

Experimental assessment of the determinants of usefulness of b-learning platforms

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Abstract

An experimental situation was designed with the aim of analysing the effect of the association of logotypes and security certificates on the usefulness of b-learning web platforms, widely introduced in recent years. In terms of the improvement of perceived usefulness, the successful outcome of such web technologies depends on the experimental situation and other explanatory factors under the control of the organization that developed them. The results of our analysis underline the relevance of the system for b-learning tasks and the need for sponsorship on the Internet. Specifically, we found that web platforms could benefit mainly for use of logos or a combination of logos and security certificates.

1. INTRODUCTION

Innovation diffusion theory (IDT) establishes three main states: evaluation, adoption and implementation of the innovation (Prescott & Conger, 1995). Many studies have centred on the adoption state of a technological innovation from the users' viewpoint, obtaining models of intention or theories of behavioural decision, traditionally applied in social psychology (Swanson, 1982; Davis, 1989; Harrison et al., 1997; Pavlou 2002). Researchers therefore seem to have decided that theories of behavioural decision or intention provide a basis for the study of adoption of Information Technologies (IT) (Davis, 1989; Davis et al. 1989; Taylor & Todd, 1995; Bernadette, 1996; Harrison et al., 1997; Karahanna et al., 1999; Malhotra & Galletta, 1999; Venkatesh & Davis, 2000; Moon & Kim, 2001; Koufaris, 2002; Venkatesh, et al., 2003) and electronic commerce (Chen et al., 2002; Pavlou, 2002; 2003; Featherman & Pavlou, 2003; Gefen et al., 2003; Castañeda et al., 2004; 2005; Sánchez & Rondán, 2004; 2005).

Among the models most frequently used to examine adoption of technological innovation are the Theory of Reasoned Action, TRA (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980), the Theory of Planned Behaviour, TPB (Ajzen, 1991), the Technology Acceptance Model, TAM (Davis et al., 1989) and the Motivation Model (Davis et al., 1992). Although the first models of Fishbein and Ajzen were designed to explain any human behaviour, they also contained theoretical principles valid in a wide variety of contexts. The predictive value of TAM and TRA to explain behaviour towards adoption of IT has been consistently significant (e.g., Lucas, 1975; Davis, 1989; Davis et al., 1989; Bernadette, 1996; Harrison et al., 1997).

In view of the foregoing, perceptions about the use of an innovation are key to its diffusion, rather than a traditional definition of perceptions about the innovation *in itself* (Moore & Benbasat, 1991). From the perspective of e-commerce, the usefulness of this kind of model lies in describing the factors conducive to the acceptance of online exchanges, which helps both academics and users to better understand online behaviour in emerging B2C exchange relations (Pavlou, 2003).

Although considerable research has been done on the acceptance of new IT or information systems, less attention has been paid to the assessment of the factors determining perceived usefulness, despite the fact that this belief has been one of the most important factors in the acceptance of the Internet (Moon & Kim, 2001; Koufaris, 2002; Chen et al., 2002; Pavlou, 2002; 2003; Koufaris, 2002; Featherman & Pavlou, 2003; Sánchez & Rondán, 2004; 2005; Castañeda et al., 2005; Bhattacharjee & Premkumar, 2004).

2. PERCEIVED USEFULNESS AND THE GENERATING TRUST MECHANISMS AS MAIN DETERMINANTS OF TECHNOLOGICAL ACCEPTANCE

Perceived usefulness is a subjective measurement as far as the user is concerned and represents the degree to which the system can be useful when seeking a specific objective. This belief is defined as “the prospective user’s subjective probability that using a specific application system will increase his or her job performance within an organizational context” (Davis, 1989: 985) and has a direct influence on the use of information technology in particular. Analysis of the literature on technological innovations shows some of the effects of perceived usefulness. Specifically, this is a multidimensional concept related to increased speed of work, the manner work is done, increased productivity and effectiveness as well as other practical aspects (Featherman & Pavlou, 2003). There is consistent evidence of the relation between attitude and usefulness in research focussed on information systems and computer technology (e.g. Davis et al., 1989; Malhotra & Galletta, 1999) and electronic commerce (e.g., Bhattacharjee 2000; Sánchez & Rondán, 2005).

