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The effect of content representation design principles on users’ intuitive beliefs and use of e-learning systems

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A model is proposed to assess the effect of different content representation design principles on learners’ intuitive beliefs about using e-learning. We hypothesized that the impact of the representation of course contents is mediated by the design principles of alignment, quantity, clarity, simplicity, and affordance, which influence the learner’s intuitive beliefs about using e-learning systems. The model was empirically validated using data collected from a survey administered to university students. This study demonstrates that these design principles are essential predictors of learners’ intuitive beliefs, which in turn directly influence their decisions about using e-learning systems. The findings provide system designers with quasi-quantitative managerial insights into how to motivate users to continue using e-learning systems.

Keywords: interactive system design; human–computer interaction; information representation; pedagogical design issues; system adoption

1. Introduction

Electronic learning (e-learning) is a relatively effective innovation in distance learning that incorporates information and communication technology (ICT) to produce a learning situation where instructors and learners may be separated by physical distance, time, or both (Raab, Ellis, & Abdon, 2001). E-learning emphasizes the use of network technologies to create, foster, deliver, and implement learning independent of time and space. Participants can access the learning programs at any time they desire, and there is no explicit need for synchronous interactions with instructors. E-learning is widely accepted and is expected to be one of the most important tools for learning in the forthcoming decades. Past studies on first-generation e-learning systems tend to focus almost entirely on the management aspects, whereas little to no value to the learning process is added. With no intention to apply design guidelines to support internal content production, “learning management systems were seen to be nothing more than launch pads for third party content” (Allen, 2011, p. 1).

Acquiring authentic learning designs could improve educational outcomes of students by providing them with interactive design of learning content. Herrington (2006) argued...
that online technologies afford the design and creation of truly innovative authentic learning environments. Such aspect was also viewed by educational researchers as a pedagogic framework and a structured set of design features, both of which can be integrated into the design of a course. This was advised by Moon, Birchall, Williams, and Vrasidas (2005) as a reflection of efficacy from design process that resulted in the formation of the design principles for supporting accelerated learning in the workplace.

In the learning practice, situations arise whereby various requirements to effective design are exploding. The design of e-learning systems should consider enriching the learning experience in terms of selecting, organizing, and specifying the learning experience necessary to carry out learning task (Horton, 2011).

Such experience can be supported by enriching the current design experience for effective use (vom Brocke, 2007). As such, attitudes of students toward system representation design can be assessed by different dimensions associated with their behavior to learning activities. This in turn led to the acceptance of e-learning representation to consider the aspects of forming interface elements in which it enables users to locate information easily (Collis, 1991; Martins & Kellermanns, 2004; Muilenburg & Berge, 2005; Ndubisi & Jantan, 2003; Poon, Low, & Yong, 2004).

Historically, research on decision to adapt or use system has been oriented toward finding its discrete and rational components (Kahneman & Lovallo, 1993). Unstructured processes that cannot reliably be represented with reductionist objectivity have traditionally been ignored in the analysis of system adaptation (Tversky & Kahneman, 1974). However, recent research provides compelling evidence that decision to use relies not only on rational components but also on a loose network of nonlogical thought processes like intuition, which are built upon cognitive components such as learning over time, multifactorial expertise, and introspection about acquired knowledge (see, e.g. Gregory, Peters, & Slovic, 2011; Peters, Slovic, Västfjäll, & Mertz, 2008). However, intuition is more than the sum of the components of definable operation-focused decision states (Eisenhardt, 1989; Slovic, 2007). Intuition is an instinctive process. Despite criticism of the use of nonrational methods, inferences based on intuition are positively acknowledged by Agor (1984) and Dane and Pratt (2007). Moreover, although the acquisition and output of intuition appear to be unpatterned, these can be highly organized through the development of intuition with defined variables which can result in logical, precise, and well-defined outputs.

The present study proposes a research model for assessing the impact of different design principles on learners’ intuitive beliefs about using e-learning systems. The study examines whether the representation of course contents, specifically, the alignment, quantity, clarity, simplicity, and afforadance of the representation, influence learners’ intuitive beliefs about using e-learning systems.

Traditionally, intuition has been defined as a way of perceiving which relies on relationships and cognitive processes beyond the reach of the conscious mind (Myers, McCaulley, & Most, 1985). It is a way of knowing in which we often do not know how we know what we know (Vaughan, 1979). The present study draws from the concepts of organizational engineering (Salton & Fields, 1999) and uses a set of logical processors as inputs to test whether these defined components result in enhanced intuition that facilitates e-learning. Specifically, different dimensional constructs of content representation in an e-learning environment are tested as endogenous variables to examine whether they enhance learners’ intuitive beliefs and motivations to use e-learning.

