Science Centre Engagement on Visitor Personal Connection

Nurhaya Baniyamin, Zaiton Abdul Rahim

Abstract: ***Museum exhibition environment provides experiential learning through its messages 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 research focuses on how science centre as part of a museum discusses various practical methods to inspire visitor into having a response. The review features multiple theories of learning advocating how visitors learn and how these theories influence a museum's exhibition design endeavors. Using the experience of selected Science Centres as primary case-studies, this article analyses various perspectives and organizational approaches. Cultivating visitor interest through visitor personal connection represents an important echoing concept which reaches at the essence of the exhibition design practice. Visitors act as celebrants of science information in an edutainment context, motivated by a quest for social and enlightening experiences. How does science centre engage in visitor personal connection? How do they sustain quality visitor experience and informal learning objectives? Responses to these queries are the core of this article.***

Index Terms: Exhibition design; Informal learning; Science Centre; Visitor experience.

I. INTRODUCTION

The biggest challenge for science centre institutions is to well provide chances for cognitive and affective learning whilst concurrently enabling enjoyment and fun. Studies conducted found that many families choose to visit museums because they anticipate that there will be fun and entertaining things for everyone in their group to see and do there (Moussouri, 2003). In most instances, families say that they come to the centre to learn something new, to enjoy themselves and to spend quality time together (Borun, 2008). Recent studies in museum have examined various factors that can influence learning such as engaging visitors' emotions or connecting with visitors' prior knowledge and interests. The style of the exhibit presentation profoundly affects the kinds of thinking engaged in by visitors (McManus, 1989). In science centre, the varieties of exhibits spanning various disciplines are incubators of scientific knowledge and emphasise hands-on exploratory learning. Using the recent experience of selected renowned Science Centres as case-studies, this article explores the replies of the science centre management in order to discover the boundary to which the process take place. The nature of their roles at the respective Science Centres had resulted in a correspondingly wide-ranging mesh of findings.

The theme of cultivating visitor interest through visitor personal connection represents an important echoing concept which reaches at the essence of the exhibition design practice. A comparison of approaches across science centre institutions which differ in size, type and location offer a better understanding from different perspectives and approaches.

II. LITERATURE REVIEW

In the 1980s, exhibition design began to receive greater eminence to deliberately arranging and choreographing the museum visitor experience (Miles, Alt, Gosling, Lewis, & Tout, 1988). In the museum context, exhibitions have been likened to a theatrical production: an exhibition has a theme or narrative (story) that can be allotted into acts (galleries or subdivided spaces) and scenes (display clusters). (Crawley, 2012; Rabinowitz, 2013). Similarly, Yellis (2010) draws counterparts between the museum and the theatre when both can vary visitors on an emotional level. He contends that together a compelling story as well as concentration to the atmospherics, are important for portraying this transformation. In a museum, an experience can be seen as a process of mutual interaction or "dialogue" between a visitor and their setting (McCarthy & Ciolfi, 2008). In this study, the formation of visitor experience used allies with the definition as "an individual's immediate subjective and personal response to an activity, setting or event outside their usual environment" (Packer et al., 2013).

The museum field is rich with literature that addresses the concept of informal learning or "free-choice" learning in museums (Falk & Dierking, 1992, 2000). Hein (1998) suggested that museums typically do not have set formal curriculum, rather they provide visitors with informal education opportunities. Visitors mostly entered by their own preference and are thus innately driven. According to Greenhill (1999a), visitors participate in activities in a self-directed manner, and thus, their means of learning are varied. In relating the combination of intrinsic motivation into a theory of learning, Rice (2001) emphasized the task of

Revised Manuscript Received on December 22, 2018.

