TECHNOLOGY USE FOR TEACHING AND LEARNING

USOS DE LA TECNOLOGÍA PARA ENSEÑAR Y APRENDER

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The article main objective is to categorise the different uses teachers and students make of Information and Communication Technologies (ICT) as a teaching and learning tool in technology-rich classrooms. A questionnaire about possible uses was developed following the guidelines provided by the literature review. A sample of teachers (n=278) who teach in highly technological classrooms participated in the study. Four types of educational ICT uses in the classroom turned out of the exploratory factor analysis, technology usage for: teachers' content generation and interaction, and students' content generation and interaction. Useful ideas for researchers and teachers are provided.
Keywords: Learning tool, educational innovation and ICT, technology-rich learning environments, ICT and teaching.

El principal objetivo de este artículo es clasificar los diversos usos que los docentes y los alumnos hacen de las Tecnologías de la Comunicación y la Información (TIC) como herramienta de enseñanza y aprendizaje en aulas altamente dotadas de tecnología. Se desarrolló un cuestionario sobre los posibles usos siguiendo las directrices proporcionadas por la revisión de la literatura. Participaron en el estudio una muestra de profesores (n = 278) que enseñan en aulas altamente dotadas de tecnología. El análisis factorial exploratorio muestra la existencia de cuatro tipos de uso educativo de las TIC en las aulas: el profesor usa la tecnología para el contenido, el profesor usa la tecnología para la interacción, los alumnos usan la tecnología para el contenido, y los alumnos usan la tecnología para la interacción. Finalmente, se proporcionan ideas útiles para investigadores y profesores.
Palabras clave: Herramienta de aprendizaje, innovación educativa y TIC, entornos de aprendizaje ricos en tecnología, enseñanza.

1. Introduction.

According to Van Braak, Tondeur and Valcke (2004), teachers use computers mainly for two types of professional activity, referred to as «supportive use of computers» and «use of computers in the classroom». Computers are used *as a support* when they are incorporated into the teacher's professional practice outside the classroom (Meneses, Fàbregues, Rodríguez-Gómez & Ion, 2012), providing assistance to classroom teaching. Several authors (Bebell, Russell & O'Dwyer, 2004; Hsu, 2010; Russell, Bebell, O'Dwyer & O'Connor, 2003; Ward & Parr, 2009) include in this category computer uses for the professional development of teachers, administrative tasks, the design and planning of instruction, and personal use. The use of computers *in the classroom* involves the use of ICT during the lessons, as an integral part of the teacher's teaching and student's learning.

Several authors (Tondeur, Van Braak &Valcke, 2007; Twining, 2002) distinguish between three types of computer use in the classroom: as content (learning basic computer skills), as an information tool, and as a learning tool. The first type of use relates to acquiring «computer literacy». ICT is a specific school subject designed to teach students the basic technical skills to use computers, use keyboards and mice, and to learn the basic concepts and procedures of operating systems. The second type of use refers to the concept of computers as information tools, which includes this use to select, retrieve, store, access, view, display and send information. Finally, the view of computers as learning tools, according to Ainley, Banks and Fleming (2002), is related to the role of technology in mediating the educational interaction that students can establish with the syllabus content and their peers.

We consider that there are two important limitations concerning these categories. First, all existing classifications are biased towards students' learning activity and do not incorporate the teacher's activity as a criterion. Furthermore, the third category that considers ICT as a learning tool is too broad to be useful to characterize technology as a support for teaching and learning. Accordingly, it is necessary to go deeper into this topic in order to have a new and integrated overall classification that helps researchers and teachers, as a starting point for a reasonable and good use of ICT in the classroom, not only from the technological point of view but also from the point of view of teaching and learning specific curriculum content.

2. Technology use as a teaching and learning tool.

To achieve such a classification proposal it is necessary to take into account the technological, instructional and educational issues that may influence the use of ICT as a learning tool. The Squires and McDougall (1994) approach meets this challenge as it proposes three different criteria for identifying and classifying the use of educational computers in the classroom: software use, instructional role of the software, and software relationship with educational rationales.