Different investigators, especially in psychology research, have proposed that there is a spectrum of inner selves, that is, perceptions of one’s own beliefs about one’s actual and
ideal self and of what others believe the person should be. Higgins (1987) integrated these different cognitive dimensions of the representation of the self – the “actual self,” the “ideal self” and the “ought self” – into the concept of self-discrepancy theory (SDT), which has been applied to analyze motivational significance from a psychological perspective. Inconsistency in an individual’s beliefs generally leads to cognitive dissonance, which results in disappointment or dissatisfaction. In a sense, this can be interpreted as a directive to develop an intuitive state with an ongoing trend toward creating equilibrium in order to diminish negative outcomes, as proposed by Jung and Shamdasani (2009). The present study adopts this principle by modulating the input parameters of e-learning with the aim of decreasing such internal psychological discomfort and thus enhancing learners’ intuitions to accept the use of e-learning. Quasi-quantitative measures of these cognitive state outcomes are estimated to test the validity of our model.

2. Research model and hypotheses

A user’s identification of the benefits and ease of negotiating a tool will contribute to its acceptance. To this end, we tested whether input variables of design principles of content representation lead to greater acceptance of e-learning.

To obtain theoretical insight into the principles that might guide the rational design of information systems for wider acceptance, the concept of self-efficacy derived from social cognition theory and posits that the more convenient a system is to use, the greater the user’s sense of efficacy will be. Previous research supports an assumption that self-efficacy is positively related to user’s willingness to choose and participate in ICT-related activities, expectations of success in such activities and effectiveness in coping with related difficulties (Sang, Valcke, Braak, & Tondeur, 2010; Tømte & Hatlevik, 2011; Tseng & Tsai, 2010). Hu, Clark, and Ma (2003) surveyed 130 participants and found that self-efficacy is an important determinant of their acceptance of IT. Sang et al. (2010) showed that prospective e-learning and teaching significantly correlated with self-efficacy. Schunk and Ertmer (2000) acknowledged that individual’s thoughts, feelings, and actions that are planned and systematically adapted motivate one’s efficacy.

In addition, it has been hypothesized that the system of thoughts and feelings that make up one’s self-concept serves to organize and guide personal processing of information. People are usually strongly motivated to maintain an internal sense of consistency among their beliefs and self-perceptions. When an actual experience is less optimal than an individual thinks he or she is or is capable of achieving, the person will generally experience a pattern of negative emotions, including sadness, dissatisfaction, anxiety, or fear. Such self-discrepancy was addressed by Higgins (1987). We hypothesized that an effectively designed e-learning system should create a cognitive state in the learner where the components of self-discrepancies attain a low level of entropy as the result of an equilibrium state.

Such aspect is called “intuition” which defined as “a preliminary perception of coherence (pattern, meaning, structure) that is at first not consciously represented, but which nevertheless guides thought and inquiry toward a hunch or hypothesis about the nature of the coherence in question.” (Bowers, Regehr, Balthazard, & Parker, 1990, p. 74). Intuition is understood as an innate capacity not directly accessible through consideration of the process which led to a judgment or action involving it. Thus, intuition seems to be a residual process accommodating whatever cannot be explained by reductionist components. The existing literature reflects the inherent lack of an obvious conceptual framework for the
term “intuition.” Importantly, intuition has been famously described as a pattern of thought that is distinct from the rational mode (Jung & Shamdasani, 2009).

Our key results demonstrate that acceptance and continued use of an online learning system result from a probable decrease in cognitive discomfort, thus creating an intuitive state conducive to learners’ adopting e-learning. Our proposed research model which outlines the tested dimensional constructs is shown in Figure 1 and is elaborated in hypotheses in the following subsections.

2.1. Alignment

The existing literature has scant investigation of the connection between the alignment of content representation and e-learning systems. Alignment has therefore not been translated into a representational enhancement of e-learning systems for use in higher education institutions. Reeves (2006) identified alignment as an arrangement of learning contents, structure, and procedures that system designers need to incorporate to promote learning. It has been argued that an e-learning environment is rendered interactive if it allows learners to self-test or facilitate easy display and downloading or uploading of materials (Pituch & Lee, 2006). Most of the previous studies (Dias & Diniz, 2014; Kim, Lee, & Ryu, 2013; Yang, Hwang, & Yang, 2013) were conducted to provide different representational styles that can facilitate a certain activity. However, little attention was given by prior studies on how alignment can drive one’s experience to locate aspects related to their expectations. This in return led us to wonder the role of alignment in the design of e-learning system. The alignment in this study was compressed into the e-learning representation by lining up the items along their edges. It was aimed to provide a balanced organization of text’s levels. Hence, we formed our rationale for examining the alignment of the content representation in e-learning systems.

