How are ICT used in the classroom? A study of teachers' beliefs and uses

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Abstract

Introduction. Several studies show that one of the essential factors in the way teachers use Information and Communication Technologies (ICT) in their lessons are the beliefs they hold regarding ICT as tools for teaching and learning. This study analyses the relationship between these beliefs and the way teachers use ICT in the classroom through design of a *System of Categories for the Analysis of Beliefs about and Uses of ICT*.

Method. We applied an open-ended questionnaire about beliefs and uses of ICT to 16 teachers of Child and Primary Education and collected 42 activities proposed by them where ICT were crucial. To analyse the answers, we designed a *System of Categories for the Analysis of Beliefs about and Uses of ICT*, based on three essential dimensions: what teachers said they taught, the psychological processes they activated in their students and the activities or tasks they proposed to achieve that learning.

Results. The results indicate that there is a wide gap between the beliefs teachers hold and the way they actually use ICT. While they said that ICT should be used to make learning more student-centred and to foster motivation, most of the activities proposed were aimed at one-directional conveyance of contents, and were neither highly developed nor did they noticeably transform traditional ways of teaching.

Conclusions and Discussion. The paper concludes with a few reflections and suggestions about how ICT could really be integrated in the classroom based on a new learning culture.

Keywords: educational beliefs, pedagogical practices, teacher ICT use, technology integration

Cómo se utilizan las TIC en el aula? Un estudio sobre las creencias y los usos

Resumen

Introducción. Numerosos estudios muestran que un factor clave para explicar la forma en que los docentes usan las Tecnologías de la Información y Comunicación (TIC) en las aulas son las creencias que mantienen en relación con estos dispositivos como herramientas de enseñanza y aprendizaje. Este trabajo analiza la relación entre esas creencias y el uso que hacen los docentes de las TIC en el aula a través del diseño de un *Sistema Categorial para el Análisis de las Creencias y Usos de las TIC.*

Método: Aplicamos un cuestionario de preguntas abiertas sobre creencias y usos de las TIC a 16 docentes de Infantil y Primaria y analizamos 42 actividades propuestas por ellos donde las TIC tuvieran un papel relevante. Para analizar las respuestas, diseñamos un *Sistema Categorial para el Análisis de las Creencias y Usos de las TIC*, basado en tres dimensiones fundamentales: qué es lo que los profesores dicen enseñar, qué procesos psicológicos activan en sus estudiantes y las tareas o actividades que proponen para alcanzar sus objetivos de aprendizaje.

Resultados: Los resultados indican que existe una distancia considerable entre las creencias sostenidas por los profesores y el uso educativo que realmente hacen de las TIC. Mientras que los profesores afirman que las TIC son buenas herramientas para diseñar entornos de aprendizaje significativos centrados en el alumno, la mayoría de las actividades propuestas favorecen formas de enseñanza tradicionales centradas en el contenido.

Conclusiones y discusión: El artículo concluye con algunas reflexiones y sugerencias para una verdadera integración de las TIC en el aula basada en una nueva cultura del aprendizaje.

Palabras clave: creencias educativas, prácticas pedagógicas, uso de las TIC, integración tecnológica.

Introduction

The study of ICT as tools for designing significant teaching and learning scenarios has been widely dealt with in recent years (Hadjithoma & Karagiorgi, 2009; Monereo, 2004; Thompson, 2013). Despite the fact that there are opposing positions regarding the educational potential of ICT, usual discourse, whether political, educational or social (Coll & Monereo, 2008; Ertmer, 2005), associates them to processes of change and improvement in educational quality. Coll & Monereo (2008) highlight their qualities as tools for thinking and inter-thinking – instruments of symbolic nature offering unprecedented possibilities for accessing, finding, processing, conveying and sharing information.

However, most studies conducted to date on integrating ICT in classrooms systematically point out that merely introducing them into the classroom will not in itself guarantee educational transformation and improvement (Coll & Monereo, 2008; Cuban, Kirpatrik & Peck, 2001; Ertmer, 1999). Peggy Ertmer (1999) describes the obstacles to including ICT in the classroom as type I and type II barriers. Type I barriers are anything to do with the type of resources (equipment, time, training, support, etc.) to which the teacher has access. They are the first obstacle that needs to be overcome for true integration of ICT in the classroom. Type II barriers are less tangible, yet determinant, in the opinion of some authors (Fisher, Dwyer &Yocam, 1996), and refer to the type of belief, often in the form of an "implicit theory" (Pozo et al., 2006), which the teacher holds with regard to teaching, learning and acquisition of knowledge. Below, we shall analyse in more detail the nature of these beliefs, reflect on different uses of ICT in the classroom, and finally, try to establish links between them.

Educational beliefs held by teachers

The concept of teachers' beliefs is a recurring topic in research into education (Nespor, 1987; Pajares, 1992). Although it is a difficult concept to define, there are many agreements regarding it. An initial approach would be the definition proposed by Richardson (2003), who defines beliefs as psychological representations, premises or propositions that an individual feels are true. They are relatively stable, develop based on personal experiences which compromise us emotionally, and help us see and understand the world in a given way (Pajares, 1992).

Teachers' educational beliefs, psychology and intuitive pedagogy (Olson & Bruner, 1996; Pozo et al., 2006) are implicit or explicit representations of individuals, objects and events, and the relationship among them within the educational context (Hermans, van Braak & van Keer, 2008). They develop over years of experience, ranging from life as a student at school (Richardson, 2003) to the different practices involved in professional performance as a teacher (Prestridge, 2012). This is why beliefs are stable and often resistant to change, though not impossible to modify. As noted by Prestridge (2012), in the context of change of teaching practice, professional development is successful when it promotes a change in beliefs (from teacher-centred to student-centred) by making them explicit and raising awareness, or by the teacher's reflection on his/her own practice (Schön, 1987).