The Technology Acceptance Model (TAM) also proposes a direct relation between usefulness and behavioural intention (Davis et al., 1989). In organizational contexts, the relation between usefulness and behaviour is based on the idea that people form intentions towards behaviours they believe will improve their work, beyond positive or negative feelings about the behaviour *per se*. This is because perceived usefulness is considered a tool to achieve rewards extrinsic to the content of the work. In this sense, the present study is based on the hypothesis that perceived usefulness will increase intentions to reuse a web system supporting learning tasks.

Few studies have focussed on the assessment of the antecedents of usefulness, including trust, relevance of results for job (in our case, learning), quality of results, ease of use¹, accessibility to information or quality of content (Venkatesh & Davis, 2000; Venkatesh et al., 2003; Pavlou, 2002, 2003; Hu et al., 2003; Chen et al., 2002). In other words, perceived usefulness is a function of the system’s characteristics, such as, the high quality results perceived when a web site offers rich information (Chen et al., 2002).

Concretely, the trust shown by people towards something determines the nature of many social and business relations (Fukuyama, 1995; Wrightsman, 1991). Trust refers to “the expectations that other individuals or companies with whom one interacts will not fall into inappropriate conveniences deriving from the dependence one has on them” (Gefen et al., 2003: 308). Trust is merely a simple transactional decision (specific task) occurring at a single moment (specific time) and consists in an individual’s interpretation of responsibility and actual risk given limited information about the reality (Pavlou, 2002).

Moreover, as put forward by Singh & Dalal (1999), individuals consider a web site to be an additional source of information for promotion of the organization. Internet, and

¹ In this research ease of use had no effect on usefulness.

particularly web pages, can thus be considered advertisements, given their conceptual similarity, physical appearance and function (Singh & Dalal, 1999), so that the concept of attitude towards the advertisement can be equated to attitude towards the web site (Luna et al., 2002). In view of the foregoing, many models used to examine consumer behaviour towards advertising can also be used for the Internet.

Therefore, given the lack of trust that can be generated towards information found on particular web sites, it may be desirable to sponsor a recognised organization to ratify the (lucrative or not) benefits to be obtained by using a web site. This could increase the message's credibility and, therefore, improve the trust in assessment of the benefits obtained by the system, thus strengthening purchase intention and behaviour (Parkinson, 1975). Improved consumer trust in a web innovation can be attained, among other methods, by sponsorship of either public institutions or private independent organisms.

So, this study aims to analyse how the application in Internet of generating trust mechanisms: structural assurance and situational normality (e. g. McKnight et al., 1998; Yousafzai et al., 2005) can affect the usefulness of a web innovation. Specifically, we focused in the application of logotypes of recognised entities (situational normality) and private security (structural assurance) certificates. Equally, the aim is to test the effect on the usefulness of its main determinants, i.e., trust toward the new web technology and relevance of use for learning tasks.

3. RESEARCH HYPOTHESES

Gefen et al. (2003), Gefen & Straub (2000) and Pavlou (2002 and 2003) include the trust construct in the context of electronic services. Moreover, trust influences transactional behaviour through intentions, attitude and perceived control, as well as indirectly through perceived usefulness and ease of use (Pavlou, 2002 and 2003; Chircu et al., 2001).

According to Gefen (1997), trust is a determinant of perceived usefulness, especially in online contexts, as the consumers' assurance of achieving a certain degree of web-interface usefulness depends on the people behind the web site. In some studies, the relatively weak effect of trust on behavioural transaction intentions suggests that it operates indirectly through perceived usefulness and other factors (Pavlou, 2003).

