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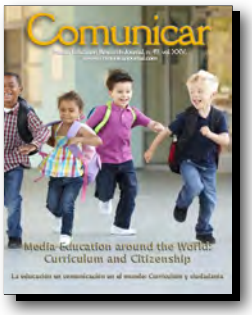

Teachers' Perceptions of the Digital Transformation of the Classroom through the Use of Tablets: A Study in Spain

Percepción docente sobre la transformación digital del aula a través de tabletas: un estudio en el contexto español

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ABSTRACT

This study examines the transformation of classroom dynamics brought about by the use of tablets for educational purposes. The empirical bases of this study were defined by the "Samsung Smart School" project, which was developed by Samsung and Spain's Ministry of Education during academic year 2014-15, in which teachers and 5th and 6th year students attending 15 primary schools across several Autonomous Communities in Spain were provided with tablets. The research sample comprised 166 teachers. A qualitative analysis strategy was applied by means of: a) non-participant observation, b) focus groups, c) semi-structured interviews with teachers, and d) content analysis of teaching units. These techniques enabled us to extract and examine six dimensions of teaching (educational objective, teaching approach, organization of content and activities, teaching resources, space and time, and learning assessment). Our findings show that teachers tend to apply a transversal approach when using tablets to work on different competencies, focusing more on activities than on content through the use of apps. They reclaim the act of play as part of the learning process, and indicate tablet use encourages project-based learning. To sum up, this study shows that teachers view tablets not only as a technological challenge, but also as an opportunity to rethink their traditional teaching models.

RESUMEN

El presente estudio examina la trasformación de la dinámica del aula a través del uso educativo de las tabletas. La base empírica de este estudio se enmarca en el proyecto «Samsung Smart School», desarrollado entre Samsung y el Ministerio de Educación de España en el curso 2014-15. Se dotó de tabletas a profesores y alumnos de aulas de 5º y 6º de primaria de 15 centros de Educación Primaria de distintas comunidades autónomas del territorio Español. En suma el estudio se llevó a cabo con una muestra comprendida por 166 docentes. Se empleó una estrategia analítica cualitativa mediante: a) observación no participante, b) grupos focales, c) entrevistas semiestructuradas al profesorado y d) análisis de contenido de unidades didácticas. Dichas técnicas permitieron abordar el estudio de seis dimensiones pedagógicas (finalidad educativa, enfoque pedagógico, organización de contenidos y actividades, recursos didácticos, espacio y tiempo y evaluación del aprendizaje). Los hallazgos evidencian la tendencia del profesorado a trabajar con tabletas de forma transversal distintas competencias, centrarse en las actividades más que el contenido a través de las apps, asumir el reto de recuperar el juego como parte del aprendizaje y poner en práctica el aprendizaje basado en proyectos. En suma, la principal evidencia es que los docentes entienden la tableta no solo como un reto tecnológico, sino como la oportunidad para repensar sus modelos pedagógicos tradicionales.

KEYWORDS | PALABRAS CLAVE

Educational technology, teaching, tablets, learning, m-learning, school culture, cooperative learning, educational apps.
Tecnología educativa, pedagogía, tabletas, aprendizaje, aprendizaje móvil, cultura escolar, aprendizaje cooperativo, aplicaciones educativas.

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1. Introduction and state of the question

The use of mobile devices in the classroom is currently a subject of keen interest for the teaching community (Johnson, Adams-Becker, Estrada, & Freeman, 2014), not only for the huge potential they offer for enriching the educational process (Traxler & Wishart, 2011) but also for their broad acceptance, accessibility and the educational expectations they generate (Maich & Hall, 2016). This recognition is not just a question of the increasingly sophisticated nature of these technological devices in terms of their use in education (Kanematsu & Barry, 2016), but also due to factors such as: the increase in sales of mobile devices over personal computers, the exponential development of educational devices, the potential to access educational resources or the experience of ubiquitous anytime connection that opens up new paths for education and learning (Haßler, Major & Hennessy, 2015; Kim & Frick, 2011).

