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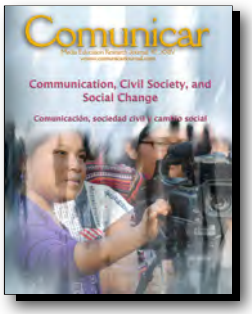

Models of educational integration of ICTs in the classroom

Modelos de integración didáctica de las TIC en el aula

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ABSTRACT

We present in this paper the results of a study analyzing the scope and use that teachers make of ICT in classrooms and schools with abundant availability of information and communication technologies: one computer per student, interactive whiteboards, multimedia projectors and internet access. The main goal of this study is to detect models or patterns of educational use of ICT resources available in classrooms related to some personal and professional characteristics of the teachers that took part in the study, such as gender, years of experience, educational stage, digital competence and degree of use of ICT in their daily lives. A descriptive correlational design based on a survey study answered by over 3160 teachers from all over Spain who participated in the School Program 2.0 was used. The results show two clear different patterns of ICT use according to frequency and type of tasks assigned to the students: a weak integration-teaching model against a strong educational integration of ICTs. We come to the conclusion that teachers who develop a model of intensive educational use of ICTs are teachers with many years of professional experience, that make regular use of ICTs and, moreover, perceive themselves as sufficiently trained and with a highly developed digital competence.

RESUMEN

En este artículo se presentan los resultados de un estudio que analizó el grado y tipo de utilización que el profesorado hace de las TIC en aulas con abundante disponibilidad de tecnologías de la información y comunicación: un ordenador por alumno, Pizarra Digital Interactiva, proyectores multimedia y acceso a Internet. El objetivo del estudio fue detectar modelos o patrones de uso didáctico de las tecnologías y relacionarlo con algunas características personales y profesionales del profesorado, tales como el género, los años de experiencia, la etapa educativa, la competencia digital y el grado de uso de las TIC en su vida cotidiana. Se empleó un diseño de tipo descriptivo correlacional basado en un estudio de encuesta donde respondieron más de 3.160 profesores de toda España que participaban en el Programa Escuela 2.0. Los resultados obtenidos muestran que existen dos tipologías nítidas de modelos de uso de las TIC en función de la frecuencia y el tipo de tarea demandada al alumnado: un modelo de integración didáctica débil frente a un modelo de integración didáctica intensa de las TIC. Asimismo, se concluye que el perfil del profesorado que desarrolla un modelo de uso didáctico intensivo de las TIC es un docente con bastantes años de experiencia profesional, ciudadano usuario habitual de las TIC y que, además, se percibe suficientemente formado y con competencia digital.

KEYWORDS | PALABRAS CLAVE

ICT, teachers, teaching practice, teaching resources, educational technology, school 2.0, survey, educational integration models. TIC, profesorado, práctica docente, recursos didácticos, tecnología educativa, escuela 2.0, encuesta, modelos de integración didáctica.

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1. Introduction and state of the art

In Spain, starting almost three decades ago, different programs –promoted by the central government or the autonomous regions- are being implemented in order to facilitate the educational use of ICT in schools. The last project of this kind was School 2.0 (2010-2012), which equipped classrooms with an important amount of digital technology (netbooks, interactive whiteboards and Internet access), particularly in Year 5 and 6 of Primary Education and Year 1 and 2 of Secondary Education.

This paper comes out of a research project called «The Politics of «One Computer per Student» in Spain. Teachers' Views and Practice on School 2.0 Program. A Comparative Analysis among Autonomous Regions» (ICT in School System, TICSE 2.0) and funded by the R+D National Plan 2010 from the Spanish Ministry of Science and Innovation (EDU-2010-17037). Eleven research groups from different Spanish universities collaborated on this project. Different types of studies were conducted such as surveys, case studies, interviews and classroom observations. All of them had the aim of exploring teachers' opinions about ICTs and the impact of the School 2.0 Program in classroom practice and school organization. An analysis of the ICT educational policy in the participating autonomous regions (15 in total) was also carried out.