Trust allows the consumer to depend on web retailers and the underlying infrastructure and so make the interaction more useful. Conversely, if web retailers are trusted but behave differently to the beliefs instilled, the interface will become useless. The reason is that excessive risk causes the consumer to reject use of the system and, in this case, there is no reason to expect usefulness to be gained with use of the interface (Pavlou, 2002). We can therefore establish the following hypothesis:

H1: Trust has a positive effect on the perceived usefulness of a system.

The job relevance is a "function of the importance within one's job of the set of tasks the system is capable of supporting" (Venkatesh & Davis, 2000: 191) and is a cognitive judgement distinct from other social influences that exercises a direct effect on perceived usefulness.

Venkatesh & Davis (2000) include job relevance as an instrumental cognitive process which, together with quality of result, demonstrability of results and perceived ease of use make up the instrumental cognitive determiners of perceived quality. Quality of result has related aspects included in the concept and specificity of perceived usefulness. The effect of job relevance on usefulness of technology was also examined by Hong et al. (2002) and Hu et al. (2003).

Several authors have linked user acceptance with variables similar to relevance for work, such as the job-determined importance, involvement or task-technology fit (Leonard-Barton and Deschamps, 1988; Hartiwick and Barki, 1994; Goodhue, 1995). In the context of distance learning, the users of the system tends to acquire autonomy in their learning process, which implies the choice of web support technology, supplementary teaching material, methods of task submission, etc. In this sense, it is important to assess the relevance for the results of a new technology. We can therefore establish that:

H2: The more importance attributed to the results obtained by use of a system, the greater will be the perceived usefulness of that system.

In order to increase perceived usefulness, it may be pertinent to include trust-creating mechanisms such as logotypes of recognised organizations in the field of education (situational normality) and a private security certificate (structural security). As generating trust elements (McKnight et al., 1998; McKnight et al., 2004; Yousafzai et al., 2005) we can expect that:

H3: The presence of logotypes of recognised organizations increases the perceived usefulness of a system.

H4: The presence of security certificates increases the perceived usefulness of a system.

and therefore:

H5: The presence of logotypes of recognised organizations and of security certificates increases the perceived usefulness of a system.

Together with the above, we also consider the effect the inclusion of logos can have on the relationships postulated in the first two hypotheses. In situations of low uncertainty, the effect of trust on intention is significantly lower (Pavlou, 2002). Such situations are characterised by being less complicated and containing organisms that encourage trust in the medium in general and in the web site in particular. When this occurs, trust has very little effect on intentions, which causes a higher indirect effect on perceived usefulness (Pavlou, 2003). Moreover, mentions must be made of the mediating effect of perceived risk on usefulness, although in the opposite sense (Pavlou, 2002; Featherman & Pavlou, 2003). Therefore:

H6: The presence of logotypes of recognised organizations reinforces the effect of trust on the perceived usefulness of a system.

Conversely to the foregoing reasoning, in complicated situations, with reference to loss of privacy or access to the information by third parties, we can expect an increase in the effect of trust on the acceptance of a web system. This would cause a lower indirect effect on perceived usefulness, as is found in e-commerce environments with regard to other environments of simple information supply (Pavlou, 2003). We therefore put forward:

H7: The presence of security certificates weakens the effect of trust on the perceived usefulness of a system.

With regard to the relation between relevance of tasks and perceived usefulness, we can hypothesize that:

H8: The presence of logotypes of recognised organizations reinforces the relevance of learning tasks over the perceived usefulness of a system.