Scientific literature has often classified educational beliefs along a continuum, with more traditional, mainly teacher-centred beliefs at one end, and more progressive, constructivist, student-centred beliefs at the other (Cox & Webb, 2004; Kerlinger & Kaya, 1959a, 1959b). In the former, the teacher is in charge of conveying clearly defined knowledge, and the quality of learning is measured by the student's capacity to acquire and reproduce this knowledge as faithfully as possible. In the latter case, the teacher mediates the learning process, which emerges from sharing dialogue and reflection with the students, and thus, knowledge is a progressive construction rather than a given.

Focusing more specifically on beliefs regarding the use of ICT, Ertmer (1999, 2005) classifies pedagogical beliefs about ICT as educational tools into three categories: 1) as a complement to the syllabus, for motivating students and developing their skills, 2) as support to the existing syllabus, where ICT would be an educational tool for teaching content, fostering cooperation among the different agents and promoting elaborate thinking, and 3) as tools fostering the emergence of a new syllabus adapted to the demands of the twenty-first century, where the student must change the way he learns. Similarly, Prestridge (2012) distinguishes four pedagogical beliefs regarding the use of ICT as educational tools: 1) to develop technical skills for using the device (using mouse, keyboard, interactive whiteboard, etc); 2) to perform functional activities (such as using a text processor), 3) to suggest tasks that extend and enrich the existing syllabus, and 4) to promote and explore new areas of teaching and learning. In the same vein, Mama and Hennessy (2013) suggest a similar classification, but add a belief type ("subversive") which includes the fear that ICT often produce in teachers.

Uses of ICT in the classroom

A number of definitions, classifications and typologies have been developed within the context of educational use of ICT (Tondeur, van Braak and Valcke, 2007). For example, Prestridge (2012) conducted a study using the "Digital Age Learning Matrix" designed by Starkey (2009) where the author compared possible uses of ICT (accessing, presenting, processing, playing and communicating information) and learning levels promoted, which were, from least to most complex, doing, thinking about connections, thinking about concepts, criticising and evaluating, creating knowledge and sharing knowledge. Tondeur van Braak and Valcke (2007) conducted a factorial analysis on a sample of 352 primary school teachers, with the aim of developing a possible typology of uses at that educational level. The structure found revealed three factors: one referring to the use of ICT as information tools, another as learning tools, and a third focusing on developing basic skills (psychomotor). Coll and Monereo (2008) designed a typology of uses focusing on the teacher-learner-content interactive triangle, in an effort to overcome those focusing only on ICT potentialities and characteristics (Squires & McDougall, 1994) or on major pedagogical and didactic issues (Salomon, Perkins & Globerson, 1991). They also avoided neutral description (as in Twining, 2002), taking a firm stand from the socio-constructivist approach, which serves as reference for identifying the principal dimensions of educational practice.

We believe that the interactive triangle among teaching activity, contents of learning and student activity to acquire them is highly relevant. Therefore, as described below, we distinguish among three basic components present in any learning/teaching activity (Pozo, 2008): *outcomes* (what is learned), *processes* (the cognitive activity by means of which learning takes place, subdivided into two aspects, namely, the cognitive processes activated and the type of processing done with ICT, in a very similar vein to the uses suggested by Prestridge, 2012) and *conditions* (the teaching tasks or activities through which learning takes place), which are described in depth in the Methodology section.

Different uses of ICT have been identified through these different typologies, although in most cases their complexity is rather low. The famous study by Cuban et al. (2001) noted the little-developed educational uses to which teachers put ICT, even when almost complete

technological infrastructure is available to them. The authors note that practice was characterised by simple use of ICT based on text processing and as a support to their lectures. These uses seemed to foster the conservation of traditional teaching models rather than their transformation.

More recently, Sigalés, Mominó, Meneses and Badia (2008) wrote an exhaustive report about the integration of internet in education in Spain. They say, "*When teachers use ICT, it is primarily to convey contents and guide student learning. And when students use ICT, it is primarily to access contents and produce documents with content. Clearly, when teachers and students use ICT in class, it is usually content-related, making use mainly of information technologies, and to a much lesser extent, making use of communication technologies and the recently named learning technologies*" (p.175). It seems that the oft-mentioned technological revolution barely manages to break through the walls of schools (Coll & Monereo, 2008). Can teachers' educational beliefs provide any clues to the reason for this?

Teachers' educational beliefs and how they relate to the use of ICT in the classroom

Ertmer (2005) believes that once extrinsic barriers (technological infrastructure, technical support, etc.) have been overcome, teachers' beliefs are a key factor for integrating ICT in the classroom. Many papers report a positive relationship between constructivist conceptions and the active use of technology (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012; Hermans, Tondeur, van Braak & Valcke, 2008; Kim, Kim, Lee, Spector & DeMeester, 2013; Niederhauser & Stoddart, 2001). For example, Cox and Webb (2004) analysed teachers' perceptions of ICT during the teaching process, based on the instructional/constructivist model, and conclude that constructivist stances favoured the use of ICT in the classroom. In the same vein, Sang, Valcke, van Braak and Tondeur (2010) found that teachers who held strong constructivist pedagogical beliefs were more receptive to integrating ICT in the classroom than teachers who did not hold these beliefs.

Otherwise, some studies have found inconsistencies between teachers' pedagogical beliefs and the activities they proposed (Liu, 2011; Zhao & Cziko, 2001). Teo, Chai, Hung and Lee (2008) studied teachers in Singapore, and found a positive correlation between constructivist beliefs and both constructivist and traditional practices, although traditional beliefs were negatively correlated to constructivist practices. Tondeur, Hermans, van Braak

and Valcke(2008) conducted a study on 574 primary school teachers and concluded that those who held strong beliefs, whether traditional or constructivist, used ICT in the classroom more often. Liu (2011) used questionnaires to analyse beliefs and practices with ICT in 1139 primary school teachers in Taiwan, concluding that although most teachers hold learner-centred beliefs, the way in which they integrate technology in the classroom diverges from constructivist practices.

