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Modelo de la aceptación de evaluaciones en línea de matemáticas: percepciones de los estudiantes de licenciaturas en ciencias sociales

Acceptance's model of on-line math assessments: perceptions from undergraduate social science students

Modelo de aceitação de avaliações de matemática on-line: percepções de estudantes de graduação em ciências sociais

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Resumen

Aunque se han realizado estudios en la aceptación de las evaluaciones en línea, no se han explorado para la enseñanza de las matemáticas en estudiantes de licenciaturas en ciencias sociales. Este estudio analiza los efectos de un grupo de factores que afectan la actitud, la aceptación y la intención del uso de las evaluaciones de matemáticas en línea, en estudiantes de la modalidad a distancia de la escuela de Comercio y Administración del Instituto Politécnico Nacional en México. Para ello se utilizó un instrumento con 15 reactivos aplicado a 23 estudiantes. Comprender los factores tratados requirió del modelo para la aceptación de la tecnología (TAM, por sus siglas en inglés), el cual ha probado ser un modelo robusto para determinar la actitud e intención de uso de la tecnología en diversos contextos, incluyendo el educativo. El análisis se realizó mediante la técnica de ecuaciones estructurales, usando mínimos cuadrados parciales, propia para estudios exploratorios y muestras pequeñas. Los resultados sugieren que los factores *facilidad de condiciones* e *influencia social* son los principales determinantes de una actitud y aceptación favorable para usar exámenes de matemáticas en línea, por lo se puede concluir que el proporcionar a los alumnos la infraestructura tecnológica y servicio técnico adecuado es importante, y que el mantener una comunicación continua y eficiente de autoridades y maestros puede influenciar favorablemente a la actitud de los estudiantes para usar la plataforma.

Palabras clave: Adopción de tecnología, educación a distancia, educación superior, evaluación electrónica, exámenes de matemáticas en línea.

Abstract

This study analyzes the effects of a group of factors that affecting the attitude, acceptance and intention to use on-line financial mathematics assessments on students on a distance education course for a School of Commerce and Management at the National Polytechnic Institute in Mexico. To understand these factors, we used the technology acceptance model (TAM), which has proven to be a theoretical model to determine the attitude and intention to use technology. For the analysis, the structural equations model was used to measure hypothetical variables. Results suggest that perceived ease of use and social influence are the main determinants of students' favorable attitude and acceptance to using on-line mathematics test; so, we can conclude that providing the students with the technological infrastructure and adequate technical support is very important, as well as keeping continuous and efficient communication from authorities and teachers to positively influence students' attitude to use the platform.

Keywords: Technology adoption, distance education, higher education, electronic assessments, mathematical on-line exams.

Resumo

Embora tenha havido estudos na aceitação de avaliações on-line, eles não foram explorados para o ensino de matemática em estudantes de graduação em ciências sociais. Este estudo analisa os efeitos de um grupo de fatores que afetam a atitude, aceitação e intenção do uso de avaliações de matemática on-line, em estudantes da modalidade à distância da Escola de Comércio e Administração do Instituto Nacional Politécnico do México. Para isso, utilizou-se um instrumento com 15 reagentes aplicados a 23 alunos. Compreender os fatores tratados exigiu o modelo de aceitação de tecnologia (TAM), que provou ser um modelo robusto para determinar a atitude e a intenção de usar a tecnologia em vários contextos, inclusive educacionais. A análise foi realizada utilizando a técnica de equações estruturais, utilizando mínimos quadrados parciais, próprios para estudos exploratórios e pequenas amostras. Os resultados sugerem que os fatores de facilidade de condições e influência social são os principais determinantes de uma atitude e aceitação favorável para usar exames de matemática on-line, pelo que pode-se concluir que proporcionar aos alunos a infra-estrutura tecnológica e o serviço técnico adequado é importante, e que manter uma comunicação contínua e eficiente de autoridades e professores pode influenciar favoravelmente a atitude dos alunos para usar a plataforma.

Palavras-chave: Adoção de tecnologia, educação a distância, ensino superior, avaliação eletrônica, exames de matemática on-line.

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Introduction

The rise in the use of technology offers new opportunities that cover all fields of human endeavor, including the educational context (Taylor, 1995, p.1). Under this perspective, studies have been carried out that show the benefits that technology has brought to the teaching-learning processes. For example, the studies of Wang and Wang (2009), Bucheli (2015) and Cisneros (2017) point out that technology enables communication between teachers and students by serving as a platform to facilitate teaching and learning. Also, the authors Gunasekaran, McNeil and Shaul (2002); Torrealba (2008), and Salazar and Flores (2016) affirm that technology fosters interaction and communication between students and teachers.

The impact of technology has extended widely to all areas of teaching, including mathematics, as evidenced by the work of Gunasekaran, et al. (2002), which addresses the effectiveness of technology to facilitate its teaching. Likewise, in the study of Larson and Bruning (1996) perceptions are examined in an interactive collaborative mathematics course. Their findings demonstrate that the distance learning format gives teachers access to more resources, is useful for underperforming students and is an effective way to implement national curricula and instructional standards. Similarly, McCollum (1997) describes how the division of students from a statistics course into two groups (one group was taught in a traditional way and the other in an online version of the course) had an effect on the performance: the students who took the online option performed the course better than the other group.

The electronic evaluation

The electronic evaluation or e-assessment is the process where the technology is used for any activity related to the evaluation, from the design of the tasks to the storage of the results (Joint Information Systems Committee, 2007, p. 6 The process of educational evaluation is the central point of the teaching-learning process and an essential component of effective learning (Gikandi, Morrow and Davis, 2011, Freitas, 2016) .The evaluation process is considered the key factor that stimulates thinking of higher order, social skills and teamwork (Buzetto-More and Alade, 2006, p 256), as Brown, Bull, and Pendlebury point out: "if you want to change student learning, then change the methods of evaluation "(1997: 7) .Therefore, these methods must be placed in the correct place, recognizing their crucial role in teaching and learning.

The literature divides the evaluation (either traditional or online) into two main categories: formative and summative. Formative feedback alerts students to their mistakes during the course, which allows them to improve their areas of weakness and avoid repeating the same mistakes (Gill and Greenhow, 2008, p.207). The formative evaluation has been recognized in recent years as a strategy to improve student learning. The Black and Wiliam researchers give evidence that improving formative assessment in the classroom leads to higher student performance (1998, p.10). Summative assessment is the conventional form of evaluation practice and is the final evaluation of student learning during a course, often with an attached grade.