H1: Alignment of course content representation will positively affect learners’ intuitive beliefs about using e-learning.
2.2. **Quantity**

Quantity is an essential indicator which can be easily identified in content that is represented online based on the number and length of postings (Turvey, 2008). Dennen (2005) stated that sufficient learning content needs to provide a standard quantity of postings for learners to believe that learning will take place, but this may or may not be the case. In this study, quantity refers to the amount of information available within the representation of the e-learning system. The study examined whether, as reported earlier by Turvey (2008), acceptance of the system is dependent on the learner’s perception of how much information has been assimilated from the e-learning opportunity. Keller and Staelin (1987) stated that the nature and quantity of information determine how to decide about aspects related to the undergoing task. It has been assessed that users’ incentives to process information is decreased when a certain threshold is exceeded (Hsu & Liao, 2014). This means that increasing quantity of information will in turn result in user skipping or ignoring its message. In this study, we decided on the volume of information in every isolated object based on the length required for users to judge the appropriateness of information presented. As such, user can simulate further reading if needed. We also ensured that the volume of the content is reasonable for students not to spend much effort scrolling further.

\[ H_2: \text{Quantity of course content representation will positively affect learners' intuitive beliefs about using e-learning.} \]

2.3. **Clarity**

Processing fluency is related to aesthetic pleasure, especially the visual component. This has a direct impact on predicting effort and motivation (Reber, Schwarz, & Winkielman, 2004; Song & Schwarz, 2008). Gefen and Straub (2000) acknowledged that the clarity of the representation contributes to the user’s preference to use or adopt the technology. In contrast, Zohar, Degani, and Vaaknin (2001) suggest embedding some cognitive practices to the current teaching and learning system by segmenting complex task into simpler objects, “leading students through a sequence of steps necessary to solve a problem, giving clues, adding more examples” (p. 12). We have noticed that for the content of e-learning material to be usable, format and presentation are very important components and should be clear. The presented text serves little purpose if its graphic layout is small or the font style is unreadable, as both affect the communication of the content. In this study, clarity refers to the readability of the content representation in the e-learning system. This was incorporated into the design of e-learning system by isolating and organizing the content into short matrix structure for easy recognition and reading. This is believed to promote students’ cognitive process to read and memorize the main parts of learning contents easily (Al-Samarraie, Teo, & Abbas, 2013).

\[ H_3: \text{Clarity of course content representation will positively affect learners' intuitive beliefs about using e-learning.} \]

2.4. **Simplicity**

Simplicity refers to the directness of expressions. It has been proposed as a key factor in developing motivation to use computer-based systems (Fogg & Hreha, 2010). Simplicity of representation leads to a reduced need for instruction and support (Maeda, 2006).
Kopetz (2011) stated that the most common challenges in design interface consist of forming a representation that can be modeled at different levels of abstractions. These abstractions have been explained as the concept for reducing design complexity by omitting irrelevant details from the representation. This can be achieved by partitioning the main representation into divisions at the core of reductionism. Insights by Dantzich, Robbins, Horvitz, and Czerwinski (2002) addressed such concept as the unification of design isolations in order to reduce one’s distraction to the representation. With little concern paid to the design of e-learning system, interface designers appear to be misleading in incorporating simplicity into the representation of learning content whereby most systems attend to the user population that as a result advocate a user-centered approach to their work (Picking, Grout, McGinn, Crisp, & Grout, 2010). Failure to emerge simplicity into the design of e-learning systems can in turn reduce students’ use of it. Therefore, simplicity can be used as a factor to evaluate whether it contributes to one’s intuitive beliefs to use systems. We stand to the point that providing a short content unified in a structure way can help students process better learning.

H₄: Simplicity of course content representation will positively affect learners’ intuitive beliefs about using e-learning.

