Sánchez-Prieto, J. C., Olmos Migueláñez, S., & García-Peñalvo, F. J. (2017). Assessment of the Disposition of Future Secondary Education Teachers Towards Mobile Learning. In J. M. Dodero, M. S. Ibarra Sáiz, & I. Ruiz Rube (Eds.), *Fifth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'17) (Cádiz, Spain, October 18-20, 2017)* (Article 27). New York, NY, USA: ACM. doi:10.1145/3144826.3145374

Assessment of the Disposition of Future Secondary Education Teachers Towards Mobile Learning

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ABSTRACT

Mobile technologies occupy an increasingly important place within the catalogue of didactic resources available to teachers, who play a key role in the success of innovation processes in the field of education. The research presented in this paper intends to contribute to the knowledge of the factors that condition the acceptance of mobile devices on the part of future secondary education teachers. To this end, we have elaborated a TAM-based model expanded with the constructs of perceived enjoyment and self-efficacy. The questionnaire for this model has been administered to 222 students from the Secondary Education Teacher Training Master's Degree of the University of Salamanca. The results of the study show a slightly positive attitude towards the use of mobile technologies on the part of the students. The hypothesis test reflects significant differences in the means of the construct perceived enjoyment according to gender.

CCS CONCEPTS

• Applied computing→ Education→ Computer-assisted Instruction. • Social and professional topics → User characteristics.

KEYWORDS

TAM; technology acceptance; university students; pre-service teachers; mobile learning

1 INTRODUCTION

The use of mobile devices as a didactic tool is a field of study that attracts a growing number of researchers [1], a fact that is in tune with the popularity achieved by these technologies, which has lead administration to implement programmes aiming to provide schools with the technological resources necessary for their integration [2, 3].

Thus, the term mobile learning (mLearning) groups different educational initiatives aiming to get the most out of these technologies in the teaching-learning process [4], both inside and outside of formal education contexts [5, 6]. From a pedagogical point of view, we can classify the main characteristics of the use of mLearning in formal education in three groups [7]:

- **Immersion:** The multimedia capacity and the nature of mobile devices cause a motivational effect on the students that facilitates immersive learning.
- **Presence:** Presence refers to the ability of mobile devices to promote interaction structured around three axes: content-student, student-student, and teacher- student.
- **Flexibility:** The connectivity and autonomy that mobile technologies currently display enable learning anytime and anywhere, thus breaking the limits of the classroom and overcoming space and time issues.

When analysing the factors that influence the success or failure of teaching innovation initiatives based on mLearning, we can group them in three categories [8]:

- **Technological factors:** Those that have to do with the physical features of the devices, such as screen size, interface or power.
- **Student factors:** Related to the attitude of the students and their relationship with the devices.
- **Teacher factors:** This category encompasses the factors related to the essential role of teacher predisposition in the implementation of a new technology in the classroom.

Technology adoption models are a common resource when aiming to analyse user attitudes towards a given technology. Among these models, the most popular one [9] is currently the TAM (Technology Acceptance Model), created by Davis [10] based on the assumptions of the TRA (Theory of Reasoned Action) [11] and the TPB (Theory of Planned Behaviour) [12].

Davis intends to explain the acceptance process based on two concepts: perceived ease of use (PEU), which refers to the individual's perception of the degree of effort necessary to use the technology, and perceived usefulness (PU), which measures the degree to which a person perceives that the use of a technology will enhance their work performance.

These two constructs condition the individual's attitude towards the use of a tool. In their turn, both the attitude and usefulness condition the intention to use the technology, a construct that in the TAM, following the proposals of the TRA and TPB, constitute a direct antecedent of the performance of the behaviour, in this case the use of technology.

The popularity achieved by the TAM model, thanks to its simplicity, adaptability and ability to explain the variance, has caused the use of this model in a wide array of fields, including education, in studies conducted both with students [13] and teachers [14]. In numerous occasions, these studies opt for modified versions of Davis' original model, which is expanded with constructs from other theories [15, 16], such as the IDT (Innovation Diffusion Theory) [17] or the TTF (Task-technology Fit) [18], aiming to analyse the influence of a given factor in the acceptance process, or to improve the model's explanatory capacity.