Categories of software use have a twenty-year tradition (Khan, 1989; Rutven & Hennessy, 2002; Selwyn, Potter & Cranmer, 2009; Waite, 2004). Currently, software possibilities are often analysed as ICT affordances. For instance, Conole and Dyke

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(2004) propose a taxonomy of ICT affordances that includes categories such as information accessibility and immediacy, fast information exchange, diversity of learning experiences, extensive communication and collaboration technologies, reflection by means of written discourse analysis, and multimodal or non-linear access to information. This type of classification highlights the technological influences on managing information and communication in educational contexts, but do not provide information about the teaching and learning processes that occur in the classrooms.

There is also an extensive bibliography on frameworks focused on the instructional role of the software (Ainley, Banks & Fleming, 2002; Duffy & McMahon, 1999; Inan, Lowther, Ross & Strahl, 2010; Jonassen, 1995; Lim & Tay, 2003; Passey, 2006; Ruthven, Hennessy & Deaney, 2005). The educational intentions of the teacher are taken as core classification criteria.Two types of educational uses of ICT can be distinguished: computer-based instruction (Martin, Klein & Sullivan, 2007), and technology supported learning (Jonassen, 1995). From a learning-based classification, three broad ICT uses have been identified: technology as tool for information management (information resources, information access, representation of ideas, communication with others, product generation), technology as an intellectual partner or mind tool (to support student thinking when expressing ideas, reflecting on what they have learned, or building representations of knowledge), and technology as a learning context (for example, to represent and simulate significant real-world problems or to support discourse among students through knowledge building communities).

Significant literature can also be found on classifications of educational uses of ICT based on educational rationales, often related to teachers' beliefs about teaching and learning (Hermans, Tondeur, Van Braak & Valcke, 2008; Levin & Wadmany, 2006; Palak & Walls, 2009; Tondeur, Hermans, Van Braak & Valcke, 2008). The distinguishing criterion adopted is based on the educational principles that underlie different educational paradigms. The vast majority of these authors distinguish between two different educational perspectives: teacher-centred teaching, and student-centred learning. In the first case, the teacher uses ICT to promote direct instruction and the transmission of contents. One example is the use of information presentation software to transmit content. In the second case, ICT is used to help students' knowledge acquisition, whether individually or through collaborative learning among peers. One example of this is the use of online forums to encourage students to develop the necessary educational interaction for building shared meanings on a syllabus topic. Some authors (Levin & Wadmany, 2006) argue that student-centred teachers use more open constructivist software that engage students in complex learning tasks, work with specific contents, and are based on problems whose resolution requires multiple points of view. By contrast, teachers who adopt direct instruction approaches use *skill-based software*, *computer-assisted learning*, and *learning with technical tools*. It may be important to identify the educational paradigm that underlies the use of ICT, but often does not provide useful knowledge to be used at the pedagogical level.

The three criteria used by Squires and McDougall (1994) are relevant, but it would

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be useful to interrelate them to have an integrated approach that would help to provide a broad vision and higher understanding of how ICT can be used by teachers and students, as a teaching and learning tool, in classrooms. An integrated analytical model also is needed in order to decide how educational software can be useful to teaching and learning, whatthe instructional roles that can be developed by educational software are, and what the educational rationales that provide a theoretical framework for an educational useare.

3. Technology-rich classrooms.

A more specific categorization of the educational uses of ICT would be very useful especially for technology-rich classrooms (Craig, Ault & Niileksela, 2011; Levin & Wadmany, 2006; Palak &Walls, 2009).These types of classrooms are characterised by a high level of access, both by teachers and students, to a wide variety of technologies that can help teaching and learning, and by a high level of skills in the educational uses of these technologies.

The research presented here is based on data collected from eight schools that joined the project for «Advanced ICT Integration» (In Catalonian: *Integració Avançada de les TIC, IA-TIC*), run by the Department of Education of the Catalonia Government (2004-2007), with the aim of fostering the integration of ICT in schools. Eight public schools (five Kindergartens and Primary schools, and three Secondary schools) were selected to participate in this innovative teaching experience.