2.5. Affordance

Among the numerous factors that have been examined for contributing to acceptance of e-learning opportunities, affordability has been proposed as an important component (Alexander & Golja, 2007). In interface design, affordance has been introduced as externalized mechanism in order to direct user’s actions through appearances based on its features (Zhao, Liu, Tang, & Zhu, 2013). Such representational features must be incorporated into the design to direct one’s behavioral response to the interaction. This interaction is known as affordance (Gibson, 1979). In system representation, affordances result from the complex interaction between user and features of the representation (Van Osch & Mendelson, 2011). Norman stated that designers should pay more attention to what the user perceives than what is actually true (2008). This can be examined based on the one’s perceptions of design representation. However, little work has focused on emerging the concept of affordances into the design of e-learning systems in a way that can facilitate the understanding and practice of social media interaction design (Zhao et al., 2013). However, developing a user interface where the representation matches the user expectation is a challenging process (Mahmood, Shahzadi, & Tariq, 2014). Given this backdrop, we attempted to explore how design affordance into the design of e-learning system can drive students’ intuitive belief to use it. We identified the main roles of affordance into such design by empowering students’ control of making choices of the learning content rather than of one’s own behavior. Affordance was incorporated into e-learning representation by enabling students to easily access the contents by navigating using keywords or subject matters to the main content. This was to provide quality representation that helps to enhance access to and understanding of the course contents. In addition, we incorporated this principle into representation to provide students with information about the content’s properties in terms of its log statistics. We have examined whether affordance of the representation contributes to learners’ beliefs about using e-learning systems.

H₅: Affordance of course content representation will positively affect learners’ intuitive beliefs about using e-learning.
2.6. Intuitive beliefs

Intuitive beliefs have been proposed for overcoming the ever-increasing complexity of systems and promoting the user’s thinking activities while using a system (Hadar & Leron, 2008). When an organism is identified as possessing a cognitive system, this may be attributed to at least two kinds of representations. The overall purpose of a cognitive system is to allow the organism to change its behavior in reaction to an altered environment. For this, a cognitive system must contain representations of the actual conditions of what is happening, referred to as a database. It must also contain impressions of behaviors that it can utilize, representations that are capable of guiding these behaviors, which may also be referred to as plans (Sperber, 1990). Although isolating content offers simplicity, the phenomenon of isolation still lacks an active integration of other design elements for avoiding fragmentation of the isolated ones in the design representation. Hence, researchers like Mayer, Winter, and Mohr (2011) advised that future studies should integrate isolated objects in homogeneous way. With more use of partitioning or isolating concepts into design, we believe that the experience that emerged from such use can be useful for students’ recognition of the content, which also reflects one’s intuition towards interface design of a system. As such, this can drives user’s intuitive belief toward representation capability to narrow the design problem for effective user experience. Since intuition depends on user’s experience to recognize aspects related to the dynamics of a situation (Klein, 1999; Lockton, Harrison, & Stanton, 2010), we assumed that incorporating design principles into the design of e-learning representation can contribute to students’ control and understanding of learning content. This in turn led to the shaping of the following hypothesis:

H_6: Intuitive beliefs of learners about the content representation affect their use of e-learning.

3. Method

This study employed a survey among university students to examine the effect of content representation design principles on users intuitive believes to use e-learning system. The sampling, procedure, measures, and pretest analysis are described in the subsections below.

3.1. Sample

Mixed-gender students from different programs were invited to provide their opinions about the current representation of course contents in e-learning. The selected students were active participants of e-learning courses who relied on e-learning systems on a daily basis to facilitate their learning process. A survey was administered to students from Universiti Sains Malaysia. A total of 300 students majoring in 4 programs – Pure Sciences, Applied Sciences, Pure Art, and Applied Art – were selected. The total number of returned questionnaires was 230, of which 13 were not usable, thus yielding 217 effective questionnaires. Table 1 characterizes the respondents.

3.2. Procedure

The selected students from the four programs were sent email notifications to inform them about and guide them through the upcoming activity. A short demonstration of the functionality offered by the e-learning system was conducted for the students in order to explain their
responsibilities in using the system as learners during the evaluation phase. For this purpose, school computer labs were used for live 40-minute demonstrations followed by one hour of self-practice to ensure that all students are familiar with the system’s features. This self-practice also helped us to ensure that all students were allowed to access the learning materials and to use the system anytime/anywhere. The researcher also provided required technical support for those who had problems in accessing or understanding the system functionalities. The evaluation phase involved four months of the selected students’ online activity. After the period ended, students were asked by email to participate in online survey.