In the area of online assessment, technology plays an important role in building a bond between students and evaluating their learning, as mentioned by Bennett, the computer evaluation offers innovative perspectives for the evaluation of exams (1998 , p.5). Likewise, the research of Heinrich, Milne and Moore (2009) mentions the benefits that educational technology has brought to the evaluation process, such as the improvement of the quality and feedback of the evaluation process, provides support for the manual qualification, A vision of student understanding through tests and exams, provides advantages of electronic submission and task management. Whitelock and Watt point out that technology has also contributed significantly to the educational evaluation process (2008, p.151). They mention that "the benefits obtained include the retention of students, a higher quality of information, flexibility for distance learning, strategies to deal with large groups of students, objectivity in the qualification and the most effective use of virtual learning environments "(151) The work of Centeno & Lira (2015) shows how the development of a web system for the preparation of online exams for high schools brings benefits, such as saving time for teachers, and with it, to be able to dedicate itself to improve the learning of the student.

Likewise, the research of Terzis, Moridis and Economides mentions that educational technology based on the web, whether formative or summative, offers advantages, such as "(a) high interaction and adaptation with the examinees, (b) real-time feedback , (c) real-time results reports, (d) more efficient management, configuration and delivery of exams, (e) easier data management, (f) cost reduction, (g) self-evaluation and recognition of strengths and weaknesses of students "(2012a: 1986). Within the context of mathematics teaching, the study by Whitelock and Raw (2003) mentions that mathematics is appropriate for an online assessment strategy, and can provide valuable feedback to students studying alone at a distance university. In summary, Dreher, Reiners, and Dreher (2011), and Wang (2013) argue that electronic evaluations are technological tools that carry the potential to improve the evaluation process for all stakeholders.

Although the role of educational evaluation has been more recognized, greater efforts are required to enrich evaluation practices, as mentioned in the students' annual report: "We would like to see all universities implement a systematic policy to provide innovative evaluation "(Joint Information Systems Committee, cited in National Student Forum-Annual Report, 2009: 6). This perception coincides with the results found by Iannone and Simpson (2013), where the students' perception of mathematics about evaluation practices in higher education is explored and reveals that students perceive traditional evaluation (closed book exams).) as the main discriminator of mathematical ability.

However, the use of educational technology also poses serious challenges (Andersson and Grönlund, 2009, Aroyo and Dicheva, 2004, Sife, Lwoga and Sanga, 2007). Within the educational context, the attractiveness of the new and cost savings have often led to design strategies for adopting educational technology that are not entirely successful (Gonçalves and Pedro, 2012, Levy, 2007).

Many of these strategies have ignored important attitudinal factors that may affect the use of technology for learning, so analyzing the factors that can guarantee student satisfaction to use online assessments is the key starting point of this research. This has been confirmed by researchers in the area of information systems, who have recognized the importance of personal factors, such as attitudes, beliefs, culture and behavior for the acceptance of technology in recent decades (Davis, Bagozzi and Warshaw, 1992; Reátegui Guzmán, et al., 2015; Sun, et al., 2008). These factors are also being investigated due to the role played by the acceptance of educational technology in higher education (Cheung y Vogel, 2013; Liu, Liao y Pratt, 2009; Teo, 2009; Terzis y Economides, 2011).

On the other hand, it is important to mention that there have been previous studies in the acceptance of online assessments (Dermo, 2009, McCann, 2010, Miller, 2009, Terzis and Economides, 2011, Terzis, et al., 2012b, Terzis, Moridis and Economides, 2013). However, the acceptances of online assessments for teaching mathematics have not yet been explored.

That is why this study aims to understand what are the factors that affect the attitude, acceptance and intention to use online assessments in a context of teaching mathematics for undergraduate students in social sciences. Knowing these factors one could count on the propitious elements to make known what students consider crucial for a satisfactory design of online math assessments.

Technology acceptance model

To understand the factors involved in the acceptance of technology, researchers have used various models to study the attitude, acceptance, perception of usefulness and a person's feeling towards technology. One of these is the technology acceptance model (TAM), proposed by Davis (1989), which has proven to be a robust model to determine the attitude and intention of using technology in the educational context.

The TAM had its foundation in the theory of reasoned action (TRA) by Fishbein and Ajzen (1975). This describes how beliefs and attitudes relate to individual intentions to accomplish something. According to the TRA, attitudes towards behavior are determined by beliefs about the consequences of the behavior (based on the information available or presented to the individual) and the affective evaluation of those consequences by the person. Beliefs are defined as the estimated probability of an individual to perform a certain behavior, which will result in a given consequence.

The TRA proposes that the actual behavior of a person can be explained by their intentions and beliefs and that the intentions can be explained by their attitude and subjective norms (SN, for its acronym in English). Fishbein and Ajzen define attitude as "the degree of evaluation or favorable or unfavorable assessment of a person to conduct in question" (1975, p.287), that is, the attitude towards the use of technology is defined as a general affective reaction from the individual to the use of technology. The TRA model also establishes that attitude plays an important role in the intention to use. In recent years, researchers have used the TAM model to examine the attitudes of users to different applications of technology, such as an online learning portal (Drennan, Kennedy and Pisarski, 2005; Pando-García, 2015), showing that Having a positive attitude towards computers is beneficial for the integration of technology in educational practices (Sang, Valcke, Braak and Tondeur, 2010, Mueller, Wood, Willoughby, Ross and Specht, 2008). Fishbein and Ajzen define subjective norms as "a person's perception that most people who are important to him or her think that he or she should or should not perform the behavior in question" (1975, p. 302). The effects of SN on the intention to use are direct. We have included attitude and subjective norms in this study, the second with the name social influence.

The TAM proposes mainly two variables or constructs as the main factors that influence (antecedent) in the attitude of a person to adopt or use technology: perceived utility (PU) and perceived ease of use (PEU, for its acronym in English). Davis defines the first as "the degree to which a person believes that using a particular system would enrich their performance at work" (1989, p.320) and the second as "the degree to which a person believes that using a system in particular it would be free of physical and mental effort "(Davis, 1989, p.320).

The TAM model uses the TRA as a theoretical basis for the specification of the causal links between the perception of utility, perceived ease of use, people's attitudes, intentions and the actual behavior towards the adoption of a system.

