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How, when and for what purpose 16 primary school teachers use ICT: A field study

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ABSTRACT

This article explores the way in which 16 primary school teachers use ICT resources in their classrooms. More specifically, the analysis seeks to discover whether there is a link between the ICT resources the teachers use and the types of activities involved in their classes. The premise underpinning this approach is that teachers adapt and adjust the use of ICT resources to suit the teaching methods they apply in the classroom. A multiple case study was conducted with 16 primary school teachers, who were recorded for three whole schooldays over three school years, furnishing a total of 159.5 h. The research design was based on a mixed methods approach. The results indicate that the teachers link ICT resources in the classroom to the now traditional use of analogue ones and to teaching approaches involving a wide range of different tasks and exercises. Digital resources are barely used in templates of activity related to pupil assessment or planning the school day. The results provide guidelines on teacher training that simultaneously address ICTs and didactic competencies that respond to the challenges of classroom practice. A further finding involves the need to adjust the design of educational ICT resources to the patterns of real classroom activity.

1. Introduction

The exponential increase in the availability of information and communication technologies (ICTs) and their potential impact on pupils' education [5,13,31] explains the increase in research into the ways teachers use digital resources in the classroom. Recent studies in this field have reported that teachers use those technologies they have at hand [22,30,40], although their deployment usually coexists alongside traditional curricular materials [3].

This article is the result of a publicly funded project involving studies of a diverse nature, such as classroom observations, interviews, case studies, and surveys designed to shed light on classroom activity templates in which ICTs acquire meaning in classroom practices in primary education. This article presents part of the results obtained, specifically those on how teachers use technologies in their practice.

1.1. Theoretical framework

1.1.1. The incorporation of ICTs in the classroom: some preliminary considerations

The debate on the introduction of ICTs in schools has intensified since the beginning of this century, largely because of schemes for the digital transformation of school systems designed to stimulate innovation and foster global economic competitiveness [23]. Among other aspects, this debate has revealed that the effective classroom use of ICTs is a complex process, modulated by numerous factors that affect the development of teaching practices [4,35]. The research findings on the introduction of technologies increasingly stress that their impact depends on how they are used, why, and when [42]. It has been reported that their deployment is a gradual and ongoing process [11], which often involves a complex set of objectives, based on a plan of action that is progressively being readjusted. This means it is a non-linear and dynamic process [17]. Nevertheless, expectations on the impact of ICTs on education have not been fully realized despite their ease of access in schools. An OECD report [27] suggests that technology's impact on

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education remains at a suboptimal level. A review by See et al. [34] raises serious doubts about the value of ICTs for assessing pupil's progress. The lack of a common and detailed definition of what is understood by these technologies hampers the formation of a reasoned and rigorous body of knowledge [7].

Those aspects with the most influence on teachers' decision-making regarding the integration, or not, of technology in the classroom are informed by their engagement with the tool, whether they think their pupils will be able to handle it, and whether they can make confident use of it [26]. Indeed, an increase in the amount of technology in the classroom does not seem to be enough to change teachers' practices with ICTs unless they are accompanied by a reappraisal of their teaching practices. The recurrent issue that arises in more recent studies is that it is not simply a matter of teachers using technologies in the classroom, but rather how they do so.

1.1.2. The teacher as the keystone in the incorporation of ICTs in classrooms

To understand how technologies are used in the classroom, it is important to know how teachers perform in them, as, among other aspects, they transform teaching objectives, resources, scientific knowledge, and curricular proposals into meaningful experiences for pupils from an educational perspective. Ultimately, while they are involved in direct classroom practices with pupils, teachers adapt or change those elements available to them according to in-situ interactive processes and specific concessions. Teachers inform the process and are the key players -together with the pupils- of any classroom analysis [38]. Classroom practice is therefore mediated by the teachers and by such tangible factors as the physical setting and the resources available, and by such intangible ones as school routines and socio-historical conditions [24]. Understanding how technologies are used in the classroom therefore requires their study from the perspective of the wealth and multiplicity of factors that define them. The topic addressed here involves an analysis of whether there is a link between the ICT resources teachers use and the kinds of activities into which their classes are structured. The overarching aim is to use an analysis of practices to understand the classroom use of technologies.

Some of the theoretical constructs used to explain how teachers approach the deployment of ICTs in their classroom practices are Technological Pedagogical Content Knowledge (TPACK) and the framework for the Teachers' Digital Competences. The former stems from the programme propounded by Shulman [37], while the latter is more rooted in the european tradition of didactic theory [18].

Based on the approaches taken by Shulman [37], Koehler et al. [19] incorporate technological knowledge (TK) into Schulman's original characterisation of teachers' knowledge, referring to it as TPACK. The TPACK framework also includes technological content knowledge (TCK) and technological-pedagogical content knowledge (TPK): in other words, knowledge on the reciprocal relationship between technology and content, and technology and pedagogy. This construct has often been used in research into teachers' knowledge when using ICTs [9]. Nevertheless, in their review of the literature on TPACK, Voogt et al. [41] have warned that defining teachers' knowledge is not enough, calling for studies on the use and development of teachers' practical knowledge to understand their decisions on the use of technology.

Regarding the notion of Teachers' Digital Competences, some scholars, such as Engel [11], propose moving away from the definition of digital competency as the knowledge and general skills that can be applied in all kinds of situations. By contrast, Teachers' Digital Competences needs to be directly related to specific uses and situations. It thus shows how the competencies teachers need to use ICTs in their classroom activities involve their skills at adapting and adjusting their ICT resources in different settings and contexts. These skills are on a par with the tailoring and transformation of disciplinary knowledge into classroom knowledge [10], and this recontextualisation is a core activity in a teacher's professional duties [12]. In the case that concerns us here, digital competency is recontextualised and transformed into Teachers' Digital Competences as teachers take significant steps forward in the use of technology according to the pedagogies applied in classroom practices.

The literature review conducted by Shavelson and Stern [36] has already indicated that when teachers plan their classroom practices they consider a whole raft of elements including, amongst others, the content they are going to teach, the objectives they aim to achieve through their practice, the learning activities or situations that affect both teachers and pupils, time management regarding the sequencing of tasks, the necessary materials and resources, and the class groupings depending on the planned activities. A series of aspects that are likewise framed within specific sociocultural and curricular contexts [44] which often serve as regulators of the practices [20]. This means that planning the practices is a complex activity. Furthermore, teaching in a real context always entails a particular condition, namely, it is unique in its own right, despite the common traits shared across schools and classes [33]. This means that each classroom practice becomes a unique action in which each teacher is constantly assessing "what is most appropriate for these pupils in these circumstances". As noted earlier, incorporating technologies within the context of classroom practices involves associating with another series of factors that are more implicit in these practices and which function according to criteria related to their pedagogical meaning in the sum of elements involved. Those teachers that successfully use technologies are the ones that adapt their pedagogical approaches and the content to the technology [8,14], although, as Heitink et al. [14] indicate, teachers use technologies more with traditional pedagogical models based on knowledge transmission. Nevertheless, links have been found between the digital competency of educators in ICTs and an increase in activities of a constructivist nature [1]. It is often the case that the more popular technologies (word processors, Google applications, browsers…) are flexible and can be used for numerous educational purposes, while others (Moodle, Plickers, Snappet…) are designed for specific ones [15,21,43]. Certain technologies also have more persuasive power for their widespread classroom use: Ruggiero & Mong [30] conclude that primary school teachers with interactive whiteboards in their classrooms use them throughout the school day, not only in one or other subject.

An important consideration regarding the use of ICTs involves the period of lockdown during the COVID pandemic, when the materials and resources that underscore the teaching process were radically transformed by the switchover to non-presential teaching, when digital technologies in the vast majority of cases mediated the teaching process [25] in terms of usages (repository, offline, online work), formats (synchronous/asynchronous), and participation (individual/group). During the lockdown, this transition was immediate, and schools did not have enough time to suitably prepare themselves, highlighting the shortcomings in the education system [39]: the curriculum was not designed for on-line teaching, and teachers were not trained to teach solely through technological media. Such an exceptional situation highlighted the fact, among others, that the use of ICTs is a complex process that is constantly being redefined depending on the conditions of the practice.