And once more we can expect that:

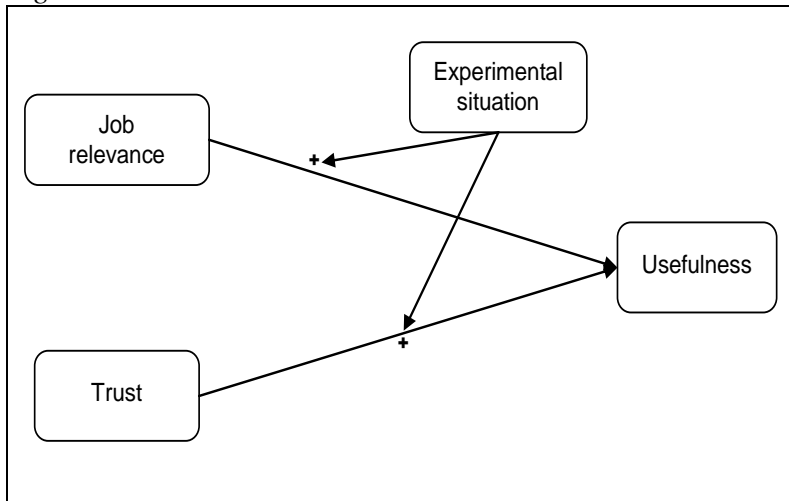
H9: The presence of security certificates weakens the effect of relevance of learning tasks over the perceived usefulness of a system.

4. METHODOLOGY

4.1. Experimental design

A real experimental design was set up in which the stimulus consisted in exposing the student to a fully operative teaching support platform [WebCiM]².

Figure 1. Theoretic model



Since the aim of the study consists in analysing the effect of the incorporation of logotypes of recognised entities and security certificates on usefulness, trust and job relevance (for the learning tasks) regarding use of the Web platform, three treatment levels were set up (see appendix) plus one control group, CG. The CG consisted in using the platform without any added elements (treatments). The first two levels involved adding to this group the logos of the University of Granada and the Ministry of Education and Science (experimental group 1, EG1) and an imaginary “Secured Version” security certificate (EG2). The third joint treatment included both the logos for free public access and downloading of material (after prior user identification on the platform), and also the security certificate for access to the student’s intranet data management and access to notifications and results (EG3). The cases were assigned at random to the treatments and the sizes of the EGs and CG were kept balanced (see next section).

In order to increase the robustness and power of the contrasts to be drawn and also to give the experiment internal validity, the treatments were guaranteed to be carried out in the same conditions. To this end the interviewers were suitably instructed on the operations to be followed and special care was taken that the different stimuli had the same colour, screen definition and speed.

² This platform was developed by the Department of Commercialisation and Market Research of the University of Granada. It incorporates several support utilities for student learning. It is available at <http://marketing.ugr.es>, although access to teaching content is restricted to teachers and students of the Department.

4.2. Sampling and measurement scales

Information was gathered from 381 students from different courses at the Business Faculty of the University of Granada, who were offered a questionnaire structured according to the scales commented here after they had become familiarised with all the options of the WebCiM platform. The elements sampled were selected and assigned by the researcher's judgment, with the aim of obtaining a balanced size (approximately 100 cases per treatment) for each group. The fieldwork was carried out over the first two weeks of October 2005. Seven questionnaires were discarded because of an excessively high number of missing data and five because of atypical behaviour. The final sample consisted of 369 valid cases (see table 1).

Table 1. Distribution of sample by treatment applied

Treatment	Valid cases (%)
CG: WebCiM ^a platform	92 (24,93)
EG1: UGR and Ministry of Education logotypes	88 (23,84)
EG2: Security certificates	88 (23,84)
EG3: Logotypes and security certificates	101 (27,37)
Total	369 (100%)

A structured questionnaire was used to measure both variables to be explained (usefulness) and trust and job relevance by using the Web platform. The introduction prior to completing the questionnaire did not refer to the aims of the research, in order to prevent an artificial effect of the treatments on the variables of behaviour and their determinants.

Venkatesh & Davis (2000) include job relevance as an instrumental cognitive process, which, together with the quality of the result, demonstrability of results and perceived ease of use make up the instrumental cognitive determinants of perceived quality. Quality of result shows some aspects included in perceived usefulness and were not therefore included in the study. A certain relation between ease of use and usefulness was also found, but not a significant effect on this construct. Demonstrability of results was not included in our study, as it was considered a construct that can not be valued by new users of the system.