The TAM proposes that the intention of use is influenced by the attitude toward use, as well as the direct and indirect effects of perceived utility and perceived ease of use. Both variables jointly affect the attitude toward use, showing that perceived ease of use has a direct impact on perceived utility. That is, the TAM suggests that users formulate a positive attitude to technology when they perceive useful and easy-to-use technology (Davis, 1989, p.320). We have also adapted both variables to study the effects of perceived utility and perceived ease of use in the student's attitude towards the use of online math assessments.

There are other studies in different areas that have extended the use of TAM by including different variables. Within the educational context, TAM has been widely used to predict the acceptance and use of educational technology. For example, Teo (2009) examines the degree of acceptance of technology in trainee teachers by analyzing the variables "technological complexity" and "ease of conditions". The research proposed by Cheung and Vogel (2013) incorporates additional variables such as "resources, compatibility", "exchange of knowledge" and extends the variable "subjective norms", represented by peers, teachers and the media to explain the factors that influence the intentions of students to use Google applications (Google Applications) for collaborative learning. For the educational evaluation, Terzis and Economides (2011) analyze the effect of students' intention to behave in order to use computer-based assessments (CBA), adding "content" and "goal expectations" as two new variables.

Given that external factors may influence attitudes, in this context we consider including accessibility to technology services, or as already mentioned, "ease of conditions" as a potential factor. This is similar to what Venkatesh, et al. (2003, p.453) called "technology and conditions that facilitate resources." In this regard, Venkatesh explains that "in the context of the use of technology in the workplace, specific issues such as the availability of support staff, is a response from the organization, to help users overcome barriers and obstacles to the use of technology, especially in the early stages of learning and use "(2000, p.187). In other words, the conditions that facilitate the use of technology include environmental factors that shape a person's perception of the ease or difficulty of performing a task (Teo, 2012, p.7). It covers factors such as technical support (provision of online help desks and support services), which has been cited as one of the important factors in the acceptance of educational technology and in the satisfaction of users (Williams, 2002 ; Teo, 2012).

According to the structure of the TAM and the factors involved in this research, the following model and hypothesis is proposed. The rest of the article presents, in the first instance, the materials and methods, then the results of the proposed research model. Finally, the results are discussed and conclusions are presented.

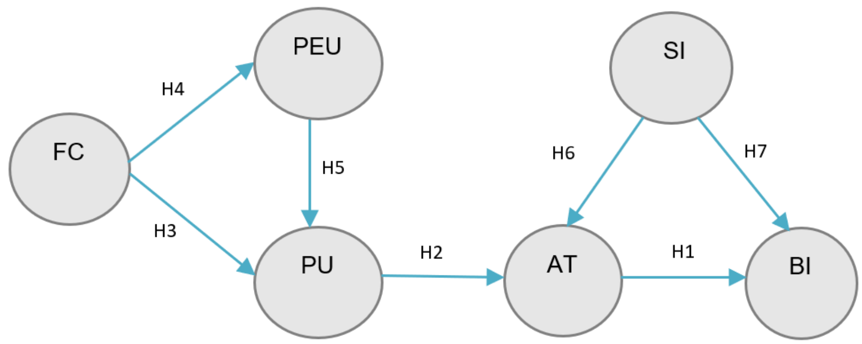
Materials and methods

Research model and hypothesis

Figure 1 shows the research model with the hypothetical relationships between the different constructs, from which the following hypotheses emerge:

- H1: There is a causal relationship between attitude (AT) and intention to use online assessments (BI).
- H2: There is a causal relationship between perceived utility (PU) and attitude to using online assessments (AT).
- H3: There is a causal relationship between ease of conditions (FC) and perceived utility to use online assessments (PU).
- H4: There is a causal relationship between ease of conditions (FC) and perceived ease of use of online assessments (PEU).
- H5: There is a causal relationship between perceived ease of use (PEU) and perceived utility to use online assessments (PU).
- H6: There is a causal relationship between social influence (SI) and attitude to using online assessments (AT).
- H7: There is a causal relationship between social influence (SI) and intention to use online assessments (BI).

Figura 1. Representación visual del modelo para las respuestas del estudiante.



Las flechas representan relaciones hipotéticas entre las variables latentes. PU: Utilidad Percibida, PEU: Facilidad de Uso Percibida, FC: Facilidad de Condiciones, SI: Influencia Social, AT: Actitud, BI: Intención de uso.
Fuente: Elaboración propia

Research method

To test the proposed model, a questionnaire was applied that included 15 items (Table 6), which are based on and adapted from previous research (Davis, 1989, Ajzen, 1991, Bandura, 1986). The questionnaire was applied online to the students of the Higher School of Commerce and Administration Unit Tepepan of the National Polytechnic Institute, in Mexico City, during the polyvirtual period from March to June 2014. The students surveyed were studying one of the following bachelor's degrees in the area of social sciences: Public Accountant, International Business or Commercial Relations. Likewise, they were studying some of the mathematics subjects taught by the institution (Mathematics for Business, Financial Mathematics, Statistics for Business, Descriptive and Inferential Statistics, Statistical Method and Applied Statistics).

Each item was evaluated on a five-point Likert scale with response options between strongly disagree (1) and totally agree (5). A total of 26 responses were obtained, of which three were withdrawn, since one was an incomplete response and two repeated a single response (standard deviation = 0) resulting in a data set of 23 respondents.

With this set of 23 surveys the statistical method Structural Equation Models (SEM) was used, which is evaluated following a two-layer method. The first involves estimating the path model or exterior (measurement model) for all latent variables. In this, it is determined how well the variables observed (indicators) are adjusted to the unobserved (latent) variables. In the second layer, the structural (causal) or internal model includes the relationships between hypothetical latent variables, also called constructs. These variables represent attitudes, feelings and opinions of a person. From the relationships between the constructs the hypotheses are established according to the logical and theoretical reasoning (Götz, Liehr-Gobbers y Krafft, 2010).

To evaluate both models, the PLS-SEM analysis (SmartPLS 2.0) was used (Ringle, Wende and Will, 2005). Terzis and Economides (2011), and Hair, Sarstedt, Ringle and Mena (2012) point out that this method is particularly appropriate for: a) small-sized samples, b) testing theories in early stages of development (Fornell and Bookstein, 1982; Hair, et al., 2012) and c) predict better (when compared with techniques based on covariance, CB-SEM). In the field of acceptance of educational technology there are several studies that apply the PLS-SEM analysis, such as Gong, Xu and Yu (2004); Terzis, et al., (2012b), and Sánchez-Franco, Peral-Peral and Villarejo-Ramos (2014).

