

# Informal Tools in Formal Contexts: Development of a Model to Assess the Acceptance of Mobile Technologies among Teachers

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## ABSTRACT

Traditionally, mobile learning has been more strongly developed within the field of informal education. However, in the past few years there has been a growing interest for the integration of these technologies in the formal education field. Among the key elements needed to successfully achieve this integration process is the acceptance of mobile technologies by the teaching body.

In this paper we propose to identify the determining constructs that explain the teachers' intention of using mobile technologies. To this end we have designed a research model based on the Technology Acceptance Model (TAM), expanded with constructs from other theories. The resulting model was subjected to a content validation process performed by a committee of experts.

Lastly, we selected nine constructs for the development of the research model and we formulated 13 hypotheses that describe the relationships among them. Further studies on the research model to extend its validity and reliability are suggested.

## Keywords

mLearning; Technology Adoption; Technology Acceptance Model; In-service teachers; Attitude assessment.

## 1. INTRODUCTION

Over the past few years, mobile technologies have experienced an important expansion process and the consolidation of their popularity as devices used in day-to-day activities (Fundación Telefónica, 2014). This quick expansion has caused an increase in the fields that have shown interest in the advantages derived from the integration of these resources. Thus, the concept of mobile learning (mLearning) emerged in the educational field aiming to make the most out of mobile devices as learning tools.

This new methodology has been reinforced lately thanks to the incorporation of two devices, smartphones and tablets, which have strengthened the advantages inherent to mLearning, such as the individualization of the content, the increased flexibility of the learning process, the adaptability, the access to the information and the multimedia support, helping to overcome problems related with the autonomy or, in the case of the tablets, with content creation (Rossing, Miller, Cecil, & Stamper, 2012).

Traditionally, mobile learning has been more strongly developed within the field of informal education, where we can find experiences in settings such as museums (Wishart & Triggs, 2010). This phenomenon is mainly due to the fact that mLearning entails a more contextual, individualized and situated learning (Traxler, 2009).

The integration of processes and resources from informal education into formal education can contribute to offer educational solutions to help schools adapt to the needs of an ever-changing society that demands a more flexible and individualised education, and to locate the students at the centre of the teaching-learning process and offer them more control (Conde et al., 2012). As a consequence of this, there are a growing number of experiences on the use of mLearning as a bridge between informal and formal education (Dabbagh & Kitsantas, 2012).

The educational application of these technologies promotes communication and the student's autonomous learning, and it allows us to take the teaching-learning process out of the classroom, thus enabling learning anytime, anywhere. This causes the barriers between formal and informal education to debilitate, demanding the development of new methodological strategies (Sharples, Amedillo Sanchez, Milrad, & Vavoula, 2009) which contribute to opening up the schools to the outside world, creating bonds between schools and families and between teachers and students which allow teachers to guide the students' learning process inside and outside the classroom (Mills, Knezek, & Khaddage, 2014).

Currently, we can find experiences related to the integration of mobile devices in all stages of the formal education system, from the teaching of language and literature in pre-primary and primary education (Beschoner & Hutchison, 2013; Hutchison, Beschoner, & Schmidt-Crawford, 2012) to the creation of personal learning environments (PLE) (Conde González, García Peñalvo, Alier, & Piguillem, 2013), including the use of tablets as an only working tool in zero-paper environments (Hesser & Schwartz, 2013) or as a support for augmented reality (AR) applications in secondary education (Navarro, Galindo, & Fonseca, 2013).

However, despite the growing interest, the integration of mLearning strategies in formal education institutions and processes is still at a primary development stage, given that the initiatives are isolated, they rarely have any continuity and in some cases they don't yield the expected results (Sánchez Prieto, Olmos Migueláñez, García Peñalvo, & Torrecilla Sánchez, 2014).

One of the cornerstones of the integration of new technologies in the teaching-learning process is their acceptance by the teachers involved in said process (Chen, Looi, & Chen, 2009). To this end, it is important to know the key elements that lead to technology acceptance so we can diagnose, predict and intervene in the appropriate situations.

With the objective of exploring and identifying the factors that determine primary teachers' acceptance of mobile technologies, we have proposed a model based on the Technology Acceptance Model (TAM) (Davis, 1989), which, based on the literature consulted, we have expanded by adding constructs and relational hypotheses from other models and theories such as Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Gordon B. Davis, & Davis, 2003) or the Theory of Planned Behaviour (TPB) (Ajzen, 1985). After drafting the original proposal, and aiming to ensure the validity of its content, a validation process was carried out by a group of experts from different fields.

In order to present said model, this paper will have the following structure: we will begin by describing the TAM model and its use as a tool to study technology acceptance processes in the educational field, then we will focus on presenting our model by explaining the foundation of the selected construct and describing the content

validation process, as well as the ensuing changes in the model. Lastly, we will present some brief conclusions where we will indicate the future steps in the process.

## 2. THE TAM MODEL

Since Davis (1986) formulated it, the TAM model has followed an intense evolution process over the years, until it became the reference model it is nowadays (Marangunié & Granié, 2014).