Finally, there are two later versions of the model, TAM2 [19] y TAM3 [20], who intend to integrate the most relevant findings of studies conducted with expanded TAM models.

This paper presents the results of a descriptive study developed in the University of Salamanca on the attitude of the students from the Secondary Education Teacher Training Master's Degree towards the use of mobile devices as a didactic resource in their future teaching practice, through the use of a TAM-based model.

Section two presents the methodology employed in the study, including the development of the model and the definition of the constructs that compose it, as well as the composition of the measurement instrument and the description of the sample. In section three, the results of the descriptive analysis are shown, and so is the hypothesis test conducted to verify whether there are significant differences according to the gender of the students. Lastly, section four contains the most relevant conclusions drawn from the study.

2 METHODOLOGY

For the development of this study, we designed a TAM-based technology adoption model, adapted to measure the disposition of future secondary education teachers towards the use of mobile technologies in their professional practice. The model was completed with two additional constructs from other theories, perceived enjoyment (PE) and self-efficacy (SE).

Below, we will describe in detail the construction process and the main characteristics of both the adoption model and the measurement instrument employed in the study, as well as the characteristics of the participating sample.

2.1 Model development

As we have seen, in order to develop the model used in this research, we decided to start from the original TAM model, thus conserving the constructs of perceived usefulness, perceived ease of use, attitude towards use and behavioural intention. The only variable removed was actual use, given that the subject of the study was the intention of students to use mobile technologies once they are in-service teachers.

This study also maintains the relational hypotheses initially proposed by Davis for these factors:

H1: Perceived usefulness is positively related to the intention of the students from the Secondary Education Teacher Training Master's Degree to use mobile devices in their future teaching practice.

H2: Perceived usefulness is positively related to the attitude of the students from the Secondary Education Teacher Training Master's Degree towards the use mobile devices in their future teaching practice.

H3: Perceived ease of use is positively related to the attitude of the students from the Secondary Education Teacher Training Master's Degree towards the use mobile devices in their future teaching practice.

H4: Perceived ease of use is positively related to the usefulness perceived by the students from the Secondary Education Teacher Training Master's Degree of the use mobile devices in their future teaching practice.

H5: Attitude towards use is positively related to the intention of the students from the Secondary Education Teacher Training Master's Degree to use mobile devices in their future teaching practice.

Although the TAM model constitutes an effective theory to explain the technology adoption process, it is subject to expansion through the integration of constructs from other theories in order to increase its explanatory power.

One of the limitations of the original TAM model is the lack of inclusion of factors that allow for the measurement of the effect of intrinsic motivational elements, which are those elements related to the enjoyment provided by the use of a given technological tool regardless of the effect it has on the work performance of the person.

Davis, Bagozzi and Warsaw developed the Motivational Model of Use of Technology (MM) [21], a proposal for the integration of the intrinsic motivational element in technology adoption models through the construct of perceived enjoyment (PE), placing it as an antecedent for behavioural intention.

Perceived enjoyment is a widely-used construct in technology adoption models in all kinds of contexts. Within the educational field, it has been tested with students and pre-service teachers with good results [22, 23]. For our study, we propose the following hypotheses based on the proposal by [24]:

H6: Perceived enjoyment is positively related to the usefulness perceived by the students from the Secondary Education Teacher Training Master's Degree of the use mobile devices in their future teaching practice.

H7: Perceived enjoyment is positively related to the ease of use perceived by the students from the Secondary Education Teacher Training Master's Degree of the use mobile devices in their future teaching practice.

H8: Perceived enjoyment is positively related to the intention of the students from the Secondary Education Teacher Training Master's Degree to use mobile devices in their future teaching practice.

The second construct added to the model is self-efficacy (SE), a concept developed by Bandura [25], which has been integrated in technology adoption models in many occasions, aiming to measure the subject's perception of their own ability to use a given technology [26, 27]. This construct is also integrated in the third version of the TAM model.