3.3. Measures
A survey research method was adopted to collect data from the participants in this study. A questionnaire was constructed by modifying items from previous studies related to the use of e-learning so that they would be appropriate for the current study. The modified items included items for content alignment, quantity, clarity, simplicity, and affordance, along with use of e-learning. The items used to measure the intuitive belief construct were developed based on the premises of Sperber (1997). He addressed how cognitive system must contain representations of behaviors to be engaged in by the level of control in which representation is capable of guiding these behaviors, in other terms, plans. The simplest link between data and plans consists in having the triggering of every plan-guided behavior conditional on the addition to the database of a specific datum. Hence, we assumed that providing a representation that guides students’ behavior to learn can be explained by the usefulness of the representation in doing so. Therefore, we constructed the first and second items in order to reflect the representation’s effectiveness by enabling students capturing useful information and performing better control on the learning activity assigned under this representation. On the other hand, Sperber (1997) stated that simple cognitive systems have a database that matches the functional architecture of representations for matching with stored one. He argued that all “the representational capacity should have limits” (p. 2) in order to allow an individual to perceive information in the way he or she finds it similar to his/her cognitive systems. Also, the author claimed that individual must be capable of entertaining thoughts of a not fully understood concept. This led us to construct the third item in order to show how students can easily recognize the representation in learning. After all, the development of the items focused on how the design principles for e-learning content representation helped students to discover facts and relations in each segment, how the principles allowed them to control their learning activities, and how they intend to use e-learning in their studies. The details are shown in Table 2.
Table 2. Results from the test of measurement model, reliability, and validity.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Loadings</th>
<th>CR</th>
<th>AVE</th>
<th>Cronbach’s α</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alignment of the representation</strong></td>
<td>(&gt;0.70)</td>
<td>(&gt;0.70)</td>
<td>(&gt;0.50)</td>
<td>(&gt;0.70)</td>
<td>Modified from Pituch and Lee (2006); Selim (2007)</td>
</tr>
<tr>
<td>(1) The placement of the visual and text elements was easy to understand.</td>
<td>0.821</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) The paths to certain functions were logical.</td>
<td>0.726</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) It was very simple for me to understand the content.</td>
<td>0.727</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantity of the representation</strong></td>
<td></td>
<td>0.784</td>
<td>0.547</td>
<td>0.782</td>
<td>Modified from Turvey (2008)</td>
</tr>
<tr>
<td>(1) The structure of this representation contained much information.</td>
<td></td>
<td>0.731</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Based on the given representation, I learned much about the contents.</td>
<td></td>
<td>0.775</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) The amount of this representation helped me to decide the suitability of the content.</td>
<td></td>
<td>0.712</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clarity of the representation</strong></td>
<td></td>
<td>0.839</td>
<td>0.635</td>
<td>0.837</td>
<td>Modified from Bobkowska (2003); Choi and Lee (2012)</td>
</tr>
<tr>
<td>(1) Sequence of this representation was very clear.</td>
<td></td>
<td>0.824</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Organization of information was very clear in this representation.</td>
<td></td>
<td>0.787</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) The structure of this representation was readable.</td>
<td></td>
<td>0.778</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Simplicity of the representation</strong></td>
<td></td>
<td>0.805</td>
<td>0.580</td>
<td>0.806</td>
<td>Modified from Bobkowska (2003); Choi and Lee (2012)</td>
</tr>
<tr>
<td>(1) It was simple to understand this representation.</td>
<td></td>
<td>0.736</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) It was simple to locate the content I needed using this representation.</td>
<td></td>
<td>0.758</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) It was simple to navigate and browse other contents in this representation.</td>
<td></td>
<td>0.789</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimension</td>
<td>Loadings</td>
<td>CR</td>
<td>AVE</td>
<td>Cronbach’s α</td>
<td>Authors</td>
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<td>-----</td>
<td>--------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Affordance of the representation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) This representation enhanced my access to learning opportunities and resources.</td>
<td>0.851</td>
<td>0.655</td>
<td>0.850</td>
<td>Modified from Alexander and Golja (2007)</td>
<td></td>
</tr>
<tr>
<td>(2) It was easy to understand the learning contents offered in this representation.</td>
<td>0.804</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) This representation provided me qualitatively different learning opportunities.</td>
<td>0.810</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intuitive belief</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) This representation was useful to my learning.</td>
<td>0.840</td>
<td>0.637</td>
<td>0.839</td>
<td>Self-developed based on Sperber (1997)</td>
<td></td>
</tr>
<tr>
<td>(2) This representation helped me to control my learning activities.</td>
<td>0.838</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) I can clearly see how such representation can be used in learning.</td>
<td>0.758</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Use of e-learning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) I intend to use this representation to assist my learning.</td>
<td>0.797</td>
<td>0.568</td>
<td>0.798</td>
<td>Modified from Lewis (1995)</td>
<td></td>
</tr>
<tr>
<td>(2) I intend to use this representation as an autonomous learning tool.</td>
<td>0.762</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) I intend to continue using this representation in the following semester, rather than discontinue its use.</td>
<td>0.706</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
items were measured using a 5-point Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree).