According to the literature there are several criteria to validate a model of structural equations. In relation to sample size, PLS-SEM works efficiently with small sample and complex models, and makes virtually no assumptions about the underlying data [distribution] (Hair, Ringle, & Sarstedt, 2013; Hair, Hult, Ringle, & Sarstedt, 2014). In PLS-SEM, the guideline is that the size of the sample should be ten times the number of arrows pointing to a constructor (Hair et al., 2014). Given that the proposed model has two independent variables that impact a dependent variable, the proposed model complies with what was suggested by these authors.

The external model specifies the relationship between the observed variables and their underlying construct for the purpose of evaluating their quality. For this purpose, several criteria mentioned below are evaluated:

a) Validity of the construct. It is the composite reliability index that is used to test the fit of a construct measured by its assigned observed variables (Götz, et al., 2010, p.695). This index can vary between 0 and 1. values greater than 0.6 are considered acceptable (Bagozzi and Yi, 1988). The composite reliability index is similar to Cronbach's alpha index.

b) Convergent validity. This shows when each indicator correlates strongly with the indicators of the same theoretical construct. An accepted measure to analyze convergent validity is the average variance extracted (AVE, for its acronym in English), defined by Fornell and Larcker (1981). The AVE explains the variance of the indicators that is captured by the underlying construct. An AVE of more than 0.5 is considered sufficient (Götz, et al., 2010, 696).

c) Reliability of the indicator. Shows how much the variation of an indicator can be explained by the theoretical construct. A common criterion is that more than 50% of the variance of an indicator must be explained by the underlying construct, which means that indicator loads greater than 0.7 are acceptable. Empirical research may include weak loads, especially when new scales are applied (Hulland, 1999).

d) Discriminant validity. It is shown when each indicator is weakly correlated with all other constructs, except with that which is theoretically associated and is confirmed when the square root of AVE of a construct is greater than any other correlation (of any other construct with which it is not associated). theoretically), also known as Fornell and Larcker criteria (1981).

Results

In this section, the coefficients of validity of the construct will be revealed, in the first instance, the coefficients of the indicator loads, and then the hypothesis tests will be announced. After executing both the internal model and the external model, table 1 shows the results of the coefficients of validity of the constructs.

Tabla 1. Coeficientes de validez del constructo convergente y discriminante para el modelo exterior.

	AVE	Índice de Fiabilidad Compuesto	AT	BI	FC	PEU	PUS	SI
AT	0.821	0.932	**0.906**					
BI	0.844	0.915	0.621	**0.919**				
FC	0.698	0.822	0.648	0.363	**0.835**			
PEU	0.908	0.952	0.545	0.411	0.793	**0.953**		
PU	0.771	0.931	0.388	0.632	0.294	0.527	**0.878**	
SI	0.711	0.861	0.599	0.434	0.686	0.359	0.248	**0.869**

En la diagonal principal, la raíz cuadrada de AVE de cada constructo.

Fuente: Elaboración propia

Table 1 shows the coefficients for the composite reliability of each construct, which are greater than 0.5. The coefficients of the average variance extracted (AVE) are also shown for all constructs and it can be seen that all cases exceed the appropriate value (0.5). All values of the square roots of AVE are higher than any correlation value. The range for AVE values is between 0.671 to 0.928, which confirms the convergent validity. The indices for composite reliability ranged from 0.803 to 0.963 demonstrating reliability for all constructs, so this model complies with the composite reliability criterion.

The results presented indicate that the constructs are reliable. However, the Cronbach alpha of the whole scale with a value of 0.947 is included as an additional data, which shows a very adequate reliability value. Also, Table 2 includes the Cronbach alpha indices for each variable or construct that shows adequate values, including the FC construct that shows a value (α = .60), which according to Hair, Black, Babin and Anderson (2010) , is an acceptable value ($0.6 \leq \alpha < 0.7$) for an exploratory study like the present one.

The values that comply with the recommended minimum indexes to achieve discriminant validity were obtained following the Fornell and Larcker criteria (1981). Table 1 shows the square roots of the AVE values (values in the diagonal of the table) and the correlations of the latent variables (values to the right of the diagonal). It can be seen that all the square roots of the

AVE values are higher than any other correlation value. Therefore, discriminant validity is met in this analysis.

Tabla 2. Estadística descriptiva y alfa de Cronbach.

		Media ()	Desviación Estándar ()	Varianza()
	Utilidad Percibida (α = 0.90)			
PU1	Responder exámenes en línea mejora mi aprendizaje.	3.261	1.096	1.202
PU2	Hacer evaluaciones en línea mejora mi trabajo.	3.609	0.988	0.976
PU3	Realizar exámenes en línea aumenta mi productividad.	3.043	1.107	1.225
PU4	Encuentro útil usar exámenes en línea para evaluar mi aprendizaje.	3.304	1.222	1.494
	Facilidad de Uso Percibida (α = 0.90)			
PEU1	Me resulta sencillo usar exámenes en línea para apoyar mi aprendizaje.	3.348	1.071	1.146
PEU2	He utilizado exitosamente computadoras e Internet antes de hacer exámenes en línea.	4.000	0.798	0.636
	Influencia Social (α = 0.70)			
SI1	Las autoridades de mi escuela apoyan el uso de exámenes en línea para mi aprendizaje.	3.217	1.126	1.269
SI2	La gente a mi alrededor es positiva sobre el uso de exámenes en línea.	3.043	0.928	0.862
	Facilidad de Condiciones (α = 0.60)			
FC1	La velocidad de banda ancha de Internet en mi universidad es suficientemente buena para contestar mis exámenes en línea.	3.087	1.311	1.719
FC2	Considero que mi universidad tiene suficiente infraestructura tecnológica para apoyar el aprendizaje en línea.	3.783	0.998	0.996
	Actitud (α = 0.90)			
AT1	Creo que hacer exámenes en línea es más interesante para mi aprendizaje.	3.261	1.096	1.202
AT2	Considero que hacer exámenes en línea es divertido.	2.957	1.022	1.043
AT3	Espero con interés esos aspectos de mi aprendizaje que requieren que haga evaluaciones en línea.	3.261	1.137	1.292
	Intención de Uso (α = 0.80)			
BI1	Tengo la intención de usar exámenes en línea para apoyar mi aprendizaje en un futuro.	3.478	0.846	0.715
BI2	Mi predicción es que usaré exámenes en línea para evaluar mis habilidades aprendidas en un futuro.	3.348	1.027	1.055

Fuente: Elaboración propia

Table 3 shows the reliability coefficients of the indicators, the results show values above the recommended criterion. Therefore, the indicator loads are values that validate that more than 50% of the variance of each indicator is explained by the underlying latent construct.

