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DETERMINANTS OF THE USE OF TECHNOLOGICAL INNOVATION IN DISTANCE LEARNING: A Study with Business School Instructors

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ABSTRACT

This study's overall purpose is to identify the factors determining the use of technological innovation in Distance Learning (DL), as perceived by instructors of Business Education programs. The theoretical basis for the study is the Innovation Diffusion Theory (IDT).

The study's sample is made up of 436 instructors; we used a quantitative approach and applied Confirmatory Factor Analysis and multiple regression. We found that not all of the attributes selected for analysis as proposed by IDT showed a direct effect for the use of innovation for the instructors investigated. The identified attributes were: compatibility, which shows how consistent innovation is with their values, practices and needs; relative advantage, indicating an innovation's perceived improvement from its predecessor; and demonstrated results, according to which instructors understand the tangible results obtained from the use of innovation.

Keywords: Instructors; Diffusion of Innovation Theory; Distance Learning.

INTRODUCTION

The past two decades have seen a massive expansion of the use of technology in the higher education environment, particularly with the development of new Information and Communication Technologies (ICTs) and the advance of the world wide web of computers beginning in 1992. (Kenski, 2009). The adoption and use of technological innovations have enabled the development of new learning alternatives, a paradigm change associated mainly with distance learning (DL) for its status as one of the main boosters of the breakthrough in the education area. (Behar, 2008). Technological progress has brought about significant changes in education. In this context Distance Learning (DL) grows and acquires expressive importance in the Brazilian educational context (MEC/INEP/DEED, 2011). Studies on the adoption of information technology (IT) are widespread in the literature. Particularly at the international level, several studies have tested the characteristics of the acceptance of technological innovation in e-learning, with the purpose of

understanding the impacts of its adoption and use. (Cheng *et al.,* 2011; Hong *et al,* 2011; Huang *et al.,* 2012; Pituch & Lee, 2006; Sugar *et al*, 2005; Teo & Noyes, 2011).

One of the main challenges for Learning Institutions (LIs) that have been disseminating by means of DLis the search for a pedagogical language appropriate to learning mediated by the many media available, which involves reformulating the functions of the "actors" involved, which include education managers, professors, students and monitors, among others.

The increasing adoption of technology in education has been raising many questions about the teaching techniques of educators, particularly in connection with the challenges of using new instruments and with how to develop new technology skills.

Given the above, obtaining a better understanding of the attributes that influence the success or failure of the adoption of technological innovations in DL, has become crucial. Therefore, this study's problem question is: What factors determine the use of technological innovation in Distance Learning, as perceived by Business Program teachers? This study's overall goal lies in identifying the factors that determine the use of technological innovation in Distance Learning, as perceived by Business program teachers. The technological innovation this study addresses is the Virtual Learning Environment (VLE) and the paper's theoretical foundation is the- *Innovation Diffusion Theory* – IDT (Rogers, 1983), expanded by the model proposed by Moore and Benbasat (1991). The authors suggest that a user's perception of an innovation affects adoption or non-adoption.

Thus, in addition to standing as an important subject for investigation, technological innovation in learning, which is represented here by the identification of factors that determine the use of technology in DLas perceived by teachers in the VLE, is a relevant contribution to the LIs that are currently implementing this learning model, as they are investing in systems and information technology to improve their results and the performance of their instructors and students.

THEORY AND HYPOTHESES

Innovation Diffusion Theory is regarded as one of the most important theories on the process of the adoption, use and acceptance of Technological Innovation. The theory's main goal is to explain how the process of innovation diffusion and use takes place in organizations, based on individual and group behavior and attitude towards the innovations introduced into the social context in which they exist (Moore & Benbasat, 1991). Studies on Diffusion Theory have spotlighted technological innovations, and particularly those introduced by Information Technologies and Systems. For the purposes of this study, the approach is associated with technological innovation in education. An innovation's perceived attributes are important to explain its usage rate, which comprehends a five-stage decision-making flow: initial awareness of an innovation; formation of an attitude toward the innovation; decision whether to accept or reject the innovation; implementation of the new idea; and, finally, confirmation of the decision to adopt the innovation (Huff & Mcnaughton, 1991; Rogers, 1983).

Several studies (Agarwal & Prasad 1999; 2000; Davis *et al.,*1989; Mathieson, 1991;Venkatesh & Davis, 2000; Venkatesh *et al.*, 2003; Lewis, Agarwal & Sambamurth, 2003; Moore & Benbasat,

1991; Compeau, Meister & Higgins, 2007) address technological adoption and innovation, as researchers are interested in understanding the factors associated with the process of accepting a technology in terms of implementation and use in the workplace and for productive tasks, attempting to analyze factors that influence the use or intent of using such technologies. The innovation diffusion theory (Rogers, 1983) is often quoted in studies of IT acceptance and diffusion. Rogers (1983) proposed a theoretical framework that reveals the relationship between perceived innovation and adoption rate. Moore and Benbasat (1991) expanded on the constructs, and the scale they propose is widely disseminated in studies.