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museum educators is to move people into becoming learners. the mission of moving people from a recreational agenda to a learning-centered agenda, there is no better motivator than a powerful aesthetic experience" Rice (2001, pp. 49). A theory of learning that mixes into it the purpose of motivation is eventually one that can merge affective encounters with the making of meaning. Perry (1992) stated that necessities for an intrinsically motivating museum experience include the ability to instill curiosity, challenge, control, confidence, play and communication in the visitor's experience. To achieve intrinsic motivation, the learning theories underpinning how visitors learn and how these theories impact a museum's exhibition design efforts are further discussed.

Meaningful learning has two components. First, the content should be meaningful and motivate the learner. Second, the learning process should be arranged pedagogically in a meaningful way according to the learner's age, prior knowledge, and skills, and according to the logical structure of the topic being taught (Salmi, 2010). The phenomenon is closely related to the growing impact of science and technology in our everyday lives. The aim is to produce a new generation of citizens who are scientifically literate and thus better prepared to function in a world that is increasingly influenced by science and technology (Coombs, 1985).

Behaviorism models are drawn from traditional classroom studies and have been applied to design museum exhibits in the nineteenth and early twentieth century (Greenhill, 1999b). This led to authoritative, didactic displays, frequently arranged to illustrate conventional epistemological hierarchies and classifications (Hein & Alexander, 1998). Behavior-based objectives are not always the most efficient approach to facilitate learning, especially in unstructured or informal learning environments (Duffy & Cunningham, 1996; Hein, 1998). In the past three decades, additional learning theories have become established in exhibitions. Along with the modification in theories, an improved description of learning itself has arrived.

Hein (1988) concluded that learning is realized as the active participation of the learner with the environment and hence, museums become central to any educational effort when the focus shifts from the written word to learners' active participation through interface with objects. These newer theories include John Dewey's Experiential Learning theory, Constructivist theory by George Hein, the Contextual Model of Learning by John Falk and Lynn Dierking, and Howard Gardner's Multiple Intelligences theory.

A. Experiential Learning Theory

The underpinnings of museum exhibitions as we know them today began with the Experiential Learning theories. The growing emphasis on exploration and reflection as well as interaction and environments for learning can be attributed to Dewey's (1933) thinking and beliefs. John Dewey's educational philosophy presented in *Experience and Education* (1933) represents a seminal work in the foundations of experience-based education and museum education (Ansbacher, 1998). Applying Dewey's perspective to a museum exhibit, the exhibit experience itself would supersede any specific instructional outcomes a museum exhibit was intended to achieve. The implication is that visitors will take individual meaning from exhibitions based upon their previous individual experiences and their present encounter in the museum. Dewey also accepted the continuity of personal experience; that one encounter builds upon the earlier. Inside a museum, this denotes that visitors' learning is not a fixed process, and learning is an ongoing, lifelong progression. He also recognized the connection between a learner's environment and their way of learning.

According to Dewey (1933), "the principle of continuity of experience both takes up something from those who have gone before and modified in some way the quality of those which come after" (pp. 27). The principle of interaction is grounded in the notion that the conceptions of situation and interaction are inseparable. Experience is as it is because of *the transaction* taking place between "an individual and what, at the time, constitutes his environment" (Dewey, 1933, pp. 41). For a museum environment, these two principles suggest that individual visitor backgrounds and the environment impact one's experience.

The experiential learning theory (Kolb, 1984) has roots in Dewey's philosophies related to the formation of knowledge. Kolb (1984) states learning is "the process whereby knowledge is created through the transformation of experience" (pp. 38). Based on Kolb's experiential perspective, learning is an adaptive process through which knowledge and experience are continuously being recreated and transformed, both objectively and subjectively.

The present study is guided by beliefs similar to those of Dewey and Kolb. The learner and his or her learning agenda and goals are considered important, as are the experiences and processes which transpire to create new knowledge and foster learning. Constructivist learning is aligned with these ideas.