Tabla 3. Coeficientes de las cargas de los indicadores.

	AT	BI	FC	PEU	PUS	SI
AT1	0.926					
AT2	0.868					
AT3	0.923					
BI1		0.907				
BI2		0.93				
FC1			0.847			
FC2			0.825			
PEU1				0.959		
PEU2				0.947		
PU1					0.943	
PU2					0.771	
PU3					0.88	
PU4					0.91	
SI1						0.861
SI2						0.878

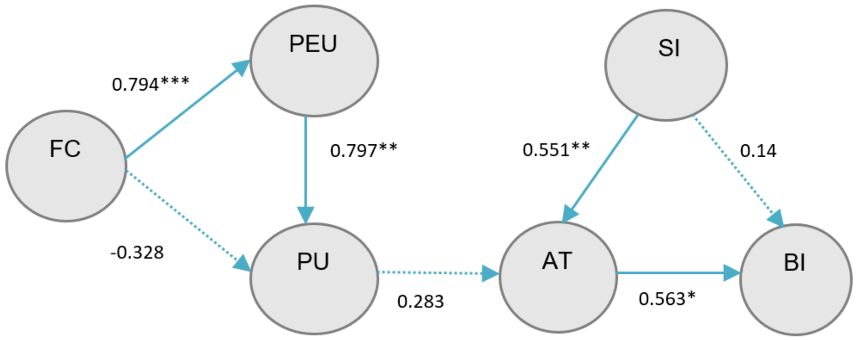
Fuente: Elaboración propia

The reliability and validity of the external model were confirmed by its internal consistency, convergent validity and discriminant validity. Therefore, the exterior model is within the recommended ranges, achieving a good fit. In other words, it has been proven that the model is a good representation of the data.

The significance of the causal relationships was tested given the estimated trajectory coefficients, by means of the t-student test, which can be obtained by the bootstrapping procedure, which treats the observed sample as if it represented the population. The procedure creates a large, pre-specified number of bootstrap samples. Each sample has the same number of cases as the original sample. Each sample is created by obtaining random cases with replacement of the original sample. Once the mean and the standard error of each relation are obtained, a t-student test is carried out to verify its significance (Henseler, Ringle and Sinkovics, 2009, p.306).

After the constructs have been confirmed as reliable and valid, the next step is to evaluate the structural model, with the aim of identifying patterns in the relationships between the data. Figure 2 shows the coefficients of the trajectories and the levels of significance.

Figura 2. Modelo estructural usado para las pruebas de las hipótesis (coeficientes de la trayectoria).



Las significancias de los coeficientes de las trayectorias mostrados son: * p<0.05, ** p<0.01, ***p<0.001.
Fuente: Elaboración propia

Analysis of hypotheses

H1 predicts a causal relationship between attitude and intention to use. The results show that the attitude shows effects in the intention of use with a trajectory coefficient (β: 0.536, t = 2.014, p = 0.045), therefore, this hypothesis is accepted. The causal relationship between perceived utility and attitude (H2) is not significant in (β: 0.283, t = 1.096, p = 0.274). H3 shows that the ease of conditions is not a significant determinant of perceived utility (β: -0.328, t = 0.362, p = 0.362), so this hypothesis is not accepted. The causal relationship between ease of conditions and perceived ease of use (H4) is strongly accepted in (β: 0.794, t = 6.658, p = 0.732E-11). H5 predicts a causal relationship between perceived ease of use and perceived utility (β: 0.797, t = 2.75, p = 0.006), then this hypothesis is accepted. The causal relationship between social influence and attitude (H6) is significant in (β: 0.551, t = 3.038, p = 0.003), therefore, this hypothesis is accepted. H7 shows that social influence is not a significant determinant of intention to use (β: 014, t = 0.384, p = 0.701), so it is concluded that this hypothesis is not accepted.

The coefficients of determination (R^2) they are values between 0 and 1; Higher values indicate a higher level of prediction accuracy. The construct perceived ease of use was predicted by ease of conditions, this explains 62% (R^2 = 0.629) of the perceived ease of use variance, which indicates a general value R^2. The perceived utility was predicted by ease of conditions and perceived ease of use, both constructs explain a moderate effect (Chin, 1998) of about 32% (R^2 =

0.319) of the variance in perceived utility. The attitude was predicted by perceived utility and social influence, both explaining 42% ($R^2 = 0.420$) of the variance in attitude, a moderate effect. Intention of use was predicted by attitude and social influence, both explaining a moderate effect of 39% of the variance ($R^2 = 0.392$).

Discussion

Online assessments are part of educational technology. The objective of this study is to extend prior knowledge of the technology acceptance model and adapt it to the context of online assessments for financial mathematics subjects for higher education.

The results reveal that the construct ease of conditions shows a strong effect, which means that the causal relationship between ease of conditions and perceived ease of use is very significant. This could imply that when students have technological resources (technical support, such as help desks, online support services and guidance from technical support staff) they perceive that it is easier to use technology. Providing technical assistance makes it easier to use the online environment. This may indicate that it is very important for students to have the technological communication facilities, such as the speed of the internet, an environment that is functioning properly and that have technical assistance. This result is comparable with the findings of Venkatesh and Davis (2000), Lim and Khine (2006), Zhang (2016) and Acosta-Gonzaga and Walet (2017), whose results show that aspects related to support structures (a central concept within the construct ease of conditions) are largely included within perceived ease of use. Likewise, the results also reveal that the construct ease of conditions does not show direct effects on perceived utility, but rather through ease of use as already explained. This could imply that it is important that the student first perceives the ease in the use of the technology, granting him the appropriate technological facilities, so that later he can perceive usefulness.

The perceived ease of use shows effects on perceived utility (PEU -> PUS = 0.791). This finding implies that the student perceives that it is easy to use the platform to do online exams, which encourages him to also consider it useful.

The results also show that perceived utility has no influence on the attitude construct. This could mean that evaluation strategies should be redesigned where tangible and systematic benefits are shown, including innovative evaluation methods and online formative assessment practices, in order to foster the most favorable attitude among the students.