The huge increase in the use of personal devices at home and school poses important questions concerning their usage and role in the development and process of learning (Chiong & Shuler, 2010, Crescenzi & Grané, 2016; Price, Jewitt, & Crescenzi, 2015; Ruíz & Belmonte, 2014). The presence of these devices in students' everyday lives means that we can now talk in terms of some serious emerging educational alternatives, with technology such as BYOD (Bring Your Own Device) (Arias-Ortiz & Cristia, 2014) or "the flipped classroom" (Davies, Dean, & Ball, 2013). The potential is even greater when you find the same, or even more, technology at home than at school (Mascheroni & Kjartan, 2014).

However, although the advantages of using mobile devices in the classroom seem evident, the "positive impact" of their emergence in formal education is by no means overwhelming. Several studies show that their use in the classroom improves the quality of education as opposed to traditional learning methods, while others do not find sufficient empirical evidence to justify such positive claims. In this sense, Nguyen, Barton and Nguyen (2015) show that although the use of tablets in the educational context enhances the learning experience, it does not necessarily lead to improvements in performance. Similar studies coincide with works by Leung and Zhang (2016) and Dhir, Gahwaji and Nyman (2013), who point out that while tablet use can stimulate motivation towards learning, its real impact is limited. Instead, motivation to learn is based on challenge, curiosity, cooperation and competitiveness rather than the use of these devices in the classroom (Ciampa, 2014).

Studies on the use of tablets in education tend to report on what works and what does not, or on the scenarios and conditions that must be in place for technology and "mobile learning" to function in class. In other words, they provide good practice models that aim to act as a teacher toolkit on the subject. The question posed by educational studies on tablet use should not be about whether these devices are effective or not, but how they can be deployed in the classroom and whether their use continues to be conditioned by traditional pedagogical or text book-based models (Marés, 2012).

Apart from academic performance, tablets can also enhance the learning experience in the classroom. For example, Kucirkova (2014) shows that the academic value of a tablet depends on the features of the apps and how their content can influence participation in the classroom. Likewise, Falloon (2013) shows how app design and content are crucial for learning in a productive and motivating setting, as demonstrated by the author with an effective intervention programme based on a careful selection of apps for the classroom. Falloon (2015) also shows that tablet usage in the classroom can consistently broaden students' learning provided there is a carefully designed itinerary based on collaboration, debate and negotiation, and sufficient role changing when group work is undertaken. This type of study, like the work we present here, insists on the pedagogical rather than the technological component (Flewitt, Messer, & Kucirkova, 2015).

According to Ciampa (2014), academic research into tablet use in the classroom should focus on the pedagogical benefits, the device's potential for self-directed learning, personalization of the device, team work, increasing and improving communication and collaboration, reinforcing autonomous learning, students' commitment and motivation, the potential for individualized learning (personalized), more effective special needs teaching and the creation of interactive classroom environments (Kim & Jang, 2015). All this forms part of the "pedagogical culture" surrounding technology, and tablets, that all teachers need to develop (Freire, 2015).

So, the use of technology in general, and tablets in particular, should adhere to the premise that pedagogy involves technology, not the reverse (Hennessy & London, 2013). Without an alternative pedagogical model based on good practices, mobile devices amount to no more than a sophisticated resource in the teaching and learning process, one more piece of academic furniture (Suárez-Guerrero, 2014). So, the objective of our study is to understand and characteri-

ze the pedagogical model designed to promote the educational use of tablets in the classroom rather than determine if there is a causal link between tablet use and improved academic performance. Our work is aligned to Botha and Herselman (2015) in terms of understanding the process of integrating tablets as one part of the technological and pedagogical ecosystem.

