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THE INFLUENCE OF INSTITUTIONAL MEASURES AND TECHNOLOGICAL PROFICIENCY ON UNIVERSITY TEACHING THROUGH DIGITAL PLATFORMS

[*Influencia de las medidas institucionales y la competencia tecnológica sobre la docencia universitaria a través de plataformas digitales*]

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Ficha del artículo
Sobre los autores
Formato HTML

Abstract

The objective of this study is to empirically test the theoretical model that explains the influence of primary and secondary factors on the integration of digital platforms in university teaching. A sample of 495 teachers from universities in Andalusia completed an online questionnaire that analysed the functions of usage, the digital materials used, the didactic and technological proficiency of the teaching staff, the support measures adopted by the institutions and the effect on teaching of platform use. Prior factor analysis and the application of the Amos program enabled us to develop a structural equation model to corroborate the indirect influence of the support measures and institutional recognition on teachers in their use of the platforms, and the direct influence of the teachers' technological proficiency.

Resumen

Este estudio tiene como objetivo poner a prueba empíricamente el modelo teórico que explica la influencia de los factores de primer y segundo orden sobre la integración de las plataformas digitales en la docencia universitaria. Para ello, sobre una muestra de 495 profesores universitarios andaluces, se aplica un cuestionario online que analiza las funciones de uso, materiales digitales utilizados, competencia didáctica y tecnológica del profesorado, medidas de impulso institucionales, y efectos didácticos del uso. El análisis factorial previo y la aplicación del programa Amos permite la elaboración un modelo de ecuación estructural que corrobora la influencia indirecta de las medidas de apoyo y el reconocimiento institucional sobre los efectos didácticos del uso de plataformas, así como la influencia directa de la competencia tecnológica del profesorado.

Keywords

Learning Management System (LMS), university teaching, technological proficiency, support measures, technological effects.

Descriptores

TIC, Sistema de Gestión del Aprendizaje, docencia universitaria, competencia tecnológica, medidas de impulso, efectos tecnológicos.

It is common knowledge that merely having information and communication technologies in the classroom is no guarantee of better quality education unless there is total commitment to integrate them into the teaching-learning process. Various studies have attempted to explain this paradox (Bilbeau, 2002; Newhouse, 2002; Pelgrum & Plomp, 2002; Richardson, 2002; Hew & Brush 2007; Somekh, 2008; Inan & Lowther, 2010; Montero & Gerwerc, 2010) via explicative models that show the dialectic relation between the variables that influence the integration of technology in the classroom by differentiating between first- and second-order factors or barriers (Brickner, 1995; Ertmer, 1999, 2001, 2005; Pelgrum, 2001; Georgina & Olson, 2008; Colás & Casanova, 2010).

The teacher is influenced by first-order factors (external) such as access to technology, availability of time, support, materials and training, and second-order factors (internal), attitudes, beliefs, practices and resistance, all of which affect teachers' efforts to integrate technology in the classroom (Brickner, 1995).

Although numerous studies have demonstrated that such factors influence the use of technology in teaching, most do not contain empirical models that test the simultaneous influence of various aspects, or if they do, they are not applied to the university context. This study attempts to corroborate the influence of these aspects on the didactic effects of the use of digital materials in learning management systems or platforms within university teaching.

First-order factors: institutional stimulus measures

Many studies examine the role that first-order factors play in the efficacy of processes to integrate technology (Owen, 2006; Fletcher, 2006). These are defined as:

- Access to technology. Fortunately in the West, this factor is less influential as an obstacle to technology integration since equipment, networks and Internet access to them are increasingly an everyday part of life at universities, schools and home, due to institutional initiatives on all levels of education.
- Facilities for developing teachers' technological proficiency. All educational reforms must set aside time for teachers to achieve this in a systematic way. For teachers to acquire the necessary skills to integrate technology effectively in the classroom requires educational administrators to provide them with the opportunities for this to happen. Administrators must find creative alternatives that enable teachers to take time out to participate in workshops, conferences, courses and work groups (Byrom, 1998; Ertmer, 1999).
- Continuous professional development. The educational systems must consider developing long-term professional development programs. Educational centers that contemplate professional development as an occasional or infrequent activity will be unable to carry out educational reforms (Bybee & Loucks-Horsley, 2000). This professional development must also aim to improve not only the teachers' technological but also pedagogical skills (Dwyer, 1994). In fact, training programs based on tutorials or coaching at the centre where they work usually help to increase the rate at which technology is integrated in the classroom (Pedroni, 2004).
- Administrative resources. Administrators must have a clear idea of how technology influences the pedagogical processes within their educational systems (Roberts, 1998); as a consequence governments must dedicate substantial resources to teachers' technological and pedagogical training in order to achieve their objectives for education (Byrom, 1998).
- Support staff. As well as administrative support, teachers should also have access to on-site support staff to help integrate technology in teaching practices. On-site support staff is deemed necessary for overcoming first- and second-order barriers to the integration of technology in teaching (Hofer, Chamberlin & Scot, 2004). These people are variously called *computer coordinators*, *information technology coordinators*, *facilitators* and *educational technologists* (Hofer & al., 2004). Ronnokvist, Dexter & Anderson (2000) differentiate between two types of support provided by these personnel: technical and pedagogical. Technical support covers all aspects of technology, such as the proper functioning of the software, and hardware and software problem solving, that are unrelated to any particular didactic method. Pedagogical support refers to didactic strategies and the application of various teaching methods. The coordinator acts as trainer or instigator of teacher training processes.