According to researchers Venkatesh and Davis (2000) and Venkatesh, Morris, Davis and Davis (2003), social influence has a significant effect when (the study context) is mandatory, but not when it is voluntary. The results reveal that this construct has an important effect on attitude, which corroborates that in this study the use of technology is mandatory, since students are studying an online degree (Public Accountant, International Business or Commercial Relations). The findings also reveal that students somehow feel influence from authorities (teachers) and peers (classmates) to use the online environment.

The results show that the attitude construct has influence on intention of use (AT -> BI = 0.536). This is consistent with previous research that suggests that attitude towards use is a significant predictor of the intention to use technology, mainly under mandatory conditions (Venkatesh, Morris, Davis and Davis, 2003, Teo and Noyes, 2011). Taking these results into account, we can consider that encouraging a positive attitude in students is the ideal way to use technologies, through the creation of effective communication strategies between authorities, teachers and classmates.

On a more extensive examination of this finding, the attitude construct is significant only when the constructs related to performance and effort expectations are not included in the model (Davis, et al., 1989). Therefore, the inclusion of these concepts is grounds for subsequent investigations.

Based on the findings, the attitude of the students increases the intention to use online exams. Similarly, an increase in the ease of conditions leads to an increase in the perceived ease of use and the latter increases the utility perceived by the students. This shows that factors such as ease of conditions and perceived ease of use positively influence the usefulness of the tool. Finally, the increase in social influence clearly contributes to the student having a good disposition to use technology to perform math exams. On the other hand, hypotheses H2, H3 and H7 were not significant.

Conclusions

This study explored the factors that influence behavioral intention to use online assessments within a higher education school that teaches online degrees in social science areas. Both models (interior and exterior) were supported by the data collected, therefore, this research leads to the following conclusions.

The attitude construct showed to be a determinant of the behavioral intention to use online evaluations, this is consistent with previous research that suggests that the attitude towards use is a significant predictor of the intention to use technology, mainly under mandatory conditions of use of the same (Venkatesh, et al., 2003).

Given that social influence plays an important role, school authorities could devise strategies to implement effective support structures that include the same authorities and teachers where students obtain successful experiences in the use of technology, which would contribute to Cultivate a positive attitude to ensure its continuous use over time.

It is also important to ensure that students have the appropriate technological infrastructure, including adequate technical support (online help and support services) as well as technological facilities such as the speed of the Internet and the environment working properly. In this sense, the administrative authorities play an important role, as Whitelock, Mackenzie, Whitehouse, Ruedel and Rae (2006, p.508) point out, a successful implementation of electronic evaluation depends on institutional and administrative support.

This study also provides useful results for decision makers in the implementation of educational technology. The research highlights important factors that an online assessment platform has to consider in order to be used effectively by students. The results show that the social environment and the conditions that facilitate technological resources play a very important role in fostering a positive attitude in students and guaranteeing their use over time. Given that authorities and teachers can influence their attitude, it is important to maintain close communication with students, in order to promote the use of educational technology and contribute to forming an acceptable image of a subject considered difficult. Therefore, this study offers a first step towards analyzing the acceptance of online assessments with math content for undergraduate students in social sciences.

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References

Acosta-Gonzaga, E. y Walet, N.R. (2017). The role of attitudinal factors in mathematical on-line assessments: a study of undergraduate STEM students. *Assessment & Evaluation in Higher Education*. 43(3), 1-17. DOI: 10.1080/02602938.2017.1401976.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. DOI: 10.1016/0749-5978(91)90020-T.

Andersson, A. S. y Grönlund, Å. (2009). A conceptual framework for e-learning in developing countries: A critical review of research challenges. *The Electronic Journal of Information Systems in Developing Countries*, *38*(8), 1-16.

Aroyo, L. y Dicheva, D. (2004). The new challenges for e-learning: The educational semantic web. *Educational Technology & Society*, *7*(4), 59-69.

Bagozzi, R. P. y Yi, Y. (1988). On the Evaluation of Structural Equation Models. *Journal of the Academy of Marketing Science*, *16*(1), 74-94. DOI: 10.1177/009207038801600107.

Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Nueva Jersey: Prentice Hall.

Black, P. y Wiliam, D. (1998). Assessment and Classroom Learning. *Assessment in Education: Principles, Policy & Practice*, *5*(1), 7–74. DOI: 10.1080/0969595980050102.

Bennett, R. E. (1998). Reinventing Assessment. Speculations on the Future of Large-Scale Educational Testing. A Policy Information Perspective. *Policy Information Center, Educational Testing Service, 1-20 Princeton*. Recuperado de http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED424254.

Brown, G., Bull, J., y Pendlebury, M. (1997). *Assessing student learning in higher education*. Londres: Routledge.

Bucheli, M. G. V. (2015). Manejo de herramientas de la web 2.0 como base para fortalecer procesos de mediación tecnológica. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, *6*(11), 588-604. Recuperado de https://www.ride.org.mx/index.php/RIDE/article/view/140.

Buzetto-More, N. A. y Alade, A. J. (2006). Best Practices in e-Assessment. *Journal of Information Technology Education*, *5*, 251–269.

Centeno, B. D. A. y Lira, O. A. (2015). Sistema de evaluaciones en línea como herramienta para los niveles de educación media superior. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, *6*(11). 1-34 Recuperado de https://www.ride.org.mx/index.php/RIDE/issue/view/11.

Cheung, R. y Vogel, D. (2013). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Computers & Education*, *63 (2013)*, 160-175. DOI: 10.1016/j.compedu.2012.12.003.

Chin, W. W. (1998). The partial least squares approach for structural equation modeling. *Modern methods for business research*, 295(2) 295-336. Nueva Jersey: Lawrence Erlbaum Associates Publishers.

Cisneros, L. V. (2017). Las Tecnologías de la Comunicación. ¿Incorporación/Exclusión Educativa en Guanajuato? *Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, *7*(14), 325-344. DOI: 10.23913/ride.v7i14.287.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319-340. DOI: 10.2307/249008.

Davis, F. D., Bagozzi, R. P., y Warshaw, P. R. (1992). Extrinsic and Intrinsic Motivation to Use Computers in the Workplace. *Journal of Applied Social Psychology*, *22*(14), 1111-1132. DOI: 10.1111/j.1559-1816.1992.tb00945.x.