1.1.3. Some features of classroom practices in primary education

Finally, give the interest in understanding the context of the practices involving the teachers taking part in this research, there is a need to describe some of the main features of the classroom practices in primary education (ages 6-12), above all regarding the use of digital resources. In Spain, at least, primary education has been regulated by a series of different plans for the integration of ICTs, with the latest of these, Escuela 2.0 [School 2.0] opting for a one-to-one model for the classroom deployment of technologies among the older pupils in this age-group [3]. The plans have been well received by primary school teachers as far as the policy on the provision of resources is concerned, although maybe less so regarding the information received, instruction,

production of materials, and teacher support [2,6].

As regards the most common practices in primary schooling, Jiménez Sánchez [16] reports a prevalence of direct teaching methods: explaining topics, asking questions individually and collectively, doing exercises in different subjects and their subsequent correction…, with major support from the textbook as a widely used tool. Although evolving toward digital formats, textbooks do not appear to have changed the way they transmit culture [32].

Based on the state-of-the-art on this matter, we are interested in exploring the templates of activities within which ICTs acquire meaning in classroom practices in primary schooling to explain how teachers deploy them in their daily activities. We understand that the use of ICTs in classrooms depends on whether these resources have a significant role to play within the templates of activities that teachers use directly. We therefore seek to respond the following questions:

- What kind of activities are technologies used for in the classroom?
- Are there any observable templates for the classroom use of ICTs in Primary? Are there any differences in the way ICTs are used by the individual teachers involved in the study?

More specifically, this article has the following objectives:

1. Identify and describe the templates of activity associated with the use of ICTs in the primary school classrooms being analysed. The templates of activity that include the use of ICTs will provide an indicator of how teachers handle these resources in terms of achieving the curricular goals set when they work jointly with the pupils. The importance of this objective lies in seeking to explore how teachers give meaning to the use of ICTs in their classrooms, how they do so, and why.
2. Describe the classes in which ICTs are used, relating them to other aspects of the teaching process, such as the year or the teacher involved, as we consider that technological resources are not isolated elements in the actions that teachers and pupils undertake in the classroom; quite the opposite, in fact, they are part of an amalgam of factors with as many configurations as there are specific teaching situations.

2. Material and method

The research design applied here used mixed methods of analysis that combine qualitative approaches involving a multiple case study model that includes real classroom practices, and quantitative analyses with statistical studies of the variables that emerge when applying proven procedures for classifying what happens in those practices.

2.1. Participants

The study focuses on the classroom activities of sixteen teachers at urban primary schools (Table 1) of a university town in the center-west of Spain. The teachers worked in 5 different schools (A, B, C, D and E -Table 1), 4 with state funding (A, B, D and E-Table 1) and 1 with mixed state and private funding (C-Table 1). Several recordings were made of each teacher over three school years, providing a total of 159.5 h of footage (Table 1). The video and audio recordings were made with a digital camera that captured the entire classroom. The camera was concealed to keep it out of sight. The teachers were also fitted with a digital recording device. None of the research team was present during the recordings.

All the participants in the study provided their informed consent. The recordings of the pupils were authorized by their parents and by each

Table 1
Participants and classes.

Teacher	Gender	School	Years of experience	Year in Primary	Sessions and hours recorded	Hours of ICT resources in the sessions	Classroom technologies	Classroom apps
T 1	F	A	25	2	3 (13.5 h.)	6.5 h.	IWB/Wi-Fi	Bouncy Balls / Cmap Tools / Online dictionary / Google Images / Digital Textbook / Interactive maps-Web resource / YouTube
T 2	F	A	25	6 5	3 (13.5 h.) 1 (4.5 h.)	5 h. 2.5 h.	IWB/Wi-Fi	Interactive Tasks / Power Point / Plickers / Google Images / Digital Textbook / Interactive maps-Web resource / YouTube
T 3	M	B	12	1	3 (11.5 h.)	5.5 h.	IWB/Wi-Fi	Interactive Tasks / Additeo / Google Images / Digital Textbook / YouTube
T 4	F	B	29	3	3(7 h.)	3 h.	IWB/Wi-Fi -Tablets	Digital Textbook / Snappet / YouTube
T 5	M	B	37	5	3 (9.5 h.)	2.5 h.	IWB/Wi-Fi -Mini laptops	Interactive Tasks / Digital Textbook / Google Search / Interactive maps-Web resource
T 6	M	C	23	4 4	2 (5.5 h.) 2 (5.5 h.)	3 h. 2.5 h.	IWB/Wi-Fi	Interactive Tasks / Digital Textbooks / Interactive maps-Web resource
T 7	F	C	9	6 6	2 (4 h.) 1 (1.5 h.)	2 h. 1 h.	Projector- screen/ Wi-Fi	Google Images /Digital Textbook / YouTube
T 8	F	D	17	5 6	3 (11.5 h.) 1 (2 h.)	3 h. 2 h.	IWB/Wi-Fi -Tablets- Mini laptops	Google Search / Plickers / Power Point / Poppler / ThingLink
T 9	M	D	16	5	3 (9 h.)	2.5 h.	IWB/Wi-Fi -Tablets- Mini laptops	Digital Textbook / Google Search / Interactive maps-Web resource
T 10	M	D/E/ D	18	2 1 5 & 6	3 (10.5 h.) 1 (3 h.) 1 (4 h.)	3.5 h. 1 h. 0 h.	IWB/Wi-Fi	Digital Textbooks / Google Maps / Google Search / YouTube
T 11	M	B	4	1	2 (7 h.)	2 h.	IWB/Wi-Fi	Digital Textbook
T 12	F	B	36	3	3 (10.5 h.)	5 h.	IWB/Wi-Fi -Tablets	Interactive Tasks / Online dictionary /Digital Textbook / Google Search / Snappet / YouTube
T 13	F	B	19	5	2 (4 h.)	2.5 h.	IWB/Wi-Fi -Tablets	Digital Textbook / Snappet / YouTube
T 14	M	B	8	1	3 (5.5 h.)	1 h.	IWB/WI-FI	Digital Textbook / YouTube
T 15	F	B	6	5	3 (11.5 h.)	4 h.	IWB/Wi-Fi -Tablets- Mini laptops	Interactive Tasks / E-mail / Google Maps / Google Search / Digital Textbooks / Kahoot / YouTube
T 16	F	B	10	5	3 (5.5 h.)	3.5 h.	IWB/Wi-Fi	Interactive maps-Web resource / Digital Textbook/

teacher, who also agreed to the recording of their classes. The authorisation guaranteed the participants' anonymity and that the recordings would be used solely for research purposes. Moreover, the study was authorised by the Department of Education of the regional government, la Junta, of Castilla y León, which also encouraged the schools to take part in the research.

2.2. Instruments of analysis: system of categories for studying the practices

The classroom practices have been studied by applying a category-based analysis that permits breaking down what happens in the classes, establishing study categories on the practice that tell us about the **types of activity** (called TCAs in our analysis, Table 3) that are framed within the teachers' actions, **the role of the different curricular elements** in the configuration of the practices, and **the parts the teachers most frequently play**. The types of activity (Table 3) refer to a series of actions that allow managing the learning environment in the classroom, creating generic patterns of exchange between teachers and pupils, and between the pupils themselves. Some examples of this are "Task organisation-planning", "Text comprehension task", "Task explanation", and "Organising break time". A list of the TCAs in this work can be found in Table 3. Within each type of activity, the system for analysing the practice provides information on the teachers' role through the instructive actions the teacher undertakes in the sessions, classifying those actions into five categories: identify, plan, explain, revise, and supervise-assess. In addition, the teachers focus their actions on five curricular elements: objectives, task, content, ICT resources, and non-ICT resources, which may take centre stage in the action (primary features) or appear in a supporting role (secondary features) [28,29].

Table 2 below provides a fragment from a class transcribed and categorised to illustrate the system of analysis. This fragment is part of the TCA "Text comprehension task", where the teacher explains content related to blood circulation. The teacher's instructive actions range from identify the task for pupils to explaining specific content related to blood circulation. These instructive actions are performed sometimes on the primary curricular element "Task", and at others on the "Content"; in turn, these tasks are based on a secondary curricular element, namely, the ICT or non-ICT resource that serves to support the tasks and explanations being undertaken.