Second-order factors: teacher proficiency and didactic practices

The second-order factors mentioned in the literature are associated to the teacher's desire to change teaching practices in the classroom. If taking account of second-order factors is essential for the integration of technology in pedagogical processes (Cuban, Kirkpatrick & Peck, 2001), then administrators and politicians should examine teachers' didactic practices in the classroom and their beliefs concerning the application of technology (Ertmer et al., 1999).

The key factor in educational change is the willingness of the teacher (Hargraves, 1992). One of the factors linked to teachers' willingness is their knowledge of ICT use, the level of skill they believe they need to use them on a regular basis or the training received (Jones, 2004). Nevertheless, awareness of teachers' technological self-confidence is insufficient for an understanding the entire pedagogical potential of ICT, which requires the development not only of technical but also pedagogical competences (McCarney, 2004; Reynolds, Treharne & Tripp, 2003; Condi & Livingston, 2007).

Hew & Brush (2007) reviewed several empirical studies and found 123 obstacles to the integration of technologies in the school curriculum, which they grouped in five categories, and they concluded that teachers' beliefs and attitudes towards technology were fundamental in determining their integration in the curriculum (Hermans, Tondeur, Valcke & VanBraak, 2006; Wozney, Venkatesh & Abrami, 2006).

A recent study by Inan & Lowther (2010) that analyzed the use of laptops in primary and secondary schools in the state of Michigan identified teachers' skills (β=0.40) and beliefs regarding the use of laptops and their impact on didactic activities (β=0.44) as a direct influence. These results corroborate those of Ertmer, Ottenbreit-Leftwich & York (2007) who sampled teachers from several states across the USA with more than 15 years' teaching experience with ICT. According to these teachers, intrinsic factors were more influential than extrinsic factors in terms of technology integration in the curriculum.

Teachers' self-confidence regarding the use of technology is an important factor in any educational reform process, and is closely linked to their proficiency and beliefs in the value and educational potential of technology. Likewise, first-order support is a strong influence on teachers' attitudes towards technology, which can affect pedagogical change.

Hypothesis and Objectives

Measures of support and institutional recognition are factors that boost the usage of platforms for teaching at universities, whether they have a direct or indirect influence on the technological and didactic proficiency of the teacher.

Teachers' technological and didactic proficiency has a direct influence on the effects of the teaching-learning processes, and an indirect effect via their influence on the didactic use of the platforms.

The main objective of this study is to test a structural confirmatory model relating to the influence of first- and second-order factors on the effects of the use of education platforms at university and the didactic styles used in their functioning.

Method

Subjects

The study's object population is the teaching staff at the universities of Cádiz, Córdoba, Huelva and Sevilla. Non-proportional random stratified sampling type was used, which Cohen & Manion (1990) call quota sampling.

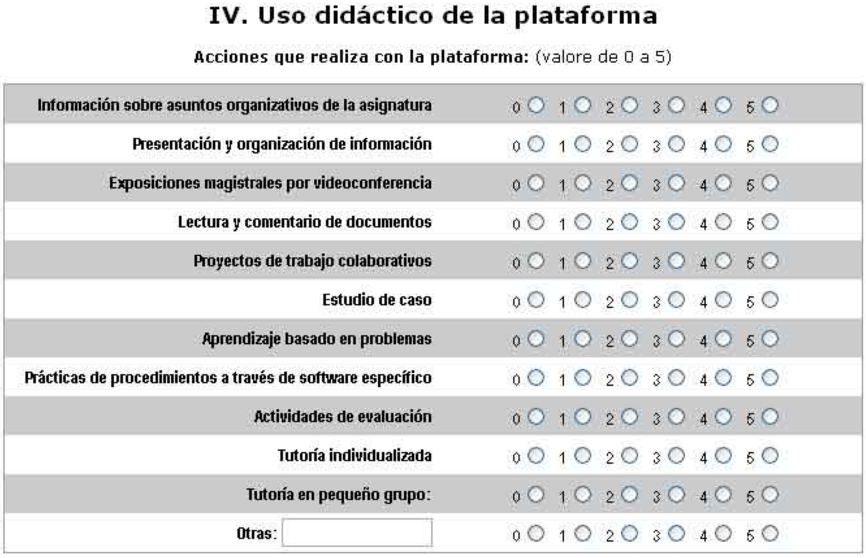
Table 1. University teacher population and sample