Dermo, J. (2009). e-Assessment and the student learning experience. A survey of student perceptions of e-assessment. *British Journal of Educational Technology*, *40*(2), 203-214. DOI: 10.1111/j.1467-8535.2008.00915.x.

Dreher, C., Reiners, T., y Dreher, H. (2011). Investigating Factors Affecting the Uptake of Automated Assessment Technology. *Journal of Information Technology Education*, 10 (2011), 161-181.

Drennan, J., Kennedy, J., y Pisarski, A. (2005). Factors Affecting Student Attitudes Toward Flexible Online Learning in Management Education. *The Journal of Educational Research*, *98*(6), 331-338. DOI: 10.3200/JOER.98.6.331-338.

Fishbein, M. y Ajzen, I. (1975). *Belief, attitude, intension and behavior: An introduction to theory and research*. Massachusetts: Addison Wesley.

Freitas, D. A., Santos, E. M. D. S., Lima, L. V. D. S., Miranda, L. N., Vasconcelos, E. L., y Nagliate, P. D. C. (2016). Teachers' knowledge about teaching-learning process and its importance for professional education in health. *Interface-Comunicação, Saúde, Educação*, 20(57), 437-448.

Fornell, C. y Bookstein, F. L. (1982). Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory. *Journal of Marketing Research*, *19*(4), 440-452. DOI: 10.2307/3151718.

Gikandi, J. W., Morrow, D., y Davis, N. E. (2011). Online formative assessment in higher education: A review of the literature. *Computers & Education*, *57*(4), 2333-2351. DOI: 10.1016/j.compedu.2011.06.004.

Gill, M. y Greenhow, M. (2008). How effective is feedback in Computer Aided Assessments? Learning. *Media and Technology*, *33*(207–220). DOI: 10.1080/17439880802324145.

Gonçalves, A. y Pedro, N. (2012). Innovation, e-learning and higher education: an example of a University'LMS adoption process. *WASET*, *Proceedings of the International Conference in Higher Education*, 1075-1082.

Gong, M., Xu, Y., y Yu, Y. (2004). An enhanced technology acceptance model for web-based learning. *Journal of Information Systems Education*, *15*(4), 365-374.

Götz, O., Liehr-Gobbers, K., y Krafft, M. (2010). Evaluation of Structural Equation Models Using the Partial Least Squares (PLS) Approach. En V. Esposito Vinzi, W. W. Chin, J. Henseler, y H. Wang (Eds.), *Handbook of Partial Least Squares*, 691-711. DOI: 10.1007/978-3-540-32827-8_30.

Gunasekaran, A., McNeil, R. D., y Shaul, D. (2002). E-learning: research and applications. *Industrial and Commercial Training*, *34*(2), 44-53. DOI: 10.1108/00197850210417528.

Hair, J. F., Black, W. C., Babin, B. J., y Anderson, R. E. (2010). *Multivariate Data Analysis*. Nueva Jersey: Prentice Hall.

Hair, J. F., Hult, G. T. M., Ringle, C., y Sarstedt, M. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Thousand Oaks: California. SAGE Publications.

Hair, J. F., Ringle, C. M., y Sarstedt, M. (2013). Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance. *Long Range Planning*, *46*(1-2), 1-12. DOI: 10.1016/j.lrp.2013.01.001.

Hair, J. F., Sarstedt, M., Ringle, C. M., y Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, *40*(3), 414-433. DOI: 10.1007/s11747-011-0261-6.

Heinrich, E., Milne, J., y Moore, M. (2009). An Investigation into E-Tool Use for Formative Assignment Assessment-Status and Recommendations. *Educational Technology & Society*, *12*(4), 176–192.

Henseler, J., Ringle, C. M., y Sinkovics, R. R. (Eds.). (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing, 20*. Bingley: Emerald Group Publishing. Recuperado de https://www.escholar.manchester.ac.uk/uk-ac-man-scw:89555.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategic Management Journal*, *20*(2), 195-204. DOI: 10.1002/(SICI)1097-0266(199902)20:2<195::AID-SMJ13>3.0.CO;2-7.

Iannone, P. y Simpson, A. (2013). Students' perceptions of assessment in undergraduate mathematics. *Research in Mathematics Education*, *15*(1), 17-33. DOI: 10.1080/14794802.2012.756634.

Joint Information Systems Committee. (2007). *Effective practice with e-assessment*. The Higher Education Funding Council for England (HEFCE) on behalf of JISC. Recuperado de http://www.jisc.ac.uk/publications/programmerelated/2007/pub_eassesspracticeguide.aspx.

_______ (2010). *Effective Assessment in a Digital Age*. The Higher Education Funding Council for England (HEFCE) on behalf of JISC. Recuperado de http://www.jisc.ac.uk/digiassess.

Larson, M. R. y Bruning, R. (1996). Participant perceptions of a collaborative satellite-based mathematics course. *American Journal of Distance Education*, *10*(1), 6-22. DOI: 10.1080/08923649609526906.

Levy, Y. (2007). Comparing dropouts and persistence in e-learning courses. *Computers & Education*, *48*(2), 185-204. DOI: 10.1016/j.compedu.2004.12.004.

Lim, C. P. y Khine, M. (2006). Managing Teachers' Barriers to ICT Integration in Singapore Schools. *Journal of Technology and Teacher Education*, *14*(1), 97-125.

Liu, S. H., Liao, H. L., y Pratt, J. A. (2009). Impact of media richness and flow on e-learning technology acceptance. *Computers & Education*, *52*(3), 599-607. DOI: 10.1016/j.compedu.2008.11.002.

McCann, A. L. (2010). Factors affecting the adoption of an e-assessment system. *Assessment & Evaluation in Higher Education*, *35*(7), 799-818. DOI: 10.1080/02602930902981139.

McCollum, K. (1997). A Professor Divides His Class in Two to Test Value of On-Line Instruction. *Chronicle of Higher Education*, *43*(24), A23-A45. Recuperado de http://www.eric.ed.gov/ERICWebPortal/detail?accno=EJ541256.

Miller, T. (2009). Formative computer-based assessment in higher education: the effectiveness of feedback in supporting student learning. *Assessment & Evaluation in Higher Education*, *34*(2), 181-192. DOI: 10.1080/02602930801956075.

Mueller, J., Wood, E., Willoughby, T., Ross, C., y Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers & Education*, *51(4)*, 1523-1537. DOI: 10.1016/j.compedu.2008.02.003.

