WCLTA-2012

Users' perception of visual design and usefulness of a web-based educational tool

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Abstract

Our research has become increasingly aware of the relevance of visual design in understanding learners' attitudes towards the use of virtual tools. Likewise, perceived usefulness is an essential antecedent of the cumulative impressions of and preferences for them. Therefore, the aim of this study is to investigate the main effects of visual design and usefulness on learning and productivity in the domain of web-based educational tools. A Structural Equation Modelling, specifically Partial Least Square (PLS), is proposed to assess the relationships between the constructs. Visual design and usefulness have a significant effect on the learner's perception of the extent to which needs, goals and desires have been fully met, and, by extension, learning performance. Furthermore, higher expressive aesthetics reduces the impact of classical features on satisfaction.

1. Introduction

Visual design is becoming one of the most important factors that influences users' affective experiences and their emotional bonds in online environments (*cf.* Hassenzahl and Tractinsky, 2006; Kim *et al.*, 2009; Sánchez-Franco and Rondán, 2010; Tractinsky *et al.*, 2000; Wolfinbarger and Gilly, 2003, among others). On the one hand, users seek pleasant fulfilment and deep emotional stimulation during consumption experiences. Accordingly, if users find virtual appearances pleasing, it is likely that both their state of mind and subsequent implied evaluations will be favourably enhanced. Our research thus becomes increasingly aware of the relevance of visual design in understanding attitudes towards the use of virtual tools. Nevertheless, visual design is certainly not the only essential issue. Assuming that the study of web-based services is still at the exploratory stage, our research also proposes that the success of an e-learning tool depends partially on the users' perception of usefulness.

This study is, therefore, designed to investigate how the traditional usability concerns and visual aesthetics of e-learning tools may be associated with learning and productivity and its consequences on perceived usefulness of adopting a user-centered perspective. Questions such as ''How can our understanding of these drivers help us design

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desirable e-learning tools that learners really want to adopt?'' naturally warrant a holistic motivational perspective in our research.

2. Theory and research hypotheses

While not diminishing the importance of other design issues, the scope of this paper is limited to visual aesthetics and usability (or perceived ease-of-use; *cf.* ISO 9241). On the one hand, expressive aesthetics is conceptualised as "the subjective judgment of a web site to exhibit novelty and appropriateness that elicits arousal and pleasure and is compatible with the user's preferences" (Zeng and Salvendy, 2008, p.6). On the other hand, classical issues are driven by a sense of clear design (*e.g.*, clean and symmetrical), "serving as linkages between usability and aesthetics" (Lavie and Tractinsky, 2004, p.290). Visual aesthetics contribute to the uniqueness (via expressive aesthetics) and usability or ease-of-use of an e-learning tool (via classical aesthetics), improving its perceived efficiency and effectiveness.

Firstly, visual design is an essential predictor of the learners' cumulative impressions of and preferences for an e-learning tool. According to classical (or functional) aesthetics, information and communication technology that is difficult to learn and difficult to use will, on the one hand, induce negative emotions and thus generate avoidance behaviour towards technology use (*cf.* Zhang, 2008); contrariwise, usability will reduce search costs as well as possible errors, emphasising the users' satisfaction. On the other hand, the positive emotions prompted by expressive aesthetics improve the experiences of interest and enjoyment, as well as the satisfaction derived from the activity (*cf.* Isen and Reeve 2005, Lindgaard, 2007, Westbrook 1987). Based on the previous arguments this research proposes the following hypothesis: H1. Visual aesthetics (*i.e.*, expressive, H1.1, and classical aesthetics, H1.2) have a positive influence on non-economic satisfaction (*i.e.*, favourable affective response of customers who find the cumulative service interactions rewarding, fulfilling and stimulating).

Secondly, research should not overlook the importance of perceived usefulness -defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). Indeed, perceived usefulness is an essential antecedent of the learners' cumulative impressions of and preferences for an e-learning tool. "To the extent that the system meets or fails to meet each of these aspirations, the user is more or less satisfied" (Seddon and Kiew, 1996, p.95). Based on the previous arguments, this research proposes the following hypothesis H2: Perceived usefulness has a positive influence on non-economic satisfaction.