	Sample	*Gender*		*Mean age*	*Professional Category*						
		H	M		As	Bec	C Dr.	CU	Ay	Col.	TU
University of Cádiz	112	64	48	43.30	19	3	7	7	2	13	61
University of Córdoba	126	65	61	44.10	12	2	17	13	7	14	61
University of Huelva	159	94	65	40.20	33	6	18	3	7	28	64
University of Sevilla	98	51	47	42.33	1	3	16	4	9	12	51
Total	**495**	**274**	**221**		**65**	**14**	**58**	**29**	**25**	**67**	**98**

The optimum sample size was 941 teachers, which guarantees a confidence level of 95% and sample error of ±3%. The final simple (Table 1) consists of 494 teachers from the universities of Cádiz, Córdoba, Huelva and Sevilla; although there are significant deviations from the sample that was initially expected, given the size and participation of all the faculties of the four universities, it can nevertheless be considered a representative sample of the teachers who use platforms in their work with students.

Procedure, instrument and variables

An *ad hoc* online questionnaire was designed which included a brief introduction that complied with established polling norms (extending an invitation to fill in the questionnaire, a request for questions to be answered truthfully, guarantee of anonymity, the approximate time needed to complete it and the aims of the study). The dimensions considered in the questionnaire are: the teachers' technological proficiency, the digital resources used, satisfaction with the resources used, didactic material used in the platforms, changes in didactic processes and results, and institutional resources for boosting technology use. Each dimension is analyzed via a Likert-type scale ranging from 0 to 5. The Alfa Cronbach test was applied to 170 variables and to a sample of 494 subjects which yielded a reliability index of 0.941.



IV. Uso didáctico de la plataforma

Acciones que realiza con la plataforma: (valore de 0 a 5)

Información sobre asuntos organizativos de la asignatura	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Presentación y organización de información	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Exposiciones magistrales por videoconferencia	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Lectura y comentario de documentos	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Proyectos de trabajo colaborativos	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Estudio de caso	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Aprendizaje basado en problemas	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Prácticas de procedimientos a través de software específico	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Actividades de evaluación	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Tutoría individualizada	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Tutoría en pequeño grupo:	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○
Otras:	0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○

Figure 1. Image of the online questionnaire

The Alfa Cronbach test was used to determine the reliability of the instruments, which produced the following results for each dimension:

- Variables relating to the didactic functions and digital resources used: Likert-type scale with values ranging from 0 (never) to 5 (very often). The Alfa de Cronbach reliability index is 0.91 for 23 elements.

- Variables relating to institutional measures: Likert-type scale with values ranging from 0 (never) to 5 (always). The Alfa de Cronbach reliability index is 0.843 for 12 elements.

- Variables relating to satisfaction: Likert-type scale with values ranging from 0 (never) to 5 (always). The Alfa de Cronbach reliability coefficient is 0.854 for 17 elements.

- Variables relating to the effects produced by the use of didactic platforms in university teaching: Likert-type scale with values ranging from 0 (no effect) to 5 (notable effect). The Cronbach coefficient value is 0.902 for 9 elements.

- Variables relating to teacher proficiency: Likert-type scale with values ranging from 0 (not competent) to 5 (highly competent), with an Alfa Cronbach value of 0.797 for 5 elements.

Data analysis

Structural equation modeling was used to confirm the validity of the model. The basis of this technique is that a theory must necessarily involve a set of correlations, and for that theory to be valid it must be possible to reproduce the (assumed) correlation patterns in empirical data. The Amos 5.0.1 program was used to carry out this analysis.

The explanatory factor analysis was performed in the knowledge of the conditions that allow this technique to be applied, and the fact that high levels of correlation would be found among the variables studied. This was carried out via the principle component method which enables data reduction, the differentiation of factors that are more inclusive than the variables studied, and their transformation into alternative measurement scales, which permits us to confirm this study's theoretical model.

Results

The analysis of the results is based on a prior factor analysis to reduce the data, differentiate and identify the factors that are more inclusive than the variables studied and their transformation into alterative measurement scales, as a condition for establishing a structural equation model that will allow us to perceive the relations and influences between the factors in the model. Pearson correlation analysis enables us to anticipate the relations between the factors in the model.