The beliefs teachers hold and the way they use ICT seem to depend on certain variables. Several studies claim that these variables allow the different teacher approaches to ICT to be predICTed (Mumtaz, 2000; Peek et al., 2014; van Braak, 2001). Gender, for example, is one of the most frequently studied variables (Vekiri 2010; Volman, van Eck, Heemskerk & Kuiper, 2005). Vekiri and Chronaki (2008) found that computer-mediated activities at school were central to male students much more often than to females. Similarly, males had much higher perceptions of self-efficacy. However, Iniesta-Bonillo, Sánchez-Fernández and Schlesinger (2013) found no significant difference with regard to access and frequency of use, although they did find differences regarding their complexity. Females usually used ICT in more elaborate ways than males.

Age is another factor that has often been analysed (Drent & Meelissen, 2008; Jamieson-Proctor, Watson, Finger, Grimbeek & Burnett, 2007). Inan and Lowther (2010) found in a sample of 1382 teachers that age was negatively related to competence in the use of computers, making their integration in the classroom difficult, and possibly reflecting the fact that the digital gap is also a generation gap. However, these differences in uses do not imply radically different ways of learning between youths and adults (Margaryan, Littlejohn &Vojt, 2011).

Howard, Chan and Caputi (2014) analysed different areas or disciplines of teacher specialisation and their relationship with educational beliefs, a key variable for predICTing integration of ICT in the classroom. The results showed that teachers of English as a foreign language considered ICT more important as educational tools than science teachers did. Tamim, Borokhovski, Abrami and Schmid (2011) conducted a second order meta-analysis of the research performed over the past 40 years on the integration of ICT in educational contexts, concluding that there are factors specific to each discipline which may condition that integration, e.g. the fact that mathematics often uses graphs (Hennessy, Ruthven &Brindley,

2005), sciences use visual representations (Cox & Webb, 2004) and language and writing development in English (Silvernail & Gritter, 2007).

Having situated the reader in the scenario of beliefs and educational uses of ICT, we shall now briefly describe the aims of our study.

Study aims

The aims of this study are to:

1.Design a System of Categories for the Analysis of Beliefs about and Uses of ICT which will allow us to look in depth at concrete aspects that other typologies do not reflect (Mama and Hennessy, 2013; Prestridge, 2012; van Braak, Tondeur and Valcke, 2004).

2. Identify teachers' educational beliefs regarding ICT as instruments for teaching and learning

3. Identify the ways in which teachers use ICT in the classroom context.

4. Determine whether there is consistency between teachers' educational beliefs regarding ITC and the ways in which they use them in the classroom

5. The final aim (though only exploratory, due to the sample size) is to analyse the influence that certain variables such as age (Drent & Meelissen, 2008), gender (Volman et al., 2005), subjects taught (Howard et al., 2014) and educational level (Pelgrum, 2001) may have on educational beliefs and use of ITCs.

Method

Participants

We used a sample of 16 teachers of Child and Primary Education (12 female, 4 male, $\bar{X}$ = 31.6 years, S.D = 6.2) that represents 47% of teacher's population from one school which has the following characteristics:

1) Newly built school (inaugurated in 2009).

2) Young teaching staff, trained and with little experience.

3) Interest in methodological and didactic innovations.

4) Decidedly focused on using ICT as learning tools: all classrooms had a video projector or an interactive whiteboard and at least three laptop or desktop computers.

We thought that this school would be suitable as a reference regarding innovative practices in the use of ICT because its approaches to type I barriers (technological access and infrastructure) and type II barriers (teachers' educational beliefs) seemed to foster adequate integration of ICT in the classroom (Ertmer, 1999).

Instrument for data collection

In order to gather the information of interest, we prepared a questionnaire made up of open-ended questions, comprising two parts:

1.   Initial question (*Educational Beliefs*): a general question about teachers' beliefs regarding ICT as instruments of change in teaching and learning processes.

2.   Concrete activities (*Uses of ICT*): in this section we asked the teachers to describe in detail the three most important activities conducted in the classroom in which the teaching and learning processes were mediated by ICT. Specifically, we asked them to specify the teaching and learning aims proposed for the task, the roles played in it by teachers and students, and how they behaved when a difficulty arose during the course of the activity (regarding behaviour, learning, etc.).

Procedure

Part of research team arranged an appointment with the school principal to explain the aims of the study and the procedure. He requested his staff to respond the questionnaire and sent it to them via email. Teachers got around a week to answer it and afterwards they should to send back to the research team via email too. We chose this questionnaire as instrument for data collection because we thought it was the best procedure to let teachers think about their own experiences. In addition, we arranged interviews with some of them in order to clarify certain points of their answers to the questionnaire.

Data analysis

As mentioned above, the main aim of the study was to provide empirical evidence that would enable us to look more deeply into the relationship between teachers' educational beliefs and uses of ICT in the classroom. Our intention was to design an instrument for analysis which would allow the study of relevant aspects on which there is not much research to date. Based on previous studies of the research team in other areas (Casas, Montero & Pozo, 2015; López-Iñíguez & Pozo, submitted; Pozo & Postigo, 2000), we developed this

instrument paying attention to four main dimensions: 1) Learning Outcomes, focusing on the learning aim set by the teacher for students through an activity, 2) Information Processing, a category conceived for evaluating the cognitive demand of the proposed activities 3) Psychological Processes that the teacher intended to activate in the students, and 4) Learning Conditions, with reference to analysis of the context in which the ICT-mediated activity took place (Pozo, 2008)

The following chart summarises each category in the System of Categories for the Analysis of Beliefs about and Uses of ICT.