In this section we will describe said process, from its direct antecedents to the current situation and the more frequent uses of the model in education.

### 2.1 Origin and Evolution

The main antecedent on the TAM model is the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975). This theory, born within the field of social psychology, intends to predict a person's behavior through their behavioral intentions, understood as the subjective probability of an individual performing a given behavior, instead of their attitudes, which represent "A person's general feeling of favorableness or unfavorableness toward some stimulus object" (Ajzen, 1985, p. 156) and whose effect on behavior would be mediated by said behavioral intention.

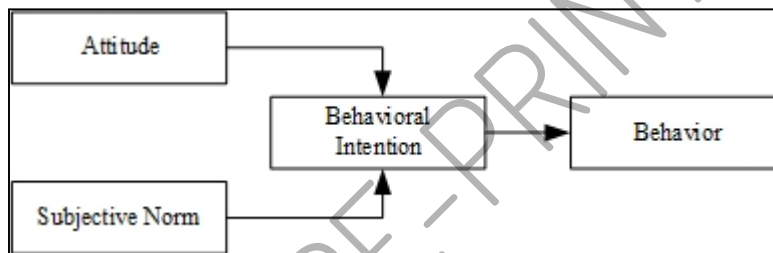


Figure 1. Theory of reasoned action (Fishbein & Ajzen, 1975)

For Ajzen and Fishbein, behavioral intention is determined by the attitude towards the behavior and the subjective norm, which is the social or organisational pressure towards the performance of a behavior as perceived by an individual (Wu & Chen, 2005).

Davis elaborated a simplified proposal from this theory's assumptions, adapted to analyse the information system (IS) adoption process, and maintaining the concept of behavioral intention (BI) as a direct antecedent of the behavior, which in this case is the actual use (AU) of a given information system.

Just like in the TRA, this behavioral intention would be determined by the individual's attitude, which would in its turn be conditioned by the usefulness and the ease of use of the information system as perceived by the individual.

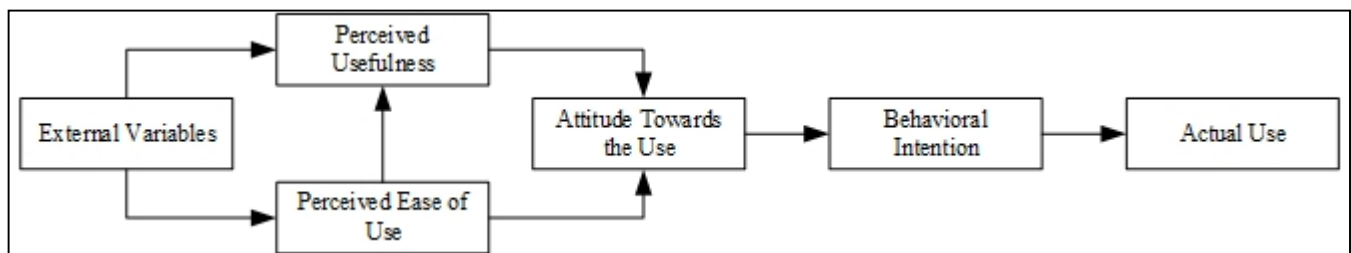


Figure 2. Technology acceptance model (Davis, 1989)

Davis defines perceived usefulness (PU) as, “*the degree to which a person believes that using a particular system would enhance his or her job performance*” (Davis, 1989, p.320)

On the other hand, perceived ease of use (PEU) is understood in this model as “*the degree to which a person believes that using a particular system would be free from effort*” (Davis, 1989, p.320). This construct would also influence the perceived usefulness, although there is some disagreement on this point among the scientific community (Hernández García, 2008).

The resultant proposal drafted by Davis has as its main advantage its simplicity and theoretical soundness, constituting a robust model which is able to explain a high percentage of the variance, which is why it is such an extended model (King & He, 2006).

However, the TAM also presents a series of limitations, among which the following stand out (Hernández García, 2008; Legris, Ingham, & Collette, 2003):

- **Lack of consideration of external variables:** Including factors such as previous experience, perceived enjoyment or facilitating conditions.
- **Dependence on self-reports:** This dependence occurs when measuring the use of the system, which limits the reliability of the model and it hinders the study of the relationship between the BI and AU of the system (Agudo-Peregrina, Hernández-García, & Pascual-Miguel, 2014).
- **Low levels of variance in exploratory studies:** In this type of studies, the explanation of behavioral intention can, on occasion, be relatively low.

Since its origin, and aiming to overcome these limitations, the model has evolved, sometimes including new constructs. Generally, the modifications made on the TAM can be grouped in the following categories (King & He, 2006):

- **Inclusion of external precursors:** Such as previous experience and self-efficacy.
- **Incorporation of factors suggested by other theories:** Some authors add constructs from other theories aiming to increase the model's predictive ability.
- **Inclusion of contextual factors:** Factors from the environment of the organisation, the individual or the information system, such as: gender, culture, or the characteristics of the technology.
- **Measurement of final elements:** This group refers to the measurement of attitude, perceived use and actual use.