An innovation's perceived attributes, as pointed out by the authors, include: relative advantage, compatibility, ease of use, trialability, image, demonstrable results, visibility, voluntariness, and use of technological innovation (which, for the purposes of this study is the VLE).

According To Moore and Benbasat (1991), an innovation's perceived characteristics have consistently influenced the adoption and use of innovations, studies show different measures of the predictive power of attributes, and some findings reveal that not all attributes influence adoption, as the differences depend on the innovation and on the period in which are applied. It is therefore advisable not to exclude any attributes from the model (He *et al.*, 2006).

The Relative advantage attribute reflects the degree to which an innovation is perceived as better than its precursor, that is, better than the one it replaces. This can be measured in economic, social prestige, convenience and satisfaction terms for the innovation in question. The individual must perceive the innovation's (Rogers, 1983). Relative advantage is represented by the rate of benefits expected from the use of an innovation.

Several studies have introduced constructs associated with the acceptance of technological innovation and indicated the positive influence of relative advantage on adoption and use. (Agarwal & Karahanna, 2000; Davis *et al.*, 1989; Plouffe *et al.*, 2001; Venkatesh & Davis, 2000; Venkatesh *et al.*,2003; Compeau; Meister; Higgins, 2007).

Therefore, in order to analyze its influence of the process of using a technological innovation-the VLE, in the present study –, the paper's first hypothesis was developed as follows:

Hypothesis 1 (H_1): The attribute Relative advantage has a positive influence on the process of technological innovation/VLE use.

Compatibility is the degree to which the adoption of an innovation is perceived as consistent and coherent with the potential adopters' existing values, practices, needs and experience. An innovation may be either compatible or incompatible with the social and cultural values of the environment in which it is to be inserted, with previously produced ideas, or with the needs of the individuals in connection with innovation. An idea that is not compatible with a social system's values and norms will seldom be adopted as easily as a compatible innovation would. (Rogers, 1983; Moore & Benbasat, 1991).

Agarwal and Prasad (1997) and Plouffe *et al.* (2001) find a positive influence of compatibility on the intent to use a technology. A user that regards an innovation as compatible with his or her

working style exercises direct influence on use intensity (Compeau; Meister; Higgins, 2007).Other studies indicate that compatibility is strongly related with relative advantage. (Karahanna *et al.*, 1999, Moore & Benbasat, 1991). Holak and Lehmann (1990) argue that familiarity with an innovation and the compatibility between its operation and the preferred way of carrying out a certain activity influence the individual's acceptance of an innovation. Assuming that the compatibility attribute may affect the use of a technological innovation, the paper's second working hypothesis is:

Hypothesis 2 (H_2): The Compatibility attribute positively influences a technological innovation/VLE's use process.

Roger (1983) referred to the ease of use attribute as Complexity, reflecting the degree to which an innovationis perceived as difficult to understand for the purposes of use by potential adopters. New ideas that are simple to understand and absorb are more quickly adopted by the members of a social system, while those that require developing new knowledge and understandings, and regarded as more complex, are more slowly adopted (Rogers, 1983). Moore and Benbasat (1991) exchanged the complexity attribute as proposed by Rogers (1983) for the 'Ease of Use' attribute, in order to determine the level to which an innovation is perceived as easy to use. For the authors, the easier an innovation is to use, the greater the probability of adoption. This study will test the Ease of Use attribute.

In the study developed by Compeau; Meister and Higgins (2007) ease of use did not positively influence intensity of use. According to the authors, their results are not compatible with other studies that find a relationship between ease of use and use intensity mediated by relative advantage.

Davis; Bagozzi and Warshaw (1989) showed that individually perceived ease of use in connection with information systems positively influence use. Based on the foregoing, the study's third hypothesisis as follows:

Hypothesis 3 ($H_{3)}$: The Ease of Use attribute positively influences a technological innovation/VLE's use process.

The Trialability attribute is defined as the degree to which potential adopters may try an innovation prior to adoption (trialability period). The ability to test an innovation can make it significant to the individual and it will usually be adopted more quickly than innovation that cannot be tried in advance. An innovation that can be tried, and which an individual can test and find out whether or not will operate according to his or her needs as a used involves less uncertainty, as it enables learning by doing (Rogers, 1983; Moore & Benbasat, 1991). Technology adoption difficulties may be supported by professional training, which is regarded as a phase in the adoption process because lacking or insufficient training may create resistance to the technological innovation (Dong *et al.*, 2007).The trialability attribute enables testing the innovation, which may influence the use of a technology. Therefore, it makes sense to analyze trialability as well, leading to the study's fourth hypothesis:

Hypothesis 4 (H_4): The Trialability attribute positively influences a technological innovation/VLE's use process.

