Investigating online museum exhibits and personal cognitive learning preferences

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Web-based technologies offer opportunities to enhance the design of online learning environments. As a result, many museums around the world are now adopting ICT tools that emphasise the use of Web-based multi-media, which enrich and fulfil their visitors' learning experiences. Nevertheless, awareness of the complexities of human computer interaction (HCI) has presented a new dilemma that challenges the design and development of content for online learning systems. As tempting as it is, the adoption of these emerging ICT tools in a museum needs to be aligned with appropriate instructional strategies to ensure the effectiveness of their visitors' learning outcomes. This paper describes the research in progress that investigates the interactive effects of information systems interface (ISI) access with students' cognitive style preferences when participating in museum learning experiences.

Keywords: Human-computer interaction, Web-based learning, cognitive preferences, instructional strategies

Introduction

In general, information and communications technology (ICT) tools, particularly the Web-based ICTs, allow for richer instructional strategies and thus offer many new opportunities for the online learning environment (Anderson & Elloumi, 2004). The literature reveals many interesting studies which explain that it is the unique nature and characteristics of the Web-based environment that provide many educational advantages (Martin, McKay, Hawkins, & Murthy, 2007). It is felt by some that the use of ICT tools in educational settings enriches students' interactive learning experiences. An example of how this trend towards favouring Web-mediated learning programmes has increased over the last decade can be witnessed in the increased levels of user-controlled online learning environments (Anderson & Elloumi, 2004; Inglis, Ling, & Joosten, 1999; Jonassen, Peck, & Wilson, 1999). As a consequence, online learning is now an important agenda for museums. They have become learning institutions in their own right as they enhance their exhibits to leverage the opportunities offered by ICT tools (Soren, 2005; Soren & Lemelin, 2004) thereby providing a wider (cognitive) thinking space for their online visitors.

Web-based museums' exhibiting environments designed to enhance the public's information and knowledge have been found to be extremely successful. For example, Museum Victoria in their 2007-2008 annual report records a triple number of online visits compared to the number of physical visits. This report also shows a doubled increase in the number of visitations to their online 'Discovery Program' compared to the previous year. Another example is the Virtual Museum of Canada (VMC) which record millions of visits each year as indicated on their website. With such outstanding figures, the potential to promote this type of learning environment has become an important agenda for many museums around the world (Copeland 2006). As the virtual museum users/visitors emanate from the formal educational sector (Peacock, Tait, & Timpson, 2009), museum curators need to be mindful of how to present their exhibits to afford effective learning experiences.

The rush towards creating online museum environments presents fresh dilemmas and challenges for museum curators and their exhibit designers (Brown, 2006; Marty, 2004; Soren, 2005). As a consequence, they require a deeper understanding of how people interact with the Internet. According to McKay (2003), there are critical design factors which should be in place to ensure effective learning takes

place with Web-mediated instructional materials. The human cognitive psychology literature looks into this dilemma (Elsom-Cook 2001; Sharp, Rogers & Preece 2007). These researchers examine human mental models, describing how human beings process their information. Such research into cognitive ability provides a rich collection of very detailed information and knowledge about how to improve the educational technology design process (Elsom-Cook 2001).

The purpose of this paper is to discuss a doctoral project underway in Australia that is using an online (or Web-based) museum exhibit to test for the interactive effects of cognitive preferences and exhibit format on museum learning experiences.

In general, museums cater for a broad range of visitors participating in their interactive exhibitions. Instead of showing us how to cater for such a diverse number of exhibit participants, the literature emphasizes a more formal educational view of such participatory visits therefore, the participants for the doctoral project will be students from a specified age range. The principal aim of this project is to investigate the appropriateness and effectiveness of the museum's ISIs for enhancing students' cognitive performances. Therefore, the research objective of this study is to consider how differently human beings process their Web-mediated learning programmes as well as to investigate the instructional strategies implemented as ISIs by museums for their online museum exhibits.

We will commence with the relevant literature relating to museums as background information. This overview is to provide a basic understanding of the complicated nature of this research project whilst highlighting the cognitive differences between the student visitors to the museum. Then, we will show how cognitive differences can be expressed as a cognitive style construct to understand how human beings may be processing the information they receive through an interactive online museum's exhibit. Our conceptual framework is described in brief followed by the project's methodological design. A short discussion ends the paper.

Background

Museums have been well accepted as informal settings for learning (Black, 2005; Falk and Dierking, 1992). There is also considerable literature that recognizes the use of museums in facilitating school-based education (G. Black, 2005; S. Black, 2002; Falk & Dierking, 2002; Hein, 1998). Although the role of museums in supporting the formal education of the general population is usually associated with visits to a physical museum, online museum environments are now playing an important part in providing more information to people, as well as further enriching their life-long learning experiences.

The literature shows that there is previous work in the museum context that has recognised the online environment as a 'cognitive space' in which a museum operates to deliver pertinent information and exhibit the artefacts. This new online role has also been highlighted in the definition of museum roles as defined by the Museums Australia Constitution in 2002. Historically, the use of ICTs to enhance the museum learning experience started in the early 1990s. During that time, the potential of interactivity and multimedia were well considered (Schweibenz, 1998) and embedded in the delivery mode of museum exhibitions (Witcomb, 2007). Even as the role of museums grows with the advent development of their ICT exhibiting tools, we see museums only taking advantage of these tools to record their collections in electronic databases or to embed the exhibition itself as an ICT artefact. Instead, we suggest that museums can play a more important role in facilitating the process of learning through the use of the newest Web-mediated ICT media tools which offer new learning opportunities (McKay, 2003).

Recently, questions have been raised on how museums will embrace the growing popularity in technology to improve their visitors' experiences. The more important question for this research study is however; to find out how an online museum's visit can better satisfy the visitors' educational requirements. Museums worldwide especially in countries like the UK, Canada, USA and Australia are now turning their attention towards the online phenomenon (Soren & Lemelin, 2004). Consequently, the process of creating and implementing online learning and educational experiences has become a new adventure for museum curators. New directions include: taking a learner-centric approach (Klevan & Kramer, 1999; Schaller, Borun, Allison-Bunnell, & Chambers, 2007) and user-centric development (Hsi, 2003; Paterno & Mancini, 1999).

The literature shows that Web-based technologies present many new opportunities for positive online learning encounters. As a consequence museum exhibit designers are now required to prioritize their work related to the complex problem of assessing and meeting users' needs (Marty, 2004). Moreover, the literature shows various investigations are being conducted to determine the changing needs and demands

of the online museum user. Nevertheless, the adoption of ICT tools serves to re-emphasize the need for the museum exhibit designers to clearly understand how online users process their Website information (Berry, 2000). However, there has been little or no consideration given to differences in cognitive preferences (McKay, 2003) and the cognitive effects of the design, and even less to the implications of such design (Berry, 2000) during the online materials' design process.

Considering learners' differences in their museum learning experiences

The differences in human cognitive preferences (which some people call learning styles) are well acknowledged. Kolb's theory is well known as an example which considers learning styles to assist the design of museum learning experiences. According to Kolb's theory, there are four learning styles: there are the divergers who are the 'why' people, the assimilators who are concerned with the 'what', the convergers who are more interested in the 'how', and the accommodators who are concerned about what happens (G. Black, 2005). It is possible to see the characteristics of this model reflected through the various exhibit designs the museum makes when constructing their learning experiences. Taking a generic approach such as this is understandable, as it is very difficult to design one instructional programme which suits everybody (Schaller & Allison-Bunnell, 2003; Schaller et al., 2007).

Over the years, museums have been implementing various instructional strategies in the arrangement and organization of their educational programs, with specified learning objectives (Hein, 1998). For instance, museum exhibits have been organized using a didactic or stimulus-response approach for educational programs with specified learning objectives. Museums adopting these types of stimulus-response learning designs are implemented through a sequentially styled exhibition, supported by labels describing what is expected to be learnt from the exhibition. Furthermore, these exhibitions tend to be arranged according to a subject hierarchy, from simple to complex (Hein, 1998). Moreover, curators feel they are more likely to promote the transmission (of information) from the 'teacher' to be absorbed by the learner (G.Black, 2005). Despite being the most convenient exhibiting approach that fits easily into the more regular museum's display framework, the exhibit's information can be conveniently structured by the curator into a suitable display, with a didactic or stimulus-response learning design promoting a more passive response from the audience. In contrast, if museums wish to achieve the cognitive richness afforded by discovery learning exhibits, they should be arranged in such a way as to allow for cognitive exploration using various active learning modes. However, in a constructivist museum exhibiting environment, no specific 'learning' path is provided by the curator's design to promote a more active learning mode. In this instance, the exhibit will be presented with a range of cognitive view points through various activities which afford the museum visitor the opportunity to delve into their own experiential museum learning. With the increased popularity of Web-based ICT tools, many museums are adopting a constructivist approach that provides open ended options for their visitors to experience learning events through both their physical and online visits.

In adopting educational technologies to support the constructivist context of a museum, the roles of ICTs need to be reconceptualised as tools from which learners are more likely to construct their own meaning (Jonassen et al., 1999). Fundamentally, technology is used to support the acquisition of knowledge (Inglis et al., 1999) which involves information a learner receives, stores and retrieves. There is an imperative to understand both how the technology should present the knowledge that may be gleaned from museum exhibits and how a learner's mental model may work in processing this information. This is a complex environment. Recent research has shown that learning is accepted as an active (ongoing) process as well as being a (final) outcome (G. Black, 2005). Since information is assimilated between the various contexts of a learning experience, this explanation depends heavily on ones mental structure/capacity (Falk & Dierking, 1992). Therefore, what ever (event/data) that has been stored within an individual's mental structure might be interpreted in parallel (as it cognitively matches) with their existing prior knowledge. If there is no prior knowledge to be matched, the data will reside as (unprocessed) information until it meets a situation which turns it into knowledge. This well known approach from cognitive psychology provides valid techniques for us to understand the museum learning process (Hein, 1998).

In both professional practice and research, five generic learning outcomes (GLOs) have been used as an assessment tool to measure physical museum learning outcomes. GLOs are the outcome of extensive research carried out by the Museums, Library and Archives Council (MLA) in the UK. In the GLO model, a museum learning experience is measured based on:

- knowledge and understanding
- skills

- activity behaviour and progression
- enjoyment inspiration creativity
- attitudes and values

Although GLOs consider visitors' cognitive styles or learning preferences (based on Gardner's multiple intelligences model), the outcomes that are derived from the GLO model provide more information about the final 'product', that is the museum experience, than explicitly capturing the experiential cognitive processes that take place during the museum visit. Moreover, it is an introspective self-report approach. Thus, we are suggesting that the GLO model is not sufficient to provide appropriate cognitive processing detail to assist the museum exhibit designer to identify which media to use. Additionally, the recent rush to adopt ICT tools within the museum environment has created a tension between the needs for curators to improve their evaluation of the effectiveness of their ISI access to support their visitors' learning experiences as well as to satisfy the diversity of their online user/audience needs (Brown, 2007).

Information system interface representing web-based information

The use of multimedia as an effective ICT learning tool for information representation is well debated among researchers. Some say that although the use of multimedia appears to allow flexibility to suit learning preferences, the research has primarily been concentrating on combinations of text and pictures (Schnotz & Bannert, 2003). The way learners process their information depends upon their individual mental model. Often the discussions in the literature are based on the differences between human cognitive preferences. Others indicate that information representation can be designed in two ways: for instruction (delivery) or for learning (knowledge acquisition) (Berry, 2000; Mayer & Moreno, 2002). Mayer and Moreno (2002) assert that if the learning goal is to promote knowledge construction/acquisition, then the design process should take the cognitive view rather than an information delivery view. Hence the way information is presented to the learner should not only deliver the information but should be designed in such a manner to help the learner to process the information in meaningful ways (Berry, 2000; Inglis et al., 1999; Mayer & Moreno, 2002) depending on an individual's mental (information processing) model.

Cognitive style construct

There is a vast amount of literature that discusses the differences in how human beings process the information they receive. Over the years, various terms have been used by other well known researchers to describe the same cognitive strategies. Riding and Cheema (1991) have grouped their cognitive style constructs into two dimensions (Table 1) called Verbal-Imagery and Wholist-Analytic (Figure 1). The latter describes the way an individual processes the information they receive for recall purposes, while Riding maintains that the Verbal-Imagery dimension represents the information representation strategy an individual may use during thinking. According to Riding, this choice will differ according to the task at hand.

Table 1: Previous cognitive style labels (Riding & Cheema, 1991)

Wholists	Analytics
Field dependence	Field independence
Impulsive	Reflective
Levellers	Sharperners
Divergers	Convergers
Holists	Serialists

According to Riding and Rayner (1998) the Wholist-Analytic dimension is inherent thus, each individual's cognitive style preference is unique and likely to be a fixed aspect of an individual's (cognitive) functioning (Riding & Rayner, 1998; Sadler-Smith & Riding, 1999), whereas the Verbal-Imagery dimension denotes an individual's thinking mode (Riding & Sadler-Smith, 1997). Moreover, since the Verbal-Imagery dimension interacts with the way information is presented (for example text, images and diagrams), it is anticipated that an individual with a Verbal preference for that task would perform better given textual information rather than images (Sadler-Smith & Riding, 1999). This should be the same for the Wholist-Analytic dimension. This dimension works within the actual organisation and structure of the information, either organised as wholes or as parts and therefore affecting the preference for instructional delivery method, media and learning performance (Sadler-Smith & Riding, 1999).

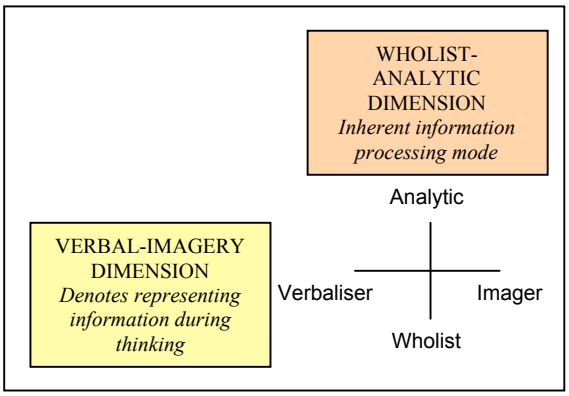


Figure 1: Cognitive styles construct (Riding & Cheema 1991)

As an individual's learning style is derived from the two dimensions discussed earlier, Verbal-Imagery and Wholist-Analytic, a person's cognitive style is anticipated to fall into one of the following categories.

- Analytic-Verbaliser
- Analytic-Imager
- Wholist-Verbaliser
- Wholist-Imager.

Based on observed behaviour choices (Riding & Rayner, 1998), each of the four style groups may have different basic preferences towards mode of instruction. As an example, learners who are from the Analytic-Verbaliser category may prefer text in contrast to those Analytic-Imagers who may perform better given a captioned picture or diagram (McKay 2000). However, there is a need for further systematic investigation (Riding & Rayner, 1998) as online learning may be highly influenced by the technological conditions (the ICT media) of the learning environment (Berry, 2000), which can be further elaborated through the lens of instructional design theories.

Instructional strategies

Gagne (1985) asserts that learning is highly influenced by the environment in which learning takes place. The way that Gagne describes learning is very similar to the contextual model of museum learning (Falk & Dierking, 1992, 2000). In the contextual model of learning (Figure 2), museum learning experiences have been conceptualised as the interaction of personal, social and physical contexts (Falk & Dierking 1992, 2000). The important point of this model is to state that learning is highly contextual and individual. Here we can discern that the role of context is emphasising that learning is a process, occurring under certain instructional-conditions that vary among individuals (Gagne, 1985). Laurillard (2006) argues that due to the continual changes in supporting technologies which may enrich the museum learning experience, the potential of these technologies can only be realised if the learning design and projected usage decisions are made from an understanding of how the users of these ICT tools learn.

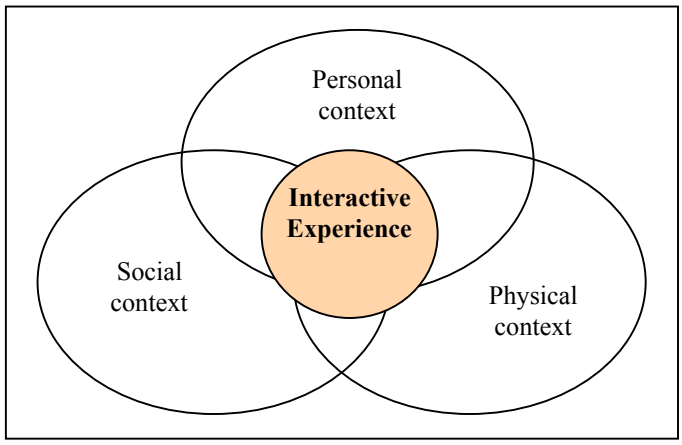


Figure 2: The contextual model of learning (Falk & Dierking 2000)

Laurillard (2006) also postulates that forms of educational media play a significant role in determining the success of the learning process. This Laurillard wisdom has foreseen the dilemmas as well the challenges which arise for many Web-based content developers due to the complexities of the HCI. Therefore, the enticement of adopting the newest educational ICT tool should be considered alongside instructional strategies (McKay, Garner, & Okamoto, 2003). This is important for an online museum's exhibits as they rely heavily on a well-designed environment to accommodate the different levels of intellectual capacity of its various visitors (Deshpande, Geber, & Timpson, 2007).

Ordinarily, there are three components of the instructional theory that may influence learning: conditions, methods and outcomes (Reigeluth, 1983):

- Conditions refer to the influencing factors on the instructional methods employed in the learning event. The conditions involve the human dimensions and the content of the learning process. For the purpose of this doctoral research project, the human dimension consists of the museum visitors (school aged students) whilst the learning content is the museum 'Dinosaur Walk' exhibition.

- Methods are the various delivery approaches that are implemented to achieve different learning outcomes under different instructional conditions.

- Outcomes identify the value measurement of alternative instructional methods under different learning conditions. It needs to be noted here that outcomes focus on the instruction rather than on the learner.

Research by McKay has shown that there are interactive effects of individual cognitive preferences with instructional strategies in a learning environment (McKay, 2000, 2003). Yet, there is a distinct lack of understanding of similar effects in the Web-based environment (McKay, 2003), thus suggesting more investigations need to be carried out on the likely effects of Web-based environments on a learner's knowledge acquisition (Berry, 2000). This call for more investigation is to further understand, and thereby provide predictable measures of instructional outcomes to assist Web designers in designing for a broader range of cognitive preferences.

Doctoral project's conceptual framework

Attempting to address the issues discussed earlier, highlights the need for further investigation on the interaction between the likely effects of learners' cognitive preferences and information representation formats to untangle what we understand about the educational outcomes from museum visits. The following conceptual research framework is proposed and we suggest that this framework accommodates the online museum as the instructional context under investigation appropriately (Figure 3).

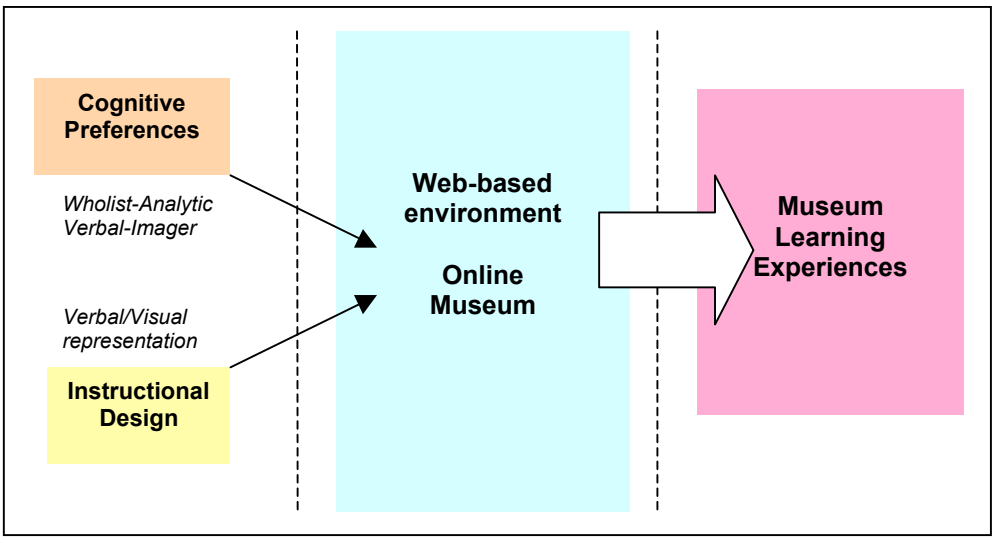


Figure 3: Conceptual model of the research

Based on this conceptual framework, the doctoral research project aims to investigate how the different instructional strategies adopted by ISIs may facilitate online museum learning experiences for both cognitive preferences (Verbal and Imagery). It is anticipated that the learners' cognitive preferences and

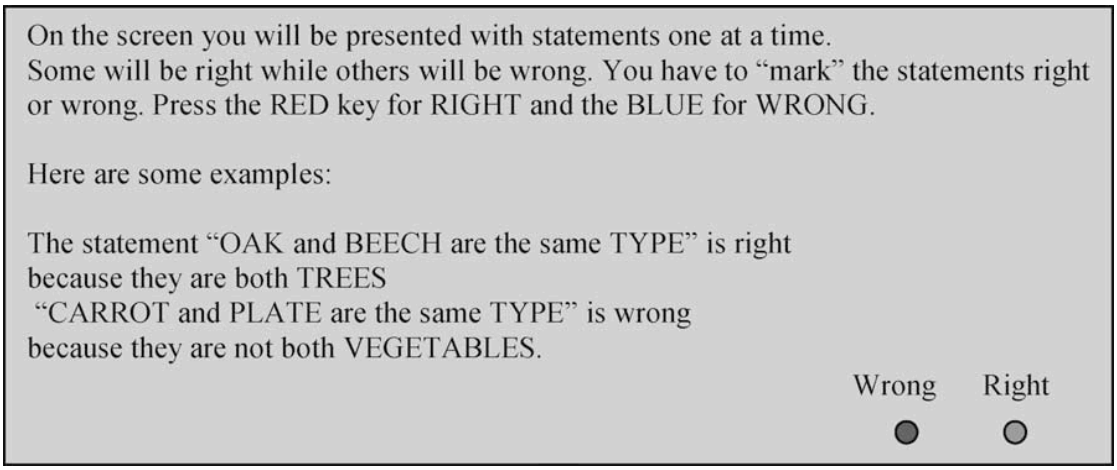
the way an exhibit's information is represented may affect the learning experiences in a Web-based environment. Museum learning experiences derived from an online museum will provide the predictable measure of the instructional outcomes thus providing the much needed finer details to inform the design and development of effective online museum learning experiences.

Experimental design

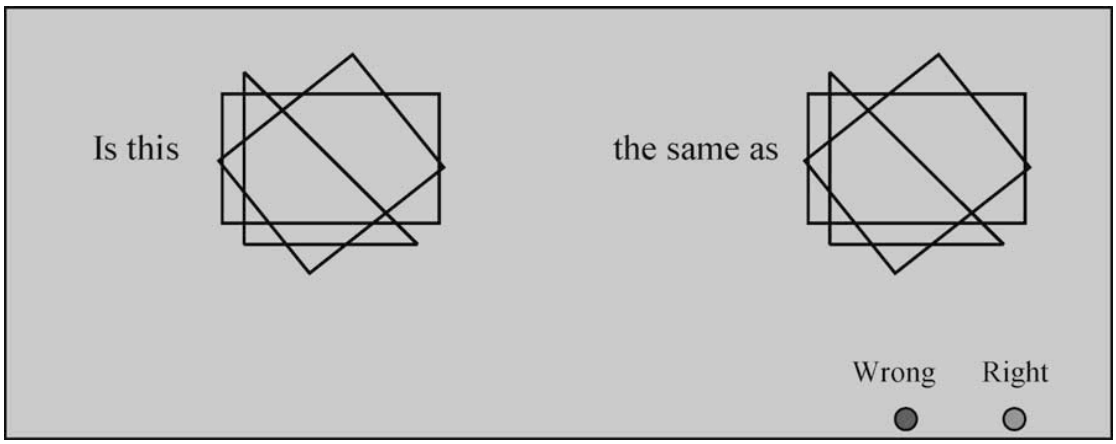
The forthcoming research will employ a quasi-experimental design. The research will be informed by two independent variables: the ISI media access which are the information representation formats (online and physical museum) and an individual's personal cognitive preference (Verbal-Imagery). A three-phase experimental design will be carried out. The first phase involves a screening test to measure cognitive style using the Cognitive Styles Analysis (CSA) tool (Figure 4) devised by Riding (1991), followed by a pre-test to determine the participant's prior domain knowledge related to the museum exhibits. Based on the CSA ratio, which identifies the cognitive style preferences, participants will be split into two museum treatment groups (online or physical visit).

The second research phase will be the actual museum activities (visiting) period in which treatment groups will be given access to either the online museum or the physical museum respectively. The final research phase will be a post-test to measure any improvement in the cognitive performance (or learning outcomes) derived from the museum's learning exhibits. The experimental design is illustrated in Figure 5.

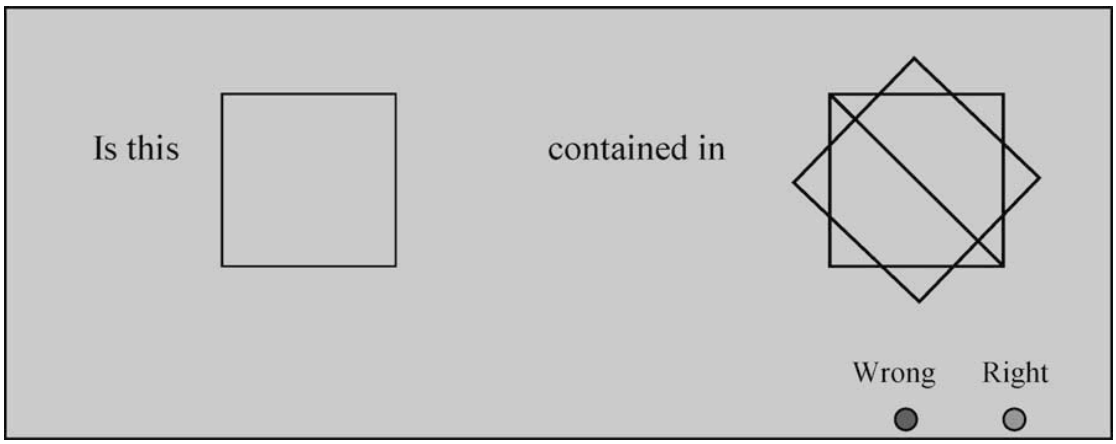
Reliability testing (calibration of the test instruments) for both pre-test and post-test will be conducted in a preliminary experiment prior to the data collection process. This preliminary experiment is important as it tests the research design as well as to check for reliability of the assessment instrument. This experiment should also provide the evidence that the test items can distinguish effectively between those participants who lack knowledge pertaining to the museum's exhibit and the knowledgeable participants.



An introduction to the first part of CSA



An example of the second part of CSA



An example of the third part of CSA

Figure 4: Sample screens of the CSA screening test (Rezaei & Katz, 2004)

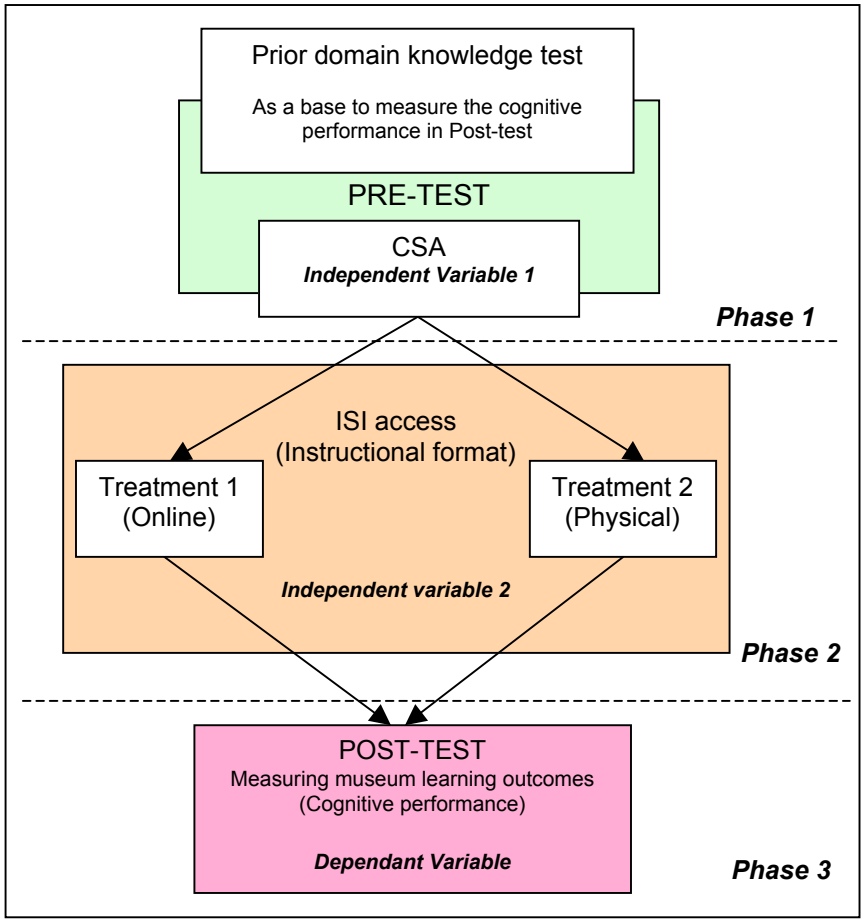


Figure 5: The experimental design of the doctoral study

Conclusion

This paper has provided an overview of the contextual issues which surround the design of an online learning environment, with particular attention to an online or Web-mediated museum. Aspects of cognitive psychology and instructional design have been explained to articulate the complex requirements of the design process of such learning environments. It has been suggested that there is an ever increasing need to consider taking a cognitive psychology perspective in the design process of the online learning environment, and this also foresees the important role instructional strategies have towards achieving effective learning outcomes. Thus, the proposed research directly addresses the challenge by blending

together different or commonly disparate research paradigms to reveal important substance for the design of effective learning outcomes for an online museum exhibit.

References

Anderson, T., & Elloumi, F. (2004). *Theory and practice of online learning*. Retrieved 11/05/06, http://cde.athabascau.ca/online_book/copyright.html

Berry, L. H. (2000). Cognitive effects of Web page design. In B. Abbey (Ed.), *Instructional and Cognitive Impacts of Web-based Education* (pp. 41-55). London: Idea Group Publishing.

Black, G. (2005). *The Engaging museum: Developing museums for visitor involvement*. New York: Routledge.

Black, S. (2002). Museum learning: Virtual or real, museums have the power to invigorate education. *American School Board Journal, 189*(1).

Brown, S. (2006). Do richer media mean better learning? A framework for evaluating learning experiences in museum Web site design. *International Journal of Heritage Studies, 12*(5), 412 - 426.

Brown, S. (2007). *Let's be specific: Predicting return on investment in online learning activity.* Paper presented at the Museum and the Web 2007, Toronto.

Deshpande, S., Geber, K., & Timpson, C. (2007). Engaged dialogism in virtual space: An exploration of research strategies for virtual museum. In F. Cameron & S. Kenderdine (Eds.), *Theorising digital cultural heritage* (pp. 261-277). Cambridge, Massachussetts: The MIT Press.

Falk, J. H., & Dierking, L. D. (1992). *The museum experience*. Washington D. C.: Whalesback Books.

Falk, J. H., & Dierking, L. D. (2000). *Learning from museums: Visitors experiences and the making of meaning*. Walnut Creek: AltaMira Press.

Falk, J. H., & Dierking, L. D. (2002). *Lesson without limit: How free choice learning is transforming education. Walnut Creek*: Alta Mira Press.

Gagne, R. M. (1985). *The conditions of learning and theory of instruction*. Florida, United States: Holt, Rinehart and Winston Inc.

Hein, G. E. (1998). *Learning in the museum*. London and New York: Routledge.

Hsi, S. (2003). A study of user experiences mediated by nomadic Web content in a museum. *Journal of Computer Assisted Learning, 19*, 308-319.

Inglis, A., Ling, P., & Joosten, V. (1999). *Delivering digitally: Managing the transition to the knowledge media*. London: Kogan Page.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. New Jersey, Ohio: Prentice Hall

Klevan, D., & Kramer, A. (1999). *Creating an interactive student medium for learning about holocaust.* Paper presented at the Museum and The Web, Pittburgh, USA.

Laurillard, D. (2006). *Rethinking university teaching* (2nd Edition ed.). New York: Routledge Falmer.

Martin, J., McKay, E., Hawkins, & Murthy. (2007). Design-personae: Matching students' learning profiles in Web-based education. In *Enhancing learning through human-computer interaction,* London: Idea Group

Marty, P. F. (2004). The evolving roles of information professionals in museums. *Bulletin of the American Society for Information Science and Technology,* 20-23.

Mayer, R. E., & Moreno, R. (2002). Aids to computer-based multimedia learning. *Learning and Instruction, 12*(1), 107-119.

McKay, E. (2000). Measurement of cognitive performance in computer programming concept acquisition: Interactive effects of visual metaphors and the cognitive style construct. *Journal of Applied Measurement, 1*(3), 293-327.

McKay, E. (2003). Managing the interactivity of instructional format and cognitive style construct in Web-mediated learning environments. In W. Zhou, B. Corbitt, P. Nicholson & J. Fong (Eds.), *Advances in Web-Based Learning–ICWL 2003* (Vol. 2783, pp. 308-319). Berlin Heidelberg: Springer.

McKay, E., Garner, B., & Okamoto, T. (2003). *Management of collaborative Web-based experiential learning.* Paper presented at the IASTED International conference on Web-based education, Rhodes, Greece.

Paterno, F., & Mancini, C. (1999). *Designing web user interfaces adaptable to different types of use.* Paper presented at the Museum and The Web, Pittsburgh, USA.

Peacock, D., Tait, S., & Timpson, C. (2009, April 15-18). *Building digital distribution systems for school-based users of museum content: New initiatives in Australia and Canada.* Paper presented at the Museum and the Web, Indianapolis, USA.

Reigeluth, C. M. (Ed.). (1983). *Instructional design theories and models: An overview of their current status*. New Jersey: Lawrence Erlbaum.

Rezaei, A. R., & Katz, L. (2004). Evaluation of the reliability and validity of the cognitive styles analysis. *Personality and Individual Differences*, 36(6), 1317-1327.

Riding, R., & Cheema, I. (1991). Cognitive styles: An overview and integration. *Educational Psychology, 11*(3 and 4), 193-215.
Riding, R., & Rayner, S. (1998). *Cognitive styles and learning strategies: Understanding style differences in learning and behaviour*. London: David Fulton Publishers.
Riding, R., & Sadler-Smith, E. (1997). Cognitive style and learning strategies: Some implications for training design. *International Journal of Training and Development, 1*(3), 199-208.
Sadler-Smith, E., & Riding, R. (1999). Cognitive style and instructional preferences. *Instructional Science, 27*, 355-371.
Schaller, D. T., & Allison-Bunnell, S. (2003). *Practicing what we teach: How learning theory can guide development of online educational activities.* Paper presented at the Museum and the Web, Toronto.
Schaller, D. T., Borun, M., Allison-Bunnell, S., & Chambers, M. (2007). *One size does not fit all: Learning style, play, and online interactives.* Paper presented at the Museum and the Web, San Francisco, Califonia.
Schnotz, W., & Bannert, M. (2003). Construction and interference in learning from multiple representations. *Learning and Instruction, 13*(2), 141-156.
Schweibenz, W. (1998, 3-7 November 1998). *The "Virtual Museum": New perspectives for museums to present objects and information using the Internet as a knowledge base and communication system.* Paper presented at the Internationalen Symposiums fur Informationswissenschaft (ISI 1998), Prag.
Soren, B. (2005). Best practices in creating quality online experiences for museum users. *Museum Management and Curatorship, 20*(2), 131-148.
Soren, B., & Lemelin, N. (2004). "Cyberpals!/Les Cybercopains!": A look at online museum visitor experiences. *Curator, 47*(1), 56-83.
Witcomb, A. (2007). The materiality of virtual technologies: A new approach to thinking about the impact of multimedia in museums. In F. Cameron & S. Kenderdine (Eds.), *Theorizing digital cultural heritage: A critical discourse* (pp. 35-48). Cambridge, Massachusetts: The MIT Press.

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