IA-TIC project provided the best possible technological conditions of that time to these eight schools - for example, availability of Internet and computer infrastructure, educational software and educational platforms for synchronous and asynchronous communication, teacher training and technical support to solve needs or problems - with the idea that teachers and students would teach and learn through ICT without technological or skills and working conditions barriers. More specifically, the

INDICATORS	DATA FROM SCHOOLS IN SPAIN	DATA FROM IATIC CENTERS
Mean of the total number of computers	55.7	197.50
Mean of the total number of computers used by teachers for educational purposes	10.6	15.33
Mean of the total number of computers used by students for educational purposes	43.20	176.83
Mean of the total number of computers with Internet access	49.90	197.50
%of schools with web page	67.0%	100%
% of schools with intranet	58.5%	100%
%of schools with Wi-Fi connection	49.8%	100%
% of schools with Wi-Fi access in the classrooms	34.8%	100%
% of schools that use laptops in the classrooms	70.3%	100%
%of schools that provide technical support to teachers	73.4%	100%
% of schools that provide pedagogical support to teachers	57.2%	100%

Table 1.Comparison of the IATIC centers infrastructure with general schools in Spain.

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eight schools maintained a full ICT infrastructure, consisting of complete Internet access anywhere through Wi-Fi, private educational Intranet, a mean of 42.9 computers connected to Internet per 100 pupils, plenty of educational software in all curricular areas, and enough technical and pedagogical human support for the teachers in their own centre. Table 1 compares some data of the ICT infrastructure available in the IE-TIC centers (with high technological equipment) with data from a sample of conventional schools, representative of the Spanish educational system (Sigalés, Mominó, Meneses & Badia, 2009).

According to the information presented in the theoretical background, the analysis performed during the study has, as main objectives:

a) To figure outnew categories that can be useful to classify the possible educational uses of ICT for teaching and learning in classrooms.

b) To identify the use of the software by teachers and students in each category.

c) To examine the differences in the types of ICT educational uses between Kindergarten,Primary education, and Secondary education.

4. Method.

This research paper is part of a larger research project called ICT integration in schools (in Catalonian: *Integració Escolar de les TIC, IE-TIC*), funded by the Department of Education of the Catalonia Government, and carried out between 2006 and 2009. The main aim of this research project was to study the issues directly related to the integration of ICT in school classrooms, namely, approaches to teaching and learning with ICT, educational uses of ICT by teachers and students inside and outside the classroom, and the obstacles, supports and incentives touse ICT by teachers.

4.1. Participants.

Teachers belonging to the eight schools that participated in the IA-TIC project fulfilled a questionnaire specially designed to study ICT integration in schools. They were 278 teachers (74 from Kindergarten,108 from Primary education and 96 from Secondary education). Teachers' distribution among the three educational levels is shown in Table 2.

The sample of participants consisted of 72.1% of women and 27.9% men. The average age of participants was 41 (SD = 9.83); 46.9% of teachers had a three-year Diploma, 39.9% had a Bachelor's degree, and 13.3% held a Master's or Doctoral degree; 89.6% of them were civil servants, with an average experience of 16.45 years (SD = 10.62) as teachers.

	SCHOOL								
	1	2	3	4	5	6	7	8	TOTAL
Kindergarten	11	24	16	12	11				74
Primary education	12	25	26	26	19				108
Secondary education					13	19	30	34	96
TOTAL	23	49	42	38	43	19	30	34	278

Table 2. Sample distribution.

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When this research was carried out, 70.3% of teachers considered that they had integrated ICT in their classroom because it was a shared priority in their schools, 84.2% of teachers were Internet users for more than 3 years, 84.2% had received training on ICT educational uses in the last three years, 86.4% gave high value to the training, and 87% had a minimum connection of 2-3 timesper week to Internet.

4.2. Measures.

The three theoretical frameworks described above, based on categories of software use, on the instructional role of the software, and on the relation between software and educational rationales, were taken into account to develop the two scales of the questionnaire. Table 3 shows how we incorporated these three contributions.

Among other measurements, two ad-hoc scales, with eight items each, were drawn up to analyse ICT uses in lessons (Sigalés, Mominó, Meneses & Badia, 2009). The items were selected to show prototypical educational uses of ICT in technology-rich classrooms (Craig, Ault & Niileksela, 2011; Levin & Wadmany, 2006; Palak & Walls, 2009). The first scale relates to the activity carried out by teachers when giving lessons on their subject and describes the frequency with which they use technological media such as computers, computers with an Internet connection or digital whiteboards for a series of educational aims. The second scale explores the uses that teachers encourage among their students while teaching the subject and assesses the frequency with which students use ICT in the teaching and learning process. All the items (you can see all of them in tables from 4 to 7) use the same answer scale: «I do not use them» (1), «Occasionally» (2), «Frequently» (3), and «I always use them» (4). Personal and professional background information was also collected, including age, sex, education and qualification level, teaching experience, current teaching level and subjects.

