attitudes toward ICTs and that it encourages them to use technology in the classroom (Schoolnet, 2013), the findings of this study, as far as pre-service teachers are concerned, are not in full support of this notion. This means that there are considerable implications for the ICT courses per se, as they proved to be ineffective. In order to rectify the situation, the following can be considered:

- The vast majority of students studying at the Departments of Education in Greece have a social sciences background; in high school, due to the Greek educational system, subjects related to natural sciences and technology played an unsubstantial role in their education (Stamelos & Emvalotis, 2001). Thus, they do not have a well-developed technological background. This fact, which was reflected to both their actual and perceived competence in computers, calls for interventions aiming to establish a much-needed technology orientated culture. Seminars and workshops providing hands-on experiences are well-suited for this cause and a good idea is students to attend them prior to studying courses related to the educational uses of ICTs.
- As the results demonstrated, subjective self-assessment is not a predictor of actual computer competence. Then again, it can be useful in the design of pre-service teachers' training programs such as the above. By knowing what students' beliefs are, one can encourage them to reflect upon their perceptions on one hand and their actual knowledge and skills on the other, in order to find by themselves what are their strengths and weaknesses (Maderick et al., 2015).
- Technology should be incorporated throughout the curriculum and should be linked to practice (Brush et al., 2003; Jang, 2008), providing experiences on how it can be applied in specific subjects (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). While it is encouraging that the Departments of Education have a large number of ICT related courses, in the light of the study's findings it has to be examined whether these courses conform to the above and, if not, to re-design them.

- Finally, the literature suggests that teachers can greatly influence students' views and attitudes (Margaryan et al., 2011). Moreover, students expect their teachers to train them on how to use technology (Dahlstrom, Walker, & Dziuban, 2012). In this respect, it is the academics task to become role models for pre-service teachers, to provide a frame of reference, by adopting and demonstrating innovative approaches to technology-enhanced learning.

CONCLUSION

Although the study's results were thought-provoking, there are limitations that need to be acknowledged. While all necessary precautions were taken, participants' accuracy and trustworthiness of responses is always an issue in self-reporting questionnaires. Actual knowledge and skills in computers were not adequately explained; there are other factors exercising a substantial influence but were left unmapped by this study. Also, there was a limited number of items examining pre-service teachers' knowledge and skills in computers. It is quite probable that their spread of abilities was not accurately recorded. Finally, as the study's sample was limited only to Greek pre-service teachers, the results' generalizability is limited. Future research can address the above limitations. For example, future studies can explore further which factors have a significant impact on actual ICT competencies. Comparative studies across countries can identify differences or similarities to the findings of the present study. Also, it would be interesting to examine whether perceived or actual competence in computers can be included as predictors in a model examining teachers' intentions to use computers during their teaching; Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989) can serve as a basis for such research.

In conclusion, the study contributes to the relevant literature (a) by highlighting the gap between actual and perceived knowledge and skills, (b) by indicating that competence in basic computer use had an overwhelming impact on how competent pre-service teacher think they are, and (c) by revealing the minimal impact that the ICT courses had on both perceived and actual ICT competencies. Thus, the study's results might prove useful to universities in adapting their curriculum of study so as to be more effective in preparing pre-service teachers to meet the challenges of using ICTs at school.

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