Table 1. *Learning Outcomes*

A. *Learning Outcomes*						
This category focuses on the learning aim set by the teacher for the students through an activity.						
A.1 *Verbal learning* Handling symbolic codes (language, numbers, maps. "Know how to say".		A.2 *Procedural learning* Learning ordered actions directed towards a goal. "Know how to do".		A.3 *Attitudinal learning* Learning relatively stable and long-lasting ways of evaluating objects, persons or events, and ways of acting consistently with them (Sarabia, 1992).		
A.1.1 *Information* Facts and data. Precise assimilation. "All" or "nothing" learning.	A.1.2 *Understanding concepts* Learning about relationships between facts and data.	A.2.1 *Techniques* Repetitive practice and absence of reflection.	A.2.2 *Strategies* Reflective practice. Metacognitive processes, planning, goals and evaluation.	A.3.1 *To knowledge* Attitudes related to how we interact with information and knowledge.		A.3.2 *Social* Attitudes related to how we interact with others.
				A.3.1.1 *Passive* Without cognitive and affective implication.	A.3.1.2 *Active* With cognitive and affective implication.	A.3.2.1 *Competitive* "Winner-loser" dichotomy.	A.3.2.2 *Supportive* Mutual help. Cooperation.

Table 2. *Information Processing*

B. Information Processing
This category evaluates the cognitive demand of the activities proposed, i.e. what kind of mental operations and cognitive resources students must put in motion to resolve the activity satisfactorily. We used the typology developed by Pozo and Postigo (2000).

B.1 *Acquisition*	B.2 *Interpretation*	B.3 *Analysis*	B.4 *Comprehension and Organisation*	B.5 *Communication*
Acquiring new information. Procedures of finding, gathering, selecting and maintaining information.	Transcribing information to a new code or comparing it to a model in order to be able to work with it.	Drawing conclusions. Involves inferences and deductive-inductive procedures.	Simultaneous relationship of present and non-present information. Specific procedures for organization (outlines, conceptual maps, summaries, etc.).	Conveying, exchanging and contrasting information among students.

Table 3. *Psychological Processes*

B. Psychological Processes
This category analyses the psychological processes that teachers say they consider when they propose their activities.

C.1 *Memory*	C.2 *Attention*	C.3 *Motivation*	C.4 *Metacognitive Processes*
Storing and retrieving information.	Focusing cognitive resources.	Setting in motion cognitive and affective resources to perform a task.	Becoming aware of the various aspects of mental activity: planning, evaluation, defining goals, etc.

Table 4. *Learning Conditions*

D. Learning conditions In this category we have grouped relevant aspects regarding "how" the ICT-mediated teaching and learning activity has been carried out.	*D.1 ICT Support* "Hardware" through which the activity proposed by the teacher materializes.	*D.1.1 Projector/Interactive whiteboard*
		D.1.2 Portable computer
	D.2 What ICT are used for "What is done with ICT" in the classroom.	*D.2.1 Accessing information* Following preset steps to make specific information available.
		D.2.2 Presenting information Showing given information considered interesting, whether it is essential or complementary to the contributions of teacher and/or student.
		D.2.3 Finding information Accessing given sources to select and contrast specific information.
		D.2.4 Gaming and entertainment Fun and recreational aims.
		D.2 5 Producing contents Developing some kind of product.
	D.3 Task complexity Level of difficulty of the task. Number of possible solutions, degree of uncertainty to be worked with or student manoeuvring leeway.	*D.3.1 Closed task* Single solution, low uncertainty and manoeuvring leeway for the student.
		D.3.2 Open task Multiple solutions, high uncertainty and student autonomy.
	D.4 Control of task Who is ultimately responsible during the course and development of the activity.	*D.4.1 Student*
		D.4.2 Teacher
		D.4.3 ICT
		D.4.4 Shared
	D.5 Social organisation Distribution of students in the classroom and type of relationship between them, determined by the activity itself.	*D.5.1 Individual* The activity is performed alone, with hardly any student-teacher interaction.
		D.5.2 Group The activity is performed in a group (two or more persons) without the need for cooperation among agents.
		D.5.3 Cooperative The activity is performed in a group (two or more persons), and requires cooperation to attain the aim of the task.
		D.5.4 Undefined Not enough information to determine it.

Classification of teachers' educational beliefs and use of ICT

Once the definite categories were defined, we analysed teachers' discourse. To do so we applied the categories we designed to each teachers´ answers according to their educational beliefs and the 42 activities collected that represented the uses of ICT. This was done in duplicate, independently by two of the researchers on the team. Cohen´s κ was run to determine if there was agreement between them. According to Landis & Koch (1977), there was a substantial and almost perfect agreement respectively, $\kappa = .750$, $p<0,01$ (in the case of educational beliefs sections) and $\kappa = .875$, $p<0,01$ (in the case of uses of ICT)

The results shown below correspond to the number/percentage of cases assigned to the different levels of each category (over a total 16 teachers for the Initial Question and 42 for Activities), taking into account that each case could only be assigned once (e.g. even if one teacher spoke several times within a single activity about an "active attitude" in the student, it would only be considered once within that activity). Except for some of the levels, such as attitude to knowledge, type of support or task complexity, the levels were not mutually exclusive. For example, a single task could demand both acquiring and interpreting information. Finally, the information gathered was processed using QDAMiner software. Results are presented below.