4.3. Data collection.

Data of the two scales were collected between March and June 2008. The researchers provided the questionnaires on paper to the headmaster of each school, and each school organized to collect the questionnaires completed by the teachers and students. Overall, between 40% and 60% of teachers in schools answered the questionnaire. Later, data were recorded in a computer file to be processed using SPSS-version 17.

METHODOLOGICAL DECISIONS	THEORETICAL FRAMEWORKS
We created two different questionnaires: one for teachers-ICT users, and another for students-ICT users	Software rationales from both educational perspectives: teacher-centred teaching, and student-centred learning
We developed a list of items related to different instructional aims and according to different instructional roles	Instructional role of the software
We included different prototypical uses of software to each item	Categories of software use

Table 3. Relationship between methodological decisions and theoretical frameworks.

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FACTORS	EXPLAINED VARIANCE	CRONBACH'S ALPHA
TEUCT	43.597	0.722
TEUIT	14.482	0.764
Total scale	**58.079**	**0.813**
SEUCT	47.907	0.829
SEUIT	14.983	0.733
Total scale	**62.890**	**0.841**

Table 4. Explained variance and Cronbach's alpha of Teachers' and Students' ICT use.

5. Results.

Firstly, we applied an exploratory factor analysis to the two scales. Principal components analysis revealed two structures of two factors, representing the uses by teachers (KMO=0.821 and a significant Bartlett test, p=0.000) and the uses by students (KMO=0.839 and a significant Bartlett test, p=0.000), reaching an acceptable explained total variance of 62.89% and 58.08%, respectively. Two non-orthogonal solutions with oblique rotation (Oblimin with Kaiser normalisation) were calculated to examine potential correlations between factors. Since they were significantly correlated (i.e. -0.417 and 0.437, respectively), the computation of two orthogonally rotated solutions was not required.

5.1. Categories of technology use as a teaching and learning tool.

We identified four new categories that can be useful to classify the educational uses of ICT for teaching and learning in school classrooms. Based on the meaning of the items with high factor loadings, these factors were named «Teachers' Educational Use of Content Technologies (TEUCT)», «Teachers' Educational Use of Interaction Technologies (TEUIT)», «Students' Educational Use of

	MEAN	SD	TEUIT	TEUCT
TEUCT	**1,88**	**0.54**		
Support the oral presentation of content	2.22	0.76	**0.779**	-0.362
Present contents through a multimedia or hypermedia system	1.85	0.72	**0.749**	-0.265
Support conversations with my students	1.72	0.72	**0.709**	-0.236
Show examples of products that students are required to develop	1.75	0.75	**0.704**	-0.482
TEUIT	**1.46**	**0.53**		
Extend classroom to virtual classroom	1.33	0.595	0.238	**-0.788**
Communicate with students	1.48	0.702	0.446	**-0.777**
Monitor the progress of the learning process	1.34	0.685	0.276	**-0.767**
Provide guidance and guidelines to facilitate learning	1.68	0.760	0.570	**-0.700**
Total scale	**1.67**	**0.47**		

Table 5. Items including the educational uses of ICT by teachers.

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	MEAN	SD	SEUIT	SEUCT
SEUCT	**2,11**	**0.66**		
Search for information for class assignments	2.34	0.823	**0.850**	0.360
Organise and classify content documents	1.84	0.993	**0.806**	0.457
Access information previously selected by the teacher	2.24	0.773	**0.796**	0.292
Develop educational products	2.04	0.876	**0.703**	0.252
Obtain information relating to the real world	2.00	0.828	**0.702**	0.440
SEUIT	**1.32**	**0.50**		
Use of ICT for collaborative work with other students	1.28	0.624	0.430	**0.866**
Learn in complex learning environments	1.28	0.596	0.255	**0.805**
Communicate to exchange information with other students	1.40	0.646	0.483	**0.740**
Total scale	**1.80**	**0.54**		

Table 6. Items including the educational uses of ICT by students.