This analytical procedure is based on the transcription of the class recordings. The system allows using successive levels of precision to identify what is happening in the actual classroom practice. The steps in the application of the analysis system are summarized in Fig. 1:

The sequence developed for applying the analysis system to the transcribed class sessions (manual throughout the entire process) was as follows:

a. A class session is categorized simultaneously by three members of the research team trained in the system, in order to reach agreement regarding the contents of the categorisation.
b. The six members of the research team work in pairs to categorise another of the class sessions involved in the study.
c. The six members of the research team work individually to categorise the rest of the class sessions.
d. A review is made of the degree of agreement in the categorisation of the classes analysed, and whenever necessary agreements are reached regarding the discrepancies that may arise, until a univocal categorisation is attained. This stage began with an agreement rate surpassing 84.2 % for individual categorisations, and ended with 100 % in the final joint categorisation.

2.3. Data analysis

The application used for analysing the classes allowed counting the frequency in each category. This count provides the sample used for processing the data presented in the results section. The various analyses conducted further information on the types of activity used in each class and their relative weight during the classes. In addition, results are presented on the relationship between the subjects and the use of ICT resources and non-ICT (analogue) ones, and the relations between these and teaching practices.

The data gathered in the categorisation have been inserted into a matrix in the SPSS Statistics 26 program, which besides descriptive analyses produces cross tables for determining the following:

Table 2
Example of the categorisation of a transcribed fragment.

Fragment 1: Text comprehension task Natural Sciences 6th (years 11–12)	Instructive action	Primary curricular elements	Secondary curricular elements
192 Teacher: Ainhoa please, can you read? Pupil Ainhoa: (Reading from the book) Blood vessels. There are three types of blood vessels, arteries, carry blood from the heart to capillaries… in the rest of… of… this blood is oxygenated.	192 Identify	192 Task	192 Non-ICTRes.
193 Teacher: Very important! Arteries… you need to know this, they carry blood (points to the interactive whiteboard) from the heart… to the rest of the body, they leave the heart with clean blood, okay? Arteries, they go from the heart (points to the Interactive Whiteboard) to the rest of the body, okay… right! Pupil Sergio: Then the blood used…	193 Explain	193 Content	193 ICTRes.
194 Teacher: Wait a second! Stand by, step by step Sergio…	194 Identify	194 Task	
195 Teacher: (Points to the interactive whiteboard) This blood is oxygenated, which means, it has a lot of oxygen, ok? Let's see the next… Capillaries… Pupil Sergio: But then, all that has to happen there in a very short time, doesn't it?	195 Explain	195 Content	195 ICTRes
196 Teacher: Of course Pupil Sergio: Of course…	196 Identify	196 Content	
197 Teacher: (Points to the interactive whiteboard) Capillaries are tiny blood vessels, can you see?	197 Identify	197 Content	197 ICTRes
198 Teacher: It's like branches coming out of the veins and arteries, and they come together, ok? (Points to the image on the interactive whiteboard). Can you see? They are very small… they are tiny (gesticulates) and they have very… thin walls, ok? In the fingers we have capillaries, in our hands… Pupil Sergio: Do we have 5 capillaries?	198 Explain	198 Content	198 ICTRes
198 Teacher: No! Many! Millions! Okay? We have millions of capillaries!	198 Identify	198 Content	

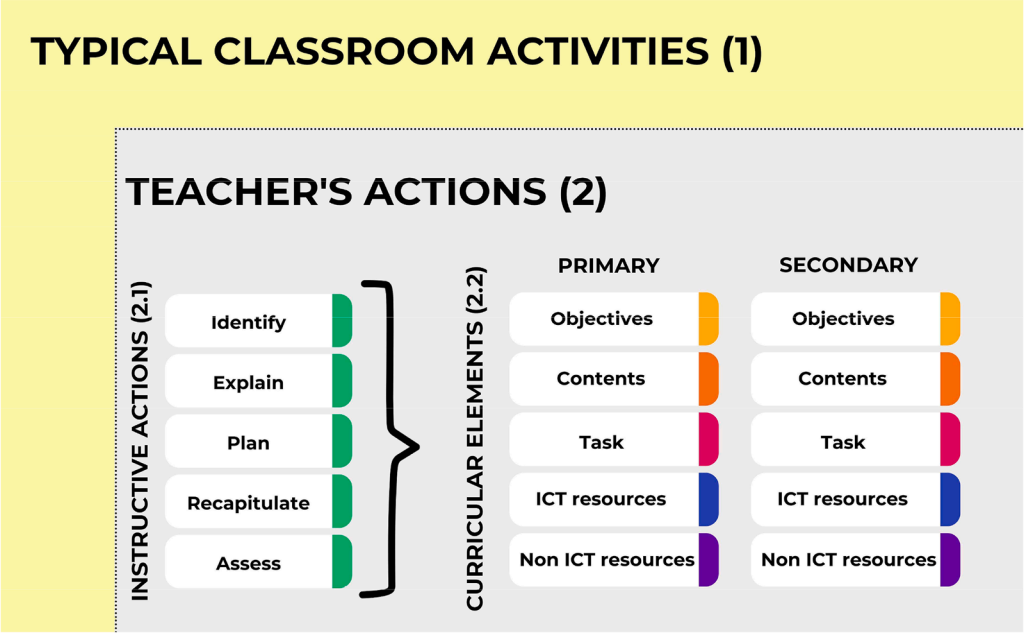


Fig. 1. Summary of class analysis procedure.

- First, whether there are any significant differences between the variables analysed. This has involved the use of the Pearson chi-square test ($\chi 2$), which because of the high number of frequencies reported by the category system ($n = 24\ 134$) needs to be complemented by an analysis of the dependence between the variables using Cramer's V statistic to avoid sample size causing an error in the interpretation of the Pearson $\chi 2$.
- Second, regarding those variables recording a significant difference, an analysis is made of the adjusted standardised residuals appearing in each one of the variable's categories. This is an essential step for a more accurate and coherent interpretation given the complex nature of the study variables. As examples, the TCA variable has 43 distinct categories, and Teacher has 16.

3. Results

Objective 1: Identify and describe the templates of activity associated with the use of ICTs in the primary school classrooms being analysed here. The templates of activity that include the use of ICTs will provide an indicator of how teachers handle these resources in terms of achieving the curricular goals set when they work jointly with the pupils. The importance of this objective lies in seeking to explore how teachers give meaning to the use of ICTs in their classrooms, how they do so, and why.

As a prior consideration related to all the data provided here, it needs to be stressed that the resources (both ICT and non-ICT) appear in most of the actions undertaken by our teachers as secondary curricular features (ICT resources, 37.5 %, and non-ICT resources, 62.5 %). This means that teachers use them when they teach content or organise tasks. They are the means that enable them to proceed accordingly, and only rarely are they the main focus of the teacher's actions.

The p-value for the chi-square indicates that the data obtained are significant and, therefore, justified by the TCA. Furthermore, although it is true that an analysis of the adjusted standardised residuals for each one of the values reveals that some of them are outside the range of 95 % adjusted significance (i.e., the data in Roman font), an examination of those values shows they belong to a TCA with a percentage of duration below 0.25 %, which may explain this circumstance.

As regards the distribution of the TCAs detected according to the four blocks considered, more than half are related to task performance (52.94 %); these are followed by TCAs related to explanations (20.92 %) and TCAs related to assessment (17.29 %), with a minor presence of TCAs related to Organisation and planning (8.85 %). Internally, each one of these blocks has its own particular distribution, with certain TCAs recording a higher temporal presence and others a shorter duration (see the figures in the Duration column, Table 3).