This article presents some of the research findings, particularly, those related to the analysis of the teachers' use of ICT in their teaching in relation to these questions:

- In classrooms with abundant digital technology, to what extent do teachers make an educational use of technologies while configuring differentiated models or patterns of teaching practice?
- Are there any relationships between those integration models and educational use of ICTs and the teachers' personal or professional characteristics?

1.1. Teachers' use and practice of ICTs in the classroom

One of the main areas within educational research in recent years is the study of the processes of integrating ICTs in schools – one of the main aims of educational policy in most western countries (Area, 2006). Since more than a decade ago, different studies have focused on assessing the impact of these policies in many countries (Pelgrum, 2001; Richarsond, 2000), in European schools (Balanskat, Blamire, & Kefala, 2006; Becta, 2007; Condie & Munro, 2007; Euridyce, 2004, 2011; European Commission, 2006, 2013) and in the Spanish school system (Marcolla, 2006; Meneses, Fàbregues, Jacovkis, Rodríguez-Gómez, 2014; Montero, 2009; Sigalés, Josep, Mominó, Meneses, & Badia 2008).

However, in spite of the abundance of empirical research about the processes of integrating ICT in schools, «the research results, although not contradictory, have few convincing and inconsistent inferences which limit the generalization of conclusions and significantly reduce their impact» (Mama & Hennesey, 2013: 380).

A decade ago, Balanskat, Blamire and Kefala (2006) in a study conducted for the European Schoolnet concluded that teachers use ICTs to support the existing pedagogies and do not show a significant change of teaching principles and methods. A few years later, the European Schoolnet (European Commission, 2013: 102) actualized the study and, comparing the results from 2006 and 2013, argued that «in general, the use of ICTs has not incremented as much as it was expected from 2006, but it seems to have remained stable from then. There is still a long way to go before ICTs are completely integrated in schools and teaching (…). On the other hand, there is no relationship between the high levels of ICT equipment and teachers' and students' confidence, use and behavior towards them. Curiously, survey shows that there is no relationship between the number of computers in schools and the students' frequency of use, neither at European nor at national level».

The OECD's report (2015a) –elaborated from the data obtained in the survey TALIS 2013 (Teaching and Learning International Survey)– shows that less than 40% of teachers from the studied countries use ICTs as part of their teaching process. School headmasters point out that the main obstacles for its use are the lack of computers, the limited Internet connection and shortage of appropriate software. Teachers consider that ICT training is the second or third priority.

Likewise, the OECD (2015b) has just published a report conducting an international comparative analysis of the digital abilities of students and their learning atmospheres. The report shows that there is no direct and causal relationship between availability and accessibility to technologies and its educational use in the classroom. In fact, it shows important variations in its use according to teacher's personal characteristics, contextual factors related to the implemented educational policies and other organizational and institutional factors.

1.2. Patterns or models of use of ICT resources

Changes and innovations in school culture are always controversial – they suggest the idea of crisis, ins-

tability and uncertainty. In this context (well known and described in the innovation and educational change literature), the school institutions (the systems) and the individuals within them react in different ways and adopt different strategies that Marcinkiewicz (1993) relates to the teachers' innovative trend and that define or suggest patters or profiles of use.

Different authors have tried to identify the typology of ICTs used by teachers (Hsu, 2011). The work of Barron and others (2003) is here of particular significance. They identified four types of ICTs use in classroom teaching: the computer as a research instrument for students, as a tool for problem solving and decision-making, as a production instrument (for the making of reports and papers), and lastly, as a communication resource.

Likewise, Russell & al. (2003) identified six categories of ICTs use by teachers: use of ICTs for lesson preparation, material production, students guiding, special education, e-mail use, and also for recordings and registers.

Braak, Tondeur and Valcke (2004) identified two types of strategies or patterns of use of ICTs in schools: a mere support of teaching processes, and an effective use of those resources in teaching development. The latter was mediated by the teachers' age, gender, digital competence, attitude towards ICTs, and disposition towards change and innovation.

Other studies have investigated possible barriers or obstacles that contribute to the lack of an effective integration of ICTs in the teaching processes, such as the difficulties to access resources, inappropriate equipment, the lack of technical and maintenance support, or internal organization issues (Inan & Lowther, 2010; Unal & Ozturk, 2012).