Content Technologies (SEUCT)» and «Students' Educational Use of Interaction Technologies (SEUIT)». Table 4 shows explained variance and Cronbach's alpha of each factor.

Reliability analysis revealed acceptable Cronbach's alpha, ranging from 0.722 to 0.841 both on the teachers' and students' global scales and in relation to the specific factors. Tables 5 and 6 show items included in each of the four factors.

Four items form TEUCT factor. The mean (1.88) appears slightly below thevalue 2 (occasionally), with a standard deviation of 0.54. So, the most common use is the oral presentation of the content from the teacher.

TEUIT factor also consists of four items. This factor includes the teaching tasks that characterize the educational interactions between teachers and students. The most common use is to provide guidance for students to learn the content. The mean (1.46) appears in the midpoint between values such as never (1) and 2 (occasionally), with a standard deviation of 0.53.

The SEUCT factor consists of five items. Students use ICT to search, manage and elaborate content information. The relationship between students and content, mainly for syllabus contents, characterizes this type of ICT use. The mean of this factor (2.11) appears a little above the value 2 (occasionally), with a standard deviation of 0.66.

Finally, the factor SEUIT involves three items and includes learner ICT uses such as collaborative work, complex environments for learning, and communication among students. It involves the learning tasks characterized by educational interactions among students in technology-rich classrooms. The mean (1.32) appears close to value 1 (never), with a standard deviation of 0.54.

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5.2. Computer resources and software uses carried out by teachers and students.

Next we present the data on the percentage of software use on each of the items, presented as corresponding to each factor.

Table 7 shows the highest frequency of use by teachers of three types of content technologies, which are based on the principles of teacher-centered teaching and developed using computer-based instruction: a) technologies for accessing Internet content, mainly from webpages or other resources useful for teaching, b) technologies for content editing documents in order to present them to their students, and c)

	% ALMOST ALWAYS/ ALWAYS	SOFTWARE USE	% SOFTWARE USE
Support the oral presentation of content	31.8	Presentation software	36.9
		Word processor or spreadsheet software	6.8
		Web pages	56.3
Present contents through a multimedia or hypermedia system	14.2	Web Authoring software	9.0
		Video creating/editing software application	47.0
		Video-sharing website or photo sharing website	44.0
Support conversations with my students	12.9	Content edited by teacher himself	16.0
		Web pages	23.3
		Other online resources	60.7
Show examples of products that students are required to develop	13.4	Content edited by teacher himself	41.3
		Office suite: Microsoft Office, OpenOffice or similar	11.9
		Web pages or documents from internet	46.9

Table 7. Frequency of teachers' educational use of content technologies (TEUCT), computer resources and software.

	% ALMOST ALWAYS/ ALWAYS	SOFTWARE USE	% SOFTWARE USE
Extend classroom to virtual classroom	5.9	E-learning software platform (e.g. Moodle)	64.6
		Social bookmarking web service (e.g. Delicious)	3.1
		Blog-publishing service (e.g. Blogger)	32.3
Communicate with students	7.7	Asynchronous communication software (e-mail)	92.7
		Synchronous communication software (Messenger, Skype or similar)	7.3
Monitor the progress of the learning process	7.9	E-portfolio	3.8
		Computer monitoring and tracking software	15.1
		Computer-based self-assessment software	81.1
Provide guidance and guidelines to facilitate learning	16.2	Intelligent tutoring system	5.4
		Software supporting problem based learning	49.5
		Guideline made by teacher himself	45.0

Table 8. Frequency of teachers' educational use of interaction technologies (TEUIT), computer resources and software.

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technologies to display the contents in the classroom.

Table 8 reveals the highest frequency of use by teachers of two types of Interaction Technologies, which are based on the principles of teacher-centered teaching and developed using computer-based instruction: a) technologies that promote teacher and student interaction (by e-mail or e-learning software platform), and b) technologies to promote student learning, either by guiding (for example, by supporting software specific problem based learning, or also through guidelines), or by developing formative assessment or self-assessment.

Table 9 shows the most frequent use of three types of content technologies, based on the student-centered learning perspective and developed though technology supported learning : a) technologies to obtain content information (from web pages or real life) b) technologies to organize this information, and c) technologies to transform the information into a learning product (mainly word processors).