When we consider the use of resources in the overall data, it seems fairly clear that non-ICT resources (62.5 %) feature more than ICT ones (37.5 %). ICT resources obviously record higher percentages in those TCAs that require their use, such as Reading images with ICT resource (73.8 %), Task with ICT (91.5 %), Watching a film with an ICT resource (97.6 %), and COVID video call (88.2 %). In other cases, the percentage of ICT resources is also higher, although they might not appear to be essential: the TCA Singing songs (80.3 % of ICT resources) because the teachers resort to the use of videos or audios; the TCA Student task presentation (100 % of ICT resources) because the pupils use a digital whiteboard and PowerPoint software; the TCA Text writing because they use Word, and the TCA Rest because it involves pre-recorded music in digital formats. The distribution between ICT and non-ICT resources is more even in those TCAs related to task performance and in those related to explanations. Nevertheless, this equilibrium is not maintained in TCAs related to Organisation and planning or in those related to assessment, both of which clearly favour non-ICT resources (Fig. 2).

With a view to completing the data on how ICT and non-ICT resources feature in the templates of activities held in the classrooms, Figs. 3,4, and 5 below provide three examples of sessions taught by teachers in Years 1, 3, and 5 in Primary, revealing how TCAs were organised in class over the school year (1st, 2nd, and 3rd terms) with their corresponding percentages of resources used. This provides a more visual description of how the classroom sessions evolve. It is important to underline the extraordinary diversity of configurations that these practices highlight. And this variety in classroom patterns refers both to the differences between sessions of the same teacher and to the differences between sessions of different teachers. It is a very expressive example of the value of practice in understanding what really happens in the teaching process. If we look at teachers 12 (Fig. 4) and 9 (Fig. 5) it is evident that each session in each of them is particular, although teacher 12 incorporates more types of activity and less use of ICT than teacher 9. Although it is true that both differ in important features such as years of experience (Table 1), the year in Primary in which they teach (Table 1),

Table 3
Distribution of the percentages of use and significance levels of ICT and non-ICT resources in TCAs and their duration (n = 24 134).

Function	TCA	Total Duration	ICT Resource	Non-ICT Resource
TCA related to task performance 52.94%	**Assembly**	**0.22%**	**11.1% (-4.0)**	**88.9% (4.0)**
	Recording audition	**0.03%**	**100.0% (3.4)**	**0.0% (-3.4)**
	Singing songs	**0.29%**	**80.3% (7.5)**	**19.7% (-7.5)**
	Singing and dancing songs	**0.00%***	100.0% (1.3)	0.0% (-1.3)
	Home reading choice	**0.13%**	**0.0% (-4.3)**	**100.0% (4.3)**
	Date and weather	**0.05%**	**0.0% (-2.8)**	**100.0% (2.8)**
	Book exchange	**0.04%**	**0.0% (-2.3)**	**100.0% (2.3)**
	Reading aloud	**1.97%**	**5.5% (-14.5)**	**94.5% (14.5)**
	Reading pictures with ICT	**0.17%**	**73.8% (4.9)**	**26.2% (-4.9)**
	Individual reading	**0.04%**	**0.0% (-2.4)**	**100.0% (2.4)**
	Student task presentation	**0.12%**	**100.0% (6.8)**	**0.0% (-6.8)**
	Conducting experiment	**0.26%**	**6.5% (-5)**	**93.5% (5)**
	Task with ICT	**10.18%**	**91.5% (58.5)**	**8.5% (-58.5)**
	Task with ICT+non-ICT	**14.98%**	**44.6% (9.6)**	**55.4% (-9.6)**
	Text comprehension task	**7.79%**	**29.6% (-7.3)**	**70.4% (7.3)**
	Dictation	**0.74%**	**0.6% (-10.2)**	**99.4% (10.2)**
	Working with special-needs pupil	**0.14%**	**0.0% (-4.5)**	**100.0% (4.5)**
	Text writing	**0.25%**	**98.3% (9.8)**	**1.7% (-9.8)**
	Task without ICT	**14.44%**	**3.2% (-45.1)**	**96.8% (45.1)**
	Reciting poetry	**0.00%***	0.0% (-0.8)	100.0% (0.8)
	Rest	**0.02%**	**100.0% (2.9)**	**0.0% (-2.9)**
	Task review	**0.03%**	42.9% (0.3)	57.1% (-0.3)
	Conflicts-solving	**0.02%**	25.0% (-0.5)	75.0% (0.5)
	Watching a film with an ICT resource	**1.02%**	**97.6% (19.6)**	**2.4% (-19.6)**
TCA related to organisation and planning 8.85%	**Conversation with SEN teacher of special-needs pupils**	**0.00%***	0.0% (-0.8)	100.0% (0.8)
	Clearing up and home-time	**0.82%**	**22.7% (-4.3)**	**77.3% (4.3)**
	Homework	**0.98%**	**25.4% (-3.8)**	**74.6% (3.8)**
	Food time	**0.13%**	**0.0% (-4.3)**	**100.0% (4.3)**
	Time for hygiene	**0.33%**	**13.9% (-4.3)**	**86.1% (4.3)**
	Organizing break	**0.87%**	**14.8% (-6.8)**	**85.2% (6.8)**
	Organising returning from break	**0.38%**	**27.2% (-2)**	**72.8% (2)**
	Task planning-organization	**5.26%**	**41.6% (3.2)**	**58.4% (-3.2)**
	Classroom tutoring	**0.01%**	50.0% (0.4)	50.0% (-0.4)
	COVID video call	**0.07%**	**88.2% (4.3)**	**11.8% (-4.3)**
TCA related to explanations 20.92%	**Content explanation**	**8.10%**	**48.8% (10.9)**	**51.2% (-10.9)**
	Task explanation	**5.39%**	**50.2% (9.8)**	**49.8% (-9.8)**
	Resource explanation	**0.21%**	**60.0% (3.3)**	**40.0% (-3.3)**
	Group content building	**0.02%**	40.0% (0.1)	60.0% (-0.1)
	Content revision	**7.16%**	**42.2% (4.3)**	**57.8% (-4.3)**
	Group problem-solving	**0.04%**	30.0% (-0.5)	70.0% (0.5)
TCA related to assessment 17.29%	**Correcting work in class**	**13.98%**	**23.6% (-17.9)**	**76.4% (17.9)**
	Disclosing exam results	**0.24%**	31.0% (-1)	69.0% (1)
	Exams	**3.07%**	**17.3% (-11.5)**	**82.7% (11.5)**
Total		**100%**	**37.5%**	**62.5%**

($\chi^2_{42} = 6748.673$; $p < .05$)
Note. The data in brackets correspond to adjusted standardised residuals with a 95 % confidence level.
* Values with a duration lower than 0.005 %.

or the school in which they work (Table 1), it should be noted that teacher 9 teaches mainly STEM subjects, while teacher 12 teaches practically all the subjects of the course to her students. This may be an interesting fact to explore in more depth and which should be investigated further as a future line of research.

Objective 2. Describe the classes in which ICTs are used, relating them to other aspects of the teaching process such as the year or the teacher involved, as we consider that technological resources are not isolated elements in the actions that teachers and pupils undertake in the classroom; quite the opposite, in fact, they are part of an amalgam of factors with as many configurations as there are specific teaching situations.

Figs. 6 and 7 below present the data on the use of ICT and non-ICT resources depending on the year in Primary (Fig. 6) and the participating teachers (Fig. 7).

In this case, we obtain a p-value for the chi-square that indicates that the data are significant and, moreover, only in Year 6 are they not so for the adjusted standardised residuals (data in Roman font). The way in which ICT and non-ICT resources are used in the other school years is not random, as instead the differences are explained by the Year variable.

The results follow a pattern: in the first three years of Primary, non-ICT resources prevail, with ICT ones recording a use of under 30 %. In the last three years, however, ICT resources record a higher percentage of use, exceeding 38 %, except in the case of Year 4 with fewer hours of recordings, which may explain this anomalous behaviour.

In sum, there is a difference of almost nine points between the higher percentage for the use of ICT resources in the first half of Primary and the lower one in the second half.

This analysis provides a p-value for chi-square whereby the resulting data are significant and, furthermore, only the values obtained for the adjusted standardised residuals for Teacher 3 do not fall within the range of 95 % adjusted significance (data in Roman font). It may be affirmed for all the other teachers that the way of using ICT and non-ICT resources is not randomly distributed, as instead the differences are explained through the Teacher variable.