The self-efficacy perceived by teachers constitutes a relevant study focus within the field of education, be it in relation to their own teaching abilities [28] or their use of new technologies in the classroom [29-31]. Thus, the model (figure 1) is completed with the following hypothesis, in accordance with TAM3:

H9: Self-efficacy is positively related to the ease of use perceived by the students from the Secondary Education Teacher Training Master's Degree of the use mobile devices in their future teaching practice.

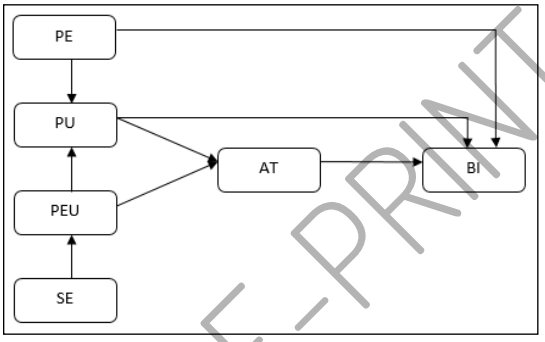

Figure 1. Research Model

Behavioural intention then constitutes the model's endogenous variable, while perceived usefulness, perceived ease of use, perceived enjoyment and self-efficacy are the exogenous variables. Lastly, we propose several explanatory variables, such as gender, age and frequency of use of mobile technologies in daily life, measured through a Likert-type frequency item (1: Almost never – 5: Almost always).

2.2 Population and sample

The population of the study is composed by the students enrolled in the Secondary Education Teacher Training Master's Degree of the University of Salamanca, to whom the paper-based questionnaire was distributed.

A total of 222 students agreed to participate voluntarily in the study, with 50.5% of them being men and 49.5% women. The average age of the students was 24.45 years, with a standard deviation of 3.18. Most of the surveyed students claims to use mobile devices in their day-to-day lives, with the average and the median for this item being 5 (the highest value).

2.3 Instrument

For the data gathering phase we designed an instrument composed by two sections. The first one collects identification data and the second one gathers data on the 6 constructs through 21 Likert-type items (1: Completely disagree – 7: Completely agree). These items were elaborated in accordance with the proposals by [20, 32, 33]:

- **Perceived usefulness:** *The use of mobile technologies can improve the teaching practice (PU_01); the use of mobile technologies can make the teaching practice more effective (PU_02); the use of mobile devices can make it easier to carry out teaching tasks (PU_03); in general, I consider that mobile devices can be useful in education (PU_04).*
- **Perceived ease of use:** *Using mobile technologies doesn't require a lot of mental effort for me (PEU_01), I find it easy to get mobile technologies to do what I want them to do (PEU_02), my interaction with mobile technologies in clear and understandable (PEU_03), I find mobile technologies easy to use (PEU_04).*

- **Attitude towards use:** *Using mobile technologies in teaching is a smart idea (AT_01); the use of mobile technologies in teaching is beneficial (AT_02); I have a good disposition towards the use of mobile devices in teaching (AT_03).*
- **Behavioural intention of use:** *Assuming I had access to mobile technologies, I intend to use them in my future teaching practice (BI_01), in case I had access to mobile technologies I predict I would use them (BI_02), I plan to use mobile technologies in my future teaching practice (BI_03).*
- **Perceived entertainment:** *The use of mobile devices in my classes adds a fun aspect to my job (PE_01), I am amused by carrying out activities with my students through the use of mobile technologies PE_02), I enjoy using mobile devices in my classes (PE_03), the use of mobile devices makes my classes more amusing (PE_04).*
- **Self-efficacy:** *I am able to design educational activities that make use of mobile devices (SE_01); I can use mobile devices in the classroom, even if there is no one to help me (SE_02); I know that I can use mobile technologies, even if I have not used them in education (SE_03).*

The internal consistency of the instrument was calculated with Cronbach's α coefficient, which yielded a value of 0.950, which indicates a very high reliability.

3 RESULTS

Once the data was collected and digitalised, we proceeded with their analysis with the statistical programme SPSS 21. As a first step, we carried out a descriptive analysis of the items (Table 1).