Prior factor reduction

An orthogonal rotation by Quantimax was used in the confirmatory factor analysis to determine the adhesion of the variables to a factor and as a result improve the discrimination between factors. Kaiser criteria for factor selection were not used for that reason.

In terms of the didactic use of the platforms, the KMO index (0.882) index shows a high correlation and hence the convenience of running a factor analysis. Finally, the Bartlett sphericity test which evaluates the applicability of the factor analysis to the variables studied yields a significance index of < 0.001, which means it can be applied to this analysis.

So, in terms of the didactic use of the platforms, we identify two factors that explain the 50.893 % variance in the set of variables, which are (Table 2):

- F1. Generative use. This factor has a variance of 33.715 % and includes the variables that help to demonstrate extensive use of platforms. Among the functions saturated by this factor are teacher presentations, collaborative work projects, case studies and problem-solving and individual or group tutorials. This factor includes the use of innovatory materials such as wikis, blogs, thesauruses, binnacles, glossaries, all of which are useful for consultation and generating content.

- F2. Assimilative use. This factor has a variance of 17.178 % and saturates variables that show a more limited and traditional use of virtual educational systems, namely the organization of information and how it is presented. It also includes digital resources such as work programmes for the subjects, documents, articles and links to other resources and proposals for further activities.

Table 2. Factor analysis on the didactic functions, resources and materials used. Matrix of rotated components

	Component	
	1	2
To inform about the subject		.805
To present and organize information		.861
For teacher presentations	.616	
For collaborative work projects	.702	
For case studies	.703	
To learn about problems	.610	
For individual tutorials	.577	
For group tutorials	.709	
It includes the programme		.842
It includes documents, articles, reports, etc,		.829
It includes proposals for practical work, activities, etc,		.667
It includes links to websites, e-libraries, databases, etc,		.436
It includes blogs, binnacles, etc,	.750	
It includes thesauruses, glossaries, etc,	.646	
It includes wikis	.713	

Extraction method: Analysis of principle components.
Rotation method: Quartimax normalization with Kaiser. Rotation converges in 4 iterations.

The descriptive analysis of both factors reveals that platforms are used more for «assimilative» ends, that is, for the organization of documents and information (Table 3). More precisely, the highest values for usage correspond to the inclusion of programmes for each subject and the documents that enable the students to follow the course as it develops.

Table 3. Assimilative use of the platform

	Mean	Stan. Dev.
To inform about the subject	3.92	1.265
To present and organize information	4.10	1.189
It includes the programme	4.46	1.154
It includes documents, articles, reports...	4.36	1.170
It includes proposals for practical work, activities…	3.96	1.512
It includes links to websites, e-libraries, databases…	3.10	1.728

On the other hand, «generative» use registers levels that are less than half of the mean values for «assimilative» use, that is, the university teachers sampled use platforms fundamentally to organize and send out information and documents throughout the course. In this sense, the use of the platforms is significant for personal tutorials but less so for the reading and analysis of documents, learning about problems, collaborative projects, etc. We can state that the platforms are hardly ever used as a support mechanism for collaborative processes and group problem-solving exercises.

Table 4. Generative use of the platform

	Mean	Stan. Dev.
For teacher presentations	.53	1.140
For reading and commentaries on documents	2.12	1.732
For collaborative work projects	2.00	1.701
For case studies	1.73	1.741
For learning about problems	2.10	1.747
For practical work with specific software	1.19	1.597
For assessment activities	2.17	1.758
For personal tutorials	2.64	1.731
For group tutorials	1.33	1.614
It includes blogs, binnacles...	.80	1.391
It includes thesauruses, glossaries...	1.04	1.512
It includes wikis	.54	1.119

The factor analysis of the variables relating to the institutional support measures for platform usage reveals a KMO index of 0.838, which confirms a correlation that justifies the factor analysis. The Bartlett sphericity test shows a significance index of < 0.001 which enables the analysis to be applied. The application of the analysis yields two factors that saturate 57.573 % of the variance of the set of variables (Table 5):

- Factor 1. Support measures. This factor saturates the variables for measures instigated by the university to promote the use of technological resources in teaching, which explains 41,664 % of the variance. The variables included in this factor are: recognition of teachers' work in this field, facilitating platform use, policies for ICT integration and development of materials, logistical and training support, and the availability of infrastructure and resources.

- Factor 2. Institutional recognition. This factor saturates the following variables: financial incentives, academic recognition and reduction of teaching hours, which accounts for 15.909 % of the variance.