3.4. Pretest analysis
A pilot test was conducted with 50 participants prior to distributing the final version of the questionnaire. The pilot questionnaire had 26 items, to ensure the appropriateness of the research instrument. After the primary results were analyzed, five items were deleted from the questionnaire because the scores did not reach the normal prescribed criterion of reliability thresholds with Cronbach’s alpha > 0.7. Exploratory factor analysis was implemented to analyze the data using principal component analysis with Varimax rotation. Five factors emerged from the analysis with eigenvalues larger than 1.0; this explained 75% of the total variance, which is considered large in terms of statistical relevance. Moreover, all same-factor loadings were greater than 0.7, as suggested by Nunnally (1978).

4. Data analysis and results
Structural equation modeling (SEM) was used to examine the hypothesized model. The two-step SEM procedure proposed by Anderson and Gerbing (1988) was employed for data analysis. The first step of the procedure examines scale validity from the measurement model using confirmatory factor analysis (CFA). The validity includes convergent validity and discriminant validity. Convergent validity measures whether items effectively reflect their corresponding factor, whereas discriminant validity measures whether two factors are statistically different (Gefen & Straub, 2000). The second step of the SEM procedure focuses on hypothesis testing using the structural model.

4.1. Measurement model analysis
To validate the measurement model, three types of validity should be assessed: goodness of fit, convergent validity, and discriminant validity.

4.1.1. Goodness of fit
CFA was conducted to assess the overall measurement model. For the measurement model to have a sufficiently good model fit, the ratio of the $\chi^2$ value to degrees of freedom ($\chi^2$/df) should not exceed a value of 3.0, the comparative fit index (CFI), Tucker–Lewis index (TLI), and non-normed fit index should all exceed 0.90, and the root mean square error of approximation (RMSEA) should not exceed 0.05 (Hu and Bentler, 1998). The results of the CFA ($\chi^2 = 187.494$, $\chi^2$/df = 1.116, TLI = 0.988, CFI = 0.990, NFI = 0.915, RMR = 0.21, RMSEA = 0.023) are shown in Table 4, which shows the recommended as well as the actual values of the fit indices. The mean values of the skewness and kurtosis were smaller than the prescribed levels (skewness: 2.0; kurtosis: 7.0), as shown in Table 3, indicating no significant problem regarding the multivariate normality of the data (Muthén, Kaplan, & Hollis, 1987).

4.1.2. Convergent validity
The convergent validity of the scales was tested by using three criteria suggested by Fornell and Larcker (1981): (1) all indicator loadings should be significant and greater than 0.70;
(2) construct reliability (CR) should be greater than 0.70; and (3) average variance extracted (AVE) for each construct should be greater than 0.5. As shown in Table 2, all factor loadings for all items exceeded the recommended threshold of 0.70. The composite reliability (CR) values of the constructs (ranging from 0.784 to 0.851) exceeded the generally accepted threshold of 0.70. Furthermore, the AVE values (ranging from 0.547 to 0.655) exceeded the generally accepted threshold of 0.50. Hence, all three conditions for convergent validity were met. In addition, the internal consistency reliability needed to test unidimensionality was assessed by Cronbach’s $\alpha$. The resulting $\alpha$ values ranged from 0.782 to 0.850 and were therefore above the acceptable threshold of 0.70.

### 4.1.3. Discriminant validity

The discriminant validity of the scales was evaluated based on the standards recommended by Fornell and Larcker (1981), that is, the square root of the AVE values from the construct should be greater than the variances any of the inter-construct correlations. Table 3 presents the correlations among the constructs (dimensions of the inputs, intuitive beliefs, and consequent use of e-learning), with the square root of the AVE expressed on the diagonal. The results show that the AVE value for each construct is greater than the correlation coefficient of that construct when compared with all the other constructs in the model. This suggests that all the indicators demonstrated a satisfactory convergent and discriminant validity for this study. In summary, the measurement model demonstrated adequate and sufficient goodness of fit, reliability, convergent validity, and discriminant validity and was therefore suitable for structural modeling.