Table 1. The digital education toolkit - environments and challenges
(Suárez-Guerrero & al., 2015)

Areas of intervention	Challenges
Students	Safety in the online digital environment Lack of digital literacy required for learning Using play as a way of learning (gamification)
Teachers	Technical aspects Increased workload New pedagogical approaches for mobile learning between school and home. New teaching roles The combination of "content and activities" Too much focus on technology Rigidity in the curriculum Assessment
School context	Resistance from the family Loneliness of the innovator

To discover teachers' perceptions of the digital transformation of the classroom via the educational use of tablets, we analysed the "Samsung Smart School" project set up by Samsung Electronics Iberia, in collaboration with Spain's Ministry of Education, Culture and Sport, and several of the country's Autonomous Communities involved in the project. The project analysed the educational changes that occurred in classroom dynamics as a result of the implementation of the "Samsung Smart School" in Spain in academic year 2014-15. The project encouraged the use of tablets in 5th– and 6th-year primary schools students in the Autonomous Communities of Aragón, Asturias, Canarias, Cantabria, Castilla-La Mancha, Castilla y León, Extremadura, Galicia, Islas Baleares, La Rioja, Madrid, Murcia, Navarra, and the Autonomous Cities of Ceuta and Melilla.

Given that understanding the process by which teachers appropriate the technology is fundamental to identifying the challenges of technology in education, and in order to help teachers manage this process, the study we made also led us to design a Digital Education Toolkit for just such users. The toolkit provides 13 structured didactic recommendations covering three major areas of intervention (table 1) so that teachers in general, and those teachers involved in the "Samsung Smart School" in particular, can learn how to manage tablets better from an educational perspective (Suárez-Guerrero, Lloret-Catalá, & Mengual-Andrés, 2015). This article describes the research process and the results on which the toolkit is based.

2. Material and methods

2.1. Aim of the study

The aim of this was to discover the pedagogical changes that occurred in the classroom as a result of the use of the tablet, based on teachers' activities and perspectives, within the framework of the "Samsung Smart School" project in Spain in academic year 2014-15. For this project Spain's Ministry of Education, Culture and Sport, through the National Institute of Educational Technologies and Teacher Training (INTEF), and the educational authorities in Spain's Autonomous Communities and Samsung selected one primary school centre from each of the participating Autonomous Communities and from the Autonomous Cities of Ceuta and Melilla, based on the following criteria: a) schools in remote rural areas, b) areas with high school drop-out rates, c) areas with high levels of unemployment, d) Special Education centres.

2.2. Design

This research applied a qualitative approach based on Grounded Theory (Glaser & Strauss, 2009) and aimed to study the educational uses of tablets in primary school settings through six pedagogical dimensions:

- Educational Objective: Which competences does the teacher aim to develop in the classroom with tablets?
- Teaching approach: Which approach for student learning does the teacher apply in the use of tablets in the classroom?
- Content and activities: What content does the teacher use and how does he/she develop it with the tablet?
- Teaching resources: What materials does the teacher use to develop learning through tablets?
- Space and time: How do tablets transform education in the classroom and how does the teacher manage time?
- Learning assessment: How are tablets used to evaluate students' learning?

We studied these dimensions by applying four

qualitative data-gathering techniques: a) non-participant observation, b) focus groups, c) virtual interviews, d) analysis of the content of the project's teaching units.

2.3. Participants and procedure

The study population consisted of 166 teachers and 766 students from 15 primary education centres. Of the teachers, 29.8% were men and 67.5% women, and their average age was 40.5 years. Among the students, 44.5% were girls and 55.5% were boys, aged between 10 and 11.

> The question posed by educational studies on tablet use should not be about whether these devices are effective or not, but how they can be deployed in the classroom and whether their use continues to be conditioned by traditional pedagogical or text book-based models

Firstly, we carried out a non-participant observation in four of the primary education centres involved in the project, in the provinces of Zaragoza, Guadalajara, Madrid and Murcia. These specific units were chosen by random sample. Three observers were responsible for developing this phase of the project. A check table was used to monitor the behaviour of the teachers and students related to the analysis of the dimensions proposed. A total of 12 check lists were formulated for subsequent treatment and analysis.