Consistent with the data obtained thus far, there are more teachers that use a higher percentage of non-ICT resources. In fact, only three of the 16 teachers in question record a greater use of ICT resources: Teachers 6 (72.3 %), 8 (52.1 %), and 9 (66.6 %).

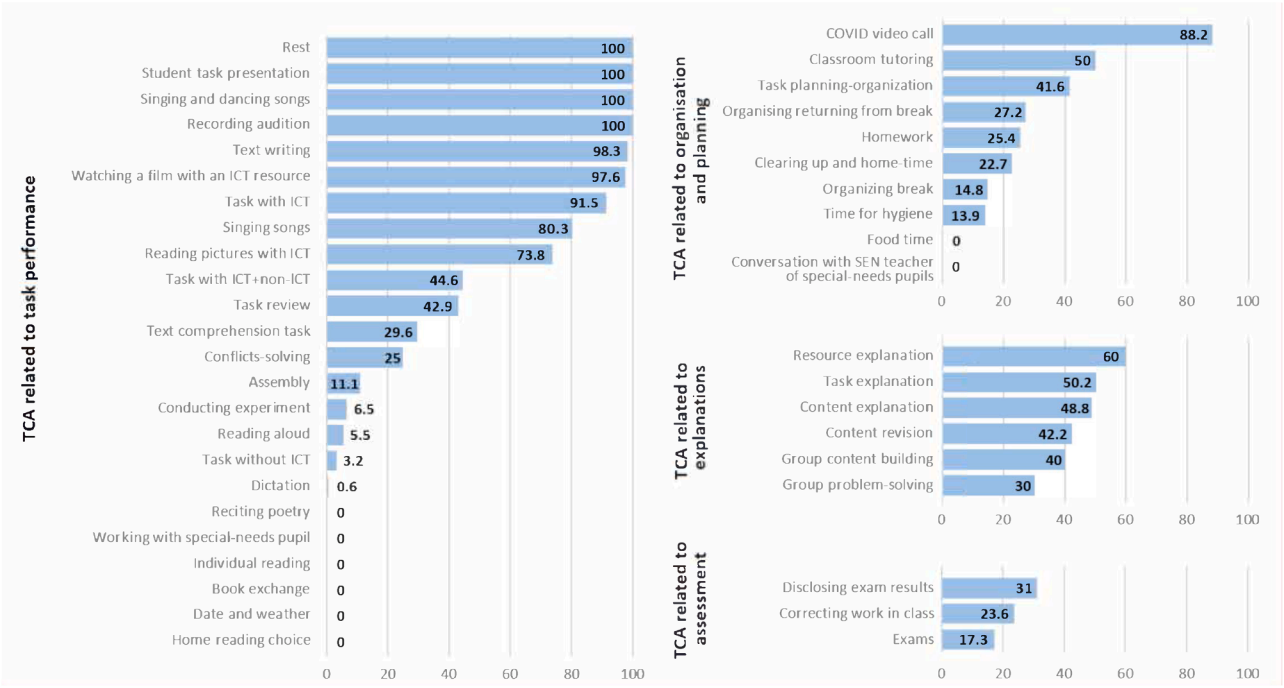


Fig. 2. Distribution of the percentages of use of ICT resources in TCAs.

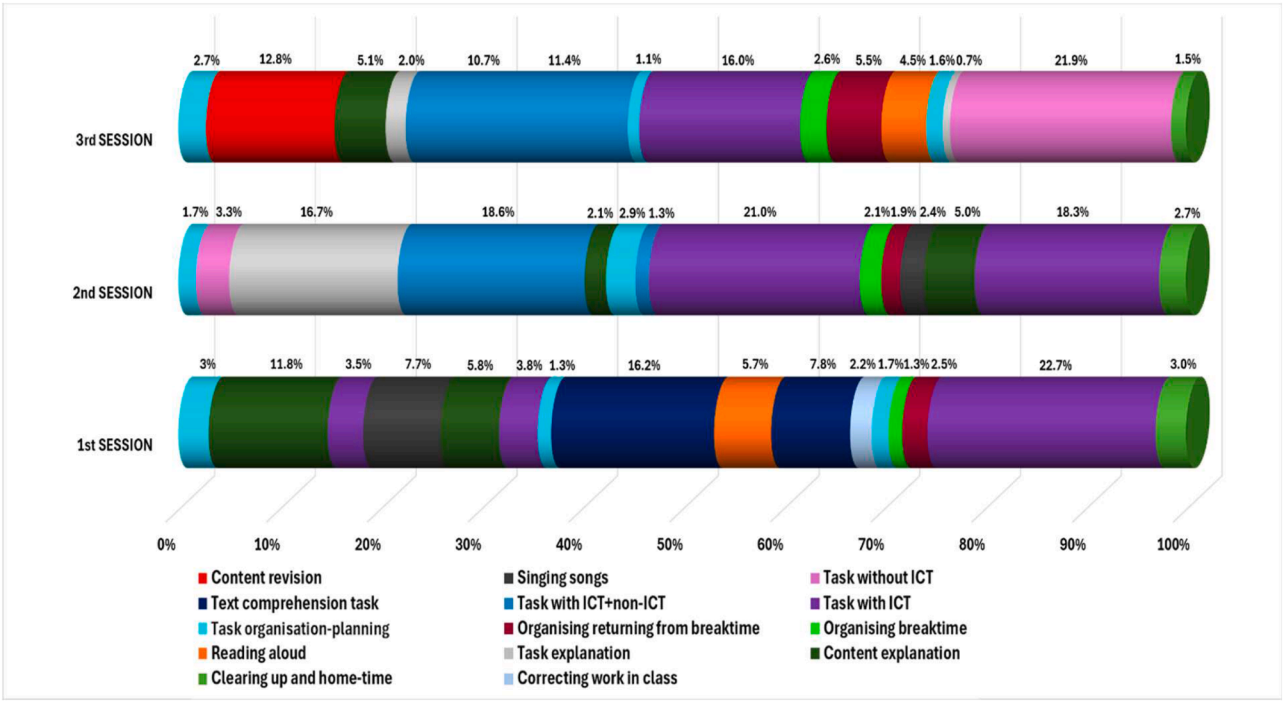


Fig. 3. Sum of TCAs held in the three sessions recorded involving Teacher 3 (Year 1).

Nevertheless, some of the other 13 teachers present more moderate profiles, with less than a 20-point difference between the use of ICT and non-ICT resources (Teachers 1, 2, 5, and 15), while others are more extreme, with ICT resources recording percentages of use of <25 % (Teachers 7, 10, 11, 12, and 16).

The appearance of such varying profiles of use prompt us to investigate the teachers' gender and years of experience. Regarding the former variable, one of the three teachers that make >50 % use of ICT resources is a woman, Teacher 8; among the five recording a percentage of use below 25 % there are three women (Teachers 7, 12, and 16), with most of the women teachers making a moderate use of between 30 % and 50 % (Teachers 1, 2, 4, 13, and 15). The results do not therefore confirm a marked difference in the use of ICT resources depending on gender.