B. Constructivism

Constructivist theory highlights that "learning is an active process of constructing rather than acquiring knowledge" and "instruction is a process of supporting that construction rather than communicating knowledge" (Duffy & Cunningham, 1996, pp. 171). With increasing frequency museums offer constructivist learning experiences (self-directed learning and discovery learning) through the use or exploration of materials and free-choice interaction with the museum exhibits or environment. Besides, visitors 'shape' their knowledge from the significance of the exhibit. This guides to a distinct focus when taking into account exhibit planning. "Constructivist educational theory argues that in any discussion of teaching and learning the focus needs to be on the learner, not on the subject to be learned. For museums, this translates that we need to focus on the visitor, not on the content of the museum" (Hein, 1999, pp. 78). The design of museum exhibitions calls for a more adaptable, audience-focused, constructivist approach to providing learning experiences.

The implementation of media and technology is a viable means for enhancing constructivist informal learning experiences of the museum visitor. New high-end technology, such as computers and multimedia, are advantageous due to their user-centered functionalities and

possibilities. The constructivist perspective would suggest that learning is the activity in context…" the entire gestalt is integral to what is learned" (Duffy & Cunningham, 1996, pp.171).

C. Contextual Model of Learning

Falk and Dierking (1992, 2000) introduced a framework related to the gestalt of the museum experience and devised a model attempting to "accommodate much of the diversity and complexity surrounding learning" (2000, pp. 10). Their model, the Contextual Model of Learning (originally called The Interactive Experience Model), emphasizes the interaction between personal, sociocultural and physical contexts involved in the museum visit. They state (2000, pp. 10-11):

The Contextual Model involves three overlapping contexts: the personal, the sociocultural, and the physical. Learning is the process/product of the interactions between these three contexts. Learning, is transient, always changing. Eventually, learning can be seen as the continuous combination and interaction of these three contexts over time adequate to make meaning.

The visitor continuously constructs each of these three contexts and the interaction of these contexts results in a constructed reality and experience unique to the individual. Their model emphasizes visitor expectations and the importance of how a museum exhibit (in the physical context), the implications of the personal context and sociocultural context in the museum experience. This theory of learning reasons for more contexts than any of the earlier theories and is particularly aimed at museum type learning. Falk and Dierking (2000) recognize that there are eight factors which influence learning within a museum, including: personal motivation and expectations; visitors' knowledge, interests, and beliefs; the visitor's ability to choose their learning; dynamics of the visitor's group; facilitated learning; pre-arrival orientation; design; and reinforcing events outside of the museum. The accomplishment of the museum learning is diverse and centered upon the useful implementation of these eight factors. For effective learning to take place within a museum, all eight of these factors should be deliberated when planning.

D. Multiple Intelligences Theory

Howard Gardner's Multiple Intelligences theory identifies the different learning styles within visitors to museum exhibits. He proposes that:

…There are at least seven different intelligences that manifest themselves [in people] in various configurations of differing degree. They are linguistic; logical-mathematical; musical; spatial; bodily-kinesthetic; interpersonal and intrapersonal. He posits that museums, when considering educational opportunities, should cater to people of all intelligences, thus making exhibits more widely accessible to all types of learners (Davis & Gardner, 1999). These multiple intelligences are usually take into account when planning for exhibition design.

III. CONCEPTUAL FRAMEWORK

A previous analysis of learning and educational theory is observed with inferences for the exhibition development process. The present research study reflects the need to examine the design and development of museum exhibitions, as related to a variety of topics and issues. Informal and experiential learning, visitor diversity and changing audiences, and media and technology implementation decisions must all be considered. Next, the article reflects the methods applied to nurture visitor into having a response and the influence this has on the visitor participation and immersion. Given the scope and complexity of the design process and the subjective nature of ideas and perspectives regarding the topics at hand, this research study warrants a rich and descriptive qualitative case study.