Secondly, focus groups were set up, and in order for all the centres to be represented, two focus groups were established, each holding a parallel two-hour session, one that consisted of teachers (n=7) and ambassadors –teachers who acted as project coordinators– at the project centres (n=8). The participants were selected by a cluster sampling procedure. The structure of the dynamic dealt with: a) habits, the relation to, and effect of, the use of tablets on students' attitudes; b) a SWOT analysis of classwork using technology; c) assessment of the "Samsung Smart School" project experience: perceptions, its potential and suitability for profiles/centres, optimization, and recommendations for implementation. The advantage of small-scale focus groups is that each participant's voice and opinion is heard (Wibeck, Dahlgren, & Oberg, 2007); it is also a common technique for gathering qualitative information in educational research (Puchta & Potter, 2004). Both sessions took place at the same time in two observation rooms with one-way mirrors, and were directed by two expert researchers who had been trained to prevent any deviation from the dimensions of the study. The project researchers had contact with session directors, and they monitored the sessions for later treatment and analysis.

The project also developed 13 virtual interviews consisting of at least one teacher/ambassador in each of the project centres. Using a semi-structured script of 10 open questions based on the six study dimensions, the 30-minute interviews –developed via Adobe Connect– gathered the perceptions of the interviewee on his/her experience of the integration of the technology in the classroom, the difficulties encountered and the recommendations and solutions they saw as feasible for other teachers in order to optimize the "Samsung Smart School" project. The 13 interviews were videoed for later treatment and analysis.

Finally, a qualitative content analysis (Mayring, 2000) was carried out on 80 teaching units used by the centres in the programme. The aim of this analysis was to understand the planning behind the teaching and learning process with tablets, as well as to detect good practices in the design of curricula with technology.

2.4. Data gathering and analysis

The data for this study were collected between December 2015 and May 2015. The interviews were videoed for subsequent analysis, with prior authorization from the interviewees. Data on the non-participant observations and focus groups were recorded manually while the teaching units were processed in RTF format. The content of the recordings, the observations, interviews and the teaching units were stored, processed and analysed, always with the utmost respect for the anonymity of the participants. The transcripts of the focus groups, interviews and non-participant observations generated a huge amount of information, so the approach of the analysis in terms of the study objectives helped us to manage these data

(Krueger & Casey, 2014). The data gathered by the instruments were processed and analysed using Atlas.ti 7 software, enabling us to analyse the content of the video recordings without the need to transcribe them. Likewise, the use of RTF and PDR files saved time on transcription and analysis.

Content analysis is a research technique suitable for formulating valid reproducible inferences from particular information that can be understood within the study context (Krippendorff, 1990). So, we performed a mixed (deductive and inductive) coding process based on the six dimensions of the study, which gave us an emergent coding (Strauss, 1987). By means of a qualitative analysis estimation –inferring relations rather than generating hypotheses– (Krippendorff, 1990), we ran an individual thematic analysis of the data by reading, codifying, recodifying, family assignation and data categorization –framed by the study dimensions- (Braun & Clarke, 2013). The themes generated were reviewed by the authors together in order to reach common agreement on the findings. The validity of the method used in this research is, therefore, rooted in compliance with the criteria described by Cresswell and Miller (2000): a) triangulation with data and researchers; b) reviewing with the members of the research team.

3. Analysis and results

Here we present the results of the analysis of the non-participant observations, the interviews, focus groups and analysis of the content of the teaching units organized around the six dimensions of the study:

3.1. Educational objective

In the teaching units generated within the project framework, the content analysis and observations reveal a clear trend towards developing learning activities with tablets that integrate the key competences in the various curricular areas. Nevertheless, the analysis of the teaching units shows a marked emphasis on developing the linguistic communication and digital competences. In contrast, mathematics and basic competences in science and technology receive least attention. It is worth noting that the very nature of the "Samsung Smart School" project enabled teachers to develop digital competence to an extent that had not been possible before due to limited access or family financial constraints: "If it weren't for the project, we could not have stimulated the development of the digital competence" (interview 7).

Furthermore, the interviews and focus groups showed that the teachers on the project saw the use of tablets in terms of learning activities related to the search for, and selection, organization and use of information, either individually or in groups. They also agreed that the educational use of tablets connected to Internet generated different expectations in the students in terms of information sources.

3.2. Teaching approach

The teachers in the interviews and focus groups insisted that tablets in the classroom could only be used effectively if there was a change in methodology, and that such a change must lead to the adoption of active methodologies like Project-Based Learning (PBL) and collaborative learning.