Visibility *(*observability) indicates the degree to which an innovation's results can be observed by an organization, which is, become visible to potential users. The easier it is for individuals to perceive an innovation's results, the greater the odds that such individuals will adopt the innovation in question (Rogers, 1983). Therefore, users need to be informed and made aware of and sensitized to the benefits of a given technology. In the communication process, it is crucial for the message to be understood and for the recipient to be able to provide feedback.

According to He *et al.*, (2006) the more visible an innovation's results, the faster its adoption and implementation will be, that is, an innovation's observability as perceived by individuals is positively related with the innovation's adoption index. Within the context of their study, Moore and Benbasat (1991) adapted the original attribute of observability to visibility, which is the term this study will use. Within this context, the *visibility* attribute provides for the observability of an innovation's results. Give this, the study's fift proposed hypothesisis:

Hypothesis 5 (H_5): The visibility attribute positively influences a technological innovation/VLE's use process.

The five characteristics (attributes) of innovation diffusion as proposed by Rogers (1983) and discussed previously provided the basis for Moore and Benbasat (1991), whose goal was to evaluate the various perceptions an individual may have on an innovation's use characteristics.

In addition to the five characteristics above, Moore and Benbasat (1991) introduced three new attributes: image, voluntariness and results demonstration. An innovation's perceived characteristics or attributes that the two authors studied are described next.

Imager eflects the degree to which using an innovation is perceived as an improvement to an individual's image or a social system's status (Moore & Benbasat, 1991).

Rogers (1983) argues that individuals are more likely to adopt innovations when they perceive image improvement. Social and political motivations are factors that influence individual behavior. The user's distinguished profile, increased prestige and social status directly influence the intensity of the use of a technological innovation (Plouffe *et al.*, 2001). However, Venkatesh and Davis (2000) pointed out that the perceived image positively influences relative advantage and adoption for use.

The Image construct may be significant in an instructor's behavior toward DL, as, if his or her reference group or LIs favor DL, acceptance may be greater. Therefore, the sixth hypothesis indicates that:

Hypothesis 6 (H_6): The Image attribute positively influences a technological innovation/VLE's adoption/use process.

Joining the constructs observability and communicability, which Rogers (1983) initially identified, became the category Result Demonstrability, indicating the degree to which the results from the use of an innovation are tangible (Moore & Benbasat, 1991). Venkatesh and Davis (2000) observed a direct relationship between demonstrable results and perceived utility. They argued that individuals form more positive perceptions of a system of the relationship between use and performance is easily detected.

In this sense, Holak and Lehmann (1990) offer that the familiarity that emerges from an innovation's compatibility with its preferred mode of operation makes it easier for an individual to recognize its benefits and communicate it to others in terms of the perceived results of its use. It makes sense, therefore, to evaluate the influence of the Result Demonstrability on the use of technological innovation, providing the grounds for the study's seventh hypothesis:

Hypothesis 7 (H_7): The Result Demonstrability attribute positively influences the process of adoption and use of a technological innovation/VLE.The Voluntariness attribute, proposed by Moore and Benbasat (1991), is defined as the degree to which the use of an innovation is perceived as voluntary or spontaneous.

Compeau; Meister and Higgins (2007) address the quick insertion of information technology based on innovations in the workplace. The authors argue that facilitating the introduction of IT innovations requires understanding the factors that influence adoption by users and continued-use decisions. Such factors are important for the voluntariness of systems, and even of mandatory ones. Voluntariness is a factor that may prolong an innovation's continued use. Therefore, this study's eighth proposed hypothesis is:

Hypothesis 8 (H_8): Voluntariness positively influences the process of technological innovation/VLE adoption/use.

This study includes two more variables, mastery of the technology and experience time, in connection with the use of a technological innovation. The variables will be analyzed in terms of their direct effect on the use of the technological innovation.

Inclusion of the mastery of the technology variable is justified in order to recognize the need for IT users to have the knowledge to use the technology. Mastery of the technology reflects the level of IT knowledge and experience, enabling instructors to embrace methodological innovation (Masetto, 2003; Zabalza, 2006; Kenski, 2009, Huertas, 2007). Huertas (2007) emphasizes that restrictions against the use of technology on the part of the teacher may be associated with his or her lack of technical skills. The findings of Gong, Xuand Yu (2004) indicate that self-effectiveness in the use of computers has a strong direct and indirect effect on the intent to use an innovation. The authors further indicate that mastery of the technology may significantly increase user's perceived ease of use of the technological innovation.

Experience stands as an important artifact to enable the dissemination of a technological innovation in learning environments. In an empirical study of e-learning, Welsh *et al.* (2003) suggest that prior experience may indicate positive attitudes towards e-learning systems and, as a result, increase intent to use. Therefore, this study's ninth and tenth hypotheses are:

Hypothesis 9 (H_9): Mastery of the technology positively influences the process of technological innovation/VLE adoption/use;

Hypothesis 10 (H_{10}): Experience time positively influences the process of technological innovation/VLE adoption/use;

However, the attributes (characteristics) perceived from the use of the technological innovation/VLE have been analyzed based on the perception of five attributes of innovation as proposed by Rogers (1983), the three supplementary attributes found in Moore and Benbasat (1991) and two variables included into the model: mastery of the technology and experience with the VLE.