### 4.2. Assessment of the ability of the dimensional constructs in the structural model to promote e-learning by influencing learners’ beliefs

The first step in model assessment involved examining the goodness of fit of the hypothesized model. The structural model yielded a $\chi^2$ value of 198.701 with 173 degrees of freedom.
freedom ($\chi^2/df = 1.149$). All fit indices of the structural model were satisfactory (CFI = 0.987, TLI = 0.983, NFI = 0.910, RMR = 0.024, RMSEA = 0.026), as shown in Table 4.

The second step in model assessment involved examining the significance of each hypothesized path in the research model. Figure 2 shows the structural model with the coefficients for each path (hypothesized relationship), where solid lines indicate supported and unsupported relationships. All hypothesized relationships are supported except for the hypothesized relationship between quantity of representation and intuitive belief (H2: $\beta = 0.044$, $p > .05$), which had an insignificant positive effect on intuitive belief.

Alignment of the representation had a significant positive effect on intuitive beliefs (H1: $\beta = 0.370$, $p < .001$), clarity of the representation had a significant positive effect on intuitive beliefs (H3: $\beta = 0.197$, $p > .05$), simplicity of the representation had a significant positive effect on intuitive beliefs (H4: $\beta = 0.314$, $p > .01$), and affordance of the representation had a significant positive effect on intuitive beliefs (H5: $\beta = 0.211$, $p > .01$). Finally, intuitive beliefs had a significant positive effect on use of e-learning (H6: $\beta = 0.662$, $p < .001$).

The results show that the four dimensional constructs, alignment, clarity, simplicity, and affordance, supported intuitive learner beliefs about e-learning ($R^2 = 0.68$), which

![Figure 2. Results for structural model.](image)

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Path coefficients</th>
<th>Hypothesis testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Alignment $\rightarrow$ Intuitive belief</td>
<td>0.370</td>
</tr>
<tr>
<td>H2</td>
<td>Quantity $\rightarrow$ Intuitive belief</td>
<td>0.044</td>
</tr>
<tr>
<td>H3</td>
<td>Clarity $\rightarrow$ Intuitive belief</td>
<td>0.197</td>
</tr>
<tr>
<td>H4</td>
<td>Simplicity $\rightarrow$ Intuitive belief</td>
<td>0.314</td>
</tr>
<tr>
<td>H5</td>
<td>Affordance $\rightarrow$ Intuitive belief</td>
<td>0.211</td>
</tr>
<tr>
<td>H6</td>
<td>Intuitive belief $\rightarrow$ Use of e-learning</td>
<td>0.662</td>
</tr>
</tbody>
</table>
ultimately culminated in the intention to continue to use e-learning ($R^2 = 0.44$). The results of the analysis of the final structural model are presented in Table 5.

5. Discussion

The results of the current study, which used SEM to analyze our proposed model for testing factors involved in user acceptance of e-learning by varying dimensional constructs of the e-learning environment, showed that: (a) the alignment, clarity, simplicity, and affordance of the content representation in an e-learning environment significantly enhance the learner’s intuitive beliefs about the usefulness of e-learning and its continued use, (b) the amount of visual information clusters and placement of the visual elements did not factor in the development of the e-learners’ intuitive beliefs and did not contribute to their acceptance of e-learning, and (c) the model evaluation had robust fit indices, with significant loading values for all input variables, a high degree of CR, and a high AVE.

Very few previous studies have focused on examining the interaction of different components that facilitate use of an e-learning environment (for example, Chang & Tung, 2008; Martínez-Torres et al., 2008; Mueller & Strohmeier, 2011; Violante & Vezzetti, 2014; Wang, 2014). The findings of the present study provide the first evidence that user inputs may be interactively modulated, and as such, these findings may provide system designers with quasi-quantitative insights about how to influence learners to continue using their e-learning systems.

The current theory of intuition suggests that intuition is a psychological function present in all populations. One of the major novel findings of the present study is that by modulating the input variables of an online e-learning environment, we demonstrated with quasi-objective measurements that these can significantly influence learners’ intuitive beliefs and thus demonstrated the possibility of statistical modulation of an intuitive state. Our results are the confirmation of Salton’s study (Salton & Fields, 1999), which states that variations in the input state can contribute to defined outputs. It also supports Mayer et al. (2011) who advised to integrate isolated objects in homogeneous way.