The attention on the theme, *engagement on visitor personal connection*, focuses on the concept of these science centres' need to offer a rich and cohesive experience. This theme also relates to reflecting the overall goals of the science centres and the nature of how and what the centre conveys to those who walk through its doors. Everything about the way an exhibition is conceptualized and designed impacts how it will be received by visitors - from the title of the exhibition down to the lighting used to illuminate the label text and the color of the wall behind it. This section addresses some primary considerations these renowned science centres take into account in their exhibitions to reach visitors on as many levels as possible. The exhibition design method, physical space, atmosphere, comfort, message, content, context, design elements, color, lighting, flow, and objects - they all can promote connections. Several specific aspects of an exhibition which can contribute to cultivating visitor connections are described in this section: (1) taking science home; (2) making science accessible; (3) providing relevance by drawing on personal and the social environment and (4) creating new interest by engaging with aesthetic theme.

IV. RESEARCH METHOD

The research question that guided the investigation:

i. What are the methods used to encourage visitor into having a response?
ii. How do this effect visitor participation and immersion?

The method of inquiry used was educational connoisseurship and criticism (hereafter referred to as educational criticism), an arts-based qualitative method of inquiry initiated by Elliot Eisner (1998; 2002) and used now by researchers worldwide (see for example Flinders, 1996; Barone, 2000; Uhrmacher & Mathews, 2005). Educational criticism requires that the researchers describe, interpret, evaluate, and discern themes, although the distinctions are "sharper on paper than in fact," Eisner points out (2002, pp. 225). The descriptive aspect of educational criticism is intended to allow the reader to "participate vicariously" in the educational situation, which points to the use of literary vignettes that are presented here.

Although the researcher's act of selecting what to include and what to leave out of a vignette is considered interpretive acts, interpretation also includes connecting the

events to relevant literature and to ask what the situation means to

those involved. Next, because "the point of educational criticism is to improve the educational process," the evaluation shows the educational significance of what has been described and interpreted (Eisner, 2002, pp. 233). Thematic in educational criticism is "recurring messages that pervade the situation…a theme is like a pervasive quality" (Eisner, 1998, pp. 104). They are, in short, lessons to be learned. Eisner points out that one learns from a single case all the time, whether by folktale, fictional or nonfictional stories.

Although attending to each aspect of educational criticism is a distinct part of the research process, the presentation of these aspects does not need to be sequential or artificially separated. Instead, the four aspects guide the inquiry process but do not limit the communication of the ideas and research findings. The data collection process began with interviewing the 7 participants, namely Curatorial, managerial staff and Director from selected science centres.

Next, the author observed and recorded in photographs the scenography, exhibitions, and activities in the galleries. The data collection process come to a concluding interview during which time the author asked the respective Directors and Curator to reflect upon how creating interest and curiosity themes emerged at the core of the exhibition design process. Next, following Eisner's ideas about "selecting a focus" and" building a plot" (see Eisner, 1998, pp.189-192), the researcher analyzed the data with pragmatic intent. That is, examined the data with an eye towards building a story.

The researcher provides several vignettes that illustrate portions of design ideas from the case studies; these vignettes in part serve as the response to the first research question inquiring on the methods used to encourage visitor into having a response. This will lead the researcher to interpret how this effect visitor participation and immersion in an understanding level of engagement of the experiential settings. The researcher then draws out the dominant themes from the vignettes and discusses each in detail and relation to other relevant literature. The researcher next describes the planning process on how using the themes helped the curator meet his scientific intentions for the visitors. The study will conclude with a discussion on the significance of the paper and its applicability to other science centres.

A. Taking Science Home

Science centre hopes to address interest in science. The planning and design of exhibitions are aimed toward this goal. As expressed by participant 1:

Questacon produces exhibitions to present and communicate a broad range of science themes to a broad audience. We do this primarily to engage youth, students, and families in science and hopefully inspire some to make it their career. Through our exhibitions, we attempt to make science accessible to as many as possible by making it appealing and enjoyable. Critical to this is the interactive experiences we produce where visitors can experience science phenomena and ideas in a safe and fun way that are not necessarily able to be experienced through other media.