National Student Forum-Annual Report. (2009). Recuperado de http://webarchive.nationalarchives.gov.uk/20100519174430/nationalstudentforum.com/report2009/.

Pando-Garcia, J., Periañez-Cañadillas, I., y Charterina, J. (2015). Business simulation games with and without supervision: An analysis based on the TAM model. *Journal of Business Research*. DOI: 10.1016/j.jbusres.2015.10.046.

Reátegui Guzmán, L. A., Izaguirre Sotomayor, M. H., Mori Ramirez, H., Castro Tamayo, R. S., y Aguedo Sussan, N. (2015). Actitud de estudiantes y profesores del Departamento de Pediatría hacia las tecnologías de la información y comunicación (TICs). *Anales de la Facultad de Medicina*, *76*(3), 261-264.

Ringle, C., Wende, S., y Will, A. (2005). *SmartPLS 2.0.M3*. Recuperado de http://www.smartpls.de. Recuperado de http://www.pls-sem.com/.

Salazar, R. L. C. y Flores, S. G. T. (2016). Diagnóstico del uso de las tecnologías en el proceso de enseñanza y aprendizaje en la educación superior. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo*, *7*(13), 273-292. Recuperado de https://www.ride.org.mx/index.php/RIDE/article/view/249.

Sánchez-Franco, M. J., Peral-Peral, B., y Villarejo-Ramos, A. F. (2014). Users' intrinsic and extrinsic drivers to use a web-based educational environment. *Computers & Education*, *74(2014)*, 81-97. DOI: 10.1016/j.compedu.2014.02.001.

Sang, G., Valcke, M., van Braak, J., y Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: predictors of prospective teaching behaviors with educational technology. *Computers & Education*, *54*(1), 103-112. DOI: 10.1016/j.compedu.2009.07.010.

Sife, A., Lwoga, E., y Sanga, C. (2007). New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *International Journal of Education and Development using ICT*, *3*(2), 250-260.

Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., y Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education*, *50*(4), 1183-1202. DOI: 10.1016/j.compedu.2006.11.007.

Taylor, J. C. (1995). Distance education technologies: The fourth generation. *Australasian Journal of Educational Technology*, *11*(2), 1-7.

Teo, T. (2009). Modelling technology acceptance in education: A study of pre-service teachers. *Computers & Education*, *52*(2), 302-312. DOI:10.1016/j.compedu.2008.08.006.

_______ (2012). Examining the intention to use technology among pre-service teachers: an integration of the Technology Acceptance Model and Theory of Planned Behavior. *Interactive Learning Environments*, *20*(1), 3-18. DOI: 10.1080/10494821003714632.

Teo, T. y Noyes, J. (2011). An assessment of the influence of perceived enjoyment and attitude on the intention to use technology among pre-service teachers: A structural equation modeling approach. *Computers & Education*, *57*(2), 1645-1653. DOI: 10.1016/j.compedu.2011.03.002.

Terzis, V. y Economides, A. A. (2011). The acceptance and use of computer based assessment. *Computers & Education*, *56*(4), 1032-1044. DOI: 10.1016/j.compedu.2010.11.017.

Terzis, V., Moridis, C. N., y Economides, A. A. (2012a). How student's personality traits affect Computer Based Assessment Acceptance: Integrating BFI with CBAAM. *Computers in Human Behavior*, *28*(5), 1985-1996. DOI: 10.1016/j.chb.2012.05.019.

_______ (2012b). The effect of emotional feedback on behavioral intention to use computer based assessment. *Computers & Education*, *59*(2), 710-721. DOI: 10.1016/j.compedu.2012.03.003.

_______ (2013). Continuance acceptance of computer based assessment through the integration of user's expectations and perceptions. *Computers & Education*, *62*(0), 50-61. DOI: 10.1016/j.compedu.2012.10.018.

Torrealba, G. (2008). Las TIC y la metodología de proyectos de aprendizaje: algunas experiencias en formación de docentes. *Educere*, *12*(40), 71-78.

Venkatesh, V. y Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, *46*(2), 186-204. DOI: 10.1287/mnsc.46.2.186.11926.

Venkatesh, V., Morris, M. G., Davis, G. B., y Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425-478.

Wang, W. T. y Wang, C. C. (2009). An empirical study of instructor adoption of web-based learning systems. *Computers & Education*, *53*(3), 761-774. DOI: 10.1016/j.compedu.2009.02.021.

Wang, N., Xu, L., Li, L. Y., y Xu, L. X. (2013). Design and Implementation of an Automatic Scoring Subjective Question System Based on Domain Ontology. *Advanced Materials Research*, *753(2013)*, 3039-3042.

Whitelock, D. M., Mackenzie, D., Whitehouse, C., Ruedel, C., y Rae, S. (2006). Identifying innovative and effective practice in e-assessment: findings from seventeen UK case studies. En M. Danson (Ed.), *Proceedings of the 10th CAA International Computer Assisted Assessment Conference*, 505-511. Loughborough. Recuperado de http://oro.open.ac.uk/11949/.

Whitelock, D. M. y Brasher, A. (2006). Developing a Roadmap for e-Assessment: Which Way Now? En M. Danson (Ed.), *Proceedings of the 10th CAA International Computer Assisted Assessment Conference*, 487-501. Loughborough. Recuperado de. http://oro.open.ac.uk/11950/.

Whitelock, D. y Raw, Y. (2003). Taking an electronic mathematics examination from home: what the students think. *Computer Based Learning in Science, New Technologies and their Applications in Education 1*, 701-713. Nicosia: Department of Educational Sciences, University of Cyprus. Recuperado de http://citeseerx.ist.psu.edu/viewdoc/summary;jsessionid=BB0BD94AD163923F458E4E8E255C6C17?doi=10.1.1.372.3458.

Whitelock, D. M. y Watt, S. (2008). Reframing e-assessment: adopting new media and adapting old frameworks. *Learning, Media and Technology*, *33(3)*, 151-154. DOI: 10.1080/17439880802447391.

Williams, P. (2002). The Learning Web The Development, Implementation and Evaluation of Internet-Based Undergraduate Materials for the Teaching of Key Skills. *Active Learning in Higher Education*, *3*(1), 40-53. DOI: 10.1177/1469787402003001004.

Zhang, J. (2016). Can MOOCs be interesting to students? An experimental investigation from regulatory focus perspective. *Computers & Education*, *95*(2016) 340-351. DOI: 10.1016/j.compedu.2016.02.003.