Aiming to incorporate the new findings derived from the expanded versions of the TAM, two new versions of the model have been proposed. The TAM2 (Venkatesh & Davis, 2000), which incorporated factors such as subjective norm, previous experience or voluntariness, and the TAM3 (Venkatesh & Bala, 2008), whose main feature is the proposal of anchor and adjustment factors that influence the perceived ease of use.

However, the complexity of the resulting models conflicts with the simplicity of the original proposal, reason why these two models are seldom used, in favour of extended versions of the TAM adapted to the context and IS in which they are intended to be applied

Currently, the TAM model is widely used to explain technology adoption processes (Lee, Cheung, & Chen, 2005). It is most popular in fields such as commerce (Chen, Gillenson, & Sherrell, 2002; Gefen, Karahanna, & Straub, 2003; Wu & Chen, 2005) or ICTs in organisations (Heijden, 2000; Hsu & Lu, 2004; Yang, Cai, Zhou, & Zhou, 2005), although we can also find examples of its use in the healthcare field (Hung & Jen, 2012; Kuo, Liu,

& Ma, 2013) and the educational field (Persico, Manca, & Pozzi, 2014; Sánchez & Hueros, 2010; Stantchev, Colomo-Palacios, Soto-Acosta, & Misra, 2014).

## 2.2 TAM And Education

The variety of uses given to ICT within the educational field and the different roles and characteristics of its users make the study of technology acceptance a key element in the ICT integration process (Marangunié & Granié, 2014). Below we present the most common educational applications of the TAM, sorted by their target population: students and teachers.

### 2.2.1 TAM applied to students

The two fields that concentrate a higher number of studies applying TAM to measure the students' technology acceptance are formal face-to-face education and eLearning.

Within the field of formal face-to-face education, we can find examples of the successful use of TAM to measure the acceptance of new technologies in high school students (Yu, Lin, Han, & Hsu, 2012) or primary education pupils, such as the exploratory study carried out by (Deshpande, Bhattacharya, & Yammiyavar, 2012).

However, the educational level most researched through TAM studies is university, where we find experiences that use Davis' original model to measure the acceptance of a given IS (Gao, 2005) or as a tool to measure the influence of external factors, such as motivation or academic success (Huffman & Huffman, 2012; Jou & Wang, 2012).

There are also studies focused on the students' acceptance of web tools as a complement to face-to-face education (Saadé & Bahli, 2005), where, on occasion, the model is expanded by adding other constructs such as perceived enjoyment, self-efficacy or social influence (Chen, Lin, Yeh, & Lou, 2013).

Within the field of eLearning we find research focused on studying its acceptance in higher education contexts, such as the research conducted by Ramayah (2010), who presents an expanded TAM model to study the effects of voluntariness, or the research carried out by Abbad, Morris and de Nahlik (2009), who present a TAM-based model that includes the constructs subjective norm, internet experience, system interactivity, self-efficacy and technical support.

We can also find a sizeable number of experiences in continuous education environments to study the role of gender in technological acceptance (Ong & Lai, 2006) or the effect of complexity (Lee, Hsieh, & Hsu, 2011).

Lastly, there are studies on the students' technology acceptance focused mostly on the university level (Yadegaridehkordi, Iahad, & Baloch, 2013; Yamakawa, Delgado, Díaz, Garayar, & Laguna, 2013)

### 2.2.2 TAM applied to teachers

There are also studies focused on the acceptance of ICTs among teachers. Below, we present the most relevant ones, both with pre-service and in-service teachers.

The TAM model can be useful in order to evaluate the acceptance of an IS among pre-service teachers and to try to estimate the probability of such system to be accepted among the teachers in the future (King & He, 2006), although this data are not always translatable (Legris et al., 2003).

On this context we find investigations that use the TAM without modifications (Koutromanos, Styliaras, & Christodoulou, 2014), both to measure the acceptance of a certain technology or to predict the effects of constructs that are external to the model, such as the research carried out by Kiraz and Ozdemir (2006) on the effects of ideology on acceptance.

The research of the factors that lead to the technological adoption among the teachers is becoming more important due to the fundamental role that they play in the process of technology integration (Liaw, Huang, & Chen, 2007).

Thus, there are investigations that use the TAM with primary education teachers, like the one carried out by Wu and Liu (2013) to examine the effect of the cognitive styles using a model that also integrated elements from the Innovation Diffusion Theory (IDT) (Rogers, 1995). In the context of higher education, Park, Lee and Cheong (2007) also applied an extended TAM model to study the acceptance of a courseware.

Lastly, it is worth mentioning the research conducted by Pynoo y Braak (2014), on the acceptance of an educational portal aimed at teachers of all levels. This study focused on the relationship between BI and AU, the latter divided in generative use and receptive use. The study concluded that there was a relationship between BI and receptive use, but not between BI and generative use, which begged to delve into the study of this relationship, which is key to technology acceptance models.

