DESIGN STRATEGIES INFLUENCING INFORMAL LEARNING IN SCIENCE CENTRE

BY

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ABSTRACT

Museum exhibition environment provides experiential learning through its messages with a view to influence knowledge, attitudes and learning behaviours of visitors. Connections in visitors' cognitive, affective, emotional and physiological responses play a beneficial role in museum visits. The focus of this study is on understanding and enhancing visitors' experience of science centre. Its subject matter is informal learning, situated in the context of both experiential design and exhibition design. The aims of the research are to understand the experiential design strategies that improves science centre intent. The first objective is to determine the tools for enchantment of message in the science centre experience. The second objective is to established the interconnection between science centres' representational systems and the tools for enchantment. The third objective is to explain design opportunities that will improve science centre visitor experience. The theoretical framework is confined to the interrelationship between the concept of atmospheric context, experiential learning, enchantment as a tool of message, representational modes and design opportunities in science centre. The changes in atmospheric context and enchantment are influenced by the design opportunities available in the science centre. Qualitative research methodology namely photographic observation and in-depth interviews were employed to achieve the objectives of the research. The research involves case studies of science centres in Asia pacific. The first finding of the research indicate that the tools for enchantment of message in the science centre experience are thematization, spatialization and scenarization of the experience. The experiential strategies include the spectacular, immersive, ritualized and commercial dimensions. The second finding suggest that design can influence visitor participation with different emphases on three dimensional representations, lighting quality and degree of linearity. The third finding propose design opportunities that improve science centre visitor experience, identified in five main themes: invoking interest, delivering the message, connecting personally, designing inclusive/immersive experience and balancing the constraints. Research conclude that design emphasis increases in complexity to overwhelm, stimulate, and transform, resulting in greater emotional impact that uplifts the level of visitor perception from mere acceptance to motivation and enjoyable learning experience. Well-designed exhibition evokes direct participation and transformational experiences for visitors. The analysis of representative modes on the dimensions of classification, formality and framing revealed the way that visitors are socially constructed as learning subjects. The design of the exhibitions creates a 'model visitor' who is highly motivated to interact with the exhibits and is also autonomous in deciding his/her own learning experiences. The research clarifies that science centre acknowledged the four processes that affect learning: attentional, affective, cognitive and compensatory. The implications from this research are design knowledge which includes connection between science centre offerings, exhibition design emphases, and visitor experiences; the concept of visitor interaction with atmospherics and the exhibition environment; and the design opportunities to improve visitor experiences.