Thirdly, visual design will have an inverse relationship with the perceived complexity of use of the technology – affecting perceived usefulness. A system that is difficult to use is less likely to be perceived as useful. The Technology Acceptance Model (TAM; *cf.* Davis 1989, Davis *et al.*, 1992) indeed posits that perceived usefulness is influenced by perceived ease of use. Likewise, as we commented above, expressive aesthetics are reflected by the creativity and originality of an e-learning tool, and increases the users' arousal. In this regard, Csikszentmihalyi (1990) found a significant relationship between aesthetics and flow. Subsequently, Agarwal and Karahanna (2000) proposed a multi-dimensional construct called cognitive absorption (encompassing flow) which had a significant influence on usefulness. These arguments lend support to the hypothesis that expressive aesthetics are also positively associated with perceived usefulness. Based on the previous arguments this research proposes the following hypothesis H3: Visual aesthetics (*i.e.*, expressive, H3.1, and classical aesthetics, H3.2) have a positive influence on perceived usefulness.

Fourthly, assuming a generic cognitive-consistency argument, when usage is more expressive (related to expressive aesthetics that elicits arousal and pleasure), functional issues (*e.g.*, classical aesthetics) ought not to come into one's main decision-making criteria for cumulative impressions of and preferences for an e-learning tool. Therefore, based on the previous arguments this research proposes the following hypothesis: H4. Expressive aesthetics weaken the relationship between classical aesthetics and non-economic satisfaction.

Finally, the more affective responses and e-learning encounters of learners are rewarding, fulfilling and stimulating, the more likely it is for them to enhance their own learning and productivity. Satisfaction can lead to commitment and reinforces the users' decision to participate in the e-learning services being offered. Therefore, based on the previous arguments, this research proposes the following hypothesis: H5. Non-economic satisfaction has a positive influence on learning performance.
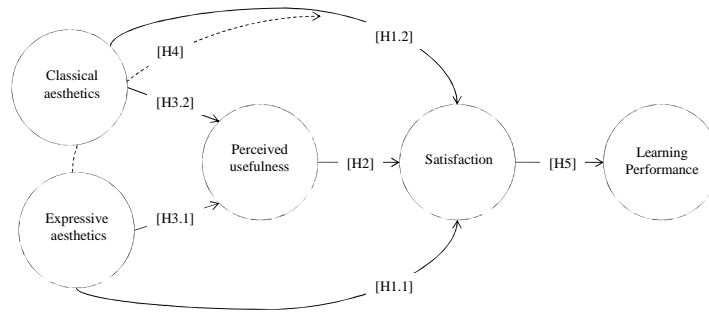
Figure 1. Research model

3. Methods

3.1. Participants

The tool analysed is a web-based educational environment that has been applied as a teaching methodology in an undergraduate course involved with social communication. The data were collected from a sample of questionnaires voluntarily filled out by undergraduate students. Specifically, one hundred and twenty undergraduate students from two social communication classes at a public university in a metropolitan area participated in this study for an extra credit. The exclusion of invalid questionnaires due to duplicate submissions or extensive empty data fields resulted in a final sample of 105 users. 74% were female respondents. The average age was 23.200 (SD: 2.730).

3.2. Measures

Ten items were used to assess expressive and classical aesthetics -taken from Lavie and Tractinsky, 2004. On the other hand, a total of three items were employed to measure non-economic satisfaction (Janda *et al.*, 2002; Smith and Barclay, 1997). Five items were used to assess the degree of perceived usefulness (adapted from Davis, 1989). Finally, three items were used to assess the degree of learning performance –taken from (Premkumar and Bhattacherjee, 2008). All items are seven-point Likert-type, ranging from «strongly disagree», 1, to «strongly agree», 7. See Table 1.