### **3. AN EXTENDED TAM MODEL TO MEASURE MOBILE ACCEPTANCE**

In this section we will present the drafting process of our model. We will begin with the original proposal and the content validation process it was subjected to, and then we will describe the final model, defining the selected constructs and their relational hypotheses.

#### **3.1. Original Proposal And Validation Process**

Our model takes Davis' original proposal as a starting point, maintaining the concepts of perceived usefulness, perceived ease of use and behavioral intention. The concept of attitude towards use was eliminated from the model, mainly due to its limited moderating effect (Hu, Clark, & Ma, 2003), with the aim of simplifying the model and reducing the number of items on the instrument to facilitate participation. Therefore we linked PEU and PU directly with BI along the lines of other models such as TAM2 or TAM3, which constitutes an extended practice in the design of TAM based models (Abbad et al., 2009; Park et al., 2007; Roca & Gagné, 2008a; Saadé & Bahli, 2005)

The proposed model has been designed with the objective of conducting a study on the acceptance of mobile technologies among the primary education teachers of the Autonomous Community of Castile and Leon (Spain). Due to the heterogeneity of technology resources available at schools and the dispersion of the schools in said region, we deemed it inadequate to conduct a study that considered the actual use of technologies that, in some cases, might not be available to teachers, and thus we decided to remove the construct AU and focus our model on other studies based on the TAM model that were also carried out in educational settings (Abbad et al., 2009; Chen et al., 2013; Roca & Gagné, 2008b; Saadé & Bahli, 2005; C. Wu & Liu, 2013).

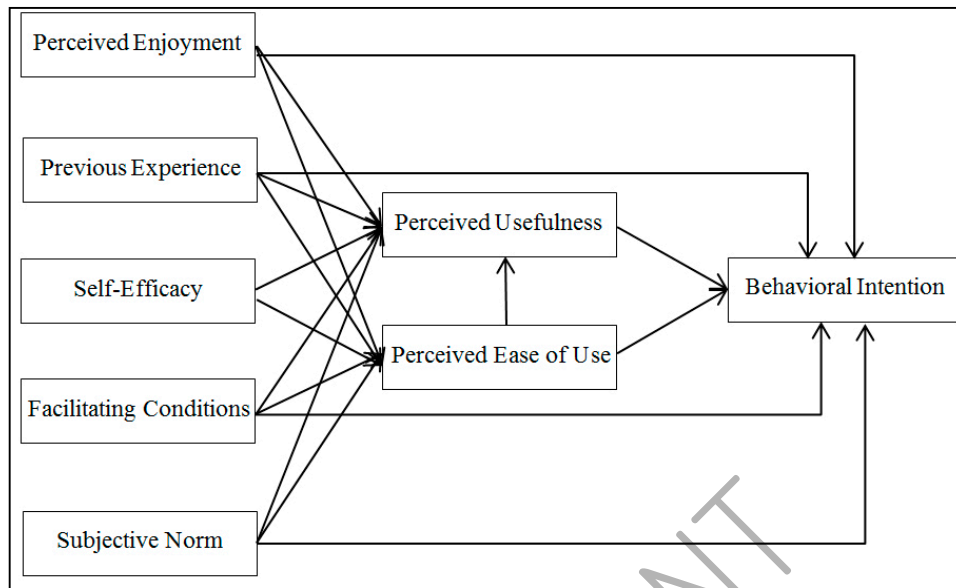
The use of technology acceptance models that propose the BI as the dependent variable of studies with teachers presents several advantages. On the one hand, as we have mentioned before, it solves the problem of the application of the model in contexts where these technologies are not available (Bourgonjon et al., 2013). Another important advantage is that the information on the actual use of a given technology might be considered too sensitive by schools, and that might hinder participation. Lastly, the use of self-reports to register the actual use of the technology makes the teachers' answers less reliable (Teo, 2011). Bearing this in mind, the selection of the BI as the dependant variable seemed the most reasonable option from a pragmatic point of view (Hu et al., 2003). This alternative is frequently employed in acceptance models designed for studies with teachers (Adiguzel, Capraro, & Willson, 2011; Chen & Tseng, 2012; Teo, 2009; Teo & Noyes, 2011).

After conducting a literature review we deemed it necessary to complete the model with exogenous and endogenous variables which would help explain the variance. Thus we selected the following variables from other models such as TRA, TPB, UTAUT, TAM2 or TAM3: previous experience (PE), perceived enjoyment (PEN), subjective norm (SN), self-efficacy (SE) and facilitating conditions (FC). The table below shows the most relevant articles we consulted regarding the selected constructs.