خلاصة البحث

إن بيئة المتحف توفر تعلّماً تجريبيا من خلال رسائله بالنظر إلى التأثير المعرفي، والمواقف والسلوكيات التعلمية للزوار. إن الروابط في استجابات الزوار المعرفية والوجدانية والعاطفية والفسيولوجية تلعب دورًا مُجدياً في زيارة المتاحف. وهذه الدراسة تركز على فهم وتعزيز تجربة الزوار لمركز العلوم. وموضوعها هو التعلم غير الرسمي ، وتكمن في سياق كلٍ من التصميم التجريبي وتصميم المعرض. وتتمثل أهداف البحث في فهم استراتيجيات التصميمات التجريبية التي تعمل على تحسين الغرض من مركز العلوم. والهدف الأول هو تحديد أدوات فن الرسالة في تجربة مركز العلوم. والهدف الثاني هو إقامة الترابط بين أنظمة التمثيل في المراكز العلمية وأدوات التفنن. والهدف الثالث هو شرح فرص التصميم التي من شأنها تحسين تجربة زوار مركز العلوم. ويقتصر الإطار النظري على العلاقة المتبادلة بين مفهوم السياق الجوي ، والتعلم التجريبي ، والتفنن كأداة للرسالة ، وأنماط التمثيل وفرص التصميم في مركز العلوم. إن التغيرات في سياق الغلاف الجوي والافتنان تتأثر بفرص التصميم المتاحة في مركز العلوم. وتم استخدام منهجية البحث النوعي ، أي المراقبة التصويرية والمقابلات المتعمقة لتحقيق أهداف البحث. يتضمن البحث دراسة حالة لمراكز العلوم في آسيا والمحيط الهادئ. وتشير النتيجة الأولى للبحث إلى أن أدوات فن الرسالة في تجربة مركز العلوم هي عبارة عن عمليات تجميع وتوضيح وتصنيف للتجربة. وتشمل الاستراتيجيات التجريبية الأبعاد المثيرة، والغامرة ، والطقوس، والتجارية. وتشير النتيجة الثانية إلى أن التصميم يمكن أن يؤثر على مشاركة الزائرين بتركيزات مختلفة على التمثيل ثلاثي الأبعاد، وجودة الإضاءة ، ودرجة الخطية. وتقترح النتيجة الثالثة فرص التصميم التي تعمل على تحسين تجربة الزائرين في مركز العلوم ، والتي تم تحديدها في خمسة مواضيع رئيسة: استحضار الاهتمام ، وإيصال الرسالة ، والاتصال الشخصي ، وتصميم تجربة شاملة / غامرة ، وتحقيق التوازن بين القيود المفروضة. وتوصل البحث إلى أن التركيز على التصميم يزيد من التعقيد ويطغى على التحفيز والتحول ، مما يؤدي إلى زيادة التأثير العاطفي الذي يرفع مستوى إدراك الزائر من مجرد القبول إلى التحفيز وتجربة التعلم الممتعة. ويستدعي المعرض ذو التصميم الجيد المشاركة المباشرة والخبرات التحويلية للزائرين. وكشف تحليل النمط الممثل لأبعاد التصنيف ، الشكلية والتأطير عن الطريقة التي يتم بها تهيئة الزائرين اجتماعياً كمواضيع تعلم. ويخلق تصميم المعارض "زائراً نموذجياً" له دوافع كبيرة للتفاعل مع المعروضات كما أنه مستقل في تقرير تجاربه التعليمية الخاصة. ويوضح البحث أن مركز العلوم قد أقر العمليات الأربع التي تؤثر على التعلم: النية ، والعاطفة ، والإدراك، والتعويض. والآثار المترتبة على هذا البحث هي المعرفة التصميمية التي تشمل الاتصال بين عروض مركز العلوم ، وتأكيد تصميم المعرض ، وتجارب الزوار ؛ ومفهوم تفاعل الزائرين مع الغلاف الجوي وبيئة المعرض ؛ وفرص التصميم لتحسين تجارب الزوار.

APPROVAL PAGE

The thesis of Nurhaya binti Baniyamin has been approved by the following:

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DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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Signature…… Date……...

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This thesis is dedicated to my loving parents.

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Memorable experience in science centre? People give many answers to this question, most of which share one common feature; an experience towards which one is strongly motivated for future visits. This basic phenomenon led my interest and study to the field of exhibition design and museum experience. Combining two wide subjects - experiential design and informal learning - was not an easy task. My supervisors from the Kulliyyah of Architecture, International Islamic University Malaysia, were able to clarify the context of my work. Associate Professor Dr. Mizanur Rashid crystallised the aim of the study by comments on its design. I would like to thank especially my supervisor Assistant Professor Dr. Zaiton Abdul Rahim for her broad perspective and advice both on the theoretical background and practical methodology of the study. I appreciate her detailed comments, useful suggestions and inspiring queries which have considerably improved this thesis. Comments and suggestions from Associate Professor Dr. Noor Hanita Abdul Majid and Professor Dr. Ar. Abd Razak Sapian made the final thesis much more comprehensive.

Comments on the first outline of this study by Professor Per-Edvin Persson, Director of Heureka, the Finnish Science Centre helped me to find the basic elements of the topic. Intensive discussions with Asger Hoeg, Executive Director of Experimentarium focussed the aim of the study. The theoretical background to science centre education was extended by insightful interview from Cindy Chambers, Head of Concepts and Education at Questacon. The clear ideas of John Richardson, Design and Online Services Manager were of great assistance in the analysis of design planning at Questacon. I would also like to thank Maria Isabel Garcia, the curator of The Mind Museum for encouraging me in this research work despite the very practical demands of managing a new museum. I have also been fortunate to get most valuable criticism on the topic of science centre exhibition from Geoff Snowdon, Director Creative Design at Team Aranda Sdn. Bhd. an expert in the fields. Daniel Tan, Director Exhibitions Group at Science Centre Singapore gave important insight at the beginning of the study. Extensive interviews with Fiona Blades, Exhibition Designer at the Powerhouse Museum and special guided tour with Matthew Connell, Principal Curator Physical Sciences and IT at the Powerhouse Museum is a fortune.