All measurements were carried out on 1 to 7 scales. The usefulness scale of 7 items was adapted to our particular case from Moore & Benbasat (1991), Moon & Kim (2001) and Hu et al. (2003). The 8 item trust scale originated in McKnight et al. (2002), was validated in the context of IT by Castañeda (2005) and Flavián (2004) and adapted to use of a learning support platform for this study. The scale of relevance for work consists of 2 items and is by Venkatesh & Davis (2000) (see annex).

5. RESULTS: EFFECTIVENESS OF EXPERIMENTAL TREATMENT

In order to test the main effects among the perceived variables, a one-way ANOVA³ was first run using the experimental groups as factor and beliefs about usefulness, trust and relevance for work as dependent variables. Significant differences were found in perceived usefulness ($p < 0.01$) and relevance for work ($P < 0.10$) (see table 2).

³ In our case, the basic suppositions of Variance Analysis (normality, equality of variances and independence of groups) are respected, except for normality, which is not present according to the Kolmogorov test, although its effect on goodness of fit can be ignored (Luque & Ibáñez, 2000: 285).

Table 2. Analysis of variance for each perceived belief

Belief	Sum of squares				F	Sign.
	intergroups	gl	intragroups	gl		
Usefulness	23.31	3	708.46	365	4.00	0.0080
Trust	0.93	3	438.20	355	0.25	0.8610
Job relevance	15.43	3	723.63	363	2.58	0.0533

Different behaviour is observed between treatments, with some effect of the “logotypes” treatment on perceived usefulness and of “security certificates” on relevance for learning tasks when compare with the CG (see figure 2). Also, we found a significant combined effect of logotypes and security certificates on perceived job relevance, due mainly to the effect of security certifications. However, we were not able to detect any differences in effect of the stimuli on perceived trust. This confirms the existence of a positive effect of logos from recognised organizations on perceived usefulness [hypothesis H3] (see *post-hoc* analysis). At the same time, a neutral effect was detected for security certificates on perceived usefulness, with no empiric evidence to support hypothesis H4. Nonetheless, this should be analysed for each specific experimental situation, since the effects of some situations can be compensated by others and in this way the joint effect can be neutralised. We also found a significant increase in perceived usefulness in the case of the combined experimental group (logotypes and certificates) [H5]. According to the previous, this effect it is due principally to the presence of logos.

Figure 2. Mean of perceived beliefs (usefulness, trust and job relevance)