The participants also pointed out that when no pedagogy exists to exploit their educational potential, tablets amount to no more than a sophisticated reproducer of monotonous tasks. For example, one teacher from the ambassadors' focus group commented that "if you have no pedagogy, then tablets won't work in the classroom". And this pedagogy is not necessarily about improving teaching in the classroom but understanding the new activities that students are capable of doing when they use tablets in their learning, either as individual learners or in groups. This means that although PBL and collaborative learning are distinctive features of the project, there are also other pedagogical challenges that can be exploited to get the most out tablets in the classroom.

3.3. Content and learning activities

The interviews and focus groups showed that teachers now view the tablet as a notebook for students to manage their own learning in digital form. Beyond reading and writing, this "new notebook" can stimulate other activities such as investigation or multimedia-based tasks. So, for many teachers on the project, the main function of the classroom tablet is not to provide content, as if it were a book, but to enable students to get involved in, and develop, new types of activities and manage their own learning. One teacher put it like this: "After using a tablet, a class given in the traditional format no longer interests them…teachers must now reinvent their educational activities" (interview 11).

The analysis of the content of the teaching units revealed that two thirds of these units clearly aim to stimulate collaborative use of the tablet among students. In the main, they direct students towards enquiry and dialogue rather than individual work and competition between students. Little of the content analysed attempts to limit tablet usage to the development of one single type of curricular content.

The interviews and focus groups show how teachers now recognize that they are no longer the single source of information, and that the students are now an active component of classwork. Data also show that teachers recognize the considerable creative potential of tablets in the classroom, for example in editing documents, making presentations, scheduling a radio programme, online investigation, book design and editing photos and videos. And these are tasks that can be developed individually and in collaboration thanks to tablet technology.

3.4. Teaching resources

Data show a trend among the teachers to use apps that are not necessarily linked to specific content but which are generic in nature and allow students to perform a variety of learning activities across a spectrum of subject areas. The most popular are "sound and image treatment" apps that enable the students to create and design content (the camera, Tellagami, Aurasma, audio and video editor, etc.), and apps for communication and information browsing. The analysis of the didactic units demonstrated that the teachers use these apps to create activities: "Tablets can help us create learning activities, not just searching for information, which is the function of the book" (interview 4).

Yet the tablet is not the only resource in the classroom. The analysis of the teaching units and the visits to the centres showed how teachers use the tablet for teaching via the TV screen or the interactive digital whiteboard (PDI), if the centre had one, as well as by laptop/PC, and even cell phone. The teachers used tablets in different ways in the classroom, and opinions on their use varied. For example, the interviews revealed how some teachers thought that tablets were more versatile in fomenting the classroom dynamic than the laptop, and others said that PDIs were technological devices that reproduce traditional pedagogical models as opposed to tablets which clearly reinforce group work.

Another useful complement for teachers in class is the digital pencil S Pen, often used in conjunction with the S Note app. The teaching units' analysis showed that teachers made extensive use of the S Pen in activities involving writing by hand from note taking to drawing, which added value to the teaching in the classroom.

An important aspect that came up in the observations and focus groups was how the teachers saw that tablet as a tool for personalizing learning. In contrast to the conventional blackboard or PDI, which the teachers associated to the dissemination of content towards the class, the tablet represents an important advance in giving students individual attention and monitoring their work more closely. However, the teachers pointed out that to make this work successfully, more time would be needed to plan and develop activities for use on the tablet.

Another positive aspect for teachers is sustainability, which saves on photocopying, but also throws up a new problem in technological incompatibility between operating systems, web apps and files.

3.5. Space and time

The observations, interviews and focus groups noted the teachers' remarks on the fact that the students are also aware of the changes that have taken place in the classroom, not just due to the physical presence of technology but also for the change in the type of learning activities, the role of the teacher and student, as well as the physical reorganization of the classroom. In the focus group one teacher said: "The students are no longer sat in rows looking at other students' backs. Classes are now mobile".

The classroom is no longer a rigid environment with students lined up in rows listening to a teacher but an open flexible space endowed with a different dynamic in which everyone can stand up, walk around and talk to everybody else, and all this thanks to the tablet. Yet the analysis of the teaching units also showed how the teachers rarely used the tablet to move out of the classroom and occupy another area and transform it into an educational space.