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Nurhaya binti Baniyamin

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CHAPTER 1

INTRODUCTION AND RESEARCH OVERVIEW

1.1 INTRODUCTION

This chapter offers a brief introduction to the context, processes, objectives, specific research questions, significance and potential benefits of this research, as well as an overview of the chapters in this thesis. Details of the research are elaborated from Chapter 2 onwards. The research explained in this thesis focuses on understanding and enhancing visitor experiences in science centre. This research is cross-disciplinary in nature. While its subject matter is informal learning, it is situated in the context of both experiential design and exhibition design.

1.2 BACKGROUND OF STUDY

Science centres are environments for informal learning, a process central to forging knowledge, skills, and positive attitudes about science. Science centres offer visitors exciting opportunities to explore scientific ideas and ways of thinking through fun, interaction and hands-on science exhibits. Most science centre professionals agree that these attractions nurture curiosity, improve motivation and attitudes toward science, engage the visitors through participation as well as social interaction and generate excitement and enthusiasm, all of which are conducive for, science learning and understanding (Anderson and Cook Roe, 1993, Dierking, 1994). Experiences in informal environments for science learning are typically characterized as learner-motivated, guided by learner interests, voluntary, personal, ongoing, contextually relevant, collaborative, nonlinear, and open-ended (Griffin, 1998; Falk and Dierking, 2000). Informal science learning experiences are believed to lead to further inquiry,

enjoyment, and a sense that science learning can be personally relevant and rewarding. Participants in them are diverse and include learners of all ages, cultural and socioeconomic backgrounds, and abilities. Ideally these experiences enable learners to connect with their own interests, provide an interactive space for learning, and allow in-depth exploration of current or relevant topics.

Bloom's Taxonomy was created in 1956 under the leadership of educational psychologist Dr Benjamin Bloom to promote higher forms of thinking in education. It is most often used when designing educational, training, and learning processes. The identified three domains of educational activities or learning (Bloom, et al. 1956) are cognitive: mental skills (knowledge), affective: growth in feelings or emotional areas (attitude or self) and psychomotor: manual or physical skills (kinesthetic). This taxonomy of learning behaviours may be thought of as "the goals of the learning process." That is, after a learning episode, the learner should have acquired a new skill, knowledge, and/or attitude.

Studies document the range of learning that museums afford (Falk, 1999; Leinhard et al., 2002; Rennie and McClafferty, 1996). Within the personal impact category, most studies are concerned with science learning in science centres. Some studies look at the effect of science centre in changing attitudes towards science and leading to the enjoyment of visitors. Other studies of the 1990s periods have demonstrated that students enjoy visits to museums tremendously and that increased interest, attitude and enjoyment of post-visit activities constitute extremely valuable learning outcomes (Anderson, 1999; Ayers and Melear, 1998; Ramey-Gassert et al., 1994).

In the middle of the 1990s, there was wide spread acceptance among researchers of the cognitive, affective and social aspects of the learning experiences of visitors in

museums and similar institutions (Raphling and Serrell 1993). Cognitive Learning Theory is a broad theory that explains thinking and differing mental processes and how they are influenced by internal and external factors in order to produce learning in individuals. These cognitive processes are: observing, categorizing, and forming generalizations about our environment. Researchers who embrace cognitive theory prefer to study the learner rather than their environment and in particular the complexities of human memory. A theory of learning that integrates into it the function of motivation is ultimately one that can bring together affective experiences with the construction of meaning. Affective experiences are an essential part of learning, decision making and social functioning (Barrett, Mesquita, Ochsner, & Gross, 2007; Immordino-Yang & Damasio, 2007; and Norman, 2004). Positive affect aids imagination and creativity, while attractive objects (which produce positive affect in the user) are perceived to be easier to use (Norman, 2004). This latter point implies that design can influence positive affect and thus help foster a mind-set that is conducive to discovery, exploration and learning. Further research into relation of exhibition design and learning processes is important to understand the conditions that facilitate an enjoyable and productive learning experience (Packer, 2006).

The social aspects of the learning experiences of visitors in science centres is where learning takes place in the context of meaningful activity and social interaction. Many people visit science centres in family groups. As they talk together, families are observed moving from identifying and describing to interpreting and applying their science centre experiences as evidence that learning is taking place (Anderson and Cook Roe, 1993b, Ramey-Gassert et al., 1994). Science centres are resources for families and schoolchildren, teachers and public. In increasing numbers, science centres are also places where people of all ages, cultures and educational levels can learn at their own

pace, engage their curiosity, and use all their senses to ask and answer questions, explore, and explain to others what they have learned.