Results

Teachers' educational beliefs

The Fig.1 shows that over half the teachers (56.25%) perceive ICT as good for motivating students, who must take responsibility for their own learning by acquiring an active attitude towards it (50%). We illustrate it with the following example: T1: *"[…] ICT are changing teaching and learning processes because there are many different possibilities and students feel attracted and motivated by them. In addition, ICT let students to become active entities and learn by experimentation"*

Teachers point out that ICT have revolutionised the way of accessing information (50%), making available to us whatever we are interested in, whenever we want it.. Aware of the demands of the Information Society, teachers see ICT as an opportunity to develop student learning strategies (43.75%) through activities controlled by students themselves (37.5%).The quotation presented below is an example:

T2:*"[…]with ICT students can self-assessment….and also they are useful for self-learning. Students are changing from being just consumers to become creators"*
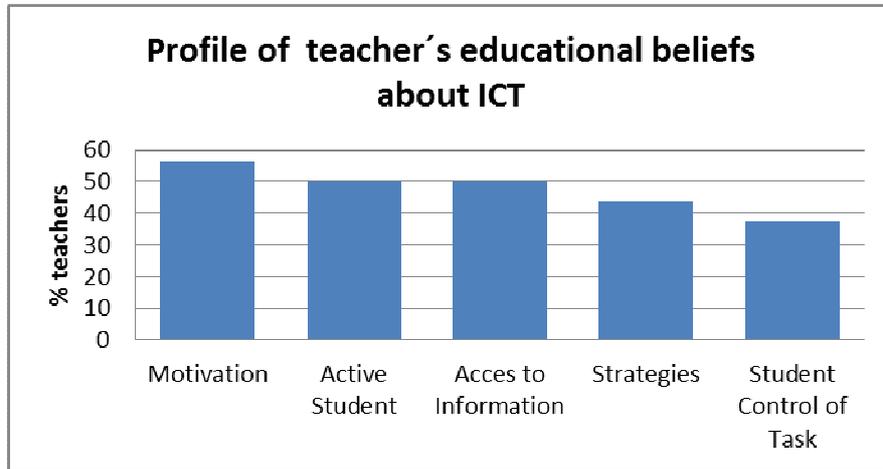

Figure 1. Profile of teachers' educational beliefs about ICT.

Teachers' uses of ICT

The Fig. 2 shows that most of the activities proposed by teachers involve acquiring information (92.82%) in closed instructional contexts (73.78%), as we showed in next example: T3: *"One activity that I propose to my students is that they have to recognize in a map projected on a digital blackboard different elements (like rivers, jungles, deserts, etc)"*. Similarly, teachers say they use ICT mainly for presenting information (57.12%) in groups (52.36%), where students have to assimilate the data and facts presented as faithfully as possible (61.9%). See the following example: T4: *"I use ICT to show videos, which aim is knowing different places. Later, I ask to the whole class what they have learnt."*
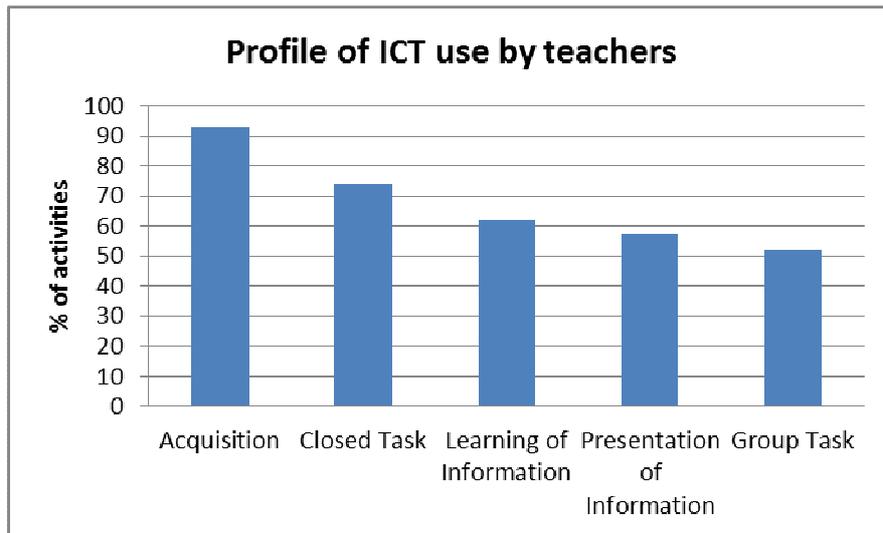
*Figure 2.*Profile of ICT use by teachers

Conclusions about teachers´educational beliefs and uses of ICT

Although teachers perceive the educational potential of ICT, showing favourable attitudes that promote their integration in the classroom, the fact is that in most cases, the activities proposed make little use of those opportunities. There are few situations in which the student really has to put into motion highly complex cognitive and affective resources, the tasks being limited to merely mechanical matters such as memorising or retrieving information. As noted by Cuban et al. (2001), the introduction of ICT to the classroom seems to lead to the reinforcement of existing educational practices rather than their transformation,

Below, we shall describe teachers' global discourse, focusing on variables where we have found significant differences in some aspect. These variables are "Subjects Taught" ("Generalist" teachers who teach subjects such as Maths, Language, or Social Studies and "Specialist" teachers who teach subjects such as Music, English as a foreign language, or Physical Education) and "Educational Phase" (teachers of Child Education or Primary Education).

Teachers' educational beliefs according to subjects taught

Table 5 shows the characteristics that teachers highlighted for ICT as educational tools, according to subjects taught.