Table 1. Descriptive analysis of the items of the acceptance model

	Mean	Median	Std. Dev.	N
AU_01	4.64	5	1.578	218
AU_02	4.68	5	1.557	222
AU_03	4.59	5	1.723	221
BI_01	4.89	5	1.652	221
BI_02	4.95	5	1.641	220
BI_03	4.95	5	1.658	219
PE_01	4.68	5	1.526	220
PE_02	4.74	5	1.508	218
PE_03	4.45	4	1.539	219
PE_04	4.62	5	1.537	220
PEU_01	5.29	6	1.699	221
PEU_02	5.22	5	1.294	221
PEU_03	5.62	6	1.189	222
PEU_04	5.70	6	1.191	221
PU_01	4.88	5	1.626	220
PU_02	4.86	5	1.604	218
PU_03	4.97	5	1.441	193
PU_04	5.20	5	1.459	194
SE_01	4.67	5	1.624	221
SE_02	5.08	5	1.538	221
SE_03	5.24	6	1.520	221

[a]Dimensions are presented alphabetically.

As we can observe in the table, students present a slightly positive attitude towards the use of mobile devices in their future teaching practice. The mean scores are above 4 in all items, although only in 6 out of the 21 items the mean exceeds 5. The constructs with higher scores are perceived ease of use and self-efficacy, which indicates that the students perceive technologies as easy to use and they have confidence in their ability to use them in their classes. The construct with lowest scores is perceived enjoyment.

After the descriptive analysis, we continued with a hypothesis test to explore the existence of significant differences in the mean scores of the students according to their gender.

As a previous step, we conducted Kolmogorov-Smirnov and Shapiro-Wilk tests (Table 2) to study the normalcy of the score distribution.

Table 2. Kolmogorov-Smirnov and Shapiro-Wilk normalcy tests.

	Kolmogorov-Smirnov	Shapiro-Wilk

	Statistics	*df*	*Sig.*	*Statistics*	*df*	*Sig.*
AU_01	0.169	179	0.000	0.913	179	0.000
AU_02	0.161	179	0.000	0.924	179	0.000
AU_03	0.178	179	0.000	0.915	179	0.000
BI_01	0.158	179	0.000	0.907	179	0.000
BI_02	0.187	179	0.000	0.898	179	0.000
BI_03	0.182	179	0.000	0.898	179	0.000
PE_01	0.208	179	0.000	0.918	179	0.000
PE_02	0.191	179	0.000	0.912	179	0.000
PE_03	0.168	179	0.000	0.932	179	0.000
PE_04	0.160	179	0.000	0.925	179	0.000
PEU_01	0.217	179	0.000	0.860	179	0.000
PEU_02	0.219	179	0.000	0.908	179	0.000
PEU_03	0.258	179	0.000	0.861	179	0.000
PEU_04	0.261	179	0.000	0.846	179	0.000
PU_01	0.175	179	0.000	0.892	179	0.000
PU_02	0.173	179	0.000	0.908	179	0.000
PU_03	0.179	179	0.000	0.912	179	0.000
PU_04	0.192	179	0.000	0.896	179	0.000
SE_01	0.174	179	0.000	0.909	179	0.000
SE_02	0.193	179	0.000	0.883	179	0.000
SE_03	0.221	179	0.000	0.873	179	0.000

[a]Liliefors significance correction.

The results of these tests lead us to conclude the rejection of the normality hypothesis, therefore we will use non-parametric statistics for the hypothesis test. Since gender constitutes a dichotomous variable, we chose Mann-Whitney's U test. Before the application of said test, we carried out a descriptive analysis of the scores obtained by the students grouped according to their gender (Table 3).

Table 3. Descriptive of the extended tam model according to the students' gender.