All of these results invite us to consider the following questions: to what extent is the teacher in the classroom confident in the use of new digital media and makes an educational use of it in school time? Are ICTs combined with traditional media such as textbooks or do they substitute them? For what activities are these technologies used in the classroom? Is it possible to identify models or patterns of educational use of ICTs according to its frequency and type of tasks that are carried out with them? Is there any relationship between the teaching models of educational use of ICTs and the teachers' personal characteristics?

2. Methods and materials

The research design used belongs to the field of non-experimental methods («ex post facto»). Specifically, this paper focuses on a descriptive correlational design, based on a survey study. The aims were:

• Aim 1: To identify models or patterns of educational use of ICTs according to its frequency and type of tasks that are carried out with them.

• Aim 2: To find out if there is any relationship between the teaching models of educational use of ICTs identified and the teachers' personal and professional profile.

> It is necessary that future research explores whether both models of use found are still being used in the new classroom contexts, where technology increases even more with the arriving of mobile devices (brought by students in many cases) and to what extent teachers readapt these patterns according to the increase of their experience in the educational use of ICTs.

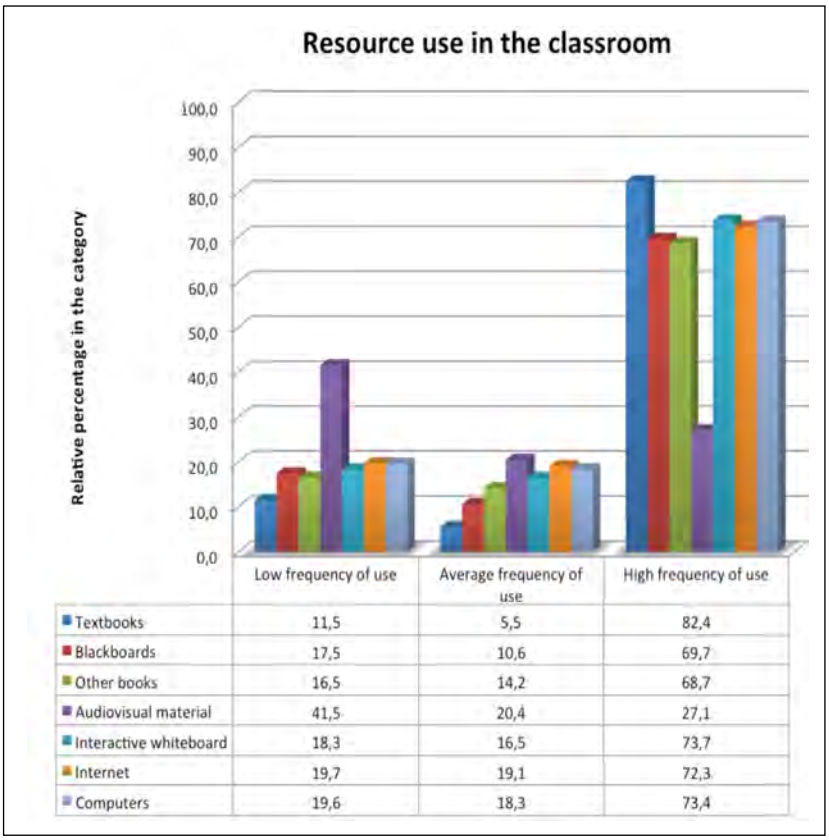
2.1. Participants and sample

The study conducted with the survey of the research Project TICSE 2.0 gathered data from a sample of 5,161 teachers in 15 Spanish autonomous regions. Most of them were participants in the School 2.0 Program in 2011. In the present study we have worked with a sample extracted from the total of survey teachers, according to the availability of ICT resources in their classroom. We selected those teachers who had the following resources in their classroom: a computer or tablet for the teacher; a computer in the classroom for students (without considering the number of computers available); an interactive whiteboard and Internet access. Taking into account these selection criteria, the analyses have been conducted with a sub-sample of 3,164 teachers from 15 Spanish autonomous regions, of which 46% were men and 53% were women, from state schools (93%) and pri-

vate schools (6%). According to educational stages, the sample is distributed as follows: 67% were teachers of Primary Education and 32% teachers of Secondary Education. According to age distribution, 50% of survey respondents were 45 years old or more.