Table 5. Factor analysis of institutional instigation measures. Matrix of rotated components

	Components	
	1	2
Recognition of the teachers' effort	.673	
Facilities for platform use are provided	.790	
An active ICT policy	.826	
An active policy for developing material	.756	
Financial incentives		.725
Logistical support	.677	
Equipment and support are on hand for ICT installation	.537	
Time and appropriate space given for training	.711	
Academic recognition		.613
Reduction of teaching hours		.823

Extraction method: Analysis of principle components.
Rotation method: Quartimax normalization with Kaiser. Rotation converges in 4 iterations.

The descriptive analysis generally shows a moderate level of support at the universities for the use of platforms and technology in teaching, which is particularly evident in the instigation of policies for integrating technology and the availability of facilities for its use (Table 6).

Table 6. Support measures

	Mean	Stan. Dev.
Recognition of teachers' efforts	2.44	1.631
Facilities are made available for platform use	3.38	1.271
An active ICT integration policy	3.28	1.402
A policy for the development of materials	2.73	1.489
Logistical support	2.86	1.518
Availability of equipment and support for ICT installation	1.92	1.656
Time and appropriate space allowed for training	2.76	1.416

The mean values for «institutional recognition» reveal a general lack of incentives for teachers to use platforms, be they financial, academic or a reduction in workload. Academic incentives, that is, rewarding the use of technologies by some form of academic recognition is the most visible of the possible external stimuli considered in this study (Table 7).

Table 7. Institutional recognition

	Mean	Stan. Dev.
Financial incentives are offered	.50	1.075
Academic recognition	1.48	1.625
Reduction of teaching hours	.60	1.231

The factor analysis of the variables relating to teachers' technological proficiency produces a KMO index of 0.796, which indicates that there is a high correlation and justifies the convenience of factor analysis. The Bartlett sphericity test gives a significance index of < 0.001 which enables the analysis to be applied. The analysis yields a single factor that saturates 67.771 % of the variance of the set of variables (Table 8). The extracted factor includes the following variables: proficiency in managing digital resources, proficiency in creating materials, proficiency in making the best of didactic resources and skill in searching for information and resources.

Table 8. Factor analysis relating to technological proficiency. Matrix of components

	Component
	1
Proficiency in managing resources	.831
Proficiency in developing materials	.795
Proficiency in making the best of didactic resources	.866
Proficiency in searching for information and resources	.799

Extraction method: Analysis of principle components. To 1 component extracted.

The descriptive analysis places teachers' technological proficiency at intermediate levels, in the opinion of the teachers themselves. However, the level of proficiency in the search for information and resources scores slightly higher than the values, as does the management of platform resources (Table 9).

Table 9. Teachers' technological proficiency

	Mean	Stan Dev.
Proficiency in managing resources	2.94	1.187
Proficiency in developing materials	2.58	1.438
Proficiency in exploiting didactic resources	2.78	1.271
Proficiency in searching for information and resources	2.95	1.477

The factor analysis of variables for changes arising from the application of technologies in university teaching gives a KMO index of 0.890, which indicates a high correlation and justifies the factor analysis. The Bartlett sphericity test has a significance index of < 0.001, which allows the analysis to be applied. The factor analysis of the group of variables identified a single factor that saturates 66.393% of the variance (Table 10):

- Factor 1. Effects. This factor saturates all the variables that refer to the changes caused by the use of educational platforms in various aspects of the didactic process such as: classroom atmosphere, group dynamic, communication between students, teacher-student communication, student participation and academic performance.

Table 10. Factor analysis of didactic effects. Matrix of components

	Component 1
Changes in classroom atmosphere	.801
Changes in group dynamic	.809
Changes in communication between students	.825
Changes in student-teacher communication	.785
Changes in student participation	.842
Changes in work autonomy	.794
Changes in academic performance	.847

Extraction method: Analysis of principle components. To 1 component extracted.

The descriptive analysis shows that teachers are aware of changes in student-teacher communication, student participation, and student self-study. The other variables show moderate values which are considerably less than the 3-point average. These moderate-to-low scores refer to the effects on the dynamic, the communication and atmosphere in the classroom (Table 11).

Table 11. Didactic effects of technology use

	Mean	Stan. Dev.
Changes in classroom atmosphere	2.47	1.588
Changes in group dynamic	2.28	1.606
Changes in communication among students	2.46	1.585
Changes in student-teacher communication Changes in student participation	3.50	1.451
Changes in work autonomy	2.96	1.466
Changes in academic performance	3.03	1.440
	2.75	1.368

Confirmation of the structural equation model

The literature review led to the calculation of an initial structural equation model to verify the influence of first-order factors such as measures of support and institutional recognition, and the second-order factor, technological proficiency, on the didactic uses and effects of the platforms. The values for the adjustment indices show a good fit for the data (Table 12, Figure 2). However, to get a better fit for the model we eliminated the low significance regressions that relate the «support measures» factor to the style of didactic use, even though its values in the adjustment indices were no better than those in the χ^2/gl index, scoring slightly less in the second model (Table 12, Figure 3). Yet, the decision is based in theory on the content of these measures, which consist of financial or academic incentives, with a direct influence on teacher involvement in platform usage.