Table 5. *Teachers' educational beliefs according to subjects taught*

		Generalists (max = 8)		Specialists (max = 8)		Chi-square	P value
Learning outcomes	Techniques		0.0%	1	12.5%	1.067	0.302
	Strategies	3	37.5%	4	50.0%	0.254	0.614
	Attitude to knowledge - active student	4	50.0%	4	50.0%	0	1
Psychological processes	Motivation	5	62.5%	4	50.0%	0.254	0.614
Learning conditions	Accessing information	3	37.5%	5	62.5%	1	0.317
	Student	3	37.5%	3	37.5%	0	1

The χ^2 test at 95% confidence level shows that there is no significant difference between the discourse of Generalist and Specialist teachers. Many teachers highlight *learning strategies* (three of the eight Generalists and four of the eight Specialists) as the main goal of using ICT in the classroom, which contrasts with the almost complete absence of teachers who think of ITCs as tools for learning technical procedures (no Generalist and only one Specialist). The main goal involves an *active* student (four of the eight teachers in both cases), often responsible for controlling the task (three of the eight teachers in both cases), who uses ICT to *access information* (three and five of the eight teachers respectively). *Motivation*, in this case, takes on a highly relevant role (five of the eight Generalist teachers and four of the eight Specialist teachers).

Teachers' use of ICT according to subjects taught

Table 6 shows the characteristics of ICT-mediated activities proposed by teachers according to subjects taught.

Table 6. *Teachers' uses of ICT according to subjects taught*

		Generalists (max = 23)		Specialists (max = 19)		Chi-square	P value
Learning outcomes	Information	16	69.6%	10	52.6%	1.265	0.261
	Techniques	9	39.1%	6	31.6%	0.258	0.611
	Strategies	2	8.7%	8	42.1%	6.402	**0.011**
Information processing	Acquisition	22	95.7%	17	89.5%	0.599	0.439
	Interpretation	3	13.0%	9	47.4%	6.007	**0.014**
	Communication	2	8.7%	7	36.8%	4.896	**0.027**
Psychological processes	Motivation	1	4.3%	1	5.3%	0.019	0.89

	Metacognitive	1	4.3%	6	31.6%	5.555	**0.018**
Learning conditions	Accessing information		0.0%	4	21.1%	5.352	**0.021**
	Presenting information	13	56.5%	11	57.9%	0.008	0.929
	Closed	21	91.3%	10	52.6%	8.05	**0.005**
	Open	2	8.7%	8	42.1%	6.402	**0.011**
	Student	5	21.7%	8	42.1%	2.019	0.155
	Teacher	11	47.8%	5	26.3%	2.041	0.153
	ICT	6	26.1%	5	26.3%	0	0.987
	Group	13	56.5%	9	47.4%	0.349	0.554

The χ^2 test at 95% confidence level shows that the activities proposed by the two groups differ significantly in *learning outcomes, processing information, psychological processes and learning conditions*. Most teachers design tasks whose aim is *learning information* (69.6% of generalist proposals, and 52.6% of specialist proposals) through *processes of acquisition* (95.7% and 89.5%, respectively). They usually proposed *close activities* (91.3% and 52.6% respectively) based on *presenting information* (56.6% and 57.9%, respectively).

However, there are noticeable differences in the use of ICT by Generalist and Specialist teachers. The former design more frequently *open tasks* (8.7% in Generalist teachers and 42.1% in Specialist teachers, (χ^2 (1.16) = 6.402; p = 0.011)) where learning outcomes are *strategies* (8.7% of Generalist proposals compared to 42.1% of Specialists (χ^2 (1.16) = 6.402; p = 0.011)) trough processes more demanding, like *Interpretation* (13% of the Generalist teacher activities and 47.4% of Specialist teacher activities, (χ^2 (1.16) = 6.007; p = 0.014)) or *Communication* (8.7% and 36.8%, respectively, (χ^2 (1.16) = 4.896; p = 0.027)). The latter proposed more *closed activities* (91.3% of the activities of Generalist teachers and 52.6% of the activities of Specialist teachers, (χ^2 (1.16) = 8.05; p = 0.005)).

Conclusions about teachers´educational beliefs and uses of ICT according to subjects taught

Although there is a gap between what teachers think and what they say they put into practice, we should distinguish between groups. The gap is very wide in Generalist teachers. On the one hand, they conceive ICT as useful tools to *learn strategies*, where the student, *motivated* by using them, is *active* and in *control of the task*. On the other hand, they propose tasks that are mostly closed, mainly teacher-directed, where the main aim is to *acquire information*,

The gap is smaller in Specialist teachers. Their theoretical discourse, which is similar to that of Generalist teachers, is largely accompanied by consistent practices. The activities proposed often involve *learning of strategies*, which requires information to be processed

differently from mere *acquisition* and taking into account *metacognitive processes.* Many tasks are *open*, where the student is in control, and often needs to *cooperate* with classmates.

In short, although there is a gap between what teachers believe and what they say they put into practice, in Specialist teachers the real model largely approaches the ideal model.

Teachers' educational beliefs according to educational stage

Table 7 shows the ICT characteristics highlighted as educational tools by teachers according to educational stage.

Table 7. *Teachers´ beliefs according to educational stage*

		1 = child and first cycle primary school (max = 8)		2 = second and third cycle primary school (max = 8)		Chi-square	P value
Learning outcomes	Techniques		0.0%	1	12.5%	1.067	0.302
	Strategies	3	37.5%	4	50.0%	0.254	0.614
	Attitude to knowledge –active student	5	62.5%	3	37.5%	1	0.317
Psychological processes	Motivation	4	50.0%	5	62.5%	0.254	0.614
Learning conditions	Accessing information	1	12.5%	7	87.5%	9	**0.003**
	Student	4	50.0%	2	25.0%	1.067	0.302

The χ^2 test at 95% confidence level shows one significant difference between the discourses of Child Education and First Cycle Primary School teachers on the one hand, and Second and Third Cycle Primary School teachers on the other, regarding the use of ICT. The latter say that ITCs have revolutionised the way of accessing information significantly more than the former (χ^2 (1.16) = 9,00; p = 0.003).