2.2. Instruments and data collection

The data collection instrument was a 32-question multiple-choice questionnaire organized in 6 parts (Area & Sanabria, 2014; De-Pablos, 2015). For the purposes of this paper, we have analyzed the answers pertaining to questions 11 and 12. In the final stage of this study, we included the personal and professional characteristics of participating teachers.



	Low frequency of use	Average frequency of use	High frequency of use
Textbooks	11,5	5,5	82,4
Blackboards	17,5	10,6	69,7
Other books	16,5	14,2	68,7
Audiovisual material	41,5	20,4	27,1
Interactive whiteboard	18,3	16,5	73,7
Internet	19,7	19,1	72,3
Computers	19,6	18,3	73,4

Figure 1. Percentage of teachers in the different levels of frequency of use for every educational resource.

2.3. Data analysis

Based on the data obtained from the 3,164 surveys that constitute the sample, we decided to carry out a two-stage cluster analysis, adding the information obtained from the selected items (frequency and type of ICT practice in the classroom). We tried to verify whether survey respondents could be grouped in categories regarding frequency and types of use of ICT resources. Subsequently, we carried out a differential analysis of the resulting distributions for questions defining personal and professional characteristics of teachers between the two obtained clusters, based on chi-squared test. All the analyses have been made using the statistical analysis software SPSS (see 19).

3. Results

• Aim 1: To identify models or patterns of teaching practice according to the frequency and type of ICT use in the classroom. First of all, we present the percentages of frequency of ICT use in the classroom in relation to seven types of resources or educational media: textbooks, blackboards, other books and bibliographic resources, traditional audiovisual resources, classroom computers, interactive whiteboard, and Internet (see figure 1). In order to simplify the interpretation of results, we decided to reduce the analysis variables from the initial five levels to three levels, according to the following criterion in the table.

The obtained results show that textbooks, interactive whiteboards, computers and Internet are used more than «a few days a week», followed by the educational support of other books and blackboards. The only resource that has a lower use is traditional audiovisual media.

In order to analyze whether there are patterns of joint use of these resources, we decided to carry out a two-stage cluster analysis.

The cluster analysis has been conducted considering the variables derived from the codification of

Initial levels	New levels
1. Never	1. Low frequency of use
2. A few times in the academic year	
3. A few days a month	2. Average frequency of use
4. A few days a week	3. High frequency of use
5. Every day	

question 11. Survey respondents were here asked about the frequency of use of educational resources in the classroom (ICTs and traditional resources). To these variables, we have added those derived from the codification of question 12, which measures the particular uses of ICT resources. We wanted to improve the cluster identification that may arise, adding to the declared frequency of use of ICT or non-ICT resources the information about the type of use of ICT resources. As a result of this analysis, two teachers' clusters or groups emerge. These groups are 48% of cases (1361 subjects) and 52% of cases (1,476 subjects) respectively. 327 subjects are lost values, since they could not be placed in any cluster.