Table 12. Adjustment indicators for both models

	χ^2/gl	CFI	IFI	NFI	TLI	RMSEA	HOELTER
Prior model	2.9	0.98	0.98	0.97	0.93	0.063	372
Definitive model	2.6	0.97	0.97	0.96	0.94	0.057	379

The model explains the 19% variance in the «generative use» that the university teachers make of the platforms as well as the 15% of variance in «assimilative use». The variance resulting from the «effects» of the use of the platforms by teachers is a particularly high 42%.

This model confirms the influence of teachers' «ICT proficiency» and «support measures» on didactic usage and effects, specifically:

- On the didactic effects (classroom atmosphere, group dynamic, communication among students, student-teacher communication, student participation and academic performance) of platform use, whether indirectly via support measures and institutional recognition (first-order factors) or directly through teachers' technological proficiency (second-order factor).

- In terms of the didactic use of the platforms, two styles of usage were identified beforehand:

  a) «Generative use» of knowledge; social and based on the protagonism and activity of the student.

  b) «Assimilative use», traditional in style, based on the presentation of information, resources and activity proposals for students to assimilate.

The indirect influence of first-order on second-order factors as a result of their predictive capacity is clear; styles of didactic use (the functions for which they are used and the materials used) and technology proficiency. However, there seems to be a paradox in the model. While the «support measures» variable has a positive influence on teacher proficiency, it does not affect styles of didactic use. By contrast, the «institutional recognition» variable influences styles of use but not teachers' technological proficiency. The explanation for this is in the content of both factors. While the «support measures» variable refers to structural measures to boost platform usage, with an influence on teachers' interest in their own training and proficiency, «institutional recognition» is a partial and direct measure that offers incentives for using technology. That is:

- First, the influence of «support measures» on teachers' «ICT proficiency» ($\beta = 0.23$, $p<0.001$) is evident, so we can state that this series of measures which includes stimulus plans, and logistical and material resources, has a positive influence on teacher proficiency even though it only accounts for 5 % of the variance of this factor. We can also confirm its indirect influence on platform use.

- Second, the exploratory adjustment of the model highlights the ambivalent influence of «institutional recognition» on the styles of platform usage identified. Similarly, what stands out is an inverse influence ascribed to «assimilative use» ($\beta = -0.19$, $p<0.001$) as opposed to a direct influence attached to the style of «generative use» ($\beta = 0.20$, $p<0.001$).

What also stands out is the predictive effect of teachers' technological proficiency on the didactic uses of the platforms, either as a utility for student participation and knowledge generation ($\beta= 0.39$, $p<0.001$), or as a resource for information and assimilation of knowledge ($\beta= 0.34$, $p<0.001$). Although the differences between these indices are slight, there is a greater dependency relation between teachers' technological ability and the broader generative-didactic option offered by platform use. It also has a direct influence on the «effects of usage» ($\beta= 0.39$, $p<0.001$).