METHODOLOGICAL PROCEDURE

This study is of a quantitative nature. The investigation used the survey strategy to directly interrogate participants by means of a questionnaire.

The study's target population comprehends teachers active or who have been active in the DL model in Business programs (Administration and Accounting) delivered in Brazil.

The study's sampling units are teachers who directly play a role in the virtual teaching and learning process, using the VLE, and who deliver or have delivered DL lessons.

The sample was intentional, non-probabilistic and by convenience, and respondent participation was spontaneous. Data gathering involved a field study and resorted to primary data collection by means of a questionnaire. To develop the questionnaire used in the study, in addition to IDT literature review, we analyzed and adapted the instrument developed and tested by Rogers (1983) and supplemented by Moore and Benbasat (1991).

Before sending the questionnaire to the respondents, the data-gathering instrument was qualitatively pre-tested. The test involved sending the questionnaire to ten instructors experienced in the DL model in the business area and using the VLE, as well to five course DL-program coordinators.

Figure: 1 shows the statements by constructs used in the study's research instrument. It is appropriate to emphasize that, in the model's validation process (confirmatory factor analysis), certain items have been excluded, as indicated.

Constructs	Items (Statements)
Relative advantage	RA1: Using the VLE enables me to do things faster
	RA2: Using the VLE gives me greater control over my work (e.g.: better interaction with and control of students) Exc*CFA
	RA3: Using the VLE improves the quality of my work
	RA4: In general using the VLE is not advantageous to my work Exc*CFA
	RA5: Using the VLE makes it easier for me to do my job
Compatibility	COMP1:Using the VLE adjusts to my manner of working Exc*CFA
	COMP2: Using the VLE is compatible with every aspect of my work (e.g.: evaluation, planning, tracking, etc.) Exc*CFA
	COMP3: Using the VLE is not compatible with my my manner of working
	COMP4:Using the VLE is entirely compatible with my current work situation
	COMP5: Using the VLE adjusts well to how I like to work
Image	IMAG1:Instructors at the LIs (where I work) who use the VLE have a distinctive profile (e.g.: more communicative; attempt to interact….) Exc*CFA
	IMAG2: Using the VLE is a status symbol at my LIs
	IMAG3: People atmy institution who use the VLE have greater prestige than those who do not ..Exc*CFA
	IMAG4:Several coworkers (more than 60%) at the LIs where I work use the VLE
Ease of Use	EU1: Learning how to use the VLE was easy for me Exc*CFA
	EU2: In general, it is easy to use the VLE
	EU3: It is easy to use the VLE to carry out my tasks
	EU4: My interaction with the VLE is clear and easy to understand
Result Demonstrability	RD1: The results from using the VLE are evident to me
	RD2: I can tell others about the implications (e.g.: results or benefits) of the use of the VLE
	RD3: I have no difficulty explaining the results of the use of the VLE to others
	DRD4: I have no difficulty explaining why the use of the VLE may or may not provide benefits Exc*CFA
Visibility	VIS1:At the LIs where I work, many instructors are known to be using the VLE
	VIS2: Using the VLE is not perceived at the institution where I work
	VIS3:At the LIs where I work, you can connect to the VLE from different locations and on different computers Exc*CFA
	VIS4: I often see other instructors using the VLE at the institution where I work Exc*CFA
Trialability	TRI1: I had several opportunities to try the VLE Exc*CFA
	TRI2: Before choosing to use the VLE, I had the opportunity to experience it
	TRI3: I was allowed to use the VLE for testing purposes for time enough to understand its utility
	TRI4: I tried the VLE for a sufficient period of time before adopting it
Voluntariness	VOL1: Using the VLE s mandatory for DL at the LIs where I work
	VOL2: My superiors to not force me to use the VLE
	VOL3: Although it is useful, using the VLE is not mandatory at the LIs where I work
Mastery of the technology	MT1:I am highly knowledgeable in and experienced with information technology
	MT2: I have little interest in information technology Exc*CFA
	MT3: I find it easy to use computers Exc*CFA
	MT4: I am highly knowledgeable in information technology
	MT5: I am highly experienced with the Internet
Use of the VLE	USO1: I intend to make more intense use of the VLE in the future
	USO2:I intend to discover new ways of using the VLEfor work
	USO3: I intend to exploit the VLE's resources and features to the utmost for work
	USO4: I consider myself an intensive user of the VLE Exc*CFA

Exc*CFA (excluded after Confirmatory Factor Analysis)

Figure: 1
Statements listed by constructs

Sample Description

This study used a non-probabilistic sample of the self-generated type. According to Malhotra *et al.* (2005), in self-generated sampling, a initial group f interviewees is selected. After completing the questionnaire, they are asked to identify other individuals in the target population. In this technique, also referred to as *snowball sampling,* the researcher asks for the participants' help identifying other persons with similar characteristics who meet the study's requirements, and the sample increases in size like a snowball. The process is repeated and results in a self-generation effect, as each reference is obtained from another.