A key goal for the science centre is to find ways for visitors to leave the centre feeling connected to science. However, fostering this connection is not always easy to do. Participant 4 share his thoughts on science centre's hope and challenges. His remark emphasizes the fact that it can be difficult to reach people interest through science. He pointed out the many factors that affect the reason to visit a science centre.

According to him, the reality of museum visit is a challenge when visitors have to balance the precious source of time, value and money. Participant 5 also acknowledged the challenges to museum visit. Her quotes share the fact that it can be difficult to reach people through science and have them feel connected to the material being presented.

However, if science content is presented in a way that affords interactive and taps into some aspect related to visitor's curiosity, then that content can promote a connection and make science understanding more fun. Getting through to visitors is about getting past the surface and striking a chord at a personal level. As Participant 1 proposed, making the visitor experience themselves in the centre and understand what they do is critical to unlocking an opportunity to encourage personal connections with the content. The galleries address the ways Questacon can open people's mind to science by making them experience it and offering some aspect of understanding to take home.

Figure 1: MiniQ of Questacon

B. Making Science Accessible

A crucial requirement for helping visitors discover connections with science is to ensure the science centre and its contents are accessible to people. Achieving this means the layout of the centre, the design of the exhibitions, and the format of the actual content all must be presented in a way that is approachable, relevant and easily understood by a range of audiences. The initial impression of the centre must be such that visitors feel comfortable. The SCS tries to provide a welcoming environment and enough variety to offer something for all visitors.

As participant 1 suggested, the overall array of experiences available in the centre is essential in making visitors feel they can explore, access, and learn from the exhibitions within. Once gaining an initial sense of comfort, visitors must find the contents accessible on multiple levels as they continue to look more closely at the exhibitions. Every aspect of the exhibitions should support the content and contribute to the whole experience. Specific ways to encourage accessibility and to make connections with content are evident in the following

examples related to exhibition flow, labels, scaffolding materials, and opportunities to interact. Participant 1 described how the flow of an exhibition impacts the comfort and accessibility of the exhibition. Participant 5 commented on accessibility and making connections with

exhibitions content:

In the foyer, we got quite a few ways that try to put a flavour to what you might find at the gallery so that a person who enters the gallery for the first time get a sense of it. There's a lot of movement, activities and this is what Questacon is all about.

These two comments support the idea that careful planning and providing wayfinding cues in the exhibition space minimize the physical, emotional, and cognitive efforts required by a visitor to navigate through space. This off-loading of required resources allows the visitor to be able to direct more attention to the content, making it more accessible and easier to consume.

Another means to make exhibition content easier to understand is by providing interpretive labels that utilize layers or levels of information to support a well-conceived, cohesive exhibit plan as suggested by Serrell (1996). Writing clear labels of all types - title, introductory, object labels - play a vital role in telling the topic underlying an exhibition and helping visitors connect with science. Participant 3 described how integral labels are to the accessibility of content:

I think that regarding content, no matter what the content is… we try to make it accessible. It has to be simple and inviting. We encourage our visitor to read the text. It's a reminder posted through our galleries.

As evidenced by participant 3, labels should be clear - both concerning the information they convey and the way they are written. About creating labels for an exhibition, the length, type size, style, format, and vocabulary should be addressed and lead to curiosity as suggested by participant 4. His comments suggested producing the right text can lead to interest and wonder in science centre visits. According to participant 5, regarding the experiential learning, the Questacon realized the need to offer additional support and assistance to encourage making connections through different styles of exhibits:

There are different styles of exhibits that we would prefer as educational/learning experiences or the informal learning approach. The style of an exhibit that we would prefer varies such as problem-solving exhibit, information communication, exploring physical phenomena; open-ended, play form, experimental style, and quizzes. There are many exhibit styles we can come up with, depending on whether that topic is important for that particular style of exhibit. Together, the Exhibition Project Team will try and pull them up together.