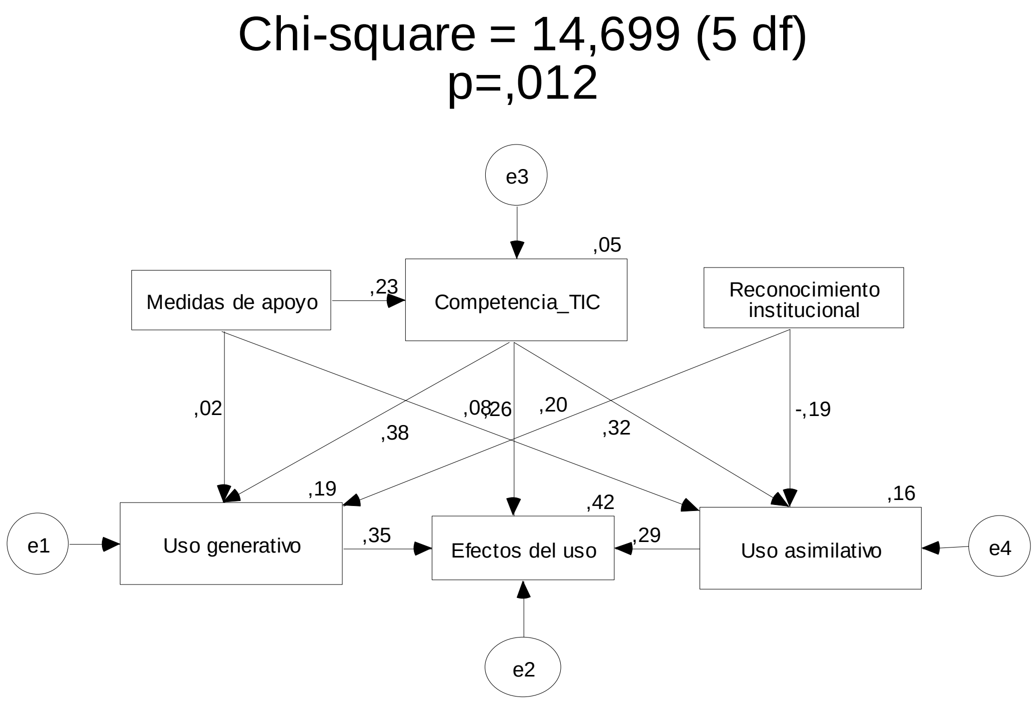


Figure 2. Prior structure model

Finally, the high value (42 %) of the «effects of use» variance is significant, due to the direct influence of teacher proficiency (β= 0.26, p<0.001), and the styles of «assimilative use» (β= 0.29, p<0.001) and, in particular, of «generative use» (β= 0.35, p<0.001).

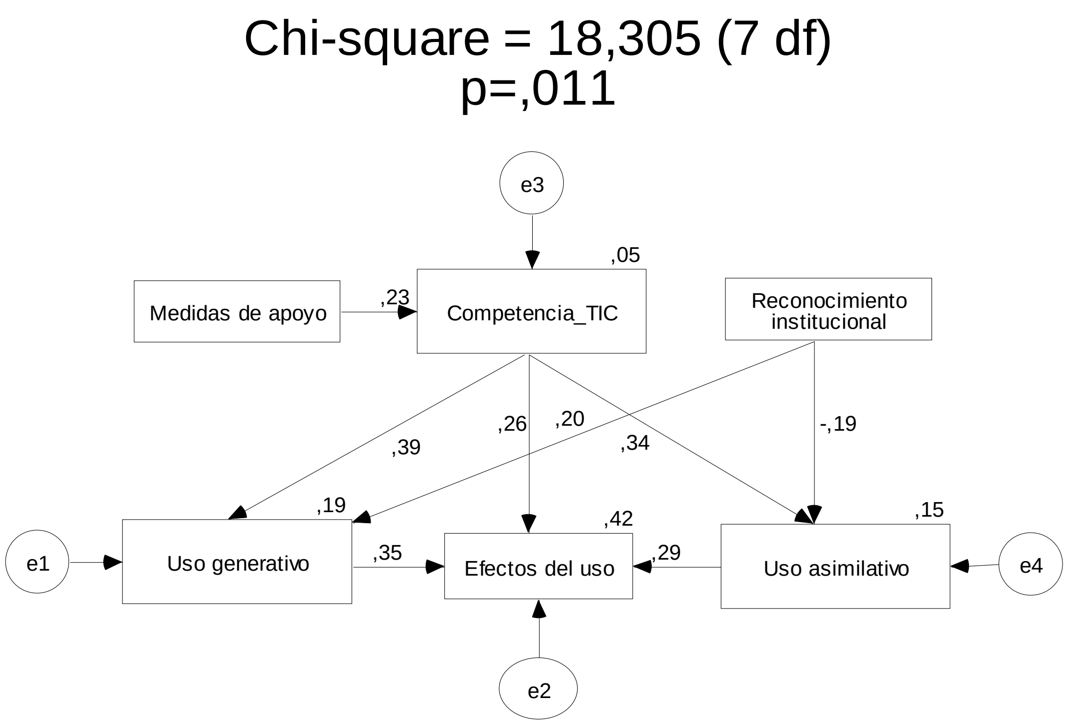


Figure 3. Definitive structural model

In general, there is a tendency towards a linear chain linking the support measures that favour teacher proficiency, which also influences the development of participative student-centered styles of teaching. It is these didactic styles that have a higher regression index on the effects.

Discussion

Since the end of the 1980s, a proliferation of studies have offered explanations and criteria for configuring a theoretical model that explains why, despite innumerable government measures to integrate technology at education centers, the expected benefits for teaching have failed to materialize.

External or first-order factors are the lack of access to computers and software, insufficient time to plan classes and the shortage of technical and administrative support (Zammit, 1992; Bitner & Bitner, 2002; Mandinach & Cline, 2000; Norum, Grabinger & Duffield, 1999; Cuban, Kirkpatrick & Peck, 2001).