For this study, we searched the E-mec Platformfor the program coordinators' name, e-mail, Website and telephone information, for LIsoffering DL Administration and Accounting programs. In addition to the E-mec Platform, we visited the LIs' Websites for information not available from the former. This enabled identification of 145 LIs, of which 52 were contacted by telephone, while the remainders were sent e-mails.

The purpose of the contact by telephone and/or e-mail was to introduce program coordinators to the study's goals and request the LIs' participation, in addition to request provision of e-mail listings of instructors who are or have been active in DL Administration and Accounting courses. Where such provision was not possible, we requested that the LI forward the link to the study to them. Most of the referrals were made by forwarding the study's link, resulting in 439 completed questionnaires, of which 436 were considered valid – the three excluded participants started answering the form, but never entirely completed it.

The final data-collection instrument used in the study was an electronic questionnaire made available over the Internet via the *Google Docs* platform. The access link was available for 45 days (March 1st-April 16th, 2012). The questionnaire used a 7-point Likert scale (1 being the minimum and 7 the maximum). To complete the questionnaire, respondents were only allowed to advance to the next phase (page) after answering every question on the current page. As a result, there were no missing values.

Characterization of the Respondents

The first part of the survey questionnaire was intended to obtain respondent-characterization data. Most (approximately 70%) of the 436 participating instructors are or have been active in DL Administration; 12% in Accounting; and 18% in both.

As for the instructors' qualification level, most (46%) have master's degrees, followed by (26%) doctor's degrees. In terms of the nature of the LIs where the instructors deliver or have delivered DL lessons, the percentage distribution was well balanced, with 51% Public LIs and 49% Private LIs. As for the occupation of the participating instructors in DL, most (38%) are active on the undergraduate level, followed by post-graduate (22%). The percentages will change (18%), considering the two activities (undergraduate and post-graduate). It has been found that the majority of instructors (83%) are also active in presence learning in addition to DL.

Analysis Strategy for the Data

Two statistical tests have been selected to analyze the data. The former is Confirmatory Factor Analysis, which we will discuss next, and then we used multiple regression to test the study's proposed hypotheses.

To ensure the construct's validity, we evaluated the components proposed by Hair *et al.,* (2009): one-dimensionality, reliability, and convergent and discriminat validity. For the CFA, we resorted to the AMOS 18.0 software and the Maximum Likelihood – ML estimation method. We made some attempts to improve the adjustment indexes by means of three extractions. A few problems were detected, such as low standardized loading values for certain variables.

According to Hair e*t al.* (2009), such occurrences are undesirable, suggesting a possible choice to eliminate problem variables, which we did. Items with standardized factor loadings under .5 and low correlation with other items in the construct were excluded; excluded items are identified with Excl*CFA in Figure: 1.

Adjustment of the Confirmatory Factor Analysis model to the Complete Model 'Attributes of the Use of Technological Innovation' was satisfactory, that is, indicated that the data collected fit. Both absolute (GFI, AGFI) and comparative (IFI, TLI, CFI, RMSEA) adjustment indices displayed good levels, according to authors Kline (2005), Brown (2006) and Hair *et. al.* (2009).

The measurement model's adjustment indices, after purging, were: Chi-squared(X_3^2) = 715.8 ; DF = 305.0; p < 0.000; GFI = 0.895; AGFI = 0.854; CFI = 0.941; RMSEA = 0.056; NFI: 0.902; IFI : 0.941; and TLI: 0.927. We analyzed the indicators found from the fitted model, as follows: convergent validity (*Average Variance Extracted*: AVE) and the reliability of constructs via Cronbach's Alpha and Composite reliability(CR). Table 1 shows the indicators found:

Table: 1
Fitted Model Indicators

Construct	Cronbach's Alpha	AVE	CC
Relative advantage (RA)	0.81	0.60	0.81
Compatibility (COMP)	0.86	0.70	0.87
Ease of Use (EU)	0.84	0.65	0.85
Trialability (TRI)	0.81	0.60	0.81
Visibility (VIS)	0.68	0.56	0.70
Image (IMAG)	0.80	0.67	0.80
Voluntariness (VOL)	0.71	0.48	0.72
Result Demonstrability (RD)	0.73	0.48	0.73
Mastery of the technology (MT)	0.86	0.69	0.87
Adoption/Use of Technological Innovation (ADOU)	0.85	0.65	0.85

According to Hair *et al.* (2009, p.591), "items that are indicators of a specific construct must converge or share a high proportion of common variance, known as convergent validity" (*Average Variance Extracted*: AVE).