3.3. Data analysis

The hypotheses testing is carried out using Partial Least Squares (PLS), specifically, SmartPLS 2.0.M3 software (Ringle *et al.*, 2008). Taking into account that hypothesis 4 is based on interaction effects, one well-known technique has had to be applied to test this moderated relationship: product-indicator approach (Henseler and Fassott, 2010).

4. Findings and results

4.1. Measurement model

The measurement model (see Table 1a) was evaluated using the full sample -all items and dimensions- and then the PLS results were used to eliminate possible problematic items. On the one hand, individual reflective-item reliability was assessed by examining the loadings of the items with their respective construct. Individual reflective-item reliabilities –in terms of standardised loadings– were over the recommended acceptable cut-off level of 0.7. On the other hand, construct reliability was assessed using composite reliability (ρ_c). The composite reliabilities for the multiple reflective indicators were well over the recommended acceptable 0.7 level, demonstrating a high internal consistency. Moreover, we checked the significance of the loadings with a bootstrap procedure (500 sub-samples) for obtaining t-statistic values. They all are significant. Finally, convergent and discriminant validities (Table 1b)

were assessed by stipulating that the square root of the average variance extracted (AVE) by a construct from its indicators should be at least 0.7 (*i.e.*, AVE > 0.5) and should be greater than that construct's correlation with other constructs. All latent constructs satisfied these conditions.

Table 1. Measurement model

1.a			
Latent Dimensions	Loadings[a]	Latent Dimensions	Loadings[a]
Expressive aesthetics		**Perceived usefulness**	
Creative design	0.8916	This e-learning tool is useful to successfully come to terms with the subject's contents	0.8774
Fascinating design	0.7965	This e-learning tool improves the productivity of my learning of the subject	0.9079
Original design	0.9081	This e-learning tool helps me to attain the aims proposed in the subject	0.8599
Sophisticated design	0.7993	This e-learning tool improves the result of the tasks the study of this subject needs	0.8684
Use of innovative effects	0.8819	This e-learning tool allows me to understand the subject's concepts more quickly	0.6985
Classical aesthetics		**Satisfaction**	
Aesthetic design	0.5874	I think that I made the right decision in using this e-learning tool	0.9054
Pleasant design	0.8069	In general terms, I am satisfied with my experience with this e-learning tool	0.8946
Clear design	0.8359	I have benefitted a great deal from my participation with this e-learning tool	0.9161
Clean design	0.8009	**Learning performance**	
Symmetric design	0.7027	I can learn new skills and competences if I use this e-learning tool	0.8933
		This e-learning tool helps me improve my results	0.8772
		The learning periods are more flexible if I use this e-learning tool	0.8501

[a] *All loadings are significant at p<.001- (based on $t_{(499)}$, two-tailed test)*

1.b					
	EA	**CA**	**PU**	**SAT**	**LP**
EA. Expressive aesthetics	**0.8658**				
CA. Classical aesthetics	0.3377	**0.7523**			
PU. Perceived usefulness	0.3131	0.1417	**0.8456**		
SAT. Satisfaction	0.2913	0.2900	0.6447	**0.9054**	
LP. Learning performance	0.3433	0.1330	0.7860	0.6452	**0.8737**

Note: Diagonal elements are the square root of the average variance extracted (AVE) between the constructs and their measures

4.2. Structural model

Our findings established the link between visual aesthetics, perceived usefulness, non-economic satisfaction and learning performance. In particular, the bootstrap re-sampling procedure (500 sub-samples) was used to generate the standard errors and the t-values. Firstly, the research model appears to have an appropriate predictive power for endogenous constructs to exceed the required amount of .10 –R-square values. Secondly, the data fully supported the model and all hypotheses are supported on the basis of empirical data. As indicated in the main effects model, expressive aesthetics have a significant impact on perceived usefulness, with path coefficients of .299 (t=3.284, p<.001). Likewise, classical aesthetics have a significant effect on non-economic satisfaction, with path coefficients of .192 (t=2.335, p<.01). Perceived usefulness also has a significant effect on satisfaction (β=.606; t=7.726, p<.001). Furthermore, non-economic satisfaction shows a relevant impact on learning performance (β=.644; t=9.678, p<.001). See Fig.2.