As she suggested, some connections may be preferable depending on the topics for different style of exhibits. For subtler connections, visitors may need a little variety and support to access the connections. The Wonder Works gallery provides content in such a way that visitors have fun while exploring science. For example, building a life-sized disordered room provides an immersive experience. Offering these types of tactile, sensory experiences makes science more readily accessible since there are multiple levels on which to interact with the content. As commented by participant 1:

We do exhibits such as the Ames Room, the disordered room. We create that space to have an impact on them. We go that extra trouble, a lot more effort to get the full body experience. Yes, set work and space is the understanding for the exhibits. It allows one to enter and physically immerse in the room to understand the phenomena - rather than reading labels of a scale model.

His quote indicates that one key design objective for the gallery was to help visitors access the content. Instilling a sense of relevance can reinforce the creation of connections. However, there are limitations of science centre experience, as commented by participant 6:

Experiments in a public setting can only deal with certain phenomena. If they are too big or too small, too fast or too slow, they have to be replaced by simulations. In some cases, narratives or historical objects provide a better approach.

As he mentioned, connections through science experiments have its constraint and limitation. Therefore, other methods such as simulation technology, narratives or historical objects can be a more suitable approach.

C. Providing Relevance by Drawing on Social Environment

Everyone has a preference - grounded in one's cultural value and own personal experiences. Incorporating exhibits, information, and issues within the science centre exhibitions that reflect on visitor's lives or social environment can help cultivate connections. The variety of issues and facts in the exhibition provides many instances for visitors to find connections to their own lives. Participant 2 described some visitors he observed making personal connections with the objects and exhibits in the exhibitions:

[People] find this personal connection in some facet of the exhibition… It can be random, it can be as simple as the chicken hatch, and they are like, "we used to watch this whenever we visit the place." That kind of stuff. I always find that interesting. Walking through and overhearing, or when I see parents telling their kids stories about, "when we grew up" looking at the gravity ball and telling stories and how they were observing them back then.

As he expressed, people get excited when they see things that reminded them of objects or memories from their own lives. Not only does seeing something familiar catch a visitor's attention, but it also reinforces memories and makes the visitor more likely to share their memories and personal history with others - passing along a bit of connection. When visitors find themselves drawn in by something familiar they are also apt to look more closely at the other exhibition components and content, thereby connecting themselves even further with the place.

Offering ways for visitors to relate to the exhibition content or context is important. Participant 2 described several examples of areas in the science show which pique visitor interest. As his comments suggested, presenting things people will recognize is an ideal way to attract visitors to look more closely at an exhibition. Familiarity offers the perfect hook for the centre to pose more detailed information and help visitors learn new things that will broaden both their

knowledge and deepen their connection with the content and science wonders. Objects can play an influential role in communicating science in the exhibition. The size, placement, and general science discovery of an object can factor into the initial impression a subject has on a visitor.

Sometimes the most significant impact of an object is tied directly to a personal connection a visitor already associates with. Participant 3 described an example:

I saw a great thing happen in a [planet] gallery, with students who had to explore the interactive exhibits and knew the rotatable link tunnel that's on display there, they go through it a few times…So it was the experience that people can connect with …when people get involved in objects, I think that has a huge impact on them.

As her description indicates, pre-existing personal experience with an object can lead to exploration of the object label, as well as promote further involvement with the surrounding objects and other components on display in the exhibition. Even if visitors do not have a personal connection with a specific object, they often find themselves drawn to certain exhibits based upon aspects related to their interests and experiences. They may see objects and be reminded of science fictions they had read from books. People seek out connections based on their lives and personal experiences, as explained by participant 7. As he described, personal details can prompt visitors to make connections. Helping visitors connect with exhibitions on a personal level can trigger questions; asking questions can lead to gathering new information; new information can result in having visitors leave the exhibition with a new personal connection with science. It's the immersive experience itself.