Table 10 discloses the two most frequent uses of interaction technologies based on the student-centered learning perspective and developed through technology supported learning: a) Technologies to exchange of information among students (mainly, e-mail) and b) Technologies tolearn in collaboration in complex environments.

5.3. Differences in the types of educational use of ICT between educational levels.

Additionally, a series of ANOVA analyses (F test) were carried out to assess the differences among uses of ICT of teachers and students from Kindergarten,Primary and Secondary education. Levene's test of homogeneity of variance was applied to test the ANOVA assumption that each group had

	% ALMOST ALWAYS/ ALWAYS	SOFTWARE USE	% SOFTWARE USE
Search for information for class assignments	37.3	Internet search engine	35.3
		Digital or Internet Encyclopaedia (e.g. Encarta or Wikipedia)	9.3
		Educational website for kids	55.3
Organise and classify content documents	25.8	Off-line folders	65.5
		Online shared folders	34.5
Access information previously selected by the teacher	34.1	Educational website for kids	63.5
		Digital or Internet Encyclopaedia (e.g. Encarta or Wikipedia)	15.2
		Other websites (e.g. virtual museums, online newspaper)	21.3
Develop educational products	28.9	Word processor or presentation software	91.8
		Web Authoring software	5.3
		3D computer graphics software	2.9
Obtain information relating to the real world	23.9	Digital camera	51.2
		Digital audio recorder	10.4
		Online questionnaire	38.4

Table 9. Frequency of students' educational use of content technologies (SEUCT), computer resources and software.

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	% ALMOST ALWAYS/ ALWAYS	SOFTWARE USE	% SOFTWARE USE
Use of ICT for collaborative work with other students	4.8	Wiki page	40.4
		Virtual discussion forum	55.3
		Social bookmarking web service (e.g. Delicious)	4.3
Learn in complex learning environments	4.0	Computer learning environment to promote critical thinking	26.4
		Computer learning environment to promote problem based learning	50.9
		Computer learning environment to promote authentic assessment	22.6
Communicate to exchange information with other students	7.4	Asynchronous communication software (e-mail)	81.5
		Distribution list	6.2
		Synchronous communication software (Messenger, Skype or similar)	12.3

Table 10. Frequency of students' educational use of interaction technologies (SEUIT), computer resources and software.

the same variance in scale and factor scores. A significant Levene's test suggests heterogeneous variances between groups, so this assumption is not adequately met and an alternative procedure must be developed. Accordingly, the researchers computed a more robust test, Welch's variance-weighted ANOVA, which also adequately deals with unequal group sample sizes.

Table 11 shows that the four factors that classify ICT use in technology-rich classrooms have significant mean differences according to the educational level: Kindergarten, Primary educationand Secondary education.

Overall, findings showthat the frequency distribution of technology uses for teaching

FACTORS	KINDERGARTEN	PRIMARY EDUCATION	SECONDARY EDUCATION		
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Levene's test*	*ANOVA*
Teachers' ICT use					
TEUCT	1.80 (0.50)	1.80 (0.52)	2.03 (0.57)	0.792	F=5.205[b]
TEUIT	1.24 (0.34)	1.38 (0.43)	1.72 (0.62)	12.059[c]	W=19.074[c]
Scale total	1.51 (0.37)	1.58 (0.42)	1.88 (0.51)	6.747[b]	W=14.155[c]
Students' ICT use					
SEUCT	1.87 (0.57)	2.14 (0.63)	2.27 (0.71)	3.403[a]	W=8.676[c]
SEUIT	1.16 (0.33)	1.29 (0.41)	1.48 (0.63)	11.485[c]	W=8.668[c]
Scale total	1.60 (0.42)	1.80 (0.48)	1.98 (0.61)	5.883[b]	W=11.292[c]

a, p<0.050, b, p<0.010, c, p=0.000

Table 11. Differences in educational uses of content and interaction technologies of teachers and students, from Kindergarten, Primary and Secondary education.