The authors indicate that the standardized loading estimates must be .5 or higher, or preferably .7 or higher, and that average variance extracted metrics must equal or exceed 50%. The reliabilityof the model's constructswas checked by means of internal consistency analysis (*Cronbach's Alpha)* and the Composite reliability (CR) of each construct, in order to test whether a single factor consistently underlies the items-set. The results shown in Table: 3 indicate that the indices found with the *Cronbach's alpha* method show whether the validity of the indicator variables relative to latent variables was accepted and, as a result, they were included in the model. Composite reliability (CR) also a displayed value regarded as appropriate and was validated, as all constructs exceeded .70, determining that the indicator adequately measured the constructs (Fornell & Larcher, 1981; Hair *et al.,* 2009). Another aspect found is discriminant validity, via the procedure recommended by Bagozzi and Philips (1982), and which shows that where the correlations between different constructs are high, this means that the metric does not capture a construct in isolation. For each group, the construct pairs were tested, that is, two models were tested for each pair of constructs. One model was tested correlating the two constructs, and the other left the constructs free (uncorrelated). We then compared the difference between the chi-squared of the two models, that is, one that contemplates total correlation (equal to 1) between the constructs, and another that considers no correlation. The results proved discriminated validity, as the difference between the chi-squared of all models (constructs) indicated statistically significant differences ($p < 0.01$), where the scales correlation was set at 1.

ANALYSIS AND DISCUSSION OF THE RESULTS

We used multiple linear regression to analyze the study's proposed hypotheses. Given the research problem above, the independent variables were set as the perceived attributes of the use of a technological innovation (relative advantage, compatibility, ease of use, Result Demonstrability, trialability, image, visibility, and voluntariness), in addition to the supplementary variables tested in this study-mastery of the technology and experience with the VLE. The dependent variable was set as 'Use of the Technological Innovation- VLE', considered as intent to use.

To apply the multiple regression, we checked the assumptions noted by Hair *et al*. (2009): standardized residuals analysis, with the purpose of observing whether they behave like random variables with average equal to zero; standardized residuals distribution normality test (Kolmogorov-Smirnov test); and determination of the absence of multicolinearity (*Variance Inflation Factor*–VIF test), for the multivariate analyses, considering the critical cutoff to be 10 (Hair *et al*., 2009). To analyze the determinant attributes for the use of a technological innovation, hypothesesH_1, H2, H3, H4, H5, H6, H7andH8 were tested using the model, showing the direct effect of the variables on the use of the technological innovation. Table: 2shows the regression analysis's results.

Table: 2
Multiple Regression Model – Determinants of the Use of Technological Innovation (IDT constructs)

Hypotheses	Variables	Beta	Standard Error	Standardized Beta(β)	t-value	*P value*	VIF	Direct Relation
	Const.	0.708	0.200		3.546	0.000	-	-
H_1	RA	0.274	0.047	0.280	5.878	0.000	2.804	Supported
H_2	COMP	0.386	0.049	0.414	7.855	0.000	3.422	Supported
H_3	EU	0.052	0.046	0.049	1.128	0.260	2.371	n.s
H_4:	TRI	-0.014	0.022	-0.022	-0.641	0.522	1.388	n.s
H_5	VIS	0.009	0.026	0.011	0.347	0.729	1.351	n.s
H_6	IMAG	0.20	0.024	0.027	0.828	0.408	1.270	n.s
H_7	RD	0.156	0.048	0.145	3.213	0.001	2.508	Supported
H_8:	VOL	-0.003	0.021	-0.004	-0.140	0.889	1.201	n.s
	N	436	Unadjusted R^2	65.4				
	Adjusted R^2	64.7						
	Sig. (Residual normality) / Kolmogorov-Smirnovtest[a] : KS: 1.347				*p-value:* 0.053			
	Sig. (Model)	0.000						

Note: ***P values*** **at 5% highlighted in grey; N=number of observations; VIF=VIF (Variance Inflation Factor) Statistic; Sig.(Residual normality) =significance for the Kolmogorov- Smirnov normality test applied to standardized residuals; Sig.(model): significance of the regression model's F test; n.s (not supported).**

The standardized regression coefficients indicate how much each construct affects the dependent variable when the variable increases by one unit. Compatibility has the highest regression coefficient (β =0.414) with the use variable, that is, when the use variable increases by one unit, the greatest contribution to this change comes from compatibility. Next comes relative advantage, with the second-highest regression coefficient (β = 0.280), followed by Result Demonstrability, at (β = 0.145).