In turn, years of experience does indeed mean a greater use of ICT resources in the intermediate ranges. The three teachers that make more than a 50 % use of ICT resources have between 16 and 23 years of teaching experience. Among the five teachers with <25 % usage, three

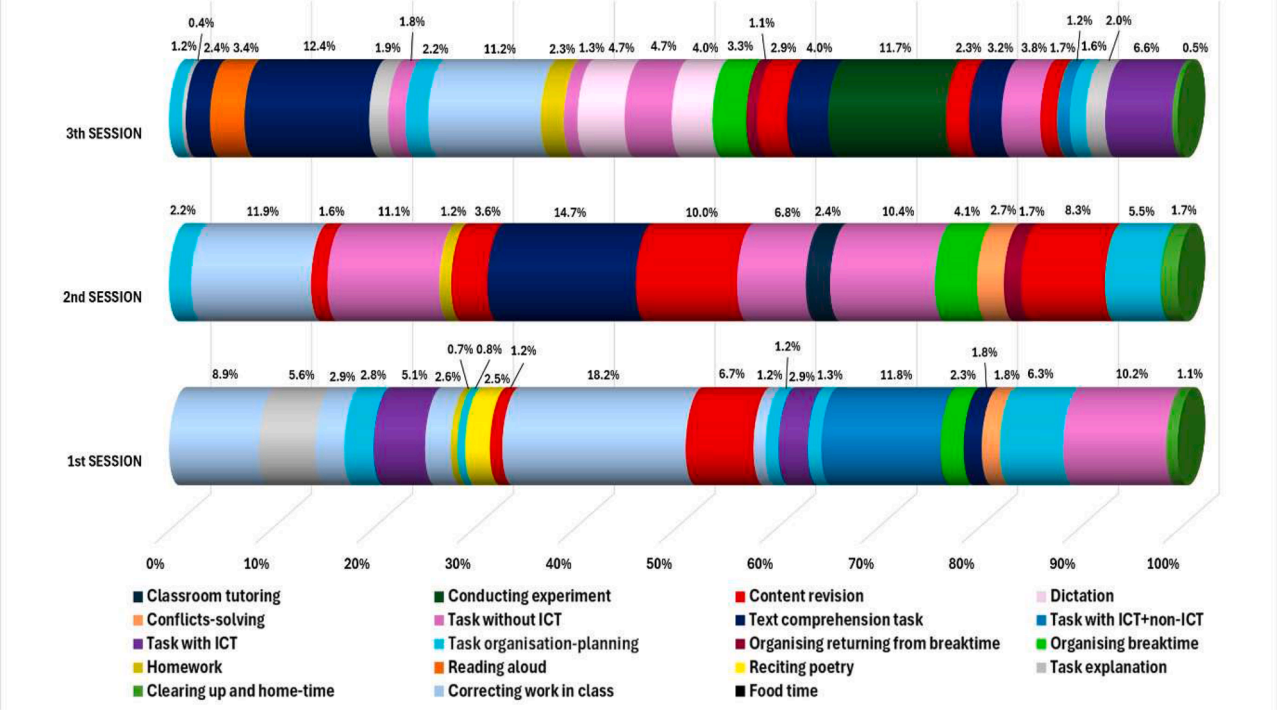


Fig. 4. Sum of TCAs held in the three sessions recorded involving Teacher 12 (Year 3).

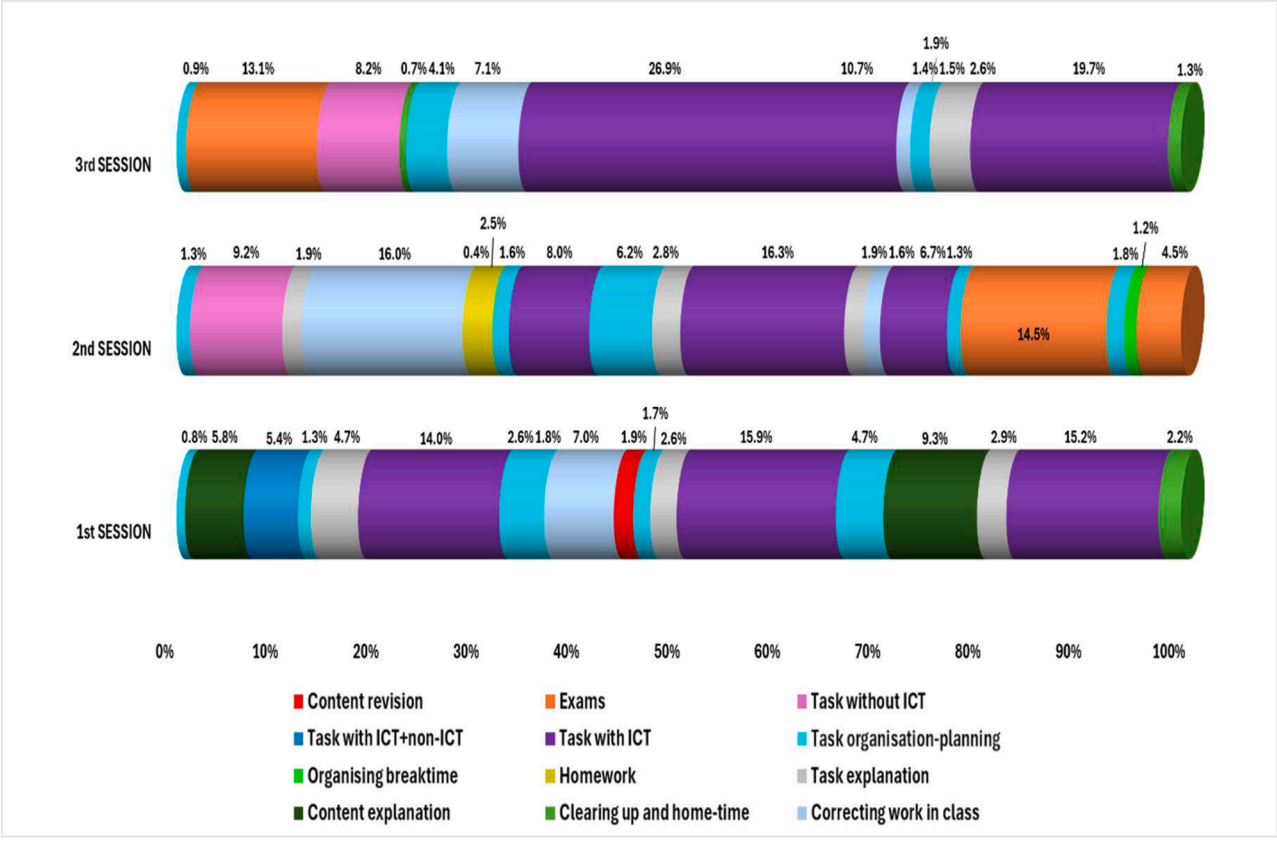
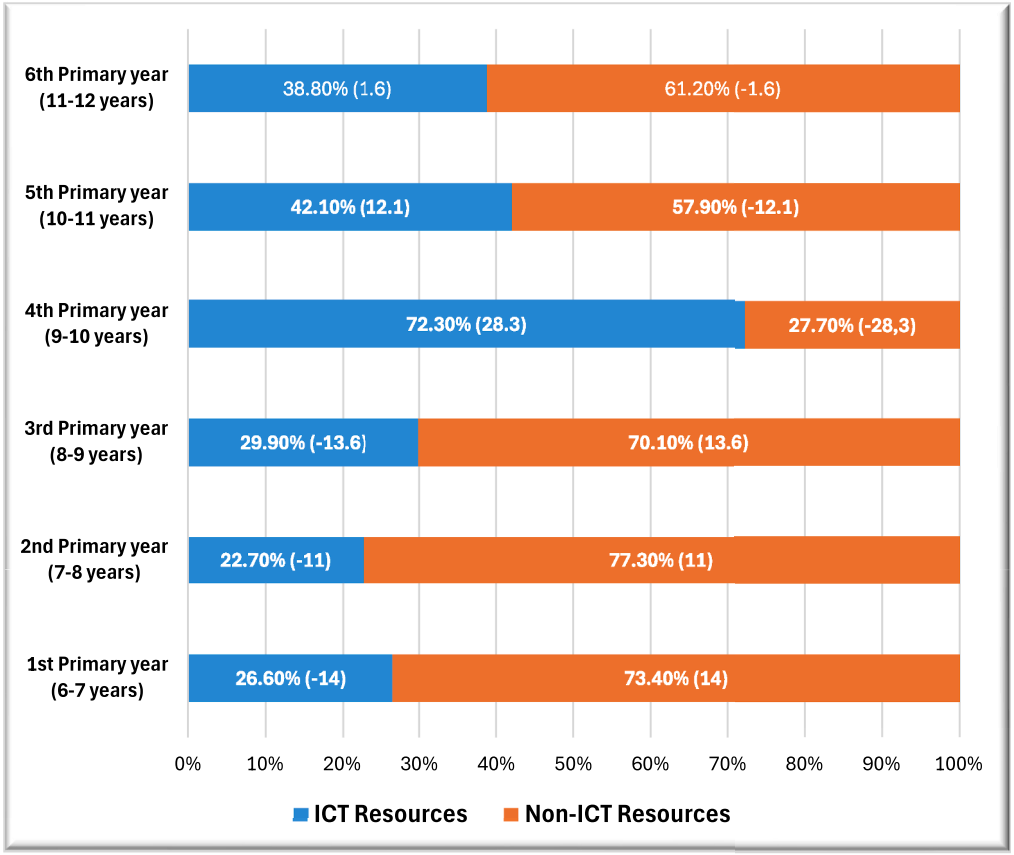


Fig. 5. Sum of TCAs held in the three sessions recorded involving Teacher 9 (year 5).

have ten years' experience or less, and one has >35.