Glennan & Melmed (1996) pinpoint the three major dimensions that must be included in any institutional planning for widespread technology usage in education centers, which we believe are also applicable to the university context, and these are: financing the costs of purchase and maintenance of technological resources, the availability of training for teachers and the necessary time to do so, and setting up a permanent support system along with the development of educational software for teachers to use in the classroom.

Our study model distinguishes two factors that incorporate the variables of support measures and institutional recognition. The variables examined in both factors are:

- Support measures: there must be an ICT integration plan whose stated policy is to develop materials, recognize teachers' work in this field, and provide equipment and logistical support, time and space for training.

- Institutional recognition: there must financial incentives, academic recognition and a corresponding reduction in teacher hours.

These are the main obstacles to full integration of technology in university teaching although their influence is indirect, as is shown in all studies on this subject. That is, they condition but do not directly affect ICT usage at university (Ertmer, Ottenbreit-Leftwich & York, 2007). This influence is revealed in our model by the regression index value that sustains the support measures factor with regards to teachers' technological-didactic proficiency.

Neither does institutional recognition have a direct influence on the didactic effects of platform use, yet it affects the teaching styles displayed when using the platform. While institutional recognition has a direct influence on the most innovative styles of platform use based on student-centered learning, it has the opposite effect on teacher-centered didactic styles.

As expected, the model shows that the expectation that ICT can ease the transition to a learning-based pedagogy continues to raise doubts although it is conceivable that this scenario could occur in the future (Mandinach & Cline, 2000, Jonassen, Peck & Wilson, 1999; Sandholtz, Ringstaff & Dwyer, 1997). The strongest influence of the student-centered learning model on the effects of platform use shows up in processes linked to innovative platform usage. Yet these teaching styles are still in the minority in the university context where teaching is generally face-to-face and classroom-based.

A change of mentality is not easy especially when the differences between the two epistemologies are so broad. It is very difficult for teachers to adjust their teaching philosophy given that the mental and psychological models involved in the teaching and learning processes are deeply entrenched in our society, and they are constantly reinforced by the current education and infrastructure systems. The widespread reach of ICT into all areas of life and society has come about too quickly to change the pedagogical mentality. In the end, it could also act as a catalyst for change in teachers who are dissatisfied with teacher-centered instruction (Windschitl & Sahl, 2002).

On the other hand, the internal second-order barriers inherent in teachers, such as over-reliance on the pedagogies of traditional teaching, fear of losing control, beliefs in the role of the teacher and students in the classroom, lack of interest, rejection or resistance to change imposed by government, the perception of an increased workload for minimal compensation (Cuban, 1986; Hodas, 1993; Ditzhazy & Poolsup, 2002; Ertmer, 1999, Kent & McNergney, 1999, Wang & Reeves, 2003) all crucially condition the integration of the use of platforms and other technological resources in teaching. A part of these variables formed by teachers' technological and didactic proficiency shows the direct and positive influence on the various teaching styles used on platforms and their effects on the teaching-learning processes. We agree with Ertmer (1999) that these are second-order aspects which determine the extent of involvement, commitment and meaning that teachers give to ICT use. In the end, it is the teacher who decides on the use of resources, and the reach and dimension of the integration of these media in the study plan (Fullan, 1982, 2001; Bitner & Bitner, 2002).

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Abstract / Resumen	*The objective of this study is to empirically test the theoretical model that explains the influence of primary and secondary factors on the integration of digital platforms in university teaching. A sample of 495 teachers from universities in Andalusia completed an online questionnaire that analysed the functions of usage, the digital materials used, the didactic and technological competence of the teaching staff, the support measures adopted by the institutions and the effect on teaching of platform use. Prior factor analysis and the application of the Amos program enabled us to develop a structural equation model to corroborate the indirect influence of the support measures and institutional recognition on teachers in their use of the platforms, and the direct influence of the teachers' technological proficiency.* Este estudio tiene como objetivo poner a prueba empíricamente el modelo teórico que explica la influencia de los factores de primer y segundo orden sobre la integración de las plataformas digitales en la docencia universitaria. Para ello, sobre una muestra de 495 profesores universitarios andaluces, se aplica un cuestionario online que analiza las funciones de uso, materiales digitales utilizados, competencia didáctica y tecnológica del profesorado, medidas de impulso institucionales, y efectos didácticos del uso. El análisis factorial previo y la aplicación del programa Amos permite la elaboración un modelo de ecuación estructural que corrobora la influencia indirecta de las medidas de apoyo y el reconocimiento institucional sobre los efectos didácticos del uso de plataformas, así como la influencia directa de la competencia tecnológica del profesorado.
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