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Procedia - Social and Behavioral Sciences 93 (2013) 1916 – 1921

Procedia
Social and Behavioral Sciences

3rd World Conference on Learning, Teaching and Educational Leadership (WCLTA-2012)

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

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Abstract

As a result of our research we have 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, such tools. 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. 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.

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Selection and peer review under responsibility of Prof. Dr. Ferhan Odabaşı

Keywords: Visual design; aesthetic; usefulness; satisfaction; learning performance.

1. Introduction

Visual design is becoming one of the most important factors that influences users' affective experiences and their emotional bonds in online environments (Hassenzahl & Tractinsky, 2006; Kim et al., 2009; Sánchez-Franco & Rondán, 2010; Tractinsky et al., 2000; Wolfenbarger & Gilly, 2003). On the one hand, users seek pleasurable fulfilment and deep emotional stimulation as part of the consumption experience. 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 has therefore led us to become 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 its 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 the perceived usefulness of adopting a user-centered perspective. Questions such as "How can an understanding of these drivers help us design

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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 & Salvendy, 2008, p.6). On the other hand, classical issues are driven by a sense of clear design (e.g., being clean and symmetrical), “...serving as linkages between usability and aesthetics” (Lavie & 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 (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 (Isen & 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 & 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 being useful. The Technology Acceptance Model (TAM; 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 in 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 (i.e., 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 that 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 can reinforce 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.

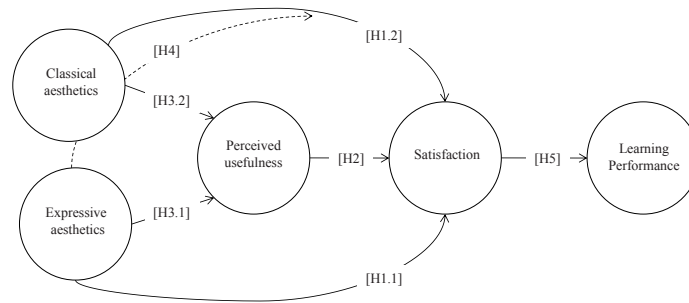


Figure 1. Research model

3. Methods

3.1. Participants

The tool analysed is one used in a web-based educational environment that has been applied as part of the teaching methodology used in an undergraduate course. The data were collected from a sample of questionnaires voluntarily filled out by 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 23.2 (SD: 2.730).

3.2. Measures

Ten items were used to assess expressive and classical aesthetics as taken from Lavie and Tractinsky (2004). In addition, a total of three items were employed to measure non-economic levels of satisfaction (e.g., 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 as taken from Premkumar and Bhattacharjee (2008). All items were seven-point Likert-type, ranging from 'strongly disagree', 1, to 'strongly agree', 7. See Table 1.

3.3. Data analysis

The hypotheses testing was carried out using Partial Least Squares (PLS), specifically, SmartPLS 2.0.M3 software (Ringle *et al.*, 2008). Taking into account that hypothesis 4 was based on interaction effects, one well-known technique has had to be applied to test this moderated relationship - the product-indicator approach (Henseler & 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 minimum acceptable cut-off level of 0.7. On the other hand, construct reliability was assessed using a composite reliability measure (ρ_c). The composite reliabilities for the multiple reflective indicators were well over the recommended minimum acceptable 0.7 level, demonstrating a high internal consistency. Moreover, we checked the significance of the loadings using a bootstrap procedure (500 sub-samples) for obtaining t-statistic values. They are all 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

Latent Dimensions		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 associated with the study of this subject	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 using 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 t-values. Firstly, the research model appeared to have an appropriate predictive power for endogenous constructs in excess of the required.10 –R-square values. Secondly, the data fully supported the model, and all hypotheses were supported on the basis of the empirical data. As indicated in the main effects model, expressive aesthetics had a significant impact on perceived usefulness, with path coefficients of .299 ($t=3.284$, $p<.001$). Likewise, classical aesthetics had a significant effect on non-economic satisfaction, with path coefficients of .192 ($t=2.335$, $p<.01$). Perceived usefulness also had a significant effect on satisfaction ($\beta=.606$; $t=7.726$, $p<.001$). Furthermore, non-economic satisfaction showed a relevant impact on learning performance ($\beta=.644$; $t=9.678$, $p<.001$). See Figure 2.

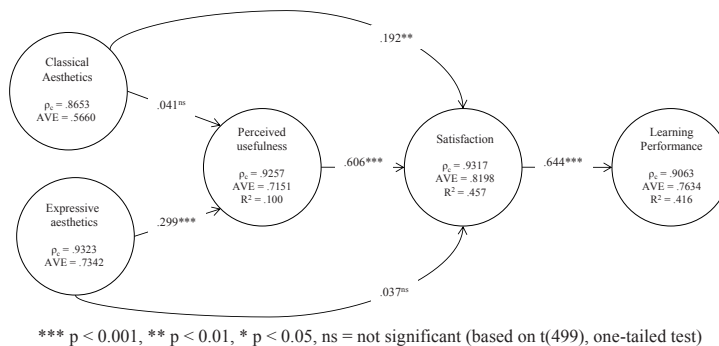


Figure 2. Results (main effects)

The interaction effect was also included, in addition to the main effects model (see Figure 3). As in regression analysis, the predictor and the moderator variable were multiplied to obtain the interaction terms. According to Chin *et al.* (2003), product indicators were developed by creating all possible products from the two sets of indicators, and the standardisation of the product indicators was recommended. However, in the presence of significant interaction terms involving some of the main effects, no direct conclusion could 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 Figure 3.

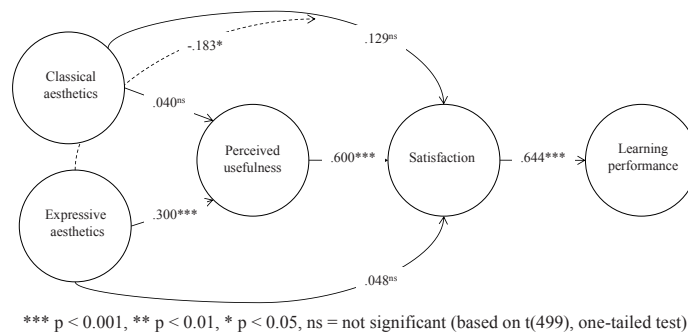


Figure 3. Results (interaction effect)

5. Discussion

This research arrives at 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 has been enhanced. Secondly, expressive aesthetics become a significant quasi-moderator, 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 & Bello, 2002, p.28). Thirdly, the possible bias in our sample is a limitation of our empirical research. Our respondents showed a gender bias. Moreover, it is difficult to generalise this quasi-moderating model and extend the results to other e-learning settings because only members using our e-learning tool were surveyed. When future researchers attempt to replicate our findings, we would recommend a repetition of this study, using a wider sample of sites.

6. Acknowledgments

This research was supported by the Junta de Andalucía (Consejería de Economía, Innovación y Ciencia), Spain (Research Excellence Program: SEJ-5801/ P09-SEJ-4568 / P10-SEJ-6081; Research Group: SEJ-494).

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