We find that the standardized regression coefficients for the trialability and voluntariness variables are negative (β =-0.011 and β=-0.004). The values are close to zero, suggesting non-significance of the perceived attributes for use of the technological innovation. One explanation for the case of trialability is the fact that the VLE is used in DL and, in the majority of implementations of this model, instructors do not have the opportunity to try the VLE for trial purposes: the information systems are provided to LIs as ready-made modules. As for voluntariness, it is worth pointing out that the VLE is required for DL and, therefore, instructors must adopt it regardless of whether they are willing or not.

Table: 2 also shows the adjusted R^2 (variance determination coefficient) for the dependent variable "use". The adjusted R^2obtained for "use" was 64.7, denoting that 64.7% of the changes in "use" are explained by changes in perceived attributes of the use of VLE. This is in line with Rogers (1983), for whom an innovation's perceived attributes explain 49%-87% of its adoption rate. Multiple regression results indicate that only the constructs Relative Advantage (RA), Compatibility (COMP) and Result Demonstrability (RD) are significant at 5% ($p<0.05$), that is, positively influence the process of Use of a technological innovation. The "Use of the Technological Innovation" variable only establishes a linear and significant relationship with the variables RA, COMP andRD.

Agarwal and Prasad (1997) also showed that relative advantage and Result Demonstrability are predictors of the future intent to use the technological innovation.

Given the results obtained, H_1, H_2 and H_7 have been supported, that is, the presence of positive influences on the dependent variable (use of the technological information) has been corroborated. Hypotheses H_3, H_4 , H_5, H_6 and H_8 were not supported. The variables ease of use, trialability, visibility, image and voluntariness did not validate the mode, that is, do not directly affect "use". A collection of empirical evidence has been demonstrating the perceived characteristics in the adoption and use of a technological innovation, with results depending on the type of the innovation, the users' beliefs, and the environment in which the innovation is being implemented.

This study confirmed this aspect (Table: 2) by means of hypotheses H_1, H_2 and H_7, as the results show direct relationships between compatibility, relative advantage and Result Demonstrability and the use of technological innovation.

The results show that the innovation (VLE) is compatible with instructors' needs and with the social and cultural values of the learning environment in which it is embedded. The relative advantage attribute, which also significantly influences use, indicates the degree to which the innovation is perceived as better than its predecessor, representing the rate of expected benefits from the 'use of an innovation' (Rogers, 1983). Compeau; Meister and Higgins (2007) showed that 'relative advantage' has the most effect on the intensity f the use of a technological innovation.

Result Demonstrability shows the degree to which an innovation's results are tangible (Moore & Benbasat, 1991). Studies indicate that the predictive power of attributes varies and that not all attributes influence adoption. The differences depend on the innovation and the period of application (Moore & Benbasat, 1991; HE et al., 2006).

The model proposed by Rogers (1983) and subsequently expanded by Moore and Benbasat (1991) hypothesizes that an innovation's perceived characteristics directly influence the adoption and use of a technological innovation. However, several studies show that the proposed attributes are not the only ones capable of influencing adoption. We therefore attempted to improve the prediction by including the variables mastery of the technology and experience with the VLE, which may directly affect the use of a technological innovation.

However, in the second regression, the sample was divided into groups, as follows: instructors with greater and lesser mastery of the technology; and instructors with greater and lesser experience with the VLE.

These groups are regarded as predictors in the regression model. As such, the two classes were labeled 0 and 1, that is, we used dummy variables to represent groups of instructors simply by zero and one. We tested hypotheses H_9 and H_{10}, which concern the direct effect of the variables "mastery of the technology" and "experience with the VLE" on "use" of the technological innovation. Table: 3 shows the multiple regression results, including the dummy variables mastery of the technology and experience with the VLE.

Table: 3
Multiple Regression Model-Determinant Attributes
of the Use of a Technological Innovation (IDT constructs and supplementary variables)

Hypotheses	Variables	Beta Coef.	Standard Error	Standardized Beta (β)	t-value	*P value*	VIF	Direct Relation
	Const.	0.705	0.197		3.579	0.000	-	-
H_1	RA	0.272	0.046	0.277	5.900	0.000	2.806	Supported
H_2	COMP	0.399	0.049	0.427	8.209	0.000	3.438	Supported
H_3	EU	0.040	0.046	0.038	0.862	0.389	2.429	n.s
H_4	TRI	-0.017	0.022	-0.026	-0.773	0.440	1.392	n.s
H_5	VIS	0.009	0.025	0.012	0.371	0.711	1.351	n.s
H_6	IMAG	0.008	0.024	0.011	0.334	0.738	1.292	n.s
H_7	RD	0.138	0.048	0.129	2.854	0.005	2.579	Supported
H_8	VOL	-0.008	0.021	-0.012	-0.404	0.686	1.209	n.s
H_9	Dom_Tec	0.311	0.084	0.111	3.723	0.000	1.126	Supported
H_{10}	Exp_VLE	-0.067	0.077	-0.026	-0.874	0.383	1.113	n.s
	N			436	Unadjusted R^2		66.5	
	Adjusted R^2			65.7				
	Sig. (Residual normality) / Kolmogorov-Smirnov test[a] : KS: 1.159					*p-value:* 0.136		
	Sig. (Model)			0.000				

Note: *P values* at 5% highlighted in grey; N=number of observations; VIF=VIF (Variance Inflation Factor) Statistic; Sig.(Residual normality)=significance for the Kolmogorov- Smirnov normality test applied to standardized residuals; Sig.(model): significance of the regression model's F test; n.s (not supported).