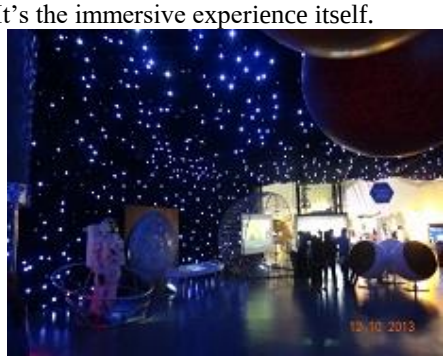

Figure 2: Universe Exhibition Gallery of The Mind Museum

D. Creating Interest by Engaging with the Exhibits

Sometimes unearthing discovery can pave the way to engaging with science, creating new interest, and introducing new ideas and connections. 'Invent,' described participant 2, exemplifies an exhibition which provides visitors the opportunity to create new awareness and find new connections by building on familiar context. As his comments suggest, 'Invent' and the scenes displayed within it carry a sense of layering message not just regarding content, but because of being on display as a market stage. Visitors who came to the gallery for the first time will likely remember the elaborate recreations of these 'streetwalk' events. The interpretive labels and interactive components placed alongside the multimedia encourage visitors to look more closely and see new details in the content presented before them. The interactive components challenge visitors to use more than just their eyes to gain a deeper understanding of the issue depicted. Visitors have the opportunity to do something - to push buttons, to play music, to click the camera - to interact with the exhibits. Interacting with an exhibition on multiple sensory levels can add depth to a visitor's experience. The technology's gallery, 'How Things Work,' was designed and developed specifically with the intent to engage a full range of sensory experiences and elicit connections with science application, as explained by participant 3. As she indicated, 'How Things Work' engages visitors by providing the opportunity to do something related to science application - helping visitors connect with the concept. She also noted how the hands-on nature and the varieties of exhibits stations contributed to the success of these exhibitions with school groups:

They are having fun…I think [they are] surprised that this type of space is here; they're doing something other than looking. So, I feel the school group visits are highly successful …we are contributing to their learning and understanding of it.

Her statements propose that by having the opportunity to interact with the exhibitions students are creating foundations for future connections and learning. Likewise, being able to relate something from one's previous knowledge with something in the exhibition can result in the formation of new knowledge and understanding. Interaction with an exhibition can lead to excitement, new knowledge, and connections. People get excited when they feel like they are part of it, especially when it involves interacting with an actual object, explained participant 5:

Excite@Q was great because it makes you do every single aspect of it. People love that. They like to be part of it... like the freefall and 360', which people love because they can feel through it, that's a bonus. It's the very first freefall design to explain its connections to the psychological science. It lets them experience a fright and excite feeling, biological feel, that's so integral to our mind and body. I think to experience the real stuff and having it being engaged in some way, is worthwhile.

As the comments implied, if a visitor can feel a real piece of science - can be part of it - then the experience becomes more tangible, more personal and heightens the connection to the theory behind it. Getting beyond the surface of the exhibition - delving into the context and the concept that the exhibition reflects - is the vital part of making a lasting personal connection with science.

Figure 3: Differentiation lighting at Excite@Q of Questacon

Participant 1 conveyed some examples of exhibits and objects at the Questacon which attempt to engage visitors' senses and gain a deeper understanding and connection with the role of science in their lives. The examples he shared exemplify how the Questacon juxtaposes current objects and stories that relate to contemporary life - of science in the environment - bring a sense of relevance to the toddlers. Providing young visitors the opportunity to be directly involved with an exhibit and make a personal connection between the exhibit and their own lives can lay the groundwork for learning. This informal learning tool has its benefits, as commented by Participant 6. The opportunity to be directly involved with an exhibit and solve a task has its intellectual and emotional benefits. Likewise, learning can be difficult to access in an exhibition setting, since it is not a structured learning environment and because visitors may not recall their visit experiences. Some may not even realize what they have learned until long after their visit. Participant 5, described learning from an exhibition in this way:

Science centre immersive exhibit play with your senses. So, sometimes the immersive that we have is an experience that will 'upset' your sense of balance a bit, or it creates a particular perception, a response. For science centre, an immersive has an impact on you. Immersive is - 'I am trying to change your senses' as the message.