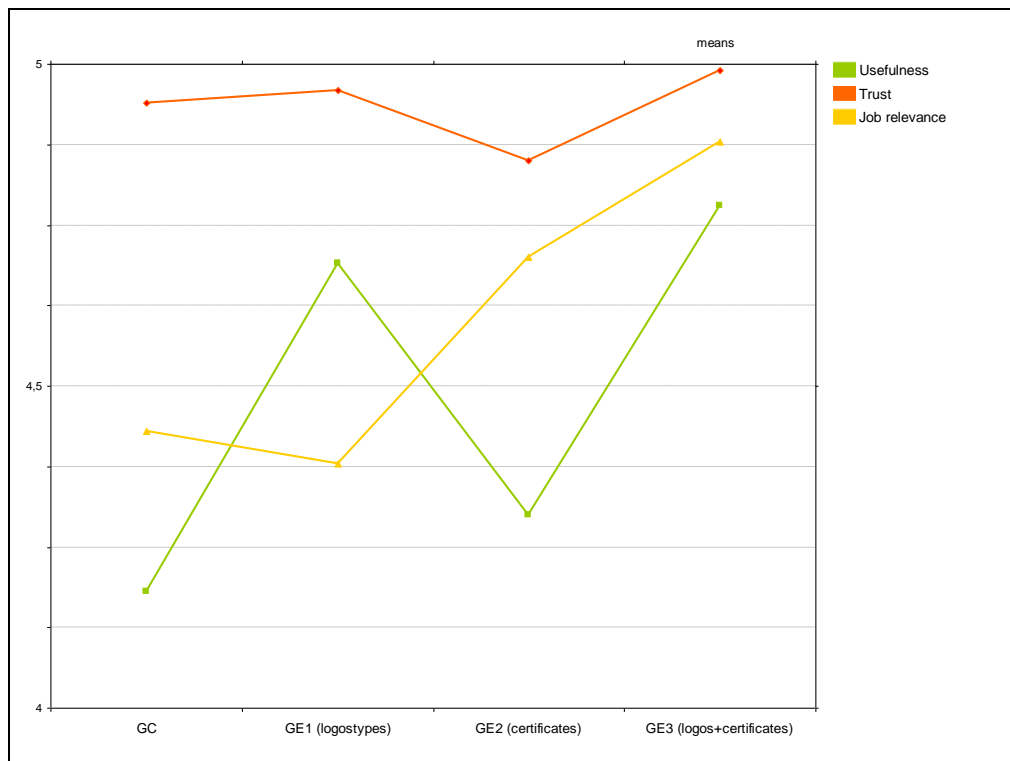


Table 3. ANOVA: Significant difference in post-hoc analysis of perceived beliefs (HSD Tukey test)

Belief	comparison	difference	significance
Usefulness	CG – EG3	0.59	0.0181
Usefulness	CG – EG1	0.50	0.0735
Usefulness	EG2 – EG3	0.43	0.0869
Job relevance	Logotypes - logos+certificates	0.50	0.0830

A regression analysis⁴ was performed on four models, one for each of the experimental situations defined by the treatments, in order to analyse the effectiveness of our experimental design and contrast the remaining hypotheses. As regards the explanatory capacity of the models, the determination coefficient (R^2) obtained intermediate values, all the models separately explaining over 50% of the total variance.

The result of the t test for parameters obtained by regression warns that for a 99% significance level perceived usefulness can be explained by the two variables (trust and job relevance) considered its determinants. According to the beta values obtained, any increase in trust or in relevance for learning tasks implies an increase in perceived usefulness, with the exception of the EG2 experimental group that was exposed to a web site including only security certificates. In this group trust ceased to explain perceived usefulness. Therefore, except for this latter case, as trust in the web site increases, so does the perceived usefulness of that site [H1]. In addition, in all four cases there is empirical support to confirm the positive effect of job relevance with the use of the web platform on the perceived usefulness of that platform [H2].

Table 4. Models obtained (Dependent variable: perceived usefulness).

Group	Variable	Non-standardised coefficients		Standardised coefficients	t	Sig.
		B	Typical error	Beta		
CG (no treatment)	(Constant)	-0.254	0.446	--	-0.571	0.570
	Trust	0.451	0.117	0.338	3.848	0.000
	Job relevance	0.496	0.082	0.528	6.018	0.000
EG1: Logotypes	(Constant)	0.246	0.462	--	0.533	0.596
	Trust	0.436	0.106	0.355	4.114	0.000
	Job relevance	0.523	0.087	0.516	5.981	0.000
EG2: Certificate system	(Constant)	0.420	0.430	--	0.976	0.332
	Trust	0.157	0.132	0.124	1.191	0.237
	Job relevance	0.665	0.100	0.688	6.616	0.000
EG3: Logos+certificates	(Constant)	0.371	0.458	--	0.809	0.421
	Trust	0.550	0.117	0.448	4.717	0.000
	Job relevance	0.350	0.094	0.352	3.709	0.000

$$R^2_1 = 0,628; R^2_2 = 0,593; R^2_3 = 0,618; R^2_4 = 0,534$$

In order to contrast hypotheses 6 to 9, a comparison was made of the coefficients calculated for the four groups and each pair of variables using a significance measurement of the differences between the beta coefficients. This was carried out using a modified version of the t test for independent samples⁵ (e.g., Goodman & Blum, 1996; Lee et al., 2000).