The results were not far different from those found in the first test's multiple regression. The constructs Relative advantage (RA)', Compatibility (COMP) and 'Result Demonstrability (RD) remained with significant effect at 5% ($p<0.05$), while the variable Mastery of the technology also showed a significant direct effect on a technological innovation's use process.Mastery of the technology reflects the degree of IT knowledge and experience, enabling instructors in connection with the methodological innovation (Masetto, 2003; Zabalza, 2006; Kenski, 2009; Huertas, 2007).

The construct mastery of the technology, tested in this regression model, positively influences the process of instructor adoption of the technological innovation (VLE).

Compatibility again showed the highest regression coefficient (β = 0.427) with the "use variable, followed by relative advantage (β = 0.277), Result Demonstrability (β = 0.129) and mastery of the technology (β = 0.111).

Given the results obtained, we find that H_1, H_2, $H_7$and$H_9$are supported, that is positively influence the use of the technological innovation. HypothesesH_3, H_4, H_5,H_6,H_8 and $H_{10}$are not supported, that is, the variables ease of use, trialability, visibility, image, voluntariness and experience with the VLE did not validate the model, or, in other words, do not have a direct effect on Use.

CONCLUSION

The results of the quantitative approach adopted in this study indicate the determinants of the use of a technological innovation introduced by the VLE in DL, as perceived by instructors in business programs (Administration and Accounting). We found that not all of the attributes analyzed, as proposed by IDT, had a direct effect on the use of the innovation for the participating instructors. The identified attributes were: compatibility, which evidences innovation's consistency with their values, practices and needs; relative advantage, according to which the innovation is perceived as better than its predecessor; and Result Demonstrability, according to which instructors understand the tangible results obtained from using the innovation.

These results suggest that the VLE is well regarded and may be used more intensely when it meets the pedagogical needs of instructors and displays greater utility than other practices. They also indicate that use of the VLE is being communicated among users and that mastery of the technology, represented by IT knowledge, influences the "use of the VLE" by DL instructors. All of the attributes suggested by innovation diffusion theory (IDT) were expected to positively influencethe intent to use the innovation (Agarwal & Prasad, 1997). The results were consistent with some empirical studies found in the literature, and snow that not all IDT attributes had a direct effect on the intent to use the innovation (Karahanna, Straub & Chervany, 1999; Compeau; Meister & Higgins, 2007; Chen, Yen & Chen, 2009).

Analysis of the mastery of technology variable also showed its direct and significant effect on the process of *Use* of the technological innovation. The variable represents instructor knowledge of and experience with IT relative to the "use" of the VLE. Based on statistical evidence, the attributes: 'ease of use', 'trialability', 'visibility', 'image' and 'voluntariness', and the variable 'experience time' do not positively affect use of the VLE, as perceived by business program instructors.

These findings run opposite to the theory surrounding the model of perceived attributes in the adoption and use of technological innovation that provided the basis for this study. This may indicate, for example, that for instructors who use or have used the technology (VLE) for Distance Learning (DL), ease of use may not be a relevant factor to explain the intent to use distance-learning platforms. The fact that image was not considered relevant to the use of the VLE may be due to the fact that, for instructors, the VLE stands as an everyday DL tool, that is, it is not

voluntary technology for distance learning.This study's theoretical contribution relates to application of the model in the education environment, and more specifically in DL, as well as to enriching the literature with a refinement of the constructs concerned with the perceived characteristics of a technological innovation that affect the intensity of adoption and use, presenting variables (scale) to help measure and predict reliable results according to the proposed theoretical precepts. Refinement of the constructs aimed to add theoretical clarity and assist in the appropriate measurement of the proposed scale.

The theoretical model was expanded with the inclusion of variables to better characterize the influence of an innovation's perceived characteristics, mainly because of the complexity of the existing relationships and of the possible direct effects on the use of the technology.

We acknowledge the study's limitation, associated with the fact that it is a simple cross-section survey and with the fact that the non-probabilistic sample obtained prevents making inferences and limits generalization of the results or transposition to the overall population. The results, notwithstanding, contribute to new developments and to future studies.

To add to this study, we propose an exploratory qualitative survey with business instructors to explore the perceived characteristics of a technological innovation in the educational environment using qualitative data collection, such as interviews with focus groups.We also suggest exploring the interrelations among perceived attributes of atechnological innovation, as influences across constructs may contribute to the development of the theory and have not yet been widely investigated.

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