In the rest of the dimensions, teachers' behaviour is very similar to that described above regarding *the subjects taught*: many of them desire *acquiring strategies* as learning outcome (three of the eight Child and First Cycle Primary School Teachers, and four of the eight Second and Third Cycle Primary School teachers), through activities where the student must be *active* (five and three of the eight teachers, respectively), taking *control* of the task thanks to the ICT (four and two of the eight teachers, respectively). In this case they also highlight the intrinsic capacity of ICT to *motivate* (four and five of the eight teachers, respectively).

Teachers' use of ICT according to educational stage

Table 8 shows the characteristics of ICT-mediated activities proposed by teachers according to educational stage.

Table 8-*Teachers' uses of ITC according to educational stage*

		1 = child and first cycle primary school (max = 22)		2 = second and third cycle primary school (max = 20)		Chi-square	P value
Learning outcomes	Information	13	59.1%	13	65.0%	0.155	0.694
	Understanding concepts		0.0%	1	5.0%	1.127	0.288
	Techniques	8	36.4%	7	35.0%	0.008	0.927
	Strategies	4	18.2%	6	30.0%	0.807	0.369
Information processing	Acquisition	21	95.5%	18	90.0%	0.47	0.493
	Communication	2	9.1%	7	35.0%	4.177	**0.041**
Learning conditions	Presenting information	13	59.1%	11	55.0%	0.072	0.789
	Finding information	2	9.1%	8	40.0%	5.517	**0.019**
	Closed	20	90.9%	11	55.0%	6.988	**0.008**
	Open	2	9.1%	8	40.0%	5.517	**0.019**
	Student	5	22.7%	8	40.0%	1.462	0.227
	Teacher	9	40.9%	7	35.0%	0.155	0.694
	ICT	8	36.4%	3	15.0%	2.473	0.116
	Shared control	1	4.5%	3	15.0%	1.329	0.249
	Individual	6	27.3%	3	15.0%	0.937	0.333
	Group	13	59.1%	9	45.0%	0.834	0.361
	Cooperative	2	9.1%	4	20.0%	1.018	0.313
	Undefined	1	4.5%	5	25.0%	3.58	0.058

The χ^2 test at 95% confidence level shows that the activities proposed by the two groups differ significantly regarding *processing information* and *learning conditions.*

Learning outcomes show that in most cases teachers propose activities that foster learning information (59.1% for Child and First Cycle Primary School teachers and 65% for Second and Third Cycle Primary School teachers) and with regard to *procedures,* they mostly propose *techniques* rather than *strategies.*

With regard to *processing information,* most of the activities proposed by teachers require processes of *acquiring information* (95.5% of tasks presented by teachers of Child and First Cycle Primary School and 90% of the tasks presented by Second and Third Cycle Primary School teachers). Nevertheless, the significant differences in this dimension appear in

communication (χ^2 (1.16) = 4.177; *p* = 0.041). While the former rarely design activities where the aim is to share the information acquired and/or prepared (9.1%), in the latter, this

Teachers' educational beliefs	Teachers' use of ICT

percentage is higher, at 35%. However, when we apply the Fisher´s exact statistical test correction this difference is not significant (p= 0,062).

Regarding *use of ICT*, more than half the teachers' proposals use ICT for *presenting information* (59.1% and 55%, respectively). However, the significant differences between groups are found in *finding information* (χ^2 (1.16) = 5.517; *p* = 0.019) (9.1% and 40%, respectively). This result is consistent with what was found for *complexity of the task*, where there are significant differences for both *closed* tasks *(*90.9% of the activities proposed by Child Education and First Cycle Primary School teachers, and 55% of proposals from Second and Third Cycle teachers (χ^2 (1.16) = 6.988; *p* = 0.008)), and for *open* tasks (9.1% and 40% respectively (χ^2 (1.16) = 5.517; *p* = 0.019)). In other words, the results seem to indicate that teachers of older children carry out activities in the classroom involving significantly more complex use of ICT by the students.

Conclusions about teachers´educational beliefs and uses of ICT according to educational stage

Again, there are major differences between what teachers think and what they say they do with ICT. They say they highlight students *acquiring strategies* through *active* role and taking responsibility for *controlling the task*. The *ability to motivate* would be the added value of the ICT, whose main use would be directed to *accessing information*. The second case, however is different. Most of the activities proposed demand *acquiring information* (rather than strategies) *which is presented* (rather than accessed). Although there are some open tasks, most of them are closed, which implies a reduction in learner *control* and *active attitude*. *Motivation* is rarely mentioned (no reference in Child Education or First Cycle Primary School, and 10% in Second and Third Cycle Primary School). The following is a summary of the results.

Table 9-*Summary of results*

Subjects taught	Educational Stage	Subjects taught		Educational stage	
✓No significant difference	✓2nd and 3rd Cycle Primary: Accessing Info	Specialists	Generalists	Child and 1st Cycle Primary	2nd and 3rd Cycle Primary
		✓Learning outcome ✓Processing Info ✓Psychological processes ✓Uses of ICT ✓Complexity of task More elaborate	✓Learning outcome ✓Processing Info ✓Psychological processes ✓Uses of ICT ✓Complexity of task Less elaborate	✓Processing Info ✓Uses of ICT ✓Complexity of task Less elaborate	✓Processing Info ✓Uses of ICT ✓Complexity of task More elaborate

Discussion

With regard to the first aim, it is worth noting that an interesting contribution of our study, along with the results obtained, is the design of the System of Categories for the Analysis of Beliefs about and Uses of ICT. We believe it is a useful, valuable tool, which will enable in-depth studies of relevant aspects of beliefs and uses of ICT, such as the learning outcomes it promotes or the type of information processing required. As described above, this system is an instrument for analysis which contributes different aspects not included in other available systems (Coll & Monereo, 2008; Mama & Hennessy, 2013; Prestridge, 2012; van Braaket al, 2004).