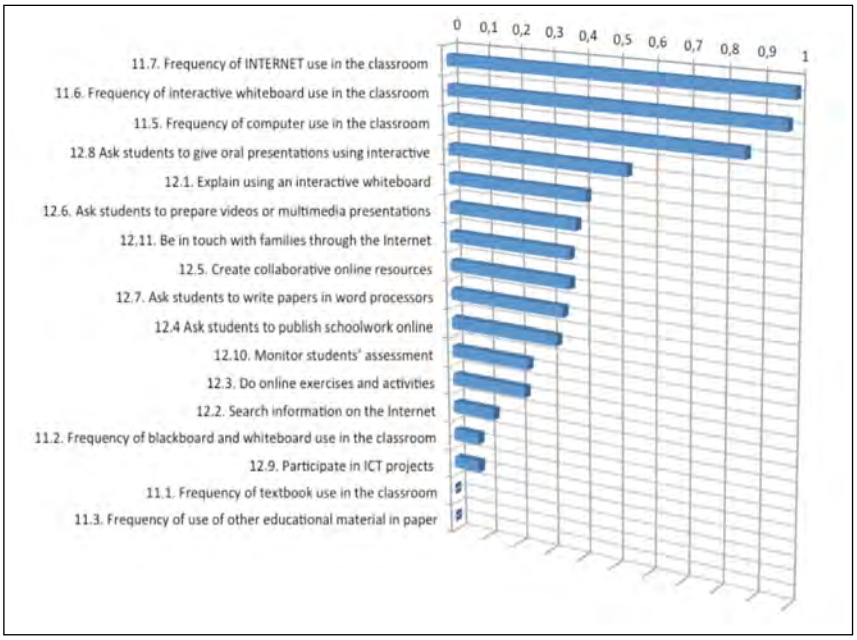


Figure 2. Relative significance of every predictor in clusters' configuration.

As we can see in figure 2, the questions that to a greater extent determine the belonging to one group or the other are, as we expected, those related to question 11.7 (frequency of internet use in the classroom), question 11.6 (frequency of interactive whiteboard use) and question 11.5 (frequency of computer use in the classroom). To these three variables we added, with a measured predictive capacity, identifying variables of the types of use that are given to these ICT resources, all related to the different questions of question 12 of the questionnaire. The variables related to the frequency of use of traditional educational resources do not have discriminant power at all. The variable associated to question 11.4 (use of traditional audiovisual media) was discarded in the analysis because of its irrelevance.

The description of every cluster, according to the characteristics of the sample obtained through the 20 variables included in the analysis, is explained in tables 1 and 2. From the analysis made we can highlight the following characteristics:

a) Cluster or group 1, called in this study «occasional ICT user teacher, with a traditional reproductive educational approach and knowledge transfer», is described by a less frequent and less diverse pattern of ICT use than the one observed in the other cluster. These teachers make a moderate and occasional use of ICT resources and they limit their application in the classroom to learning activities such as explanation of interactive contents, students' online information search, online activities and exercises, or the use of word processors for schoolwork.

b) Cluster or group 2, called in this study «regular ICT user teacher, with a more diverse and richer educational approach», is characterised by a more frequent and strong (more diverse and wider) pattern of use of the ICT resources available in the classroom. These teachers use computers, the interactive whiteboard and Internet access very often to carry out many tasks and educational applications: all those described for teachers in cluster 1 (and with a higher frequency index) and also activities such as presenting works using the interactive whiteboard, monitoring students' assessment or being in touch with families through the Internet. We have called this teaching model or pattern «strong educational integration of ICT» in classroom practice.

• Aim 2: Is there any relationship between the teaching models of educational use of ICT identified and the teachers' personal and professional profile?

a) Differential analysis of some personal and professional characteristics. There are no significant differences between both clusters regarding «gender».

Table 1. Distribution of frequencies of question 11 variables			
	Cluster 1 48% subjects (N=1361)	Cluster 2 52% subjects (N=1476)	100% subjects (N=2837)
11.1 Textbooks			
Low frequency of use	10,4%	12,4%	11,4%
Average frequency of use	5,1%	5,4%	5,3%
High frequency of use	84,5%	82,2%	83,3%
11.2 Blackboard			
Low frequency of use	12,4%	25,1%	19,0%
Average frequency of use	12,6%	9,4%	10,9%
High frequency of use	75,0%	65,5%	70,1%
11.3 Books, notebooks, encyclopedias and other paper documents			
Low frequency of use	14,8%	16,3%	15,6%
Average frequency of use	14,0%	14,9%	14,5%
High frequency of use	71,3%	68,8%	70,0%
11.5 Computers (computers, laptops or tablets)			
Low frequency of use	**12,7%**	**0,2%**	**6,2%**
Average frequency of use	**37,0%**	**2,4%**	**19,0%**
High frequency of use	**50,3%**	**97,4%**	**74,8%**
11.6 Interactive whiteboard			
Low frequency of use	**17,3%**	**0,7%**	**8,7%**
Average frequency of use	**34,8%**	**1,0%**	**17,2%**
High frequency of use	**47,8%**	**98,3%**	**74,1%**
11.7 Internet			
Low frequency of use	**13,7%**	**0,0%**	**6,6%**
Average frequency of use	**39,1%**	**1,7%**	**19,6%**
High frequency of use	**47,2%**	**98,3%**	**73,8%**

However, statistically, there are significant differences in the following variables: «teacher's age», «years of teaching experience» and «educational stage where they teach».