*** p < 0.001, ** p < 0.01, * p < 0.05, ns = not significant (based on t(499), one-tailed test)
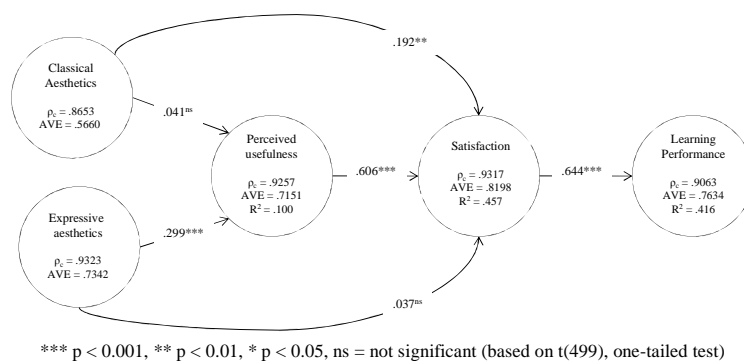
Figure 2. Results (main effects)

The interaction effect was also included, in addition to the main effects model - see Fig.3. As in regression analysis, the predictor and the moderator variable are multiplied to obtain the interaction terms. According to Chin *et al.* (2003), product indicators are developed by creating all possible products from the two sets of indicators and the standardising of the product indicators is recommended. However, in the presence of significant interaction terms involving some of the main effects, no direct conclusion can be drawn from these main effects alone (Aiken and West, 1991). Specifically, the interaction effect was -0.183 (t=2.066, p<0.05). See Fig.3.

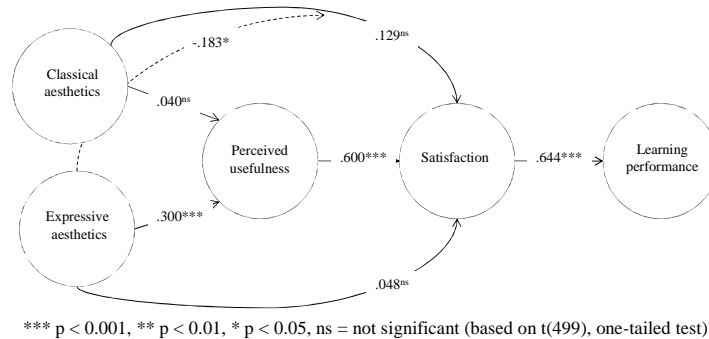*** p < 0.001, ** p < 0.01, * p < 0.05, ns = not significant (based on t(499), one-tailed test)

Figure 3. Results (interaction effect)

5. Discussion

This research reaches two main conclusions. Firstly, that visual design and usefulness have a significant effect on the learner's perception of the extent to which (a) needs, goals and desires have been fully met, and, by extension, (b) learning performance. Secondly, expressive aesthetics become a significant quasimoderator, weakening the influence of classical aesthetics on satisfaction while using the analysed web-based educational tools. When usage is more expressive, functional issues ought not to come into one's significant decision-making criteria for cumulative impressions of and preferences for an e-learning tool.

However, the model did not include all the relevant variables. Firstly, affective trust and commitment are also necessary to assess learning performance and post-adoption usage. Secondly, future research should not overlook "the state of attachment to a partner cognitively experienced as a realisation of the benefits sacrificed and losses incurred if the relationship were to end" (Gilliland and Bello, 2002, p.28). Thirdly, the possible bias of our sample is a limitation of our empirical research. Our respondents showed a gender bias. Moreover, it is difficult to generalise this quasimoderating model and extend the results to other e-learning settings because only members from our e-learning tool were surveyed. When future researchers attempt to apply our findings, we would recommend a repetition of this study, using a wider sample of sites.

6. Acknowledgments

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