	PU	PEU	BI	PE	PEN	SN	SE	FC
(Venkatesh & Davis, 2000)	•	•	•	•		•		
(Venkatesh & Bala, 2008)	•	•	•	•	•	•	•	
(Venkatesh et al., 2003)			•	•				•
Bourgonjon et al., 2013	•		•	•		•		
(Gao, 2005)	•	•	•					
(Hu et al., 2003)	•	•	•			•	•	
(Davis, Bagozzi, & Warshaw, 1992)	•		•		•			
(Bandura, 1978)							•	
(Compeau & Higgins, 1995)							•	
(Schepers & Wetzels, 2007)	•	•	•			•		
(Teo, 2010)	•	•	•			•		•
Teo & Noyes, 2011	•	•	•		•			•
(Echeng, Usoro, & Majewski, 2013)	•	•	•					•
Lee, Cheung, & Chen, 2005	•	•	•		•			
(De Smet, Bourgonjon, De Wever, Schellens, & Valcke, 2012)	•	•	•	•		•		

**Table 1. Relevant studies consulted**

Once we selected the constructs, and on the basis of the consulted literature, we formulated the relational hypotheses (Fig. 3).



**Figure 3. Original proposal of the Extended TAM Model.**

After the constructs and their relationships were selected and defined, we designed the instrument to carry out the data gathering. The instrument is divided in two sections. The first one is designed to gather the participants' identification data, including: age, gender, type of school and years of teaching experience.

The second part of the instrument is made up of a set of items formulated in a Likert-type scale of seven intervals ranged from 0 to 6 (0: Completely disagree; 1: Disagree; 2: Somewhat disagree; 3: Neither agree nor disagree; 4: Somewhat agree; 5: Agree; 6: Completely agree). We decided to start our scale from zero so as to better reflect the notion of total disagreement. A scale with an odd number of intervals was chosen in order to obtain more answers on account of the scale having a middle value, deciding on seven intervals to achieve a higher degree of reliability (Morales Vallejo, Urosa Sanz & Blanco Blanco, 2003).

We drew up a total of 64 items<sup>1</sup> (table 1), 8 of which, corresponding to the perceived ease of use and the perceived usefulness, were directly adapted from Davis' original proposal. We performed a selection of the rest of the items after the content validation process.

Construct	Number of Items
Perceived Usefulness	4
Perceived Ease of Use	4
Behavioral Intention	6
Previous Experience	10
Perceived enjoyment	10
Self-efficacy	10
Facilitating Conditions	10
Subjective Norm	10

**Table 2. Distribution of the number of items per construct**

<sup>1</sup> The complete list of items can be consulted in the following link: <https://goo.gl/LAV06Z>



### 3.1.1. Content Validation Process

To conduct the content validation process we drafted a validation tool, which was adapted from the proposal by Martínez Abad (2013). This tool contains a brief introduction on the TAM model and a description of our theoretical model, and it lays out the evaluation process in three stages.

The first stage was intended for the independent assessment of each item. For this, we presented the questions for gathering the teachers' identification data as well as the set of proposed items grouped by construct for the experts to assess them (on a scale from 0 to 6), based on three criteria: pertinence, defined as the correspondence between the content of the item and the construct it belongs to; clarity, which refers to the precision and understandability of the item; and relevance, understood as the degree of importance of the item in the explanation of the dimension.

At the end of each group of items we included a section to gather comments, suggestions and alternative ways to word the items.

In the second stage, the evaluators had to analyse the quality of each construct, by assessing the degree to which the proposed items as a whole contributed to evaluating the construct at a global level. We designed the following criteria for each construct: validity of the dimension (on a scale of 0 to 6) to measure the degree to which the items of the dimension as a whole explain the dimension they belong to; strengths and weaknesses of the dimension, expressed in a qualitative way; and an observations section aimed at collecting comments on the dimension.

Lastly, in the third stage we asked the evaluators to cast judgement on the global ability of the instrument to assess the primary education teachers' acceptance of mobile technologies according to its adequacy. We proposed the following criteria to assess (on a scale of 0 to 6): Global validity of the tool, measured according to the ability of the dimensions as a whole to explain the acceptance of mobile technologies; adequacy, defined as the degree to which the proposed instrument adjusts to the assessment of the acceptance of mobile technologies; relevance of the dimensions, which designates the degree to which each dimension collaborates in the explanation of the process of acceptance of mobile technologies.

Moreover on this stage, we included two sections for gathering qualitative information: one for the instrument's strengths and weaknesses, and the other for general observations.

After drafting the instrument, we selected a group of six external evaluators, made up by researchers from different educational and computer science fields, from national and international universities. We contacted this group to ask for their collaboration and we provided the instrument either by e-mail or in person.

Once we received the assessments, we converted them to a digital format to facilitate the result evaluation process. According to the results, we proceeded with the selection of items and constructs.

We deleted the items-factors with average values under three, performed in-depth modifications on the items with values between three and five and modifications in the formulation of the items-factors with values over five. Finally we also took in consideration the experts' qualitative suggestions which were pertinent for the studied theoretical framework. After this we chose those which had obtained the highest scores.

Regarding the individual item assessment carried out in the first stage, we obtained overall positive scores. Table 2 shows the average and standard deviation of the set of items that make up each construct, according to the three criteria established. Out of the six participating judges, four completed the quantitative part of this phase, with the two remaining judges opting to offer only their qualitative opinion through the comment section.