In the cluster of teachers with a lower ICT integration we found younger teachers, with less teaching experience and who usually teach in Secondary Education.

The teachers with an intensive ICT integration are older teachers (between 45 and 55 years old) with a longer teaching experience. Results show that teachers with longer professional experience are the ones who more frequently use ICT in the classroom and in a wider variety of learning situations.

Regarding the educational stage, we found that teachers with a stronger ICT integration are usually from Primary Education, while teachers with lower ICT integration slightly predominate in Secondary Education.

b) Differential analysis regarding the level of ICT presence in teachers' daily life, their familiarity and ICT use competence. When comparing the distributions offered by teachers in every cluster, we observe that teachers with a stronger ICT integration usually make frequent use of ICT in their daily life, this means that they are more familiar with them: they frequently use computers, access the Internet or use tablets or other electronic devices.

There are no significant differences between both clusters in the distribution of frequencies regarding mobile phones or videogames use.

Once the differential frequency with which every subject of every cluster uses different Internet services was analyzed, we observed that teachers with a stronger ICT integration more frequently surf the net, use e-mail, participate in forums or chats, use or manage blogs, use social networks, usually work with virtual learning environments, use multimedia webpages, download resources and materials, do online shopping, access online readings, make online transactions, use educational websites, etc.

4. Discussion and conclusions

The obtained results allow us to deduce that the introduction of ICT resources (and teaching methods and strategies related to them) does not mean the replacement of traditional resources, but the appearance of mixed or hybrid models, where both types of resources are useful. In classrooms with abundant digital technology, teachers usually make use of it in their practice –in different levels and versions- while also making use of traditional educational material, such as textbooks or blackboards. These results are similar to those found in previous studies such as Balanskat, Blamire and Kefala (2006) and European Commission (2006; 2013).

It is verified that in classrooms with abundant digital technology, textbooks are still the most frequently used resource by a large number of teachers, as found by Area and Sanabria (2014). This means that ICTs do not replace traditional materials, but they complement each other, as reflected by the OECD study (2015a). However, it can also be affirmed that new digital media, such as interactive whiteboards are replacing traditional or analog audiovisual media (such as slides, overhead projectors or hi-fi music systems).

This suggests that policies aimed at the general introduction of ICT equipment in schools such as the School 2.0 Program, play an active and dynamic role in fostering the use of ICT which results, at least in the first instance, in teachers needing to readjust and reconsider the use of traditional resources. When

there is abundant digital technology, teachers do not refuse to use it, but they incorporate it to their classroom practice to different degrees, with models or different patterns. However, this neither means that the mere presence of technology automatically generates educational innovation as many works have confirmed (Area, 2011; Condie & Munro, 2007; European Commission, 2013; Mama & Hennesey, 2013; Montero, 2009) nor an improvement of students' performance (OECD, 2015b). It means that the presence of ICT makes teachers reconsider how to use them and, consequently, be innovative with them.

On the other hand, there are variations in the educational use of digital technology by teachers. These patterns of ICT use emerge from the frequency of use (the amount of times they use it) and by the nature of the activity (the type of tasks and the grouping used when working with ICTs in the classroom). In the present study we have found two models or patterns of educational ICT use in the classroom:

Table 2. Distribution of frequencies of question 12 variables

	Cluster 1 48% subjects (N=1361)	Cluster 2 52% subjects (N=1476)	100% subjects (N=2837)
12.1. Explain contents or lessons using the interactive whiteboard in the classroom			
No	28,9%	2,3%	15,1%
Yes	71,1%	97,7%	84,9%
12.2. Ask students to search information on the Internet			
No	18,7%	5,6%	11,9%
Yes	81,3%	94,4%	88,1%
12.3. Ask students to do exercises or activities online (classifications, puzzles, complete sentences...)			
No	36,5%	13,1%	24,3%
Yes	63,5%	86,9%	75,7%
12.4. Ask students to publish works online (blogs, wikis or webpages)			
No	87,9%	58,6%	72,6%
Yes	12,1%	41,4%	27,4%
12.5. Prepare or use webquests, wikis and other online resources for collaborative work among students.			
No	88,5%	57,0%	72,1%
Yes	11,5%	43,0%	27,9%
12.6. Ask students to prepare videos or multimedia presentations			
No	85,6%	52,0%	68,1%
Yes	14,4%	48,0%	31,9%
12.7. Ask students to write papers in word processors.			
No	34,7%	7,1%	20,3%
Yes	65,3%	92,9%	79,7%
12.8. Ask students to give oral presentations using the interactive whiteboard.			
No	78,3%	36,2%	56,4%
Yes	21,7%	63,8%	43,6%
12.9. Participate in ICT projects with other schools through the Internet			
No	97,6%	90,2%	93,8%
Yes	2,4%	9,8%	6,2%
12.10. Monitor students' assessment			
No	72,3%	44,4%	57,8%
Yes	27,7%	55,6%	42,2%
12.11. Be in touch with students and families through the Internet			
No	80,5%	46,5%	62,8%
Yes	19,5%	53,5%	37,2%

• A weak model of educational integration of ICT in the classroom. In this model, ICTs are rarely used (rarely or a few times a week) and they are basically used for expository teaching tasks and mere knowledge transfer, using individual or whole group classroom distribution. Traditional materials are more frequently used and students are usually asked to do computer-based activities, similar to those in the textbooks, such as exercises or online activities (puzzles, completing with words, matching, etc.)

• An intensive model of educational integration of ICT. In this model, ICTs are frequently used (every day or many times a week) and they are used for a variety of tasks and educational demands that involve individual and group work, teacher and student presentations, information searches and the elaboration of digital contents by students, such as creating and communicating contents online (writing blogs or creating wikis).

As we can deduce from these aspects, a weak integration model means that teachers use traditional educational materials (textbooks) and sporadically use technology. When they do it, they follow an expository transfer of knowledge. On the contrary, the intensive integration model means a stronger mix or combination between the traditional materials and the ICTs, being the latter used in a more active learning perspective. This allow us to suggest that teachers usually incorporate ICTs in the methodological approaches and strategies that they already have, without breaking down with their previous teaching practice. These findings have already been corroborated in previous studies in this field.

We have also found a relationship or direct correlation between the pattern of ICT use in the classroom and the level of use that teachers make in their daily lives. Those teachers who are users of a variety of

technologies (computers, Internet, mobile phones) and who use them for different purposes such as surfing the net, communicating via e-mail or participate in social networks make a more intensive and frequent use of ICT in the classroom and ask students to use the web 2.0 resources.

There is, or at least appears to, a direct relationship between a teacher's competence as a digital citizen and his or her professional behavior with ICT in the classroom. The higher the level of competence and digital citizen participation the teacher has, the higher the educational use of technologies in the classroom is.

This study shows that teachers' age is a variable that is related with the model or pattern of ICT use in the classroom. However, unlike what happens in other fields where younger subjects make a more frequent use of technologies, in the school context younger teachers (less that 40 years old) do not make an intensive use of ICT in the classroom. Instead, middle age teachers (between 45 and 55 years old) with more professional experience are the ones who use technologies more intensively. This allows us to suggest that educational competence and professional experience are a necessary or, at least, relevant variable in technology-related teaching innovation. Teachers' age is considered a less relevant variable. This questions the famous thesis of users: «emigrant VS digital natives», stated by Prensky (2001). On the other hand, as opposed to Roig, Mengual and Quinto (2015) we have not found significant differences regarding gender.

The current study confirms many findings available in previous research, but it also offers new suggestions and hints that describe, and somehow explain, the different uses that teachers make of ICs in their teaching. This paper has revealed very intriguing results about profiles and teaching patterns with technologies and opens some further research questions that will be developed in future studies. Consequently, it is necessary that future research explores whether both models of use found are still being used in the new classroom contexts, where technology increases even more with the arriving of mobile devices (brought by students in many cases) and to what extent teachers readapt these patterns according to the increase of their experience in the educational use of ICT.

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