Taken together, these results, which refer to courses and professors, require an increase in the number of cases of the research to be confirmed. This is precisely the work we are addressing with the project currently underway.



($\chi^2_5 = 1270.369$; $p < .05$)
Note. The data in brackets correspond to adjusted standardised residuals with a 95% confidence level.

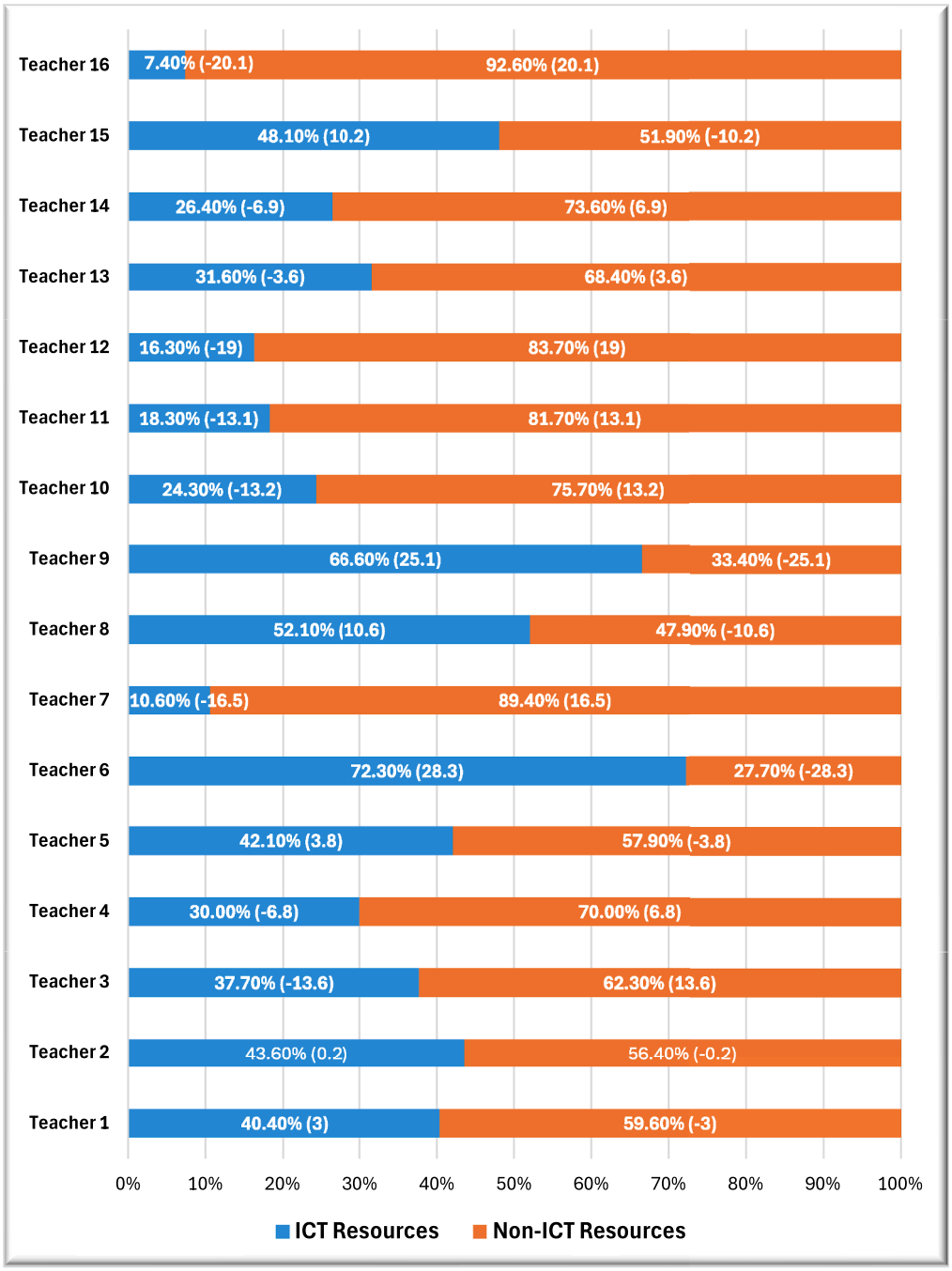
Fig. 6. Distribution of percentages of use and levels of significance for ICT and non-ICT resources by school year ($n = 24\,134$). ($\chi^2_5 = 1270.369$; $p < .05$) Note. The data in brackets correspond to adjusted standardised residuals with a 95 % confidence level.

4. Discussion

An analysis of these results prompts a series of interpretations designed to explain the objectives formulated at the start of this study.

Regarding the first objective, the results show that the templates used to organise the classes are extremely diverse and varied, although their didactic purpose means they can be classified into four main categories with different weightings in the practices as a whole. Consistent with the descriptions made by Jiménez Sánchez [16], our teachers' classroom sessions are devoted mainly to the performance of exercises and tasks of a diverse nature, ranging from readings to listenings, assemblies, experiments, text comprehension, and those with or without ICTs. The organisational templates designed to explain different aspects (content, queries, tasks) account for an appreciable share of the work recorded in the sessions. Assessment is one of the mainstays of a teacher's professional duties, and it too appears in the classroom sessions recorded, albeit it to a lesser extent than all the other activity templates mentioned above. Finally, with a shorter duration in the overall recordings, the activity templates involving the organisation and planning of classes also appear in these teachers' recordings. This is logical considering the need for the constant organisation and planning of classes at specific moments that together account for less time than those dedicated to direct teaching, such as Task performance and Explanations. Too much time spent on organisation and planning suggests that the class and the teaching process are being inefficiently orchestrated.

This snapshot of the deployment of TCAs in the body of recordings made of our teachers confirms what Strom & Martin [38] and Martín [24] have affirmed regarding the multiple factors and aspects that mediate classroom practices. It is easy to assume that the features a teacher handles in an activity, such as Assembly, and its purpose are quite different to those used, and their purpose, in an activity such as Individual reading or Date and weather, to mention just two of those that appear in the block of Task performance, which has the largest presence in the recordings made. The matter that concerns us here, nonetheless, is the use of ICT and non-ICT resources in these practices as a whole, which as the data have shown is significantly different judging by the different classroom templates. Firstly, the data analysis suggests that resources, whether on ICT or non-ICT media, are used to support exercises and tasks or to present content in all the activity templates recorded, but especially so in those TCAs of a more instructive or academic nature (except those related to Assessment); in other words, those TCAs linked to Task performance and Explanations, and not those more closely associated with Organisation and planning regarding the class itself, nor linked to the undertaking of different kinds of routines (Date and weather, Time for hygiene, Organising breaktime…). In this sense, we believe that it is interesting to highlight that in class recordings that we are currently analyzing, recorded after the confinement by Covid-19, at the Early Childhood Education stage, an increase in the use of ICT in TCAs associated with Organization and Planning can be observed. Although the data is still preliminary, we believe it is interesting to note in this context. Secondly, the use of non-ICT resources clearly prevails over ICT ones. There are significantly fewer TCAs that record a higher percentage of ICT resources, and these correspond to activity templates that necessarily have to be supported by one of these resources (sundry listening tasks, Reading pictures with ICT, Student task presentation, Task with ICT…). This confirms that the teachers continue to use non-ITC resources in their classes, where they continue to play a major



($\chi^2_{15} = 3016{,}019$; $p < .05$)
Note. The data in brackets correspond to adjusted standardised residuals with a 95% confidence level.