	Pertinence			Relevance			Clarity		
	AVG	STD	N	AVG	STD	N	AVG	STD	N
PU	5,67	,651	12	5,42	,900	12	5,42	,793	12
PEU	4,67	1,670	12	4,75	1,545	12	4,92	1,505	12
BI	4,83	,924	18	4,72	1,364	18	5,44	,511	18
PE	4,83	1,464	30	5,00	1,313	30	4,57	1,331	30
PEN	5,37	,964	30	5,27	,907	30	5,37	,809	30
SE	5,33	1,028	30	5,33	1,061	30	4,97	1,299	30
FC	5,46	1,120	37	5,68	,884	37	5,11	1,350	37
SN	5,03	1,797	36	5,27	1,644	37	4,81	1,808	37

**Table 3. Descriptives of items in Phase 1, grouped by construct.**

Most of the suggestions were related to an improvement of the clarity of the formulation and the reduction of the number of items per construct to avoid redundancies. Since reducing the number of items to those that obtained the higher scores was the initial objective of this process, this suggestion was not seen as negative. The comments were generally related to alternative formulations for the items and bibliographic recommendations which were taken into account for the drafting of the final model.

As for the assessments of the dimensions in the second stage, and the instrument's global validity of the third stage, these turned out to be positive as well, with average scores ranging between 4 and 6, and an average global validity of 5 (Table 4). Of the six judges, five completed the qualitative part of the phases 2 and 3, with the remaining judge offering his opinion in a qualitative way.

	AVG	STD	N
PU	5,40	,894	5
PEU	5,20	1,095	5
BI	5,20	1,095	5
PE	5,00	1,225	5
PEN	4,40	1,342	5
SE	5,00	1,732	5
FC	5,20	,837	5
SN	5,40	,894	5
GV	5	1	5

**Table 4. Descriptives of dimensions in Phase 2 and Global Validity (GV)**

The evaluators pointed out the theoretical basis of the instrument as one of its strengths, and the excessive amount of items per construct and the risk of multicollineality due to their similarities as the weak points of the instrument.

We were also suggested to reduce the number of relational hypotheses, to include less used constructs, such as the resistance to change, and to reconsider the construct previous experience as a moderating variable.

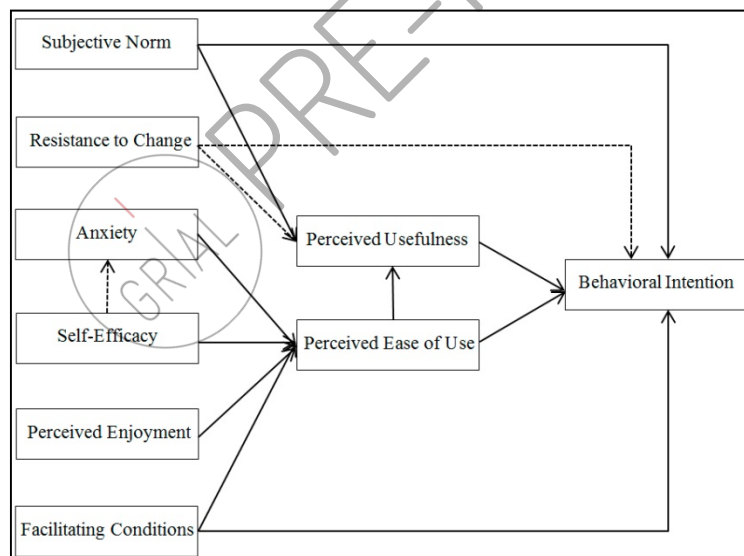
### 3.2. Description of the Model

Taking into account the experts' suggestions, we drafted the final model including the following construct to expand the TAM: perceived enjoyment, subjective norm, self-efficacy, facilitating conditions, anxiety towards mobile devices and resistance to change. All the selected constructs are understood as formative constructs.

Previous experience, which was included in the original proposal defined as the individual's previous experience with mobile devices on a day-to-day basis, was included as a moderating variable. The rest of the moderating variables selected where: age, expressed as a continuous variable; gender, formulated as a dichotomous nominal variable; years of teaching experience, expressed as a continuous variable; and type of school, formulated as a nominal variable divided in three categories representing the three types of schools where primary education can be imparted in Spain: CEIP (Public Pre-primary and Primary Education Schools), CRA (Grouped Rural Schools) and CEO (Compulsory Education Schools).

The originally proposed Likert-type scale of seven intervals which ranged from 0 to 6 was modified following the suggestions of some of the judges, who recommended turning it into a scale ranging from 1 to 7 (1: Completely disagree; 2: Disagree; 3: Somewhat disagree; 4: Neither agree nor disagree; 5: Somewhat agree; 6: Agree; 7: Completely agree), which is more frequently used.

Lastly, we also modified the relational hypotheses by reducing their number to avoid interferences during the analysis (Fig. 4).