With regard to the following three aims of our study, the main purpose was to test whether there is consistency between teachers' educational beliefs about ICT and how they use them in the classroom. The results show that there is in fact a wide gap. While in most cases, beliefs involve elaborate conceptions of ICT as educational tools, the practices carried out reflect uses that are not highly transformative. Teachers think of ICT as instruments providing novel ways of relating to information, to others and to oneself. Access, speed, ability to modify and produce information, as well as the possibility of being in continuous contact with others, are characteristics that teachers recognise and value in ICT (Coll &Monereo, 2008). Nevertheless, the use they make of them does not indicate the same. ICT-mediated educational practice, as noted by Liu (2011), reflects teacher-centred activity, with few demands regarding processing information, and where the student, once again, fulfils a

role as a passive consumer. This trend is similar to that found in other studies of teachers' conceptions of teaching and learning. Teachers still tend to focus more on the transmission of knowledge established by themselves than on construction of knowledge by students (López-Iñiguez, Pozo &de Dios, 2014; Olson and Bruner, 1996; Pozo *et al*., 2006). However, due to the sample size is very small, these results have to be interpret carefully. Future researches should pay attention at this point.

With regard to the fifth aim, although it is true that there is usually a gap between beliefs and uses, we found that some specialist teachers and teachers of second and third stage of primary school proposed activities that made the most of ICT potential: interactivity, autonomy, reflection, managing uncertainty and metacognition were just some of the processes they put into motion in their classroom practice. These teachers are the example that shows that ICT can be extraordinarily powerful tools for promoting quality educational practices, where the aim is not merely to convey established knowledge, but rather to construct true knowledge. The new learning culture requires dialogue between teachers and students which transcends the limits of the classroom to include the new scenarios opened up by ICT. Specifically, information management through ICT should help promote three essential changes in ways of teaching and learning:

1. Change from realist epistemology based on one-directional conveyance of "true", closed knowledge to joint management of knowledge, understood as collective negotiation of shared meanings.

2. Change from one-directional management of knowledge (monological) to multi-directional (dialogical), where the teacher is no longer a mere dispenser of established knowledge, but becomes a mediator in reflective dialogue.

3. Change from knowledge based on a single system of representation (written or oral language) to dynamic integration of multiple systems. This involves simultaneous management of multiple codes which make the teaching and learning processes more complex.

However, as noted throughout this paper, the mere introduction of technological devices into classrooms does not ensure change. We need to promote spaces for reflection in which to re-think the role that teachers and students play in society and education in the twenty-first century, where conceptions and beliefs about teaching and learning can be reformulated (Pozo et al., 2006). From a traditional conception based on the conveyance of

established knowledge, the role of ICT is limited to a change in the support of teaching practice. However, based on conceptions where knowledge is not only an end in itself, but also a means for constructing a complex world view nurtured by contact with multiple voices and standpoints, ICT are exceptional tools for constructing a new learning culture. Future researches should analyse how all those processes are developed in specific contexts.

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ANEXO 1. Cuestionario Profesorado

A continuación le vamos a realizar una serie de preguntas donde nos interesamos por sus concepciones en relación a las Tecnologías de la Información y la Comunicación (de ahora en adelante TIC) y su impacto educativo en los procesos de enseñanza y aprendizaje. La información es anónima y el uso de la misma exclusivamente con fines académicos. Muchas gracias por su colaboración.

DATOS PERSONALES

1-Edad:

2-Sexo:

3-¿Qué estudios ha cursado?

4-Colegio en el que trabaja actualmente:

5-¿Cuántos años hace que se dedica a la docencia?:

6-¿Qué materias imparte actualmente y en qué cursos?:

7-¿Utiliza las TIC en el contexto de las asignaturas que imparte? ¿En cuáles?:

8-¿Con qué frecuencia las utiliza? (indique la frecuencia de uso en relación a cada una de las asignaturas):

Materia	Diaria-mente	Semanal-mente	Mensual-mente	Anual-mente

9-¿Cuántos años hace que utiliza las TIC en el contexto educativo?:

10-¿Utiliza las TIC en el contexto educativo por voluntad propia o porque son las directrices del centro?

11-¿Qué tipo de tecnologías utiliza en el contexto de la/s materia/s que impartes (tanto hardware como software)?

1-Según su opinión, ¿cree que el impacto provocado por las TIC está cambiando las formas de enseñar y aprender? En caso afirmativo, ¿de qué manera lo están haciendo?

2-A continuación describa los 3 usos de las TIC que considere más importante en el contexto de alguna de las asignaturas que imparta (escoja usted mismo las materias deseadas), atendiendo a los criterios que le proponemos a continuación:

Actividad 1

Materia y curso:

Descripción:

Rol desempeñado por el docente y los alumnos:

Objetivo de aprendizaje deseado:

Posibles problemas de aprendizaje que puedan surgir en sus alumnos y su reacción como docente frente a los mismos:

Actividad 2

Materia y curso:

Descripción:

Rol desempeñado por el docente y los alumnos:

Objetivo de aprendizaje deseado:

Posibles problemas de aprendizaje que puedan surgir en sus alumnos y su reacción como docente frente a los mismos:

Actividad 3

Materia y curso:

Descripción:

Rol desempeñado por el docente y los alumnos:

Objetivo de aprendizaje deseado:

Posibles problemas de aprendizaje que puedan surgir en sus alumnos y su reacción como docente frente a los mismos:

¡Muchas gracias por su colaboración!