Mintzberg (1976) reported that intuition may be viewed as a cognitive function outside the province of reason and that it should be considered whenever established rational or other cognitive concepts do not work. In brief, intuition is the perception of reality in which an individual knows, but does not know how he or she knows. The study of intuitive insights in problem-solving or decision-making – for example, deciding to use e-learning – may be critiqued as providing little opportunity for detail or routine (Behling & Eckel, 1991). But, in the current study, we demonstrate that this might not always be the case, as well-defined conditions of refinement and precision in creating an e-learning sphere can result in predictable intuitive states, such as enhancement of learners’ intuitive beliefs about using e-learning.

SDT postulates that motivation involves individuals’ desire to diminish the difference between their actual and ideal/ought selves (Higgins, 1987). Higgins aimed to predict and define which distinct emotions would result from cognitive imbalances. From this perspective, the results of the current study show that the intuitive beliefs of learners about using e-learning systems are based on how the structure of the e-learning content is presented.

As shown in Figure 3, and after examining content representation design principles on students’ intuitive belief to use e-learning systems, we found that the learning content must be aligned to enable students taking conscious decisions about how and where elements can be located on the page. This was achieved in this study by organizing learning elements side by side, in order to facilitate students’ recognition rather than presenting information in
serial. We also noticed that the consistency of clues to process different actions can be incorporated into the design of e-learning systems to promote students’ understanding of the surface information. These clues were labeled differently in this study to represent information related to the learning content for better clarity. In order to ensure simplicity of a system, we divided the content into segments in a matrix organization structure. These segments or isolation may contain short and precise volume of information in order to motivate students’ recognition and understanding of information. We ensured that the affordance of e-learning by providing context clues in which it enables students to easily access contents related to the current learning such as keywords or subject matters to the main content. This is believed to help students control and perceive the representation properties and its relationship to the learning topic.

Overall, we conclude that elements of simplicity, clarity, affordance, and alignment are the key design principles of learning content representation that simulates students intuitive believe to learn effectively with a system.

There is a scope for future studies to further enhance our approach. For example, we can investigate in greater detail why the dimensional construct of quantity, which is a logical path to certain functions, did not significantly support the development of learners’ beliefs about e-learning. We also plan to design studies that will take into more precise account the pre-study intuitive states of the e-learners, in order to more objectively
assess the cognitive resonance resulting from modulation of the input variables in the e-
learning environment. We also plan to perform case–control investigations to validate the
reliability of the endogenous input variables in order to obtain confirmatory evidence
regarding their utility in generating positive intuitive states for e-learning.

6. Implications of the study
The findings of this study have a number of implications for practice, in particular, for stu-
dents of educational programs who use e-learning as a central information hub. As the use
of different design principles increases the intuitive beliefs of students, it is of paramount
importance that students actually use these components of the design to comprehend
what they are learning. First, the representation of course contents should contain or
support design principles that increase the usage of e-learning systems and that make the
structure of the interface intuitive. Therefore, designers of e-learning systems must take
into consideration the basic requirements of structuring the systems’ content representations
in terms of alignment, clarity, simplicity, and affordance. Second, incorporating different
design principles in the representation of e-learning content will help increase internal
motivation for continued use of the system. Third, introducing such principles can make
a difference by providing a simplified and easy-to-read display that increases students’
level of intuitiveness, which in turn increases their continued usage of e-learning
systems. Our findings show that supporting content representation with different design
principles affects learners’ intuitive beliefs about using e-learning. Our findings support
the SDT view that system characteristics affect individual behavior in performing a task.
They also support the view in the theory of intuition that inconsistency of individual
beliefs may result in cognitive dissonance, which in turn affects the intention to use the
system. Finally, our study provides the first direct evidence that content representation sup-
ported by several different design principles affects learners’ intuitive beliefs about using e-
learning systems.

7. Conclusions
In this study, we asked how different design principles for representation of content in
online learning systems contribute to learners’ intuitive beliefs. Our results confirm two
well-known theories: SDT and the theory of intuition. The current empirical study shows
that intuitive belief is an essential variable driving the learner to use e-learning. In the
context of this study, we have examined the effects of different design principles on lear-
ner’s intuitive beliefs about using e-learning systems. The study shows that representation
of course content is mediated by design principles such as alignment, clarity, simplicity, and
affordance, all of which influence the learner’s intuitive beliefs about using e-learning
systems. The findings of this study contribute to the general project of enhancing user
acceptance and promoting the use of e-learning, a major futuristic avenue for learning
and development of a borderless global education system.

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References