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and learning is significantly different in each level: a) in relation to the use of technologies made by teachers (Kindergarten: M=1.51, SD=0.37; Primary education: M=1.58, SD=0.42; Secondary education: M=1.88, SD=0.51); b) in relation to the use of technologies made by students (Kindergarten: M=1.60, SD=0.42; Primary education: M=1.80, SD=0.48; Secondary education: M=1.98, SD=0.61); c) in each of the specific uses of Content technologies and Interaction technologies.

6. Discussion.

The classification of educational uses of ICT as a teaching and learning tool, just characterized, should be understood under an integrated framework.This classification has three advantages in relation to previous classifications of ICT as a learning tool, presented in the theoretical framework. First, it is more comprehensive and complete, while taking into account the use of ICT for students' learning and also how the teacher can teach using technology. Second, it is a more integrated classification at the theoretical level, as it involves both the two traditional frameworks of educational rationales (teacher-centered and student-centered), and the two possible roles of instructional technology (computer-based instruction and technology-supported learning). Third, the classification follows an educational criterion, since the software is used in each category in a different way, in each case for a specific educational purpose.

TEUCT category refers to the research and educational practice related to what the teacher does in relation to the content. Currently, there are two lines of relevant research on the topic: the presentation of content through hypermedia technology, and through the use of smart boards in the classroom. There is a substantial body of knowledge about the use of hypermedia (Gerjets & Kirschner, 2009); however, more research is needed on the use of smart boards in class, even though there is already some research on how their use can impact classroom dialogue (Mercer, Hennessy & Warwick, 2010).Both types of content technologies are used extensively in the classroom, although there is evidence that the use of hypermedia does not always have a positive impact on student learning.

TEUIT category accounts for how the teacher uses technology to establish educational interaction with students. There are two well-known education research lines: the use of virtual classrooms, based on asynchronous and written communication, and the provision of educational and evaluative aids to facilitate content learning. Educational aids can be provided via *content scripts* (see e.g. Weinberger, Ertl, Fischer & Mandl, 2005), while formative feedback (Fitch, 2004) can provide evaluative aids. While there has been a lot of educational research in this area in recent years, yet there is little widespread of the use of these technologies in educational practice.

SEUCT category refers to the way in which students manage content using computers. Two of the fields that are related to this subject are access to Internet content, and the use of technology to help students manage the content. To get access to open content of quality published in the Internet and use it for educational purposes is one of the challenges of the schools for the next three years, according to the preliminary report NMC Horizon Project (2013). Content management with the support of technology

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has been a field of study in the last forty years (Monereo & Romero, 2008), but with few results. There has only been an advance in the study of how students use some technological systems, such as intelligent tutoring systems. Since these technological systems have had a very limited expansion, much of the research has focused on studying how students use the technologies currently available (not designed specifically for education) to manage content, and what possible problems can appear in this process (Monereo & Badia, 2012). This lack of research and in the design of this type of technology has led students not to use a technology specially designed from an educational point of view for this purpose.

Finally, SEUIT category includes two types of technology uses: collaborative learning, and learning in complex technological environments. Collaborative learning through ICT (CSCL: Computer-Supported Collaborative Learning) has been the field most researched of all, and also has had more impact on school educational practice (Stahl, Koschmann & Suthers, 2006). Nevertheless, it is a complex educational practice where it is often difficult to achieve high levels of quality of social interaction between peers (Kreijns, Kirschner & Jochems, 2003). Difficulties also arise in learning in complex technological environments (Puntambekar & Hubscher, 2005), both from the point of view of design and implementation in the classroom. The main challenge is to know what kind of educational aids are necessary to meet the diverse needs of students' learning, and when it is needed to remove them because they are not necessary. It is an emerging field, very little implemented in the classrooms.

All four categories are useful to highlight differences in the frequency of use of ICT among Kindergarten, Primary and Secondary teachers and students, probably due to the characteristics of each level of education. This fact points tothe two main limitations of this research:first, the limited sample of schools and teachers, and second, the global perspective adopted for the analysis of the educational uses of ICT. More research with other schools, perhaps even with greater technological resources, would be necessary to provide a wider empirical basis to these four categories. And it would also be necessary to determine whether these categories are useful to characterize specific uses of ICT in specific educational levels and in particular curriculum areas.

Despite these limitations, we believe that we provide an ever-lasting categorization of educational uses of ICT, which is not dependent on technological changes that may occur in the present or in the future.

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