	Gender of the students					
	Female			***Male***		
	Mean	***Std. Dev.***	***N***	***Mean***	***Std. Dev.***	***N***
AU_01	4.50	1.623	106	4.77	1.532	108
AU_02	4.44	1.542	108	4.55	1.589	110
AU_03	4.52	1.672	108	4.71	1.781	109
BI_01	4.79	1.635	108	4.97	1.680	109
BI_02	4.81	1.643	107	5.10	1.650	109
BI_03	4.80	1.604	107	5.08	1.730	108
PE_01	4.46	1.415	106	4.90	1.614	110
PE_02	4.62	1.437	105	4.89	1.589	109
PE_03	4.36	1.563	106	4.54	1.519	109
PE_04	4.42	1.486	107	4.84	1.547	109
PEU_01	5.21	1.743	107	5.38	1.659	110
PEU_02	5.26	1.342	108	5.19	1.251	109
PEU_03	5.53	1.286	108	5.70	1.080	110
PEU_04	5.58	1.281	107	5.84	1.097	110
PU_01	4.75	1.658	108	4.99	1.603	108
PU_02	4.81	1.536	108	4.90	1.682	107
PU_03	4.94	1.450	94	5.01	1.440	96
PU_04	5.21	1.428	95	5.21	1.500	96
SE_01	4.69	1.557	107	4.67	1.719	110
SE_02	5.03	1.568	108	5.15	1.533	109

SE_03	5.21	1.600	107	5.27	1.452	110

As we can see on the table, there are some differences, which leads us to calculate Mann-Whitney's U to verify whether they are significant (Table 4).

Table 4. Mann-Whitney's U results for the variable gender.

	Mann-Whitney's U	Wilcoxon's W	Z	Asym. Sig. (bilateral)
AU_01	5160.000	10831.000	-1.272	0.204
AU_02	5586.500	11472.500	-0.775	0.438
AU_03	5412.000	11298.000	-1.043	0.297
BI_01	5358.000	11244.000	-1.162	0.245
BI_02	5125.000	10903.000	-1.569	0.117
BI_03	5019.000	10797.000	-1.696	0.090
PE_01	4435.500	10106.500	-3.114	0.002
PE_02	4910.500	10475.500	-1.837	0.066
PE_03	5368.500	11039.500	-0.918	0.359
PE_04	4726.500	10504.500	-2.462	0.014
PEU_01	5572.000	11350.000	-0.696	0.486
PEU_02	5659.500	11654.500	-0.504	0.614
PEU_03	5570.000	11456.000	-0.830	0.407
PEU_04	5266.000	11044.000	-1.398	0.162
PU_01	5264.500	11150.500	-1.261	0.207
PU_02	5437.500	11323.500	-0.762	0.446
PU_03	4327.000	8792.000	-0.500	0.617
PU_04	4481.500	9041.500	-0.211	0.833
SE_01	5752.500	11530.500	-0.293	0.770
SE_02	5584.500	11470.500	-0.667	0.505
SE_03	5863.500	11641.500	-0.048	0.962

The results from Mann-Whitney's test inform about significant differences in 2 out of the 21 items, namely items PE_01 and PE_04. In both cases, women obtain lower mean scores than men.

4 CONCLUSIONS

As mentioned before, the TAM model is an effective tool to analyse the factors that condition the intention to use new technologies on the part of future teachers.

The present research has corroborated that the students from the Secondary Education Teacher Training Master's Degree from the University of Salamanca present a moderately positive attitude towards the use of these technologies, although if we compare these scores with other studies conducted in the Spanish context [34, 35] we can observe that they are lower than the scores obtained both in studies conducted with university students and with pre-service primary education teachers. In this respect, it is worth noting the low scores obtained in the construct of perceived enjoyment, which opens the door to future studies that delve into the role of this construct in the process of adopting mobile technologies according to the type of studies that the future teacher is enrolled in.

Lastly, regarding the hypothesis test, the results show significant differences in the mean scores according to gender in 2 out of the 4 items of perceived enjoyment. This leads us to conclude that men consider the use of mobile devices as a didactic tool more enjoyable. The influence of gender in the technology adoption process is still an open research subject, on which past research shows mixed results [36, 37]. However, the fact that the only two significant differences found were concentrated in perceived enjoyment encourages us to recommend further study of the influence of gender on this factor.

ACKNOWLEDGMENTS

This research work was made within University of Salamanca's PhD Programme on Education in the Knowledge Society.

The research has been founded by the University of Salamanca through the program of financial aid for predoctoral contracts (Programa III: Ayudas para contratos Predoctorales).

This work is partially founded by the Ministerio de Economía y Competitividad of the Goverment of Spain through the Project DEFINES (Ref. TIN2016-80172-R).

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