⁴ The initial suppositions of the linear regression were analysed previously and absence of severe multicollinearity was checked in all cases using Pearson's correlation coefficients, the tolerance values and the condition number. Autocorrelation is low, given that the residues are distributed in a practically normal 0 mean and 1 typical deviation, the Durbin-Watson statistic has values close to 2 and the residues were random. Finally, there was little heteroscedasticity in the data.

Table 5. Comparison of weights of independent variables between treatments

Causal relation	Treatment i		Treatment j		DIF.	T	p-value ⁶
	B	SE	B	SE			
<i>Trust</i>							
CG – EG1	0.451**	0.117	0.436**	0.106	0.015	0.095	0.4622
CG – EG2	0.451**	0.117	0.157 (n.s.)	0.132	0.294	1.667	0.0486**
CG – EG3	0.451**	0.117	0.550**	0.117	-0.099	-1.510	0.0664*
<i>Job relevance</i>							
CG – EG1	0.496**	0.082	0.523**	0.087	-0.027	-0.226	0.4107
CG – EG2	0.496**	0.082	0.665**	0.100	-0.169	-1.307	0.0965*
CG – EG3	0.496**	0.082	0.350**	0.094	0.146	1.170	0.1217

**p<0.05 *p<0.10

When logos are present on the new web platform (EG1), the effect of trust on usefulness is not significantly higher than when the platform has no logos (CG) and so there is no empirical evidence to support hypothesis H6. In the case of security certificates [EG2], the weight is considerably reduced and the T test becomes significant and so there is empirical support for hypothesis H7.

Moreover, there is a light increase of 5% in the weight of job relevance in the case of EG1 compared to CG and an even higher increase of this effect (34.07 %) in EG2 (security certificate), for a 90% significance level. Thus there is not empirical support to hypothesis H8 but yes, against what was expected for H9.

CONCLUSIONS

An experimental situation was set up in order to analyse the effect of the association of logotypes and security certificates on the usefulness of web platforms designed as learning support for university students. The successful result of this type of web technology (increase of perceived usefulness) depends on the experimental situation and the attributes of the web platform intervening in the explanation of the usefulness. These attributes can be controlled from the organization developing such platforms. Our experimental design did not allow us to adequately isolate the effect of security certificates and logos from other variables, but we can reach some interest outcomes.

The perceived usefulness of the new web platform improves with the inclusion of logotypes of recognised entities and so we suggest the need to include sponsorship of recognised prestige in the introduction of new web sites on the WWW or in the development of web platforms for distance learning or e-learning. We also found a certain effect (not hypothesised) of the application of security certificates to the web platform on the relevance for learning tasks. This effect on trust was as expected but not significant. This could be due to other factors that can have a direct influence or moderate the effect of the inclusion of logos and security certificates. Nonetheless, the use of sponsorship by recognised prestigious entities in the specific field of activity

⁵ The coefficient comparison test, based on the statistical *t* test is expressed as:

$$H_0: B_1 = B_2$$

$$t = \frac{B_1 - B_2}{\sqrt{SE_1^2 + SE_2^2}}$$

where B_i are the estimated non-standardised coefficients and SE_i are the squared standard errors for those coefficients.

⁶ Since the hypotheses postulate the direction of the moderation, the hypotheses tests are unilateral and significance is expressed considering a single tail in the T distribution.

should not be disregarded, especially in environments other than organisational or distance-learning, such as e-commerce.