As she described and echoed by all the participants, learning is not necessarily the targeted goal of an exhibit, but it can be a by-product of the experience. Rather than focusing on learning as an outcome, the Questacon strives to offer visitors stimulating experiences that will create personal connections which make enough of an impression to stay with visitors long after they leave the centre.

Figure 4: Central space at Questacon

Visitors are given an invitation to open their eyes to science and see the connections through aesthetic space. As stated by Participant 3:

Providing a lovely connection to the Bonifacio Art city…hoping when visitors leave, they are looking at the city differently. That we have provided them with fresh eyes to both art and science, as they move through the city, make new connections with artistic works outdoor and aesthetic theme of science indoor.

Helping visitors leave with new connections, as she described, relies upon knowing whom its visitors are and understanding why they came. This section focused on the need to craft a collaborative vision through the approach to the exhibition design process and the personal connections formed with people, the institutions and resources outside the centre. The interview participants' responses highlighted that science centre do visitors to find connections through making science accessible, providing relevance through personal engagement and creating new memories by engaging with the exhibits and multiple contexts of the museum experience.

V. CONCLUSION

Designing and developing exhibitions is a complex and organic process with many factors to consider - content, message, exhibits, layout, flow, media, lighting, timeline, and many other issues. The theme, *engagement on visitor personal connection*, explores the pertinence of the interrelationships formed while creating exhibitions. A science centre exhibition can be a difficult format through which to connect with visitors unless the content is presented in an accessible manner which draws on previous visitor experiences or offers new engaging opportunities. The exhibition design must support the message and aid visitors in cultivating connections by taking science home, making science accessible, providing relevance by drawing on personal and the social environment and creating new interest by engaging with an aesthetic theme.

The various design techniques discussed correspond quite closely with findings in Hood's (1983) study on museum visitor expectations. Hood identified social interaction, active participation and feeling comfortable in one's surroundings as the most valued attributes for occasional museum participants and non-participants. There is a definite overlap between the attributes Hood reported and the techniques identified in this study. In both cases, opportunities for visitors to interact, or connect, with the exhibitions and other people prove to be important. The exhibitions are a vital component in helping visitors make connections with science. Every detail in an exhibition impacts the message, so careful attention must be given to how all the design elements and physical space are fused to create a whole meaningful visitor experience. The case studies offer various levels on which visitors can make connections with the assortments of focus range in addition to the interdisciplinary method to exhibition themes. Science centre strives to convey science concepts, issues, and its related technology in application to human life and the environment. Particular attention is assumed to how the exhibition design elements and physical space are mixed and displayed to create an appealing, inclusive, multi-layered visitor experience. Pine and Gilmore (1999) suggested a successful experience needs to involve all four realms: educational experiences, entertaining experiences, aesthetic experiences and escapist experiences. The exhibition design and development process is indeed a process - one which involves people, ideas and components that must work together as a unified whole. Falk and Dierking (2000)

suggested the importance of the "whole experience" for visitors through their Contextual Model of Learning in museums. The findings here support the idea that science centre practitioners have embrace ways to create a rich environment that promote quality visitor experience.

ACKNOWLEDGMENT

The authors wish to thank participants (1) John Richardson, Design and Online Services Manager at Questacon; (2) Daniel Tan, Director Exhibitions Group at Science Centre Singapore; (3) Maria Isabel Garcia, Curator at The Mind Museum, Philippines; (4) Geoff Snowdon, Director at Team Aranda Sdn Bhd; (5) Cindy Chambers, Head of Concepts and Education at Questacon; (6) Professor Per-Edvin Persson, Director Heureka, the Finnish Science Centre and (7) Matthew Connell, Principal Curator Physical Sciences and IT, The Powerhouse Museum for their thoughtful insights. In addition, they thank the International Islamic University Malaysia and the Ministry of Higher Education for funding this project in RIGS17-086-0661.

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