Fig. 7. Distribution of percentages of use and levels of significance for ICT and non-ICT resources by teacher ($n = 24\ 134$).
($\chi^2_{15} = 3016{,}019$; $p < .05$) Note. The data in brackets correspond to adjusted standardised residuals with a 95 % confidence level.

part even though digital resources are being used to a greater extent [3]. The presence of digitalisation in teachers' professional competencies in the classroom recordings analysed here is still relatively low and, as Heitink et al. [14] contend, teachers seem to use technologies more with traditional teaching models focused on knowledge transmission. According to Engen [11], and as already noted in the theoretical introduction, teachers are facing a situation in which they are expected to have skills not only regarding the use of IT tools, but also know how to use them in practice in their classes. Our findings here provide the profile of a teacher that has simply transferred their competencies in the classroom use of traditional resources to ICT resources [32], but this use is restricted by templates of activities linked to exercises and tasks and the exposure of content. These templates involve a very low level of innovation as regards the didactic functionality provided by the use of ICT resources compared to traditional resources. The same pedagogical culture is upheld, modifying the medium through which it is presented.

In keeping with the views held by Engen [11] on the digital professional competency of educators, the findings presented contain relatively significant aspects of the professional competency of the teachers studied here, who continue to be wary of digitalisation, and most especially so in all matters involving assessment. The presence of ICT resources in TCAs related to assessment is somewhat lower than that of

non-ICT ones, despite the advantages digitalisation has for recording, storing, or operationalising many of the tasks implicit in assessment procedures in real teaching practices [34]. In relation to this issue, and although it is beyond the scope of this paper, in the framework of the research project in which this work was carried out, the recordings of the class sessions were accompanied by interviews with the teachers prior to the recordings in which they were asked, among other questions, about how they were going to evaluate what their students had learned in the class. A good number of the teachers answered that they would consult the result stored in the ICT resource to be used by the students after the end of the class, in order to record their performance. This means that some teachers do incorporate the benefits that digital technologies offer for assessment tasks as a professional competence. But they do not do so during the course of the class, but at other times in their professional teaching practice after the direct interaction with their students in the classroom. This interpretation prompts a number of original research streams that could be valuable for addressing the initial training on the use of ICTs in classrooms and the professional development of educators in this matter.

As regards the second objective, our findings confirm that the deployment of ICTs is a dynamic, non-linear, and complex process [17], modulated by numerous factors that affect the way classroom practices develop [4,35]. The reason for this is that both the variable Year and the variable Teacher play a significant role in explaining the use of ICT and non-ICT resources in the classroom. In terms of Year, we have found that the use of ICTs is more equilibrated with the use of non-ICT resources in the final years of Primary (Years 5 and 6). By contrast, traditional materials prevail in the first years (Years 1, 2, and 3). This calls for more a detailed investigation of the reasons for this difference, as the issues of the pupils' level of digital competency and literacy may be influencing the final outcome. However, other issues, such as access to hardware, which has been facilitated by the implementation of schemes such as Escuela 2.0, may only have had an impact where it has been deployed in the later years of Primary. In turn, the results obtained for the Teacher variable regarding the use of ICT resources ratify the premise made by Sanderson [33] whereby teaching in a real context is a unique activity in itself because each teacher has their own personal approach in which they are constantly deciding "what is best for these pupils in these circumstances". This means that neither a teacher's years of classroom experience nor their age or gender explains the significant differences in the use of ICTs. Each teacher has their own style, their own way of proceeding in the classroom. Considering all the teachers here as one, there are common traits and tendencies, but in terms of the use of ICT resources there are as many practices as there are teachers. As already mentioned, the professional digital competency of these educators is based on their prior understanding of how to incorporate other traditional resources accordingly, and does not involve any especially innovative templates. Although in some cases, such as Task writing, it is an activity that transfers a teacher's personal digital competency into a classroom context, by asking the pupils to compose a text using Word. This activity involves the important steps of correction, edition, and storage of the pupil's assignment that the teacher may use for assessment purposes. But the same case may apply to the TCA reading aloud that, by contrast, continues to involve non-ICT resources, despite the possibilities provided by, for example, digital reading media (e.g., the digital textbook). Along these same lines and as mentioned earlier, the professional competency of assessment has not recorded any templates that involve the use of ICTs. This means that this competency is informed by a didactic understanding of the traditional resources that is transferred to the use of ICTs, although as we have commented above, in interviews with these teachers prior to the development of the class, they do refer in several cases to the use of ICTs for recording assessment results, after class hours. Other content related to this selfsame competency has yet to be created or discovered, such as the value of ICTs for assessment or for classroom organisation and planning, amongst others.

5. Conclusions

The results discussed here reveal that the use of ICT resources in teaching practices is linked to a teacher's activities in the classroom, with the now traditional usage of analogue resources. ICTs acquire meaning in the activity templates that are typical in primary schooling, where the teaching approaches generally involve the use of tasks and exercises in class. Teachers are including ICTs within their classroom planning in a steady yet limited manner.

In this paper, the aim is to explore the use of ICT, in particular the relation between the teacher's selection of the ICT and how it is enacted in the primary classroom. The theoretical foundation of this paper is the tradition of didactic [10,18], which addresses the didactic triad of questions (what, why and how) as a whole. This serves as an exploratory and classificatory structure, and relates the general elements of the teacher, the content and the student to each other. However, in this paper, the focus is on the relationship between the teacher and the use of ICT [11]. The integration of ICT in the primary-school classroom, raises an important issue regarding the importance of highlighting teachers' professional didactic competences in relation to ICT instead of moving towards the development of other ICT influences in schools.

The way in which the teachers in this study use ICTs indicates the importance of working with them through their digital competencies, responding to the issues involved in their classroom duties. The discussion has noted accordingly how assessment tasks, which are an essential part of teaching, barely involve the use of ICTs, despite the possibilities these resources provide for them. It would therefore be expedient to liaise with teachers on the joint development of ICT and didactic competencies to tackle the challenges of classroom practices. This development, in turn, could play an important part in the initial training of prospective teachers.

These are therefore the prospective lines that emerge from this study: the instruction of serving teachers on the use of ICTs in their classrooms through their didactic competencies and the initial training of prospective teachers by linking ICT and these competencies. Neither should we lose sight of the notion of steadily adapting the design of ICT resources in education to the templates of real teaching situations.

It is clear that this study has the limitations to be expected of its ethnographic-interpretative nature and the small number of cases. Its scope for generalisation is also limited. Nonetheless, this detailed analysis of the conditions of the practices provides fundamental interpretations that point to attractive lines of development. The study of classroom practice provides extremely valuable knowledge for teaching processes and there is a need to increase the body of data gathered on what teachers and pupils do in real situations of interaction to provide a rigorous explanation on how to effectively enhance teaching overall and teaching with ICTs in particular.

Another limitation is circumscribed to the design adopted and the methodological options derived from it, given the complexity of the nature of the object of study and the challenges involved in registering teaching practices in the context where they are carried out. In this document, the data from the recordings of the class sessions have been presented, but in the project as a whole, in addition to these data, interviews with the teachers were recorded before and after the sessions. This information allows us to obtain a more contrasted analysis of teachers' practices. Due to the limitations in the length of the paper we are presenting, these approaches have not been included, but they are lines of research that we also plan to develop in the immediate future. We believe that these new data will serve to complement those aspects of the practices that explain teachers' reasons for incorporating ICT resources in their classes.

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Statements relating ethics and integrity policies

Informed consent was obtained from all those participating in the study. The recordings of the pupils were authorised by their parents and by each teacher, who also gave their permission for the classes to be recorded. The authorisation guaranteed the participants' anonymity and the use of the recordings solely for research purposes. The study was also authorised by the Regional Government's Department of Education, which encouraged the schools to take part in the research. All model authorisations are available for consultation.

The audio-visual data collected cannot be consulted, but the authors can give access to the written transcripts as they are absolutely anonymous.

CRediT authorship contribution statement

Elena Ramírez Orellana: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Inmaculada Martín Sánchez:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation. **Jorge Martín-Domínguez:** Writing – original draft, Validation, Software, Resources, Methodology, Formal analysis, Data curation. **Inés Rodríguez Martín:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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