The results of the linear regressions emphasize the higher importance of job relevance when explaining usefulness. The way to increase a web site's perceived usefulness should therefore be to find arguments that basically refer to the relevance of the tasks to be undertaken with the system. Likewise, the effect of trust toward the Web platform is inappreciable in situations characterised by uncertainty or security certificates that can suggest a possible loss of privacy. An unexpected result was that with the moderating effect of security certificates they very significantly increase the effect of relevance for learning tasks on perceived usefulness. Although we found that the relation between trust and usefulness was negatively moderated by security certificates, on the other hand, arguments must be found concerning the relevance of a distance learning web system for work tasks in order to use them together with elements guaranteeing security and/or privacy.

IMPLICATIONS AND LIMITATIONS OF THE STUDY

If an organism wants to increase the perceived usefulness of a web site it has created, it must design it in such a way that it contains attributes referring to the importance of the use of the system to carry out the job tasks. Secondly, as far as possible care should be taken to use logotypes from organizations of recognised prestige. This guarantees that the trust and job relevance perceived for usage of the web site will not have negative effects on perceived usefulness. This can all help decisively the acceptance of this type of web innovations.

Regarding public organisms centred on the management of university education, the results of this research suggest the need for a greater effort in generating trust, through mechanisms of security structural, when they are used on the Internet. Given the large number and low usefulness perceived toward security certificates (Trust-e, BBBO, Confianza online, Verisign,...) the unification of existing private certificates could lead to a higher probability of web sites or innovations being accepted, limiting the confusion and ignorance of such "sponsorship".

Finally, concerning the limitations of this study, they may have a negative effect on its external validity. The chosen web platform doubtless has a direct effect on the results obtained, and so extrapolation of them to other web platforms o different contexts should be done with care, for its application in the case of e-commerce, for example, could lead to erroneous conclusions. A future line of research could therefore be centred on a lucrative context.

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APPENDIX

Figure 1. Tratamientos aplicados

Figure a. Logos (UGR y Ministerio de Educación y Ciencia)

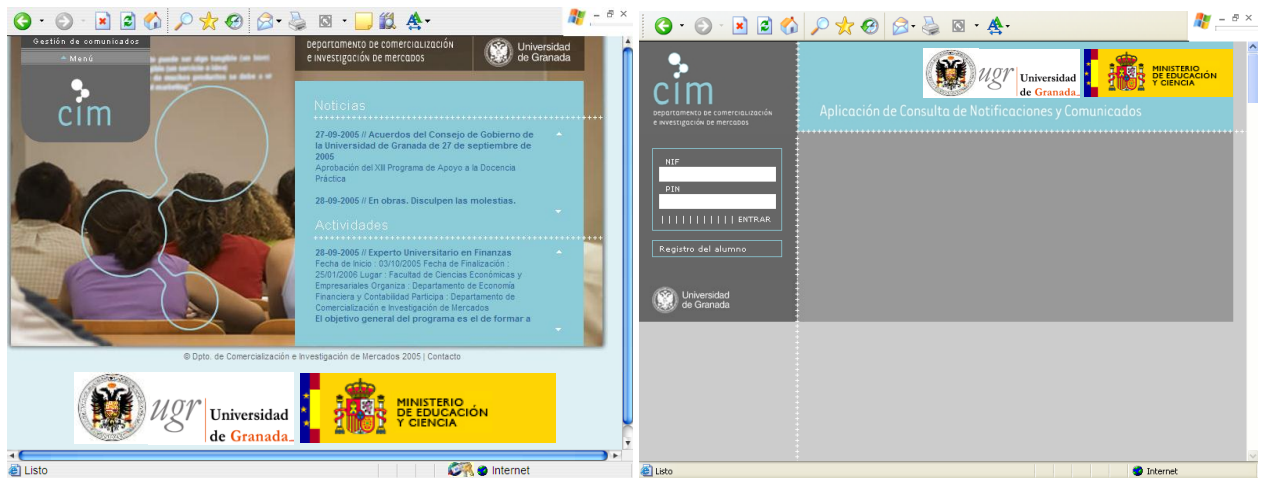


Figure b. Safety certificates