The project teachers' opinions varied in terms of the time students need to be able to work autonomously with a tablet. There was no agreement on a definitive average time required for students to be tablet self-sufficient, as the responses to this question showed, because students' previous experience with technology and the frequency of tablet use in the classroom were important unquantifiable factors. However, all teachers insisted that the students needed to be given time to manage the device independently and to evolve from using the tablet as a toy to using it as a learning tool.

3.6. Assessing student learning

Although from the visits, interviews and focus groups we learned that some teachers feel that assessment "is the big unresolved issue", most of the project participants cited four changes in the way students are assessed: assessment as a game, the introduction of rubrics, the immediacy of feedback and the use of onli-

ne multiple choice assessment. The tools most widely used in this respect are Socrative, Kahoot, Rubistar or Google questionnaires. Analysing the teaching units helped us to see how traditional forms of assessment mixed easily with alternatives such as joint-assessment, self-assessment or even the opportunity to personalize learning. As one focus group member said: "The tablet gives you more flexibility; you can design material specifically for one particular student".

4. Discussion and conclusions

This study forms part of an emergent line of investigation in education, digital pedagogy. This pedagogy is under construction, and is fundamentally centred on assessing educational models that use technology in the classroom, and on detecting its potential use, the challenges it represents and trends in other educational spaces (Boling & Smith, 2014; Chai, Koh, & Tsai, 2013, Gros, 2015; Harris, 2013). This line of investigation, as this present research, is not about technology in itself but aims to know what technology can actually do in the classroom (Flewitt, Messer, & Kucirkova, 2015).

However, we must point out that this study was carried out in optimum technological conditions since, thanks to the "Samsung Smart School" project, teachers and students each had access to a tablet and an Internet connection. So, these pedagogical findings should be measured against settings and situations in which technology access for all students and teachers is not an issue.

The content analysis of the data generated by the four qualitative techniques enables us to infer (Braun & Clarke, 2013) that the project teachers face the challenge of the table not just from a technological perspective but also construct a pedagogical vision of its use in education (Butcher, 2016). Configuring the tablet with this pedagogical vision, as shown in the categorization of the six dimensions studied, is evident in the teachers' activity with, and perception and programming of, the tablets.

And despite what one might think, the project teachers' pedagogical vision of the tablet is evident not only in answer to the question "what tool do I use to learn?", which is associated to the apps in this study, but also in the definition of the educational objective, the conception of the didactics, the development of activities, the representation of educational space and time, and in the assessment of learning. As the results show, technology opens up a wide range of new educational functions that the teacher assumes as part of his/her curricular activity. This seems to be the trend in terms of the educational value of the new conditions generated by mobile devices for learning (Traxler & Kukulska-Hulme, 2016).

In terms of the main educational functions the Internet-connected tablet offers the primary school classroom dynamic, the project teachers recognize that although the most widely worked competences are linguistic communication and digital competence, the tablet enables them to work with various other competences transversally, and that the use of this device for educational purposes involves a change in teaching methodology that fits neatly with the development of Project-Based Learning and collaborative learning. Of course, tablets provide access to information but its main didactic use is not to contribute specific content but, thanks to the generic apps it contains, to develop a wide range of activities that evolve from information consumption to production, and which implies the development of a digital competence that is directly linked to multimedia language. And, the use of tablets can open up a rich seam for personalizing learning and joint-assessment (Botha & Herselman, 2015)

As the interviews and focus groups have shown, it is essential to understand that tablets presage –which does not mean to say that they cause– a series of transitions: the evolution of the tablet from toy to learning tool, from pedagogies of information consumption to pedagogies of creation, from static pedagogies to mobile pedagogies, from the potential of the text book to that of the digital notebook, from content to activities, from managing achievements to managing errors, and

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the biggest jump, from the image of technology as a neutral tool to one that stimulates change in standard classroom culture.

Changes in education are not just about the use of the tablet in the classroom, rather it is the symbolic tool that teachers can use to think about all the pedagogical elements that range from new functions to transitions that demand going beyond the mere replacement of the old with the new.

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