**Figure 4. Extended TAM**

We selected a total of 26 items for the constructs that were incorporated in the final model, which are included in the following table:

Perceived Usefulness	
PU1	The use of mobile technologies can enhance my job performance.
PU2	The use of mobile technologies can make me more effective at work.

PU3	The use of mobile devices in my teaching practice enhances my productivity.
PU4	Generally I consider that mobile devices can be useful in my line of work.
Perceived Ease of Use	
PEU1	Learning to use mobile devices in the classroom would be easy for me.
PEU2	I find it easy to interact with mobile devices.
PEU3	Interaction with mobile devices is clear and easy to understand for me.
PEU4	Generally I consider that mobile devices are easy to use.
Behavioral Intention	
BI1	I intend to use mobile devices in the classroom.
BI2	I predict I will use mobile technologies at my job.
BI3	I plan to use mobile devices in the implementation of my teaching practice.
Self-efficacy	
SE1	I am able to integrate mobile devices in my teaching practice.
SE2	I can use mobile devices as educational tools even if there is no one to help me.
SE3	I can design materials and activities for mobile devices without external help.
Facilitating Conditions	
FC1	I have enough time to include mobile devices in my teaching practice.
FC2	I have easy access to the materials I need to develop educational activities delivered through mobile devices.
FC3	I have the necessary human resources at my disposal to be able to develop educational activities with mobile devices.
Subjective Norm	
SN1	My coworkers think I should use mobile technologies in my classroom.
SN2	In my school, teachers are expected to use mobile devices in the classroom.
SN3	The people who influence my behaviour think I should use mobile devices in the classroom.
Mobile Device Anxiety	
MA1	I doubt about using mobile technologies in the classroom because I fear making mistakes that I can't correct.
MA2	Generally the use of mobile devices in the classroom stresses me out.
MA3	I feel apprehension towards the use of mobile devices.
Resistance to Change	
RC1	I would like mobile technologies to change the way the teaching practice is implemented.
RC2	I want mobile technologies to change teacher-student interactions.
RC3	I would find it easy to assume changes in the teaching methodology introduced my mobile devices.

**Table 5. Items for the extended TAM model**

Below, we will perform a comprehensive analysis of the selected constructs and the relational hypotheses.

### 3.2.1. Perceived usefulness, Perceived ease of use and Behavioral intention

As we have mentioned before, the constructs of perceived usefulness, perceived ease of use and behavioral intention come from the TAM model. For the drafting of our model, the items belonging to perceived usefulness and perceived ease of use have been formulated using Davis' proposal (1989), and the items for behavioral intention were formulated using the TAM3.

The hypotheses for these constructs are as follows:

**H1:** Perceived usefulness has a positive relation with primary teachers' behavioral intention to use mobile devices.

**H2:** Perceived ease of use has a positive relation with primary teachers' behavioral intention to use mobile devices

**H3:** Perceived ease of use has a positive relation with primary teachers' perceived usefulness.

### 3.2.2. *Perceived enjoyment*

This construct comes from the motivational technology acceptance model (MM) (Davis et al., 1992), which explores the intrinsic factors that lead an individual to accept an IS. It is defined as the degree to which the use of the technology is perceived as enjoyable, regardless of the performance consequences that can be anticipated.

The use of this construct is rather extended, both to expand the TAM model and to be integrated in other models such as the TAM3. Its use has yielded good results with teachers, in research such as that conducted by Al-Debei (2014) and Teo and Noyes (2011).

The hypothesis for this construct in our model is:

**H4:** Perceived enjoyment has a positive relation with primary teachers' perceived ease of use.

### 3.2.3. *Subjective norm*

Subjective norm is a construct formulated within the TRA, and it plays an important role in the TPB (Ajzen, 1985) to describe the organisational or social pressure placed on the individual to perform a given behavior, as perceived by said individual. In our model it represents the social pressure placed on teachers to use a given technology. This variable appears frequently in other research (Teo, 2012b; Yuen & Ma, 2008). To formulate the items for this construct we considered the proposals by Venkatesh and Davis (2000) and Venkatesh and Bala (2008), including the following hypotheses:

**H5:** Subjective norm has a positive relation with primary teachers' perceived usefulness.

**H6:** Subjective norm has a positive relation with primary teachers' behavioral intention to use mobile devices.

### 3.2.4. *Self-efficacy*

It is described as the assessment made by an individual on their ability to properly use the devices. This term, proposed by Bandura, comes from the social cognitive theory (1978), and we can find examples of its use with positive results in a sizeable number of studies (Chen & Tseng, 2012; Holden & Rada, 2011; van Dinther, Dochy, Segers, & Braeken, 2013; Yuen & Ma, 2008). In our model, we include the following hypotheses based on the TAM3 model:

**H7:** Primary teachers' self-efficacy has a positive relation with their perceived ease of use.

**H8:** Primary teachers' self-efficacy has a negative relation with their mobile device anxiety.

### 3.2.5. *Mobile device anxiety*

This construct was not included in the original proposal and was added to the model because it is strongly linked to self-efficacy. It is an adaptation to the construct of computer anxiety from the TAM3 model. This construct is defined as the degree of an individual's apprehension, or even fear, when he/she is faced with the possibility of using mobile technologies (Hernández García, 2008). For this construct we propose the following hypothesis:

**H9:** Primary teachers' mobile device anxiety has a negative relation with their perceived ease of use.

### 3.2.6. *Facilitating conditions*

This construct measures the individual's perception of the resources at their disposal to support their behavior. This concept is integrated in the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) and it has yielded good results in previous studies on teachers' and students' technology acceptance (Deshpande et al., 2012; Echeng et al., 2013; Teo, 2011). Our model includes the following hypotheses:

**H10:** Facilitating conditions have a positive relation with primary teachers' perceived ease of use.

**H11:** Facilitating conditions have a positive relation with primary teachers' behavioral intention to use mobile devices.

### 3.2.7. *Resistance to change*

Resistance to change can be defined as the difficulty to break with routines and the emotional stress generated when facing the expectation of changes. Although it is not included in any of the main theories, it has been explored in acceptance studies based on TAM (Al-Somali, Gholami, & Clegg, 2009).

During the validation process, we were told that including this construct in the model could be interesting and, after a bibliographic analysis we decided to add it as a variable because, although it is a relatively unexplored construct, we considered it might have a significant influence on the acceptance of mobile technologies by primary teachers, bearing in mind the stress that the changes demanded by the integration of ICTs produce in this professional collective (Al-Fudail & Mellar, 2008).

This definition of the construct is closely linked to perceived compatibility (Escobar-Rodríguez & Bartual-Sopena, 2014), which comes from the IDT and it is described as the extent to which an innovation is perceived to be consistent with the individual's existing values, previous experiences and needs (Rogers, 1995). This way, resistance to change would be close to the constructs of Compatibility with Preferred Work Style and Compatibility with Existing Practices proposed by Karahanna, Agarwal and Angst (2006).

The items for this construct were adapted from the proposals for resistance to change by Bhattacharjee and Hikmet (2007) and Guo, Sun, Wang, Peng and Yan (2013), who propose to formulate the items in an inverse way.

Our model proposes the following relational hypotheses for resistance to change:

**H12:** Resistance to change has a negative relation with primary teachers' perceived usefulness.

**H13:** Resistance to change has a negative relation with primary teachers' behavioral intention to use mobile devices.

## 4. CONCLUSIONS

The use of educational strategies that employ mobile devices within the formal teaching-learning process allows us to blur the limits between formal and informal education, which places mobile learning as a bridge between both fields and it opens the door to new didactic strategies and designs which will facilitate to take the educational process out of the classroom, broadening the range of solutions to the problems of teachers and students.

In every technology integration process, the involvement of teachers has a central role, and therefore the knowledge on the teachers' attitudes towards mobile technologies is a key element to successfully guide the process of incorporating these devices to the teaching practice (Hernández-Ramos, Martínez-Abad, García Peñalvo, Esperanza Herrera García, & Rodríguez-Conde, 2014).

Although there are studies that explore the process of technology acceptance among teachers, and their number is increasing, along with the growing interest for the integration of new technologies in the classroom (Marangunié & Granié, 2014), we do not yet have a complex model that explains the relationships among the different factors and how they influence the behavioral intention (Teo, 2012a), having found that a significant number of studies are focused on exploring the effects derived from adding a construct to the TAM model and its interaction with the rest of the model's constructs.

Our proposal consists in a new model specifically designed to explain the teachers' acceptance of mobile technologies. The proposal is drafted from the TAM model, and expanded with constructs from other models such as TRA, TPB, UTAUT, IDT or TAM3.

The result is a complete theoretical model that integrates the constructs considered the most relevant to explain the process: perceived enjoyment, facilitating conditions, self-efficacy, mobile device anxiety, subjective norm, perceived usefulness, perceived ease of use and behavioral intention. It also includes a construct that has been relatively unexplored in previous studies, such as the resistance to change, which has shown interesting results in studies like the one carried out by Bhattacharjee and Hikmet (2007) to study the acceptance of healthcare technologies by physicians, or the research by Guo, Sun, Wang, Peng and Yan (2013) to measure the acceptance of mobile technologies among elders in the healthcare context. Despite these results, we haven't found any research on its effect on teachers' technological acceptance.

These variables have been grouped and defined for their assessment and the determination of their level of statistical significance, explaining the relationship among them via the formulation of 13 relational hypotheses and 26 items to conduct the data gathering process to perform the research, allowing the replication of the study and the expansion and modification of the model. This model and its corresponding instrument have been subjected to an assessment process performed by a group of experts in order to ensure the validity of its contents.

The present research opens the door to further investigations, including the replication of the study through a statistical validation process in order to ensure and extend the reliability and validity of the proposal, or the undertaking of researches to delve into the less used constructs, such as self-efficacy or mobile anxiety, and especially into the construct of resistance to change and its relationship with perceived compatibility.

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