Science centres are unique educational settings as their design allows visitors to choose the extent and level of their engagement in the different learning opportunities (Falk & Dierking, 2000). Certain visitors may have preferences for certain subject matter, exhibition styles or presentation methods. Scientists and psychologists have developed several different models to understand the different ways that people learn best. One popular theory, the VARK model, identifies four primary types of learners: visual, auditory, reading/writing, and kinesthetic. Each learning type responds best to a different method of teaching. Auditory learners will remember information best after reciting it back to the presenter, while kinesthetic learners prefer to participate in a hands-on activity.

Informal learning in science centre includes, but is not limited to, self-directed learning, discovery or constructivist learning, use or exploration of materials, and interaction with the exhibits or environment. Science Centre emphasis on interactive exhibits and focus on phenomena as opposed to objects. This three-dimensionality of exhibitions, along with the ability to interact with real objects, is particularly significant in a world that is becoming increasingly screen-based (i.e., two-dimensional) in the way that people interact with the world and gain new information and skills (Lord, 2007). "Experiential learning," "constructivist exhibitions," and "hands-on learning," are terms and concepts that have been embraced by museum professionals who create exhibitions. The basics of museum exhibitions in relation to the formation of knowledge began with the Experiential Learning theories (Kolb, 1984). The emphasis is on exploration and reflection besides interaction and environments for learning. Hein (1998) stressed the importance of applying constructivism to museum exhibition design. Constructivist

theory argues that both knowledge and the way it is learned are dependent on the minds of learners. Constructivist exhibitions should allow learners to construct their own personal knowledge. Learners mind should be encouraged to manipulate, conjecture, experiment, and draw conclusions of their own without having to conform to an outside standard of truth. Hands-on learning is the concept integrated in the museum programs and exhibitions. This is Dewey's (1933) pedagogical ideas on "learning by doing" that have been applied to the field of museum education.

Bitgood (2002) identified the objectives of informal learning emphasized the quality of experience instead of quantity of learning in formal learning. Enjoyment is measured by verbal descriptions, time at exhibits and repeated visitations. These institutions are predominately viewed by visitors as places for social engagement with family and friends (Morgan & Hodgkinson, 1999). In this free-choice learning environments, visitors largely come by their own choice and are thus intrinsically motivated. Whether visitors choose to interact with exhibits or technology is determined by their own expectations, preferences, and desire to learn (Falk & Dierking, 1992; Hein & Alexander, 1998; and Shettel, 1973). They engage in activities in a self-directed manner, and therefore, their methods of learning are varied (Greenhill, 1999).

Creating interactive exhibitions often requires a team of professionals with diverse backgrounds. While science educators tend to consider visitors' need to learn through different senses and whether the concepts presented are concrete enough to comprehend, designers pay more attention to the ambience of the entire exhibition setting and contemplate how the ambience can have an impact on visitors' perceptual, sensory experiences and level of understanding. As related to exhibition planning, design is the process by which decisions are made regarding all aspects related to how an exhibition will exist and the impact it is intended to have. The word exhibition is

generally used throughout this study to reflect a thematically based series of exhibits. The design process includes, but is not limited to exhibition arrangement, mode of presentation, media selection, and setting in relationship to: other media, the space and the visitors. Design is a non-linear, "transactional process involving logic and intuition, in which the message to be communicated, the mode and the medium are played off against one another according to the individual values placed on them" (Miles, et al., 1988).

There is an inseparable association between design and the user experience. Researchers, museums and exhibition designers have recognized the potential of experience design on bringing about improvement and a competitive edge in the field. Design researchers increasingly assume an integrative stance and take the initiative in synthesizing knowledge from diverse domains to generate cross-disciplinary insights regarding experience and identify design opportunities. As noted by Anderson (2004), science centre is an illustration of "reinvented" museum, not only as "keeper of knowledge", but as a "place of exchange of knowledge". This is globally defined as part of a logic of enchantment of the experience on offer. Enchantment is a feeling of great pleasure, delight or being captivated. Paradoxically, very little research has focused on the principles of enchantment organized in this cultural sector. In contrast, many studies have been conducted within commercial environments to identify these principles.

1.3 PROBLEM STATEMENT

Museums such as science centre have been changing, offering a wider range of choice. Museums are becoming more hybrid because of increasing cross-fertilization between culture and leisure, and more specifically between museums and amusement parks (MacDonald & Alsford, 1995; and Haywood